Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02AA		**Description :** GASKET NON-ASBESTOS		
Approved Suppliers				
1	3735	UNI KLINGER LTD	INDIA	
2	N175	NEOSEAL ENGINNEERING PRIVATE LIMITED	INDIA	
3	B144	BOMBAY CHEMICAL EQUIPMENTS	INDIA	
4	I001	IGP ENGINEERS PVT. LIMITED	INDIA	
5	S471	STARFLEX SEALING INDIA PVT LTD	INDIA	
6	T244	TEADIT PACKING AND GASKETS PVT LTD	INDIA	
7	F543	FLEXITALLIC UK LTD	UNITED KINGDOM	
8	D161	DAVE ENGINEERS PVT.LTD	INDIA	
9	3759	ASIAN SEALING PRODUCTS PRIVATE LIMITED	INDIA	
10	3853	PILOT GASKETS AND ENGINEERS	INDIA	
11	J210	JAMES WALKER INMARCO INDUSTREIS PVT. LTD	INDIA	
12	C055	CHAMPION JOINTINGS PVT LTD.	INDIA	
13	H176	HEM ENGINEERING CORPORATION	INDIA	
14	3614	SEALANT AND GASKET INDIA PVT.LTD.	INDIA	
15	3920	SUPERLITE JOINTINGS PVT LIMITED	INDIA	
16	4023	BJ&P ENGINEERS PRIVATE LIMITED	INDIA	
17	M012	MADRAS INDUSTRIAL PRODUCTS	INDIA	
18	G132	GOODRICH GASKET PVT LTD 066053052053	INDIA	
On Holiday				
1	M570	MOORSIDE MACHINING CO LTD	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)
2	J505	JAMES WALKER & CO LTD	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02AB		**Description :** GASKET METALLIC & SOFT IRON		
Approved Suppliers				
1	M012	MADRAS INDUSTRIAL PRODUCTS	INDIA	
2	M010	WIKA PROCESS SOLUTIONS INDIA PRIVATE LIMITED	INDIA	
3	3844	IGP ENGINEERS PVT.LIMITED	INDIA	
4	S471	STARFLEX SEALING INDIA PVT LTD	INDIA	
5	G132	GOODRICH GASKET PVT LTD	INDIA	
6	N175	NEOSEAL ENGINNEERING PRIVATE LIMITED	INDIA	
7	4023	BJ&P ENGINEERS PRIVATE LIMITED	INDIA	
8	3759	ASIAN SEALING PRODUCTS PRIVATE LIMITED	INDIA	
9	F543	FLEXITALLIC UK LTD	UNITED KINGDOM	
On Holiday				
1	M570	MOORSIDE MACHINING CO LTD	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)
2	J505	JAMES WALKER & CO LTD	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02AC		**Description :** GASKET METAL JACKETED		
Approved Suppliers				
1	4023	BJ&P ENGINEERS PRIVATE LIMITED	INDIA	
2	F543	FLEXITALLIC UK LTD	UNITED KINGDOM	
3	D161	DAVE ENGINEERS PVT.LTD	INDIA	
4	T244	TEADIT PACKING AND GASKETS PVT LTD	INDIA	
5	G132	GOODRICH GASKET PVT LTD	INDIA	
6	3759	ASIAN SEALING PRODUCTS PRIVATE LIMITED	INDIA	
7	N175	NEOSEAL ENGINNEERING PRIVATE LIMITED	INDIA	
8	3735	UNI KLINGER LTD	INDIA	
9	I001	IGP ENGINEERS PVT. LIMITED	INDIA	
10	H176	HEM ENGINEERING CORPORATION	INDIA	
11	S471	STARFLEX SEALING INDIA PVT LTD	INDIA	
12	M012	MADRAS INDUSTRIAL PRODUCTS	INDIA	
On Holiday				
1	M570	MOORSIDE MACHINING CO LTD	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)
2	J505	JAMES WALKER & CO LTD	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02AD		**Description :** GASKET SPIRAL WOUND		
Approved Suppliers				
1	4023	BJ&P ENGINEERS PRIVATE LIMITED	INDIA	
2	I001	IGP ENGINEERS PVT. LIMITED	INDIA	
3	F543	FLEXITALLIC UK LTD	UNITED KINGDOM	
4	D161	DAVE ENGINEERS PVT.LTD	INDIA	
5	C055	CHAMPION JOINTINGS PVT LTD.	INDIA	
6	G132	GOODRICH GASKET PVT LTD	INDIA	
7	B144	BOMBAY CHEMICAL EQUIPMENTS	INDIA	
8	3735	UNI KLINGER LTD	INDIA	
9	3853	PILOT GASKETS AND ENGINEERS	INDIA	
10	H176	HEM ENGINEERING CORPORATION	INDIA	
11	S471	STARFLEX SEALING INDIA PVT LTD	INDIA	
12	M012	MADRAS INDUSTRIAL PRODUCTS	INDIA	
13	3759	ASIAN SEALING PRODUCTS PRIVATE LIMITED	INDIA	
14	T244	TEADIT PACKING AND GASKETS PVT LTD	INDIA	
15	N175	NEOSEAL ENGINNEERING PRIVATE LIMITED	INDIA	
16	J210	JAMES WALKER INMARCO INDUSTREIS PVT. LTD	INDIA	
On Holiday				
1	J505	JAMES WALKER & CO LTD	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)
2	M570	MOORSIDE MACHINING CO LTD	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02AG		**Description :** GASKET-PTFE(GLASS FILLED)		
Approved Suppliers				
1	S471	STARFLEX SEALING INDIA PVT LTD	INDIA	
2	T244	TEADIT PACKING AND GASKETS PVT LTD	INDIA	
3	3759	ASIAN SEALING PRODUCTS PRIVATE LIMITED	INDIA	
4	G132	GOODRICH GASKET PVT LTD	INDIA	
5	3853	PILOT GASKETS AND ENGINEERS	INDIA	
6	4023	BJ&P ENGINEERS PRIVATE LIMITED	INDIA	
On Holiday				
1	D097	DIP-FLON ENGINEERING & CO.	INDIA	HOLD RFQ/PBO/PO DUE TO SHIFTING OF WORKS (EXCEPT NIT CASES)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02AH		**Description :** GASKET KAMPROFILE		
Approved Suppliers				
1	4023	BJ&P ENGINEERS PRIVATE LIMITED	INDIA	
2	3735	UNI KLINGER LTD	INDIA	
3	J210	JAMES WALKER INMARCO INDUSTREIS PVT. LTD	INDIA	
4	G132	GOODRICH GASKET PVT LTD	INDIA	
5	I001	IGP ENGINEERS PVT. LIMITED	INDIA	
6	3759	ASIAN SEALING PRODUCTS PRIVATE LIMITED	INDIA	
7	T244	TEADIT PACKING AND GASKETS PVT LTD	INDIA	
8	N175	NEOSEAL ENGINNEERING PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02BA		**Description :** HOSE- RUBBER (STEAM/GAS/AIR/WATER/CHEM.)		
Approved Suppliers				
1	G052	GAYTRI INDUSTRIAL CORPORATION PRIVATE LIMITED	INDIA	
2	I207	INSAP ENGINEERS PVT. LTD	INDIA	
3	D144	DEWAS HYDROQUIP PVT LTD	INDIA	
4	R204	RM APPLIED ENGINEERS	INDIA	
5	C088	CORI ENGINEERS PVT LTD	INDIA	
6	3999	HELIFLEX ENGINEERING AND SERVICES PRIVATE LIMITED	INDIA	
7	S773	SWAGELOK CO.	UNITED STATES	
On Holiday				
1	S254	SRIDHAR ENGG. & RUBER PRODUCTS PVT LTD.	INDIA	DORMANT (NOT TO BE CONSIDERED)
2	P316	PIX TRANSMISSIONS LIMITED	INDIA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02BC		**Description :** HOSE METALLIC FLEXIBLE SS		
Approved Suppliers				
1	S773	SWAGELOK CO.	UNITED STATES	
2	3708	QUALITY FOILS (INDIA) LIMITED	INDIA	
3	R204	RM APPLIED ENGINEERS	INDIA	
4	D144	DEWAS HYDROQUIP PVT LTD	INDIA	
5	3999	HELIFLEX ENGINEERING AND SERVICES PRIVATE LIMITED	INDIA	
6	G052	GAYTRI INDUSTRIAL CORPORATION PRIVATE LIMITED	INDIA	
7	I207	INSAP ENGINEERS PVT. LTD	INDIA	
8	B179	BENGAL INDUSTRIES PVT LTD	INDIA	
9	3981	AEROFLEX INDUSTRIES LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02CA		**Description :** FASTENERS		
Approved Suppliers				
1	3797	J J INDUSTRIES	INDIA	
2	F017	FASTENERS & ALLIED PRODUCTS PVT LTD.	INDIA	
3	3948	TECHBOLT INDUSTRIES PRIVATE LIMITED	INDIA	
4	4169	UNIVERSAL PRECISION SCREWS	INDIA	
5	B728	BEA SRL	ITALY	
6	3653	SAVETA ENGINEERING CO. PVT. LTD.	INDIA	
7	3676	HEM INDUSTRIES	INDIA	
8	M273	MEGA ENGINEERING PVT. LTD.	INDIA	
9	S137	SOUVENIR INTERNATIONAL	INDIA	
10	P258	PRESIDENT ENGINEERING WORKS	INDIA	
11	M105	MULTI FASTENERS PVT LTD	INDIA	
12	F027	FIX FIT FASTENERS MFG. PVT.LTD.	INDIA	
13	3851	ASHWIN FASTENERS PVT LTD	INDIA	
14	3592	PROCYON TECHNOLOGY	INDIA	
15	3971	FOREX FASTNERS PVT LTD	INDIA	
16	A058	AEPCOM FASTENERS PRIVATE LIMITED	INDIA	
17	P282	PIONEER NUTS & BOLTS PVT LTD	INDIA	
18	P200	PRECISION AUTO ENGINEERS	INDIA	
19	4205	FASTENERS ENGINEERING PRIVATE LIMITED	INDIA	
20	N110	NITIN FASTNERS PVT LTD	INDIA	
21	U109	UDEHRA FASTNERS LTD	INDIA	
22	S336	SYNDICATE ENGINEERING INDUSTRIES	INDIA	
23	4296	MANU ENGINEERING & TRADERS	INDIA	
24	U177	UDEHRA MECHANICAL WORKS	INDIA	
25	D125A	DEEPAK FASTENERS LIMITED(DORAHA UNIT)	INDIA	
26	I139	INDUSTRIAL ENGINEERING CORP.	INDIA	
27	T710	TRIPLE FAST MIDDLE EAST LTD	UNITED ARAB EMIRATES	
28	P326	PANKAJ INTERNATIONAL	INDIA	
29	27418	TECHNICAL METAL EST.	UNITED ARAB EMIRATES	
On Holiday				
1	K133	KUNDAN INDUSTRIES LTD.	INDIA	DORMANT (NOT TO BE CONSIDERED)
2	K639	KOREA PARTS & FASTENERS (KPF)	KOREA, REPUBLIC OF	DORMANT (NOT TO BE CONSIDERED)
3	L105	LAKSHMI PRECISION SCREWS LTD	INDIA	DORMANT (NOT TO BE CONSIDERED)
4	N090	NEXO INDUSTRIES PVT. LTD.	INDIA	DORMANT (NOT TO BE CONSIDERED)
5	O551	OME METALLURGICA ERBESE S.r.l.	ITALY	DORMANT (NOT TO BE CONSIDERED)
6	H042	HARDWIN FASTENERS PVT LTD.	INDIA	Ground-XIV (Rejected in Shop Survey)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02CA **Description :** FASTENERS				
7	P008	PRECISION ENGG. INDUSTRIES	INDIA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02CB		**Description :** FASTENERS:HIGH TEMPERATURE TO A 453		
Approved Suppliers				
1	S336	SYNDICATE ENGINEERING INDUSTRIES	INDIA	
2	4169	UNIVERSAL PRECISION SCREWS	INDIA	
3	T710	TRIPLE FAST MIDDLE EAST LTD	UNITED ARAB EMIRATES	
4	B728	BEA SRL	ITALY	
5	M273	MEGA ENGINEERING PVT. LTD.	INDIA	
6	I139	INDUSTRIAL ENGINEERING CORP.	INDIA	
7	F017	FASTENERS & ALLIED PRODUCTS PVT LTD.	INDIA	
8	3797	J J INDUSTRIES	INDIA	
9	3676	HEM INDUSTRIES	INDIA	
10	P258	PRESIDENT ENGINEERING WORKS	INDIA	
On Holiday				
1	O551	OME METALLURGICA ERBESE S.r.l.	ITALY	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02DA		**Description :** EXPANSION JOINTS (RUBBER)		
Approved Suppliers				
1	C088	CORI ENGINEERS PVT LTD	INDIA	
2	R204	RM APPLIED ENGINEERS	INDIA	
3	M033	MIL INDUSTRIES LIMITED	INDIA	
4	M733	MACOGA,S.A.	SPAIN	
5	S476	SRM EXOFLEX PVT. LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02DB		**Description :** SPRING SUPPORTS		
Approved Suppliers				
1	27517	JEONGWOO INDUSTRIAL MACHINE CO LTD	KOREA, REPUBLIC OF	
2	3742	LISEGA INDIA PRIVATE LIMITED	INDIA	
3	27480	CARPENTER & PATERSON LTD	UNITED KINGDOM	
4	P338	PIPE SUPPORTS CO	INDIA	
5	S168	SPRING SUPPORTS MFG CO	INDIA	
6	3727	BERGEN PIPE SUPPORTS INDIA PVT. LTD	INDIA	
7	27476	CARPENTER & PATERSON ASIA LTD	THAILAND	
8	3835	CARPENTER AND PATERSON INDIA PRIVATE LIMITED	INDIA	
9	T246A	HASAN-TECHNO INDUSTRY PRIVATE LIMITED	INDIA	
10	P273	PIPE HANGERS & SUPPORTS PVT LTD	INDIA	
11	U584	UnisonHKR Co. Ltd.	KOREA, REPUBLIC OF	
12	27466	LISEGA SE	GERMANY	
13	P018	PIPING & ENERGY PRODUCTS (P) LTD	INDIA	
On Holiday				
1	C748	CA.S.T.IM.2000 SRL	ITALY	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02EA		**Description :** STRAINERS (T/CONE-TYPE & Y-TYPE)		
Approved Suppliers				
1	F181	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
2	4020	FILTERATION ENGINEERS INDIA PVT. LTD.	INDIA	
3	27502	ARMSTRONG INTERNATIONAL KOREA CO. LTD.	KOREA, REPUBLIC OF	
4	3843	MULTITEX FILTRATION ENGINEERS LTD	INDIA	
5	D679	DOUGLAS CHERO SPA	ITALY	
6	4204	PETRONASH ENGINEERING SERVICES PVT LTD	INDIA	
7	3761	RAKDIN ENGINEERS	INDIA	
8	L004	LEADER VALVES LTD	INDIA	
9	4131	TRIVENI EQUIPMENTS PVT LTD	INDIA	
10	M027	MULTITEX FILTRATION ENGINEERS LTD.	INDIA	
11	A376	ARMSTRONG INTERNATIONAL PVT LTD.	INDIA	
12	B144	BOMBAY CHEMICAL EQUIPMENTS	INDIA	
13	G097	GUJARAT OTOFILT	INDIA	
14	4058	BOMBAY CHEMICAL EQUIPMENTS	INDIA	
15	3822	SUNGOV ENGINEERING PVT LTD	INDIA	
16	L050	LSI-MECH ENGINEERS PRIVATE LIMITED	INDIA	
17	3889	NORFLOW CONTROLS	INDIA	
18	4284	C-TRU PROCESS EQUIPMENTS 066053052053	INDIA	
19	3847	ACME FLUID SYSTEMS	INDIA	
20	G118	GRAND PRIX ENGINEERING PVT LTD.	INDIA	
21	E026	ESCO STEAMCON PVT. LTD.	INDIA	
22	N141	NISAN SCIENTIFIC PROCESS EQUIP. P LTD	INDIA	
23	S132	SUNGOV ENGINEERING PVT LTD	INDIA	
24	V621	VERMEER PROCESS TECHNOLOGY B.V	NETHERLANDS	
On Holiday				
1	P192	PENNANT ENGINEERING PVT LTD	INDIA	HOLD-ENQ/PO/BID OP. EXCEPT NIT CASE
2	S597	SPIRAX SARCO INTERNATIONAL INC	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
3	F501	FUJI FILTER MFG CO LTD	JAPAN	DORMANT (NOT TO BE CONSIDERED)
4	F526	FORAIN S.R.L.	ITALY	DORMANT (NOT TO BE CONSIDERED)
5	N551	NEWARK WIRE CLOTH CO	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
6	V573	VEE BEE LIMITED	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)
7	J591	JFC CORPORATION	KOREA, REPUBLIC OF	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02EB		**Description :** STEAM TRAPS-BUCKET/TH.DYN/TH.STAT/FLOAT		
Approved Suppliers				
1	G544	GESTRA AG	GERMANY	
2	T023A	THERMAX LIMITED	INDIA	
3	U054	UNI KLINGER LTD	INDIA	
4	A692	ARMSTRONG INTERNATIONAL SA	BELGIUM	
5	E026	ESCO STEAMCON PVT. LTD.	INDIA	
6	A376	ARMSTRONG INTERNATIONAL PVT LTD.	INDIA	
7	L004	LEADER VALVES LTD	INDIA	
8	3593	Velan Valves India Pvt Ltd	INDIA	
9	F181	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
10	P635	PLENTY STEAM TRAPS, PLENTY LIMITED	UNITED KINGDOM	
On Holiday				
1	P192	PENNANT ENGINEERING PVT LTD	INDIA	HOLD-ENQ/PO/BID OP. EXCEPT NIT CASE
2	T578	TLV INTERNATIONAL INC	JAPAN	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02EC		**Description :** COMPACT STEAM TRAPING ASSY+SS/CR MANFOLD		
Approved Suppliers				
1	U054	UNI KLINGER LTD	INDIA	
2	A376	ARMSTRONG INTERNATIONAL PVT LTD.	INDIA	
3	A692	ARMSTRONG INTERNATIONAL SA	BELGIUM	
4	F181	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
On Holiday				
1	P192	PENNANT ENGINEERING PVT LTD	INDIA	HOLD-ENQ/PO/BID OP. EXCEPT NIT CASE

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02EH		**Description :** AUTOMATIC MECHANICAL PUMPING TRAP		
Approved Suppliers				
1	A376	ARMSTRONG INTERNATIONAL PVT LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02GB		**Description :** EXPANSION JOINT METALLIC-PIPING		
Approved Suppliers				
1	S847	SFZ S.A.S	FRANCE	
2	L050	LSI-MECH ENGINEERS PRIVATE LIMITED	INDIA	
3	4000	WITZENMANN INDIA PRIVATE LIMITED	INDIA	
4	27439	TEADIT JUNTAS S/A	BRAZIL	
5	W526	WITZENMANN GMBH	GERMANY	
6	4278	FLUIDYNE ENGINEERS INDIA PRIVATE LIMITED	INDIA	
7	3795	FLEXATHERM EXPANLLOW PVT. LTD.	INDIA	
8	N508	NORDON INDUSTRIES	FRANCE	
9	3926	RATNAFLEX ENGINEERING PRIVATE LIMITED	INDIA	
10	4067	PRECISE ENGINEERS	INDIA	
11	S798	SENIOR FLEXONICS PATHWAY	UNITED STATES	
12	F602	FLEXIDER S.R.L	ITALY	
13	U539	U.S BELLOWS INC.	UNITED STATES	
14	3671	LSI-MECH ENGINEERS PRIVATE LIMITED	INDIA	
On Holiday				
1	E643	EAGLEBURGMANN KE,INC (FRMLY K646)	UNITED STATES	HOLD-ENQ/PO/BID OP. EXCEPT NIT CASE

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 02KA		**Description :** STATIC MIXER		
Approved Suppliers				
1	S509	SULZER BROTHERS LTD (ENQ.TO S-211)	SWITZERLAND	
2	4040	CHEMEPT SOLUTIONS	INDIA	
3	M040	MIXRITE MIXING SYSTEMS	INDIA	
4	S211	SULZER INDIA PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50AA		**Description :** VALVE GATE CAST		
Approved Suppliers				
1	H656	HANGZHOU NEW TIME VALVE CO. LTD.	CHINA	
2	4031	ZED VALVES CO. PVT. LTD	INDIA	
3	L001	L & T VALVES LIMITED	INDIA	
4	27530	SUFA TECHNOLOGY INDUSTRY CO.,LTD.CNNC	CHINA	
5	S315	SHALIMAR VALVES PVT LTD	INDIA	
6	K088	KSB LIMITED	INDIA	
7	4106	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
8	B725	BOTELI VALVE GROUP CO.	CHINA	
9	3705	NUTECH CONTROLS	INDIA	
10	3991	REGENT FLOWCHEM EQUIPMENTS PVT LTD	INDIA	
11	N626	NEWAY VALVE (SUZHOU) CO LTD	CHINA	
12	4119	SAP INDUSTRIES LTD	INDIA	
13	F636A	FLOWSERVE PTE(MFR. EDWARD)	UNITED STATES	
14	M295	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
15	G186	GM ENGINEERING PVT. LTD.	INDIA	
16	N061	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA	
17	P199	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
18	J555	JC FABRICA DE VALVULAS S.A.	SPAIN	
19	F065	FLUIDLINE VALVES CO.PVT LTD	INDIA	
20	B680	BOUVIER DARLING	FRANCE	
21	S751	STRACK-MASCHINENBAU GMBH	GERMANY	
22	B015	BHARAT HEAVY ELECTRICALS LIMITED-TIRUCHIRAPALLI	INDIA	
23	4295	VALVE TECH INDUSTRIES	INDIA	
24	M678	MSA A.S.	CZECH REPUBLIC	
25	4065	LIBRA VALVES INDIA PRIVATE LIMITED	INDIA	
26	T747	TH. JANSEN-ARMATUREN GMBH (FRMLY F604)	GERMANY	
27	A389	AMPO VALVES INDIA PVT LTD	INDIA	
28	W092	BDK VALVE PRIVATE LIMITED	INDIA	
29	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
30	S070	SAKHI ENGINEERS PVT. LTD.	INDIA	
31	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
32	A018	AV VALVES LIMITED	INDIA	
33	F138	FORWARD ALLOYS & CASTINGS	INDIA	
34	27468	CAMTECH MANUFACTURING FZCO	UNITED ARAB EMIRATES	
35	4006	FLOWJET VALVES PVT LTD	INDIA	
36	H108	HAWA ENGINEERS LTD	INDIA	
37	T238	TS FLOW CONTROLS PRIVATE LIMITED	INDIA	
38	M227	MH VALVES PVT LTD.	INDIA	
39	4201	INTEGRAL PROCESS CONTROLS INDIA PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50AA		**Description :** VALVE GATE CAST		
40	3889	NORFLOW CONTROLS	INDIA	
41	4200	SHALIMAR VALVES PVT LTD	INDIA	
42	S822	SUZHOU VIZA VALVE CO.,LTD	CHINA	
43	3817	HI TECH BUTTERFLY VALVES INDIA PVT LTD	INDIA	
44	3887	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
45	4285	JAYANT ENGINEERING & MARKETING PVT. LTD	INDIA	
46	3721	M/S. VALVINOX S.R.L. INDIA PVT. LTD.	INDIA	
47	27523	SNY VALVE (YANCHENG) CO., LTD.	CHINA	
48	3933	LEADER VALVES LTD	INDIA	
49	4003	DL VALVE PRIVATE LIMITED	INDIA	
50	3982	INTEGRAL PROCESS CONTROLS INDIA PVT. LTD.	INDIA	
51	3640	FLOTEK INDUSTRIES	INDIA	
52	3616	DEMBLA VALVES LIMITED	INDIA	
53	3764	VITON ENGINEERS PRIVATE LIMITED	INDIA	
54	4132	AEGIS VALVES INDUSTRIES PRIVATE LIMITED	INDIA	
55	Z507	Z & J TECHNOLOGIES GMBH	GERMANY	
56	P514	PETROL VALVES SPA	ITALY	
57	3593	Velan Valves India Pvt Ltd	INDIA	
58	4255	OCEAN VALVES MANUFACTURING COMPANY	INDIA	
59	O035	OSWAL INDUSTRIES LTD	INDIA	
60	K620A	KITZ CORPORATION	JAPAN	
61	S850	SHENJIANG VALVE CO LTD	CHINA	
62	E211	EXPERT VALVE AND EQUIPMENT PRIVATE LIMITED	INDIA	
63	A715	AMPO, S.COOP	SPAIN	
64	3623	NILON VALVES PRIVATE LIMITED	INDIA	
65	4042	2L ENGINEERS	INDIA	
66	H175	HAWA VALVES (INDIA) PVT LTD	INDIA	
On Holiday				
1	F002	FOURESS ENGINEERING (INDIA) PRIVATE LIMITED	INDIA	DORMANT (NOT TO BE CONSIDERED)
2	Y505	YONEKI VALVE CO LTD	JAPAN	DORMANT (NOT TO BE CONSIDERED)
3	W608	WUZHOU VALVE CO LTD	CHINA	DORMANT (NOT TO BE CONSIDERED)
4	V567	VITAS - DIVISION OF VALVITALIA S.P.A	ITALY	DORMANT (NOT TO BE CONSIDERED)
5	J565	JIANGSU Jiulong Valve Manufacture Co.Ltd	CHINA	DORMANT (NOT TO BE CONSIDERED)
6	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)
7	L564	VALVOSPAIN INDUSTRIAL S.A.U	SPAIN	Ground-III (nsolvency / bankruptcy)
8	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50AA **Description :** VALVE GATE CAST				
9	P692	PK VALVE CO.,LTD	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	DORMANT (NOT TO BE CONSIDERED)
10	S360	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50AB		**Description :** VALVE GATE CRYOGENIC CAST		
Approved Suppliers				
1	P199	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
2	S315	SHALIMAR VALVES PVT LTD	INDIA	
3	L001	L & T VALVES LIMITED	INDIA	
4	F065	FLUIDLINE VALVES CO.PVT LTD	INDIA	
5	N061	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA	
6	O035	OSWAL INDUSTRIES LTD	INDIA	
7	A715	AMPO, S.COOP	SPAIN	
8	3593	Velan Valves India Pvt Ltd	INDIA	
9	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
10	3933	LEADER VALVES LTD	INDIA	
11	W092	BDK VALVE PRIVATE LIMITED	INDIA	
12	4106	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
13	4200	SHALIMAR VALVES PVT LTD	INDIA	
14	B725	BOTELI VALVE GROUP CO.	CHINA	
15	S850	SHENJIANG VALVE CO LTD	CHINA	
On Holiday				
1	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
2	L564	VALVOSPAIN INDUSTRIAL S.A.U 066053052053	SPAIN	Ground-III (nsolvency / bankruptcy)
3	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50AD		**Description :** VALVE GATE FORGED		
Approved Suppliers				
1	L004	LEADER VALVES LTD	INDIA	
2	B690	BFE SRL	ITALY	
3	3709	JMD ENGINEERING	INDIA	
4	4065	LIBRA VALVES INDIA PRIVATE LIMITED	INDIA	
5	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
6	B725	BOTELI VALVE GROUP CO.	CHINA	
7	L001	L & T VALVES LIMITED	INDIA	
8	A288	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
9	A018	AV VALVES LIMITED	INDIA	
10	3623	NILON VALVES PRIVATE LIMITED	INDIA	
11	O035	OSWAL INDUSTRIES LTD	INDIA	
12	P199	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
13	3957	KUMARS FORGE AND VALVES PVT. LTD.	INDIA	
14	3705	NUTECH CONTROLS	INDIA	
15	4200	SHALIMAR VALVES PVT LTD	INDIA	
16	K088	KSB LIMITED	INDIA	
17	4003	DL VALVE PRIVATE LIMITED	INDIA	
18	H108	HAWA ENGINEERS LTD	INDIA	
19	3616	DEMBLA VALVES LIMITED	INDIA	
20	3749	G M VALVE PRIVATE LIMITED	INDIA	
21	3640	FLOTEK INDUSTRIES	INDIA	
22	3593	Velan Valves India Pvt Ltd	INDIA	
23	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
24	M295	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
25	3982	INTEGRAL PROCESS CONTROLS INDIA PVT. LTD.	INDIA	
26	F065	FLUIDLINE VALVES CO.PVT LTD	INDIA	
27	V213	VEE TECH VALVES PRIVATE LIMITED	INDIA	
28	3887	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
29	M227	MH VALVES PVT LTD.	INDIA	
30	O531	OMB VALVES	ITALY	
31	J555	JC FABRICA DE VALVULAS S.A.	SPAIN	
32	S315	SHALIMAR VALVES PVT LTD	INDIA	
33	4106	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
34	D679	DOUGLAS CHERO SPA	ITALY	
35	4295	VALVE TECH INDUSTRIES	INDIA	
36	B015	BHARAT HEAVY ELECTRICALS LIMITED-TIRUCHIRAPALLI	INDIA	
37	3889	NORFLOW CONTROLS	INDIA	
38	W092	BDK VALVE PRIVATE LIMITED	INDIA	
On Holiday				
1	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50AD		**Description :** VALVE GATE FORGED		
2	J565	JIANGSU Jiulong Valve Manufacture Co.Ltd	CHINA	DORMANT (NOT TO BE CONSIDERED)
3	A339	AUTOCAP INDUSTRIES	INDIA	HOLD-ENQ/PO/BID OP. EXCEPT NIT CASE
4	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
5	S360	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)
6	L567	LVF SPA	ITALY	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50AE		**Description :** VALVE GATE CRYOGENIC FORGED		
Approved Suppliers				
1	3593	Velan Valves India Pvt Ltd	INDIA	
2	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
3	A288	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
4	W092	BDK VALVE PRIVATE LIMITED	INDIA	
5	3749	G M VALVE PRIVATE LIMITED	INDIA	
6	4106	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
7	P199	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
8	L004	LEADER VALVES LTD	INDIA	
9	B725	BOTELI VALVE GROUP CO.	CHINA	
10	L001	L & T VALVES LIMITED	INDIA	
11	O035	OSWAL INDUSTRIES LTD	INDIA	
On Holiday				
1	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
2	L567	LVF SPA	ITALY	DORMANT (NOT TO BE CONSIDERED)
3	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50AH		**Description :** VALVE GATE GUNMETAL/BRASS/BRONZE		
Approved Suppliers				
1	Z12	ZOLOTO INDUSTRIES	INDIA	
2	A018	AV VALVES LIMITED	INDIA	
3	S416	SANT VALVES PVT LTD	INDIA	
4	F065	FLUIDLINE VALVES CO.PVT LTD	INDIA	
5	L004	LEADER VALVES LTD	INDIA	
6	3721	M/S. VALVINOX S.R.L. INDIA PVT. LTD.	INDIA	
7	H030	H. SARKER & COMPANY VALVES PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50AI		**Description :** VALVE GATE (MOTOR OPERATED)		
Approved Suppliers				
1	W092	BDK VALVE PRIVATE LIMITED	INDIA	
2	3933	LEADER VALVES LTD	INDIA	
3	J555	JC FABRICA DE VALVULAS S.A.	SPAIN	
4	A715	AMPO, S.COOP	SPAIN	
5	3764	VITON ENGINEERS PRIVATE LIMITED	INDIA	
6	3887	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
7	M678	MSA A.S.	CZECH REPUBLIC	
8	L001	L & T VALVES LIMITED	INDIA	
9	3982	INTEGRAL PROCESS CONTROLS INDIA PVT. LTD.	INDIA	
10	N061	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA	
11	3593	Velan Valves India Pvt Ltd	INDIA	
12	3623	NILON VALVES PRIVATE LIMITED	INDIA	
13	P514	PETROL VALVES SPA	ITALY	
14	Z507	Z & J TECHNOLOGIES GMBH	GERMANY	
15	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
16	G186	GM ENGINEERING PVT. LTD.	INDIA	
17	B015	BHARAT HEAVY ELECTRICALS LIMITED-TIRUCHIRAPALLI	INDIA	
18	A389	AMPO VALVES INDIA PVT LTD 066053052053	INDIA	
19	F636A	FLOWSERVE PTE(MFR. EDWARD)	UNITED STATES	
20	4031	ZED VALVES CO. PVT. LTD	INDIA	
21	F065	FLUIDLINE VALVES CO.PVT LTD	INDIA	
22	O035	OSWAL INDUSTRIES LTD	INDIA	
23	B725	BOTELI VALVE GROUP CO.	CHINA	
24	4201	INTEGRAL PROCESS CONTROLS INDIA PVT LTD	INDIA	
25	4285	JAYANT ENGINEERING & MARKETING PVT. LTD	INDIA	
26	T747	TH. JANSEN-ARMATUREN GMBH (FRMLY F604)	GERMANY	
27	3616	DEMBLA VALVES LIMITED	INDIA	
28	K088	KSB LIMITED	INDIA	
On Holiday				
1	Y505	YONEKI VALVE CO LTD	JAPAN	DORMANT (NOT TO BE CONSIDERED)
2	V567	VITAS - DIVISION OF VALVITALIA S.P.A	ITALY	DORMANT (NOT TO BE CONSIDERED)
3	J565	JIANGSU Jiulong Valve Manufacture Co.Ltd	CHINA	DORMANT (NOT TO BE CONSIDERED)
4	P692	PK VALVE CO.,LTD	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	DORMANT (NOT TO BE CONSIDERED)
5	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
6	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)
7	S360	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50AJ		**Description :** VALVE KNIFE GATE		
Approved Suppliers				
1	M094	MICROFINISH VALVES PVT LIMITED	INDIA	
2	H656	HANGZHOU NEW TIME VALVE CO. LTD.	CHINA	
3	J113	JASH ENGINEERING LTD.	INDIA	
4	4065	LIBRA VALVES INDIA PRIVATE LIMITED	INDIA	
5	27459	TOTAL ENGINEERING CO.,LTD	KOREA, REPUBLIC OF	
6	4230	ORBINOX INDIA PRIVATE LIMITED	INDIA	
7	E211	EXPERT VALVE AND EQUIPMENT PRIVATE LIMITED	INDIA	
8	4270	DINTECH VALVES PRIVATE LIMITED	INDIA	
9	4006	FLOWJET VALVES PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50BA		**Description :** VALVE GLOBE CAST		
Approved Suppliers				
1	A389	AMPO VALVES INDIA PVT LTD	INDIA	
2	B015	BHARAT HEAVY ELECTRICALS LIMITED-TIRUCHIRAPALLI	INDIA	
3	S822	SUZHOU VIZA VALVE CO.,LTD	CHINA	
4	N626	NEWAY VALVE (SUZHOU) CO LTD	CHINA	
5	4065	LIBRA VALVES INDIA PRIVATE LIMITED	INDIA	
6	3721	M/S. VALVINOX S.R.L. INDIA PVT. LTD.	INDIA	
7	4031	ZED VALVES CO. PVT. LTD	INDIA	
8	27468	CAMTECH MANUFACTURING FZCO	UNITED ARAB EMIRATES	
9	4132	AEGIS VALVES INDUSTRIES PRIVATE LIMITED	INDIA	
10	4006	FLOWJET VALVES PVT LTD	INDIA	
11	W092	BDK VALVE PRIVATE LIMITED	INDIA	
12	N061	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA	
13	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
14	K088	KSB LIMITED	INDIA	
15	P199	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
16	4295	VALVE TECH INDUSTRIES	INDIA	
17	4285	JAYANT ENGINEERING & MARKETING PVT. LTD.	INDIA	
18	3616	DEMBLA VALVES LIMITED	INDIA	
19	3593	Velan Valves India Pvt Ltd	INDIA	
20	3982	INTEGRAL PROCESS CONTROLS INDIA PVT. LTD.	INDIA	
21	4255	OCEAN VALVES MANUFACTURING COMPANY	INDIA	
22	G186	GM ENGINEERING PVT. LTD.	INDIA	
23	M678	MSA A.S.	CZECH REPUBLIC	
24	4200	SHALIMAR VALVES PVT LTD	INDIA	
25	3887	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
26	3889	NORFLOW CONTROLS	INDIA	
27	H108	HAWA ENGINEERS LTD	INDIA	
28	J555	JC FABRICA DE VALVULAS S.A.	SPAIN	
29	27523	SNY VALVE (YANCHENG) CO., LTD.	CHINA	
30	H175	HAWA VALVES (INDIA) PVT LTD	INDIA	
31	3623	NILON VALVES PRIVATE LIMITED	INDIA	
32	27530	SUFA TECHNOLOGY INDUSTRY CO.,LTD.CNNC	CHINA	
33	F138	FORWARD ALLOYS & CASTINGS	INDIA	
34	P514	PETROL VALVES SPA	ITALY	
35	3764	VITON ENGINEERS PRIVATE LIMITED	INDIA	
36	4003	DL VALVE PRIVATE LIMITED	INDIA	
37	S850	SHENJIANG VALVE CO LTD	CHINA	
38	F065	FLUIDLINE VALVES CO.PVT LTD	INDIA	
39	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50BA		**Description :** VALVE GLOBE CAST		
40	4119	SAP INDUSTRIES LTD	INDIA	
41	B725	BOTELI VALVE GROUP CO.	CHINA	
42	4106	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
43	3817	HI TECH BUTTERFLY VALVES INDIA PVT LTD	INDIA	
44	3933	LEADER VALVES LTD	INDIA	
45	3705	NUTECH CONTROLS	INDIA	
46	E211	EXPERT VALVE AND EQUIPMENT PRIVATE LIMITED	INDIA	
47	4042	2L ENGINEERS	INDIA	
48	O035	OSWAL INDUSTRIES LTD	INDIA	
49	K620A	KITZ CORPORATION	JAPAN	
50	A715	AMPO, S.COOP	SPAIN	
51	3640	FLOTEK INDUSTRIES	INDIA	
52	M295	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
53	A018	AV VALVES LIMITED	INDIA	
54	S315	SHALIMAR VALVES PVT LTD	INDIA	
55	S070	SAKHI ENGINEERS PVT. LTD.	INDIA	
56	L001	L & T VALVES LIMITED	INDIA	
57	M227	MH VALVES PVT LTD.	INDIA	
On Holiday				
1	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)
2	L564	VALVOSPAIN INDUSTRIAL S.A.U	SPAIN	Ground-III (nsolvency / bankruptcy)
3	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
4	P692	PK VALVE CO.,LTD	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	DORMANT (NOT TO BE CONSIDERED)
5	S360	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)
6	F002	FOURESS ENGINEERING (INDIA) PRIVATE LIMITED	INDIA	DORMANT (NOT TO BE CONSIDERED)
7	Y505	YONEKI VALVE CO LTD	JAPAN	DORMANT (NOT TO BE CONSIDERED)
8	W608	WUZHOU VALVE CO LTD	CHINA	DORMANT (NOT TO BE CONSIDERED)
9	V567	VITAS - DIVISION OF VALVITALIA S.P.A	ITALY	DORMANT (NOT TO BE CONSIDERED)
10	J565	JIANGSU Jiulong Valve Manufacture Co.Ltd	CHINA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50BB		**Description :** VALVE GLOBE CRYOGENIC CAST		
Approved Suppliers				
1	O035	OSWAL INDUSTRIES LTD	INDIA	
2	B725	BOTELI VALVE GROUP CO.	CHINA	
3	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
4	4106	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
5	A715	AMPO, S.COOP	SPAIN	
6	3593	Velan Valves India Pvt Ltd	INDIA	
7	L001	L & T VALVES LIMITED	INDIA	
8	W092	BDK VALVE PRIVATE LIMITED	INDIA	
9	P199	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
10	3640	FLOTEK INDUSTRIES	INDIA	
11	N061	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA	
12	3933	LEADER VALVES LTD	INDIA	
On Holiday				
1	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
2	L564	VALVOSPAIN INDUSTRIAL S.A.U	SPAIN	Ground-III (nsolvency / bankruptcy)
3	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50BD		**Description :** VALVE GLOBE FORGED		
Approved Suppliers				
1	3593	Velan Valves India Pvt Ltd	INDIA	
2	3616	DEMBLA VALVES LIMITED	INDIA	
3	3705	NUTECH CONTROLS	INDIA	
4	3889	NORFLOW CONTROLS	INDIA	
5	O035	OSWAL INDUSTRIES LTD	INDIA	
6	F636A	FLOWSERVE PTE(MFR. EDWARD)	UNITED STATES	
7	4042	2L ENGINEERS	INDIA	
8	B015	BHARAT HEAVY ELECTRICALS LIMITED-TIRUCHIRAPALLI	INDIA	
9	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
10	3749	G M VALVE PRIVATE LIMITED	INDIA	
11	3709	JMD ENGINEERING	INDIA	
12	W092	BDK VALVE PRIVATE LIMITED	INDIA	
13	3640	FLOTEK INDUSTRIES	INDIA	
14	3623	NILON VALVES PRIVATE LIMITED	INDIA	
15	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
16	L004	LEADER VALVES LTD	INDIA	
17	M295	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
18	A018	AV VALVES LIMITED 066053052053	INDIA	
19	J555	JC FABRICA DE VALVULAS S.A.	SPAIN	
20	H108	HAWA ENGINEERS LTD	INDIA	
21	4200	SHALIMAR VALVES PVT LTD	INDIA	
22	V213	VEE TECH VALVES PRIVATE LIMITED	INDIA	
23	4003	DL VALVE PRIVATE LIMITED	INDIA	
24	L001	L & T VALVES LIMITED	INDIA	
25	F065	FLUIDLINE VALVES CO.PVT LTD	INDIA	
26	B690	BFE SRL	ITALY	
27	B725	BOTELI VALVE GROUP CO.	CHINA	
28	3982	INTEGRAL PROCESS CONTROLS INDIA PVT. LTD.	INDIA	
29	M227	MH VALVES PVT LTD.	INDIA	
30	4106	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
31	3957	KUMARS FORGE AND VALVES PVT. LTD.	INDIA	
32	3887	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
33	O531	OMB VALVES	ITALY	
34	S315	SHALIMAR VALVES PVT LTD	INDIA	
35	A288	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
36	4295	VALVE TECH INDUSTRIES	INDIA	
37	D679	DOUGLAS CHERO SPA	ITALY	
38	P199	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
39	K088	KSB LIMITED	INDIA	

On Holiday

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50BD		**Description :** VALVE GLOBE FORGED		
1	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)
2	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
3	A339	AUTOCAP INDUSTRIES	INDIA	HOLD-ENQ/PO/BID OP. EXCEPT NIT CASE
4	J565	JIANGSU Jiulong Valve Manufacture Co.Ltd	CHINA	DORMANT (NOT TO BE CONSIDERED)
5	C673	CONVAL INC	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
6	L567	LVF SPA	ITALY	DORMANT (NOT TO BE CONSIDERED)
7	S360	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50BE		**Description :** VALVE GLOBE CRYOGENIC FORGED		
Approved Suppliers				
1	L001	L & T VALVES LIMITED	INDIA	
2	O035	OSWAL INDUSTRIES LTD	INDIA	
3	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
4	B725	BOTELI VALVE GROUP CO.	CHINA	
5	W092	BDK VALVE PRIVATE LIMITED	INDIA	
6	A288	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
7	L004	LEADER VALVES LTD	INDIA	
8	3749	G M VALVE PRIVATE LIMITED	INDIA	
On Holiday				
1	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
2	L567	LVF SPA	ITALY	DORMANT (NOT TO BE CONSIDERED)
3	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50BH		**Description :** VALVE GLOBE GUNMETAL/BRASS/BRONZE		
Approved Suppliers				
1	A018	AV VALVES LIMITED	INDIA	
2	L004	LEADER VALVES LTD	INDIA	
3	S416	SANT VALVES PVT LTD	INDIA	
4	3721	M/S. VALVINOX S.R.L. INDIA PVT. LTD.	INDIA	
5	H030	H. SARKER & COMPANY VALVES PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50BI		**Description :** VALVES GLOBE Y TYPE & STOP CHECK STRAIGHT/Y TYPE		
Approved Suppliers				
1	A389	AMPO VALVES INDIA PVT LTD	INDIA	
2	S748	SCHUF-ARMATUREN UND APPARATEBAU GMBH	GERMANY	
3	B725	BOTELI VALVE GROUP CO.	CHINA	
4	A288	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
5	A715	AMPO, S.COOP	SPAIN	
6	S315	SHALIMAR VALVES PVT LTD	INDIA	
7	A706	ADAMS ARMATUREN GMBH	GERMANY	
8	P514	PETROL VALVES SPA	ITALY	
9	B690	BFE SRL	ITALY	
10	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
11	L001	L & T VALVES LIMITED	INDIA	
12	F636A	FLOWSERVE PTE(MFR. EDWARD)	UNITED STATES	
13	3593	Velan Valves India Pvt Ltd	INDIA	
14	3749	G M VALVE PRIVATE LIMITED	INDIA	
15	4200	SHALIMAR VALVES PVT LTD	INDIA	
16	D679	DOUGLAS CHERO SPA	ITALY	
On Holiday				
1	C673	CONVAL INC	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
2	L567	LVF SPA	ITALY	DORMANT (NOT TO BE CONSIDERED)
3	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
4	T541	TAKAMISAWA VALVE CO LTD(ENQ TO MEC CORPN	JAPAN	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50BQ		**Description :** VALVE BLOWDOWN (Straight/Angle Pattern)		
Approved Suppliers				
1	F181	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
2	S149	SchuF Speciality valves India Pvt Ltd	INDIA	
3	I172	INSTRUMENTATION LTD. (PALGHAT)	INDIA	
4	G544	GESTRA AG	GERMANY	
5	4022	INDITECH VALVES PVT LTD	INDIA	
6	B015	BHARAT HEAVY ELECTRICALS LIMITED-TIRUCHIRAPALLI	INDIA	
7	S748	SCHUF-ARMATUREN UND APPARATEBAU GMBH	GERMANY	
8	H656	HANGZHOU NEW TIME VALVE CO. LTD.	CHINA	
On Holiday				
1	W608	WUZHOU VALVE CO LTD	CHINA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50CA		**Description :** VALVE CHECK CAST		
Approved Suppliers				
1	3623	NILON VALVES PRIVATE LIMITED	INDIA	
2	4295	VALVE TECH INDUSTRIES	INDIA	
3	T238	TS FLOW CONTROLS PRIVATE LIMITED	INDIA	
4	B725	BOTELI VALVE GROUP CO.	CHINA	
5	4285	JAYANT ENGINEERING & MARKETING PVT. LTD	INDIA	
6	A715	AMPO, S.COOP	SPAIN	
7	3887	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
8	4255	OCEAN VALVES MANUFACTURING COMPANY	INDIA	
9	F065	FLUIDLINE VALVES CO.PVT LTD	INDIA	
10	27468	CAMTECH MANUFACTURING FZCO	UNITED ARAB EMIRATES	
11	3764	VITON ENGINEERS PRIVATE LIMITED	INDIA	
12	H108	HAWA ENGINEERS LTD	INDIA	
13	27523	SNY VALVE (YANCHENG) CO., LTD.	CHINA	
14	J555	JC FABRICA DE VALVULAS S.A.	SPAIN	
15	F138	FORWARD ALLOYS & CASTINGS	INDIA	
16	3982	INTEGRAL PROCESS CONTROLS INDIA PVT. LTD.	INDIA	
17	O035	OSWAL INDUSTRIES LTD	INDIA	
18	M295	MICON ENGINEERS (HUBLI) PVT LTD 066053052053	INDIA	
19	M678	MSA A.S.	CZECH REPUBLIC	
20	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
21	4006	FLOWJET VALVES PVT LTD	INDIA	
22	N061	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA	
23	3640	FLOTEK INDUSTRIES	INDIA	
24	S850	SHENJIANG VALVE CO LTD	CHINA	
25	G186	GM ENGINEERING PVT. LTD.	INDIA	
26	4031	ZED VALVES CO. PVT. LTD	INDIA	
27	3616	DEMBLA VALVES LIMITED	INDIA	
28	L001	L & T VALVES LIMITED	INDIA	
29	B015	BHARAT HEAVY ELECTRICALS LIMITED-TIRUCHIRAPALLI	INDIA	
30	4132	AEGIS VALVES INDUSTRIES PRIVATE LIMITED	INDIA	
31	3705	NUTECH CONTROLS	INDIA	
32	3593	Velan Valves India Pvt Ltd	INDIA	
33	M227	MH VALVES PVT LTD.	INDIA	
34	3933	LEADER VALVES LTD	INDIA	
35	A018	AV VALVES LIMITED	INDIA	
36	N626	NEWAY VALVE (SUZHOU) CO LTD	CHINA	
37	4119	SAP INDUSTRIES LTD	INDIA	
38	F106	FLOW CHEM INDUSTRIES	INDIA	
39	4065	LIBRA VALVES INDIA PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50CA		**Description :** VALVE CHECK CAST		
40	A389	AMPO VALVES INDIA PVT LTD	INDIA	
41	4200	SHALIMAR VALVES PVT LTD	INDIA	
42	W092	BDK VALVE PRIVATE LIMITED	INDIA	
43	3721	M/S. VALVINOX S.R.L. INDIA PVT. LTD.	INDIA	
44	S070	SAKHI ENGINEERS PVT. LTD.	INDIA	
45	4042	2L ENGINEERS	INDIA	
46	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
47	27530	SUFA TECHNOLOGY INDUSTRY CO.,LTD.CNNC	CHINA	
48	S315	SHALIMAR VALVES PVT LTD	INDIA	
49	P199	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
50	4106	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
51	P514	PETROL VALVES SPA	ITALY	
52	K088	KSB LIMITED	INDIA	
53	H175	HAWA VALVES (INDIA) PVT LTD	INDIA	
54	3889	NORFLOW CONTROLS	INDIA	
55	3817	HI TECH BUTTERFLY VALVES INDIA PVT LTD	INDIA	
56	H656	HANGZHOU NEW TIME VALVE CO. LTD.	CHINA	
57	S822	SUZHOU VIZA VALVE CO.,LTD	CHINA	
On Holiday				
1	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)
2	L564	VALVOSPAIN INDUSTRIAL S.A.U	SPAIN	Ground-III (nsolvency / bankruptcy)
3	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
4	P692	PK VALVE CO.,LTD	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	DORMANT (NOT TO BE CONSIDERED)
5	J565	JIANGSU Jiulong Valve Manufacture Co.Ltd	CHINA	DORMANT (NOT TO BE CONSIDERED)
6	S360	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)
7	Y505	YONEKI VALVE CO LTD	JAPAN	DORMANT (NOT TO BE CONSIDERED)
8	W608	WUZHOU VALVE CO LTD	CHINA	DORMANT (NOT TO BE CONSIDERED)
9	V567	VITAS - DIVISION OF VALVITALIA S.P.A	ITALY	DORMANT (NOT TO BE CONSIDERED)
10	T645	TOM WHEATLEY VALVE OPERATIONS	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
11	T541	TAKAMISAWA VALVE CO LTD(ENQ TO MEC CORPN	JAPAN	DORMANT (NOT TO BE CONSIDERED)
12	F002	FOURESS ENGINEERING (INDIA) PRIVATE LIMITED	INDIA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50CB		**Description :** VALVE CHECK CRYOGENIC CAST		
Approved Suppliers				
1	3593	Velan Valves India Pvt Ltd	INDIA	
2	B725	BOTELI VALVE GROUP CO.	CHINA	
3	L001	L & T VALVES LIMITED	INDIA	
4	A715	AMPO, S.COOP	SPAIN	
5	4106	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
6	P199	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
7	O035	OSWAL INDUSTRIES LTD	INDIA	
8	N061	NSSL PVT. LTD. (NECO SCHUBERT & SALZER)	INDIA	
9	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
On Holiday				
1	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
2	L564	VALVOSPAIN INDUSTRIAL S.A.U	SPAIN	Ground-III (nsolvency / bankruptcy)
3	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50CD		**Description :** VALVE CHECK FORGED		
Approved Suppliers				
1	L001	L & T VALVES LIMITED	INDIA	
2	D679	DOUGLAS CHERO SPA	ITALY	
3	3749	G M VALVE PRIVATE LIMITED	INDIA	
4	3616	DEMBLA VALVES LIMITED	INDIA	
5	3593	Velan Valves India Pvt Ltd	INDIA	
6	P199	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
7	V213	VEE TECH VALVES PRIVATE LIMITED	INDIA	
8	3640	FLOTEK INDUSTRIES	INDIA	
9	K088	KSB LIMITED	INDIA	
10	W092	BDK VALVE PRIVATE LIMITED	INDIA	
11	3709	JMD ENGINEERING	INDIA	
12	4003	DL VALVE PRIVATE LIMITED	INDIA	
13	F065	FLUIDLINE VALVES CO.PVT LTD	INDIA	
14	H108	HAWA ENGINEERS LTD	INDIA	
15	J555	JC FABRICA DE VALVULAS S.A.	SPAIN	
16	M295	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
17	A018	AV VALVES LIMITED	INDIA	
18	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
19	3957	KUMARS FORGE AND VALVES PVT. LTD.	INDIA	
20	F636A	FLOWSERVE PTE(MFR. EDWARD)	UNITED STATES	
21	F178	FLOVEL VALVES PVT.LTD.	INDIA	
22	4200	SHALIMAR VALVES PVT LTD	INDIA	
23	4295	VALVE TECH INDUSTRIES	INDIA	
24	S315	SHALIMAR VALVES PVT LTD	INDIA	
25	B690	BFE SRL	ITALY	
26	3889	NORFLOW CONTROLS	INDIA	
27	4106	PANCHVATI VALVES & FLANGES PVT LTD	INDIA	
28	3623	NILON VALVES PRIVATE LIMITED	INDIA	
29	O531	OMB VALVES	ITALY	
30	A288	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
31	O035	OSWAL INDUSTRIES LTD	INDIA	
32	L004	LEADER VALVES LTD	INDIA	
33	3982	INTEGRAL PROCESS CONTROLS INDIA PVT. LTD.	INDIA	
34	3887	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
35	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
36	M227	MH VALVES PVT LTD.	INDIA	
37	3705	NUTECH CONTROLS	INDIA	
38	B015	BHARAT HEAVY ELECTRICALS LIMITED-TIRUCHIRAPALLI	INDIA	
39	B725	BOTELI VALVE GROUP CO.	CHINA	

On Holiday

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50CD		**Description :** VALVE CHECK FORGED		
1	T541	TAKAMISAWA VALVE CO LTD(ENQ TO MEC CORPN	JAPAN	DORMANT (NOT TO BE CONSIDERED)
2	L567	LVF SPA	ITALY	DORMANT (NOT TO BE CONSIDERED)
3	C673	CONVAL INC	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
4	J565	JIANGSU Jiulong Valve Manufacture Co.Ltd	CHINA	DORMANT (NOT TO BE CONSIDERED)
5	A339	AUTOCAP INDUSTRIES	INDIA	HOLD-ENQ/PO/BID OP. EXCEPT NIT CASE
6	S360	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)
7	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
8	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50CE		**Description :** VALVE CHECK CRYOGENIC FORGED		
Approved Suppliers				
1	O035	OSWAL INDUSTRIES LTD	INDIA	
2	B725	BOTELI VALVE GROUP CO.	CHINA	
3	L001	L & T VALVES LIMITED	INDIA	
4	A288	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
5	L567	LVF SPA	ITALY	
6	L004	LEADER VALVES LTD	INDIA	
7	3749	G M VALVE PRIVATE LIMITED	INDIA	
On Holiday				
1	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50CH		**Description :** VALVE CHECK GUNMETAL/BRASS/BRONZE		
Approved Suppliers				
1	H030	H. SARKER & COMPANY VALVES PRIVATE LIMITED	INDIA	
2	S416	SANT VALVES PVT LTD	INDIA	
3	3721	M/S. VALVINOX S.R.L. INDIA PVT. LTD.	INDIA	
4	L004	LEADER VALVES LTD	INDIA	
5	F178	FLOVEL VALVES PVT.LTD.	INDIA	
6	A018	AV VALVES LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50CJ		**Description :** VALVE CHECK DUAL PLATE		
Approved Suppliers				
1	3826	ADVANCE VALVES PVT LTD	INDIA	
2	4065	LIBRA VALVES INDIA PRIVATE LIMITED	INDIA	
3	G544	GESTRA AG	GERMANY	
4	C186	CRANE PROCESS FLOW TECHNOLOGIES(INDIA) PRIVATE LTD.	INDIA	
5	4042	2L ENGINEERS	INDIA	
6	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
7	F178	FLOVEL VALVES PVT.LTD.	INDIA	
8	S850	SHENJIANG VALVE CO LTD	CHINA	
9	G598	GOODWIN INTERNATIONAL LTD	UNITED KINGDOM	
10	27468	CAMTECH MANUFACTURING FZCO	UNITED ARAB EMIRATES	
11	S315	SHALIMAR VALVES PVT LTD	INDIA	
12	3817	HI TECH BUTTERFLY VALVES INDIA PVT LTD	INDIA	
13	27523	SNY VALVE (YANCHENG) CO., LTD.	CHINA	
14	W092	BDK VALVE PRIVATE LIMITED	INDIA	
15	3640	FLOTEK INDUSTRIES	INDIA	
16	4200	SHALIMAR VALVES PVT LTD	INDIA	
17	3933	LEADER VALVES LTD	INDIA	
18	A315	ADVANCE VALVES PVT LTD.	INDIA	
19	P514	PETROL VALVES SPA	ITALY	
20	4031	ZED VALVES CO. PVT. LTD	INDIA	
21	N626	NEWAY VALVE (SUZHOU) CO LTD	CHINA	
On Holiday				
1	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
2	C752	CRANE STOCKHAM VALVE LTD	UNITED KINGDOM	Ground-XIII (Negative networth or Financial constraints)
3	V567	VITAS - DIVISION OF VALVITALIA S.P.A	ITALY	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50CK		**Description :** VALVE CHECK EXCESS FLOW		
Approved Suppliers				
1	C136	CHANDRA ENGG. & MECH PVT LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50CL		**Description :** VALVE-NON SLAM CHECK (NOZZLE)		
Approved Suppliers				
1	S315	SHALIMAR VALVES PVT LTD	INDIA	
2	G598	GOODWIN INTERNATIONAL LTD	UNITED KINGDOM	
3	D696	DFT INC	UNITED STATES	
4	A693	ATWOOD & MORRILL & CO	UNITED STATES	
5	A315	ADVANCE VALVES PVT LTD.	INDIA	
6	M644	MOKVELD VALVES BV	NETHERLANDS	
7	C186	CRANE PROCESS FLOW TECHNOLOGIES(INDIA) PRIVATE LTD.	INDIA	
8	4200	SHALIMAR VALVES PVT LTD	INDIA	
9	4042	2L ENGINEERS	INDIA	
10	F178	FLOVEL VALVES PVT.LTD.	INDIA	
On Holiday				
1	C752	CRANE STOCKHAM VALVE LTD	UNITED KINGDOM	Ground-XIII (Negative networth or Financial constraints)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50CM		**Description :** VALVE CHECK DUAL PLATE CRYOGENIC		
Approved Suppliers				
1	A315	ADVANCE VALVES PVT LTD.	INDIA	
2	F178	FLOVEL VALVES PVT.LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50D-		**Description :** VALVE BALL-(FOREIGN SUPPLIERS)		
Approved Suppliers				
1	C718	CAMERON ITALY SRL (FORM. D659)	ITALY	
2	M576	MECA FRANCE S.A.	FRANCE	
3	K511	KITAMURA VALVE MANUFACTURING CO LTD	JAPAN	
4	J555	JC FABRICA DE VALVULAS S.A.	SPAIN	
5	L581	LCM ITALIA SPA	ITALY	
6	F627	FRANZ SCHUCK GMBH (FORMERLY BORSIG-B506)	GERMANY	
7	P544	PIBIVIESSE S. R. L.	ITALY	
8	O528	OMS SALERI	ITALY	
9	P514	PETROL VALVES SPA	ITALY	
On Holiday				
1	M700	VALMET FLOW CONTROL OY	FINLAND	Ground-XXIII (Banned by Clients)
2	F636C	FLOWSERVE PTE(MFR. NORDSTORM)	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
3	T674	TK VALVES OPERATIONS	UNITED ARAB EMIRATES	DORMANT (NOT TO BE CONSIDERED)
4	K603	KF INDUSTRIES	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
5	M662	MCCANNA VALVES INC	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
6	W608	WUZHOU VALVE CO LTD	CHINA	DORMANT (NOT TO BE CONSIDERED)
7	J565	JIANGSU Jiulong Valve Manufacture Co.Ltd	CHINA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50DA		**Description :** VALVE BALL CRYOGENIC		
Approved Suppliers				
1	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
2	W092	BDK VALVE PRIVATE LIMITED	INDIA	
3	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
4	A764	AE VALVES	BELGIUM	
5	M094	MICROFINISH VALVES PVT LIMITED	INDIA	
6	L001	L & T VALVES LIMITED	INDIA	
7	A715	AMPO, S.COOP	SPAIN	
On Holiday				
1	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
2	L564	VALVOSPAIN INDUSTRIAL S.A.U	SPAIN	Ground-III (nsolvency / bankruptcy)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50DB		**Description :** VALVE BALL NON FIRE SAFE-CCS		
Approved Suppliers				
1	3887	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
2	3933	LEADER VALVES LTD	INDIA	
3	27446	GALPERTI ENGINEERING AND FLOW CONTROL SPA	ITALY	
4	4212	STAR ENGINEERS	INDIA	
5	3605	Petro Valves Pvt Ltd	INDIA	
6	O035	OSWAL INDUSTRIES LTD	INDIA	
7	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
8	Z594	ZA.VE.RO. SRL	ITALY	
9	L581	LCM ITALIA SPA	ITALY	
10	R153	REYNOLD VALVES LTD	INDIA	
11	J555	JC FABRICA DE VALVULAS S.A.	SPAIN	
12	27491	VALVULAS FEVISA S.A.U	SPAIN	
13	B725	BOTELI VALVE GROUP CO.	CHINA	
14	3889	NORFLOW CONTROLS	INDIA	
15	M295	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
16	V608	VALVITALIA SPA	ITALY	
17	4042	2L ENGINEERS	INDIA	
18	K511	KITAMURA VALVE MANUFACTURING CO LTD	JAPAN	
19	M219	MEVADA ENGG.WORKS PVT LTD	INDIA	
20	S850	SHENJIANG VALVE CO LTD	CHINA	
21	S822	SUZHOU VIZA VALVE CO.,LTD	CHINA	
22	L004	LEADER VALVES LTD	INDIA	
23	A715	AMPO, S.COOP	SPAIN	
24	M724	MIR VALVE SDN.BHD.	MALAYSIA	
25	G186	GM ENGINEERING PVT. LTD.	INDIA	
26	3623	NILON VALVES PRIVATE LIMITED	INDIA	
27	L001	L & T VALVES LIMITED	INDIA	
28	F627	FRANZ SCHUCK GMBH (FORMERLY BORSIG-B506)	GERMANY	
29	K620A	KITZ CORPORATION	JAPAN	
30	K649	KUMKANG VALVE MFG CO.LTD	KOREA, REPUBLIC OF	
31	3616	DEMBLA VALVES LIMITED	INDIA	
32	3840	AIRA EURO AUTOMATION PVT LTD	INDIA	
33	F106	FLOW CHEM INDUSTRIES	INDIA	
34	D037	DEMBLA VALVES LTD.	INDIA	
35	V604	VALBART SRL (A FLOWSERVE COMPANY)	ITALY	
36	N626	NEWAY VALVE (SUZHOU) CO LTD	CHINA	
37	D146	DELVAL FLOW CONTROLS PRIVATE LIMITED	INDIA	
38	W092	BDK VALVE PRIVATE LIMITED	INDIA	
39	N633	NSSL ITALIA	ITALY	
40	C718	CAMERON ITALY SRL (FORM. D659)	ITALY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50DB		**Description :** VALVE BALL NON FIRE SAFE-CCS		
41	H108	HAWA ENGINEERS LTD	INDIA	
42	V213	VEE TECH VALVES PRIVATE LIMITED	INDIA	
43	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
44	F065	FLUIDLINE VALVES CO.PVT LTD	INDIA	
45	M576	MECA FRANCE S.A.	FRANCE	
46	27428	FLUITEK ORSENIGO VALVES S.P.A.	ITALY	
47	M094	MICROFINISH VALVES PVT LIMITED	INDIA	
48	4031	ZED VALVES CO. PVT. LTD	INDIA	
On Holiday				
1	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
2	3664	ANAND TEKNOW AIDS ENGINEERING INDIA LTD.	INDIA	Ground-XIII (Negative networth or Financial constraints)
3	R199	VALMET FLOW CONTROL PRIVATE LIMITED	INDIA	HOLD-ENQ/PO/BID OP. EXCEPT NIT CASE
4	A388	ANAND TEKNOW AIDS ENGINEERING INDIA LTD	INDIA	Ground-XIII (Negative networth or Financial constraints)
5	K603	KF INDUSTRIES	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
6	M700	VALMET FLOW CONTROL OY	FINLAND	Ground-XXIII (Banned by Clients)
7	M662	MCCANNA VALVES INC	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
8	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)
9	J565	JIANGSU Jiulong Valve Manufacture Co.Ltd	CHINA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50DC		**Description :** VALVE BALL NON FIRE SAFE-CSS		
Approved Suppliers				
1	K511	KITAMURA VALVE MANUFACTURING CO LTD	JAPAN	
2	V213	VEE TECH VALVES PRIVATE LIMITED	INDIA	
3	F106	FLOW CHEM INDUSTRIES	INDIA	
4	J555	JC FABRICA DE VALVULAS S.A.	SPAIN	
5	3933	LEADER VALVES LTD	INDIA	
6	3616	DEMBLA VALVES LIMITED	INDIA	
7	3605	Petro Valves Pvt Ltd	INDIA	
8	H108	HAWA ENGINEERS LTD	INDIA	
9	3887	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
10	K649	KUMKANG VALVE MFG CO.LTD	KOREA, REPUBLIC OF	
11	N626	NEWAY VALVE (SUZHOU) CO LTD	CHINA	
12	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
13	N633	NSSL ITALIA	ITALY	
14	3623	NILON VALVES PRIVATE LIMITED	INDIA	
15	D146	DELVAL FLOW CONTROLS PRIVATE LIMITED	INDIA	
16	M295	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
17	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
18	V604	VALBART SRL (A FLOWSERVE COMPANY)	ITALY	
19	4042	2L ENGINEERS	INDIA	
20	S822	SUZHOU VIZA VALVE CO.,LTD	CHINA	
21	G186	GM ENGINEERING PVT. LTD.	INDIA	
22	M094	MICROFINISH VALVES PVT LIMITED	INDIA	
23	3840	AIRA EURO AUTOMATION PVT LTD	INDIA	
24	27446	GALPERTI ENGINEERING AND FLOW CONTROL SPA	ITALY	
25	B725	BOTELI VALVE GROUP CO.	CHINA	
26	C718	CAMERON ITALY SRL (FORM. D659)	ITALY	
27	M219	MEVADA ENGG.WORKS PVT LTD	INDIA	
28	Z594	ZA.VE.RO. SRL	ITALY	
29	R153	REYNOLD VALVES LTD	INDIA	
30	O035	OSWAL INDUSTRIES LTD	INDIA	
31	A715	AMPO, S.COOP	SPAIN	
32	4031	ZED VALVES CO. PVT. LTD	INDIA	
33	K620A	KITZ CORPORATION	JAPAN	
34	L581	LCM ITALIA SPA	ITALY	
35	S850	SHENJIANG VALVE CO LTD	CHINA	
36	L001	L & T VALVES LIMITED	INDIA	
37	L004	LEADER VALVES LTD	INDIA	
38	V608	VALVITALIA SPA	ITALY	
39	M576	MECA FRANCE S.A.	FRANCE	

On Holiday

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50DC		**Description :** VALVE BALL NON FIRE SAFE-CSS		
1	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)
2	K603	KF INDUSTRIES	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
3	M700	VALMET FLOW CONTROL OY	FINLAND	Ground-XXIII (Banned by Clients)
4	M662	MCCANNA VALVES INC	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
5	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
6	J565	JIANGSU Jiulong Valve Manufacture Co.Ltd	CHINA	DORMANT (NOT TO BE CONSIDERED)
7	3664	ANAND TEKNOW AIDS ENGINEERING INDIA LTD.	INDIA	Ground-XIII (Negative networth or Financial constraints)
8	R199	VALMET FLOW CONTROL PRIVATE LIMITED	INDIA	HOLD-ENQ/PO/BID OP. EXCEPT NIT CASE
9	A388	ANAND TEKNOW AIDS ENGINEERING INDIA LTD	INDIA	Ground-XIII (Negative networth or Financial constraints)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50DE		**Description :** VALVE BALL FIRE SAFE-CCS		
Approved Suppliers				
1	H175	HAWA VALVES (INDIA) PVT LTD	INDIA	
2	V608	VALVITALIA SPA	ITALY	
3	S850	SHENJIANG VALVE CO LTD	CHINA	
4	J555	JC FABRICA DE VALVULAS S.A.	SPAIN	
5	L004	LEADER VALVES LTD	INDIA	
6	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
7	B725	BOTELI VALVE GROUP CO.	CHINA	
8	H108	HAWA ENGINEERS LTD	INDIA	
9	3623	NILON VALVES PRIVATE LIMITED	INDIA	
10	D146	DELVAL FLOW CONTROLS PRIVATE LIMITED	INDIA	
11	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
12	27523	SNY VALVE (YANCHENG) CO., LTD.	CHINA	
13	A715	AMPO, S.COOP	SPAIN	
14	L001	L & T VALVES LIMITED	INDIA	
15	M724	MIR VALVE SDN.BHD.	MALAYSIA	
16	R153	REYNOLD VALVES LTD	INDIA	
17	27446	GALPERTI ENGINEERING AND FLOW CONTROL SPA	ITALY	
18	4200	SHALIMAR VALVES PVT LTD	INDIA	
19	4116	JC VALVULAS INDIA PRIVATE LIMITED	INDIA	
20	3593	Velan Valves India Pvt Ltd	INDIA	
21	S822	SUZHOU VIZA VALVE CO.,LTD	CHINA	
22	4031	ZED VALVES CO. PVT. LTD	INDIA	
23	4212	STAR ENGINEERS	INDIA	
24	4295	VALVE TECH INDUSTRIES	INDIA	
25	3605	Petro Valves Pvt Ltd	INDIA	
26	K649	KUMKANG VALVE MFG CO.LTD	KOREA, REPUBLIC OF	
27	N633	NSSL ITALIA	ITALY	
28	M094	MICROFINISH VALVES PVT LIMITED	INDIA	
29	F106	FLOW CHEM INDUSTRIES	INDIA	
30	W092	BDK VALVE PRIVATE LIMITED	INDIA	
31	27491	VALVULAS FEVISA S.A.U	SPAIN	
32	27468	CAMTECH MANUFACTURING FZCO	UNITED ARAB EMIRATES	
33	V604	VALBART SRL (A FLOWSERVE COMPANY)	ITALY	
34	27428	FLUITEK ORSENIGO VALVES S.P.A.	ITALY	
35	M295	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
36	3887	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
37	27477	VELAN INC	CANADA	
38	4118	PHBB VALVES PRIVATE LIMITED	INDIA	
39	Z594	ZA.VE.RO. SRL	ITALY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50DE		**Description :** VALVE BALL FIRE SAFE-CCS		
40	O035	OSWAL INDUSTRIES LTD	INDIA	
41	V213	VEE TECH VALVES PRIVATE LIMITED	INDIA	
42	4042	2L ENGINEERS	INDIA	
43	3616	DEMBLA VALVES LIMITED	INDIA	
44	N626	NEWAY VALVE (SUZHOU) CO LTD	CHINA	
45	3933	LEADER VALVES LTD	INDIA	
46	G186	GM ENGINEERING PVT. LTD.	INDIA	
On Holiday				
1	R199	VALMET FLOW CONTROL PRIVATE LIMITED	INDIA	HOLD-ENQ/PO/BID OP. EXCEPT NIT CASE
2	J565	JIANGSU Jiulong Valve Manufacture Co.Ltd	CHINA	DORMANT (NOT TO BE CONSIDERED)
3	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)
4	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
5	L564	VALVOSPAIN INDUSTRIAL S.A.U	SPAIN	Ground-III (nsolvency / bankruptcy)
6	A388	ANAND TEKNOW AIDS ENGINEERING INDIA LTD	INDIA	Ground-XIII (Negative networth or Financial constraints)
7	3664	ANAND TEKNOW AIDS ENGINEERING INDIA LTD.	INDIA	Ground-XIII (Negative networth or Financial constraints)
8	M700	VALMET FLOW CONTROL OY	FINLAND	Ground-XXIII (Banned by Clients)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50DF		**Description :** VALVE BALL FIRE SAFE-CSS		
Approved Suppliers				
1	3623	NILON VALVES PRIVATE LIMITED	INDIA	
2	K649	KUMKANG VALVE MFG CO.LTD	KOREA, REPUBLIC OF	
3	27446	GALPERTI ENGINEERING AND FLOW CONTROL SPA	ITALY	
4	4116	JC VALVULAS INDIA PRIVATE LIMITED	INDIA	
5	3616	DEMBLA VALVES LIMITED	INDIA	
6	Z594	ZA.VE.RO. SRL	ITALY	
7	J555	JC FABRICA DE VALVULAS S.A.	SPAIN	
8	N626	NEWAY VALVE (SUZHOU) CO LTD	CHINA	
9	M094	MICROFINISH VALVES PVT LIMITED	INDIA	
10	4200	SHALIMAR VALVES PVT LTD	INDIA	
11	4042	2L ENGINEERS	INDIA	
12	V604	VALBART SRL (A FLOWSERVE COMPANY)	ITALY	
13	L001	L & T VALVES LIMITED	INDIA	
14	G186	GM ENGINEERING PVT. LTD.	INDIA	
15	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
16	V213	VEE TECH VALVES PRIVATE LIMITED	INDIA	
17	N633	NSSL ITALIA	ITALY	
18	M295	MICON ENGINEERS (HUBLI) PVT LTD 066053052053	INDIA	
19	W092	BDK VALVE PRIVATE LIMITED	INDIA	
20	S850	SHENJIANG VALVE CO LTD	CHINA	
21	3887	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
22	V608	VALVITALIA SPA	ITALY	
23	3933	LEADER VALVES LTD	INDIA	
24	S822	SUZHOU VIZA VALVE CO.,LTD	CHINA	
25	4031	ZED VALVES CO. PVT. LTD	INDIA	
26	3840	AIRA EURO AUTOMATION PVT LTD	INDIA	
27	B725	BOTELI VALVE GROUP CO.	CHINA	
28	L004	LEADER VALVES LTD	INDIA	
29	A715	AMPO, S.COOP	SPAIN	
30	R153	REYNOLD VALVES LTD	INDIA	
31	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
32	F106	FLOW CHEM INDUSTRIES	INDIA	
On Holiday				
1	J565	JIANGSU Jiulong Valve Manufacture Co.Ltd	CHINA	DORMANT (NOT TO BE CONSIDERED)
2	M700	VALMET FLOW CONTROL OY	FINLAND	Ground-XXIII (Banned by Clients)
3	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
4	3664	ANAND TEKNOW AIDS ENGINEERING INDIA LTD.	INDIA	Ground-XIII (Negative networth or Financial constraints)
5	L564	VALVOSPAIN INDUSTRIAL S.A.U	SPAIN	Ground-III (nsolvency / bankruptcy)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50DG		**Description :** VALVE BALL (MOTOR OPERATED)		
Approved Suppliers				
1	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	
2	D146	DELVAL FLOW CONTROLS PRIVATE LIMITED	INDIA	
3	4031	ZED VALVES CO. PVT. LTD	INDIA	
4	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
5	M094	MICROFINISH VALVES PVT LIMITED	INDIA	
6	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
7	H175	HAWA VALVES (INDIA) PVT LTD	INDIA	
8	R153	REYNOLD VALVES LTD	INDIA	
9	4042	2L ENGINEERS	INDIA	
10	3605	Petro Valves Pvt Ltd	INDIA	
11	L004	LEADER VALVES LTD	INDIA	
12	L001	L & T VALVES LIMITED	INDIA	
13	3616	DEMBLA VALVES LIMITED	INDIA	
14	M219	MEVADA ENGG.WORKS PVT LTD	INDIA	
15	4212	STAR ENGINEERS	INDIA	
16	M295	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
17	W092	BDK VALVE PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50DL		**Description :** VALVE BALL - FIRE SAFE (FORGED)		
Approved Suppliers				
1	F106	FLOW CHEM INDUSTRIES	INDIA	
2	L001	L & T VALVES LIMITED	INDIA	
3	O035	OSWAL INDUSTRIES LTD	INDIA	
4	W092	BDK VALVE PRIVATE LIMITED	INDIA	
5	H175	HAWA VALVES (INDIA) PVT LTD	INDIA	
6	V213	VEE TECH VALVES PRIVATE LIMITED	INDIA	
7	27523	SNY VALVE (YANCHENG) CO., LTD.	CHINA	
8	3887	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
9	27491	VALVULAS FEVISA S.A.U	SPAIN	
10	M295	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
11	3749	G M VALVE PRIVATE LIMITED	INDIA	
12	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
13	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
14	M094	MICROFINISH VALVES PVT LIMITED	INDIA	
15	4295	VALVE TECH INDUSTRIES	INDIA	
16	4116	JC VALVULAS INDIA PRIVATE LIMITED	INDIA	
17	27446	GALPERTI ENGINEERING AND FLOW CONTROL SPA	ITALY	
18	3623	NILON VALVES PRIVATE LIMITED	INDIA	
On Holiday				
1	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
2	3664	ANAND TEKNOW AIDS ENGINEERING INDIA LTD.	INDIA	Ground-XIII (Negative networth or Financial constraints)
3	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)
4	R199	VALMET FLOW CONTROL PRIVATE LIMITED	INDIA	HOLD-ENQ/PO/BID OP. EXCEPT NIT CASE

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50DM		**Description :** VALVE BALL NON FIRE SAFE-FCS		
Approved Suppliers				
1	L001	L & T VALVES LIMITED	INDIA	
2	3933	LEADER VALVES LTD	INDIA	
3	3605	Petro Valves Pvt Ltd	INDIA	
4	M295	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
5	M219	MEVADA ENGG.WORKS PVT LTD	INDIA	
6	3887	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
7	3623	NILON VALVES PRIVATE LIMITED	INDIA	
8	L004	LEADER VALVES LTD	INDIA	
9	3889	NORFLOW CONTROLS	INDIA	
10	27446	GALPERTI ENGINEERING AND FLOW CONTROL SPA	ITALY	
11	27551	HARTMANN VALVES GMBH	GERMANY	
12	M094	MICROFINISH VALVES PVT LIMITED	INDIA	
13	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
14	F106	FLOW CHEM INDUSTRIES	INDIA	
15	H108	HAWA ENGINEERS LTD	INDIA	
16	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
17	27491	VALVULAS FEVISA S.A.U	SPAIN	
On Holiday				
1	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
2	3664	ANAND TEKNOW AIDS ENGINEERING INDIA LTD.	INDIA	Ground-XIII (Negative networth or Financial constraints)
3	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)
4	R199	VALMET FLOW CONTROL PRIVATE LIMITED	INDIA	HOLD-ENQ/PO/BID OP. EXCEPT NIT CASE

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50DN		**Description :** VALVE BALL NON FIRE SAFE-FSS		
Approved Suppliers				
1	M219	MEVADA ENGG.WORKS PVT LTD	INDIA	
2	M094	MICROFINISH VALVES PVT LIMITED	INDIA	
3	3623	NILON VALVES PRIVATE LIMITED	INDIA	
4	H108	HAWA ENGINEERS LTD	INDIA	
5	L004	LEADER VALVES LTD	INDIA	
6	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
7	M295	MICON ENGINEERS (HUBLI) PVT LTD	INDIA	
8	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
9	3933	LEADER VALVES LTD	INDIA	
10	3749	G M VALVE PRIVATE LIMITED	INDIA	
11	F106	FLOW CHEM INDUSTRIES	INDIA	
12	3887	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
13	27446	GALPERTI ENGINEERING AND FLOW CONTROL SPA	ITALY	
14	3605	Petro Valves Pvt Ltd	INDIA	
On Holiday				
1	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)
2	3664	ANAND TEKNOW AIDS ENGINEERING INDIA LTD.	INDIA	Ground-XIII (Negative networth or Financial constraints)
3	3636	STEEL STRONG VALVES INDIA PVT LTD	INDIA	Ground-IV (Fraudulent practices)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50DT		**Description :** VALVE BALL MULTIPORT NON FIRE SAFE		
Approved Suppliers				
1	3840	AIRA EURO AUTOMATION PVT LTD	INDIA	
2	M094	MICROFINISH VALVES PVT LIMITED	INDIA	
3	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
4	4042	2L ENGINEERS	INDIA	
5	4118	PHBB VALVES PRIVATE LIMITED	INDIA	
6	3887	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
On Holiday				
1	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50DU		**Description :** VALVE BALL FIRE SAFE-CAS		
Approved Suppliers				
1	B193	BELGAUM AQUA VALVES PVT. LTD.	INDIA	
2	27477	VELAN INC	CANADA	
3	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50E-		**Description :** VALVE BUTTERFLY-(FOREIGN SUPPLIERS)		
Approved Suppliers				
1	N541	NAKAKITA SEISAKUSHO CO LTD	JAPAN	
2	H656	HANGZHOU NEW TIME VALVE CO. LTD.	CHINA	
3	P538	PIETRO FIORENTINI SPA	ITALY	
4	F636	FLOWSERVE PTE LTD	SINGAPORE	
5	K642	KOREA UNICOM VALVE CO.LTD	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	
On Holiday				
1	P682	PCC WOUTER WITZEL	NETHERLANDS	DORMANT (NOT TO BE CONSIDERED)
2	M662	MCCANNA VALVES INC	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
3	B579	BATLEY VALVE CO LTD, THE	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)
4	M700	VALMET FLOW CONTROL OY	FINLAND	Ground-XXIII (Banned by Clients)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50EA		**Description :** VALVE BUTTERFLY (MOTOR OPERATED)		
Approved Suppliers				
1	V088	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED	INDIA	
2	F193	FLOWSERVE INDIA CONTROLS PVT LTD.	INDIA	
3	W092	BDK VALVE PRIVATE LIMITED	INDIA	
4	4031	ZED VALVES CO. PVT. LTD	INDIA	
5	A315	ADVANCE VALVES PVT LTD.	INDIA	
6	S487	STAFFORD CONTROLS PRIVATE LIMITED	INDIA	
7	D146	DELVAL FLOW CONTROLS PRIVATE LIMITED	INDIA	
8	3616	DEMBLA VALVES LIMITED	INDIA	
9	L001	L & T VALVES LIMITED	INDIA	
10	4065	LIBRA VALVES INDIA PRIVATE LIMITED	INDIA	
11	3826	ADVANCE VALVES PVT LTD	INDIA	
12	L004	LEADER VALVES LTD	INDIA	
13	4042	2L ENGINEERS	INDIA	
14	C186	CRANE PROCESS FLOW TECHNOLOGIES(INDIA) PRIVATE LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50EB		**Description :** VALVE BUTTERFLY (DOUBLE OFFSET & CONCENTRIC)		
Approved Suppliers				
1	4006	FLOWJET VALVES PVT LTD	INDIA	
2	G186	GM ENGINEERING PVT. LTD.	INDIA	
3	A315	ADVANCE VALVES PVT LTD.	INDIA	
4	4042	2L ENGINEERS	INDIA	
5	L004	LEADER VALVES LTD	INDIA	
6	S487	STAFFORD CONTROLS PRIVATE LIMITED	INDIA	
7	3616	DEMBLA VALVES LIMITED	INDIA	
8	F065	FLUIDLINE VALVES CO.PVT LTD	INDIA	
9	3826	ADVANCE VALVES PVT LTD	INDIA	
10	I125	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
11	C186	CRANE PROCESS FLOW TECHNOLOGIES(INDIA) PRIVATE LTD.	INDIA	
12	D037	DEMBLA VALVES LTD.	INDIA	
13	27468	CAMTECH MANUFACTURING FZCO	UNITED ARAB EMIRATES	
14	3640	FLOTEK INDUSTRIES	INDIA	
15	3817	HI TECH BUTTERFLY VALVES INDIA PVT LTD	INDIA	
16	3840	AIRA EURO AUTOMATION PVT LTD	INDIA	
17	4065	LIBRA VALVES INDIA PRIVATE LIMITED	INDIA	
18	N626	NEWAY VALVE (SUZHOU) CO LTD	CHINA	
19	F193	FLOWSERVE INDIA CONTROLS PVT LTD.	INDIA	
20	M015	MASCOT VALVES PVT LIMITED (FMLY VALFLO)	INDIA	
21	3613	BRAY CONTROLS INDIA PVT LTD	INDIA	
22	B729	BRAY CONTROLS	UNITED STATES	
23	F030	FOURESS ENGINEERING (INDIA) PRIVATE LIMITED	INDIA	
24	L001	L & T VALVES LIMITED	INDIA	
25	V088	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED	INDIA	
26	O538	ORTON S.R.L	ITALY	
27	D146	DELVAL FLOW CONTROLS PRIVATE LIMITED	INDIA	
28	4031	ZED VALVES CO. PVT. LTD	INDIA	
29	W092	BDK VALVE PRIVATE LIMITED	INDIA	
30	H108	HAWA ENGINEERS LTD	INDIA	
On Holiday				
1	F636	FLOWSERVE PTE LTD	SINGAPORE	DORMANT (NOT TO BE CONSIDERED)
2	M662	MCCANNA VALVES INC	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
3	M700	VALMET FLOW CONTROL OY	FINLAND	Ground-XXIII (Banned by Clients)
4	B579	BATLEY VALVE CO LTD, THE	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50EI		**Description :** VALVE BELLOW SEALED		
Approved Suppliers				
1	3593	Velan Valves India Pvt Ltd	INDIA	
2	A288	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
3	L001	L & T VALVES LIMITED	INDIA	
4	M094	MICROFINISH VALVES PVT LIMITED	INDIA	
5	B166	BELL-O-SEAL VALVES PVT LTD	INDIA	
6	U054	UNI KLINGER LTD	INDIA	
7	B725	BOTELI VALVE GROUP CO.	CHINA	
On Holiday				
1	O531	OMB VALVES	ITALY	DORMANT (NOT TO BE CONSIDERED)
2	L567	LVF SPA	ITALY	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50EP		**Description :** VALVE BUTTERFLY (TRIPLE OFFSET)		
Approved Suppliers				
1	3640	FLOTEK INDUSTRIES	INDIA	
2	D146	DELVAL FLOW CONTROLS PRIVATE LIMITED	INDIA	
3	A706	ADAMS ARMATUREN GMBH	GERMANY	
4	K642	KOREA UNICOM VALVE CO.LTD	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	
5	V088	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED	INDIA	
6	B729	BRAY CONTROLS	UNITED STATES	
7	3840	AIRA EURO AUTOMATION PVT LTD	INDIA	
8	T719A	EMERSON AUTOMATION SOLUTIONS FINAL CONTROL ITALIA S.R.L.	ITALY	
9	L001	L & T VALVES LIMITED	INDIA	
10	O538	ORTON S.R.L	ITALY	
11	3616	DEMBLA VALVES LIMITED	INDIA	
12	3817	HI TECH BUTTERFLY VALVES INDIA PVT LTD	INDIA	
13	A315	ADVANCE VALVES PVT LTD.	INDIA	
14	I125	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
15	F193	FLOWSERVE INDIA CONTROLS PVT LTD.	INDIA	
On Holiday				
1	H649	HOBBS VALVE LTD	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50EQ		**Description :** VALVE TRIPLE OFFSET BUTTERFLY CRYOGENIC		
Approved Suppliers				
1	L001	L & T VALVES LIMITED	INDIA	
2	V088	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED	INDIA	
3	A315	ADVANCE VALVES PVT LTD.	INDIA	
4	A706	ADAMS ARMATUREN GMBH	GERMANY	
5	O538	ORTON S.R.L	ITALY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50FA		**Description :** VALVE DIAPHRAGM		
Approved Suppliers				
1	K511	KITAMURA VALVE MANUFACTURING CO LTD	JAPAN	
2	C186	CRANE PROCESS FLOW TECHNOLOGIES(INDIA) PRIVATE LTD.	INDIA	
3	P267	PROCON ENGINEERS	INDIA	
4	W092	BDK VALVE PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50GA		**Description :** VALVE PLUG		
Approved Suppliers				
1	27520	SICHUAN KCON VALVE MANUFACTURING CO., LTD.	CHINA	
2	G186	GM ENGINEERING PVT. LTD.	INDIA	
3	F193	FLOWSERVE INDIA CONTROLS PVT LTD.	INDIA	
4	F636B	FLOWSERVE PTE (MFR. SERCK)	UNITED KINGDOM	
5	G608	GALLI & CASSINA SPA	ITALY	
6	W092	BDK VALVE PRIVATE LIMITED	INDIA	
7	R123	RASAII FLOW LINES PVT LTD.	INDIA	
8	4042	2L ENGINEERS	INDIA	
9	C201	CHEMTROLS SAMIL (INDIA) PVT LTD	INDIA	
10	S748	SCHUF-ARMATUREN UND APPARATEBAU GMBH	GERMANY	
11	L001	L & T VALVES LIMITED	INDIA	
12	H656	HANGZHOU NEW TIME VALVE CO. LTD.	CHINA	
13	X501	XOMOX LTD	UNITED KINGDOM	
14	X001	XOMOX SANMAR LIMITED	INDIA	
15	F636C	FLOWSERVE PTE(MFR. NORDSTORM)	UNITED STATES	
16	3803	SOUDARSHINI VALVE PRIVATE LIMITED	INDIA	
17	G105	GHATGE PATIL INDUSTRIES LIMITED 066053052053	INDIA	
On Holiday				
1	F636	FLOWSERVE PTE LTD	SINGAPORE	DORMANT (NOT TO BE CONSIDERED)
2	Z639	ZHEJIANG FLOWTECH MACHINERY CO.LTD	CHINA	DORMANT (NOT TO BE CONSIDERED)
3	C715	CONTROL SEAL BV	NETHERLANDS	HOLD RFQ/PBO/PO DUE TO SHIFTING OF WORKS (EXCEPT NIT CASES)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50GD		**Description :** VALVE PISTON (GLANDLESS)		
Approved Suppliers				
1	A376	ARMSTRONG INTERNATIONAL PVT LTD.	INDIA	
2	3749	G M VALVE PRIVATE LIMITED	INDIA	
3	F181	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
4	U054	UNI KLINGER LTD	INDIA	
5	A692	ARMSTRONG INTERNATIONAL SA	BELGIUM	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50GF		**Description :** VALVE PLUG (MOTOR OPERATED)		
Approved Suppliers				
1	G105	GHATGE PATIL INDUSTRIES LIMITED	INDIA	
2	3803	SOUDARSHINI VALVE PRIVATE LIMITED	INDIA	
3	L001	L & T VALVES LIMITED	INDIA	
4	W092	BDK VALVE PRIVATE LIMITED	INDIA	
5	F193	FLOWSERVE INDIA CONTROLS PVT LTD.	INDIA	
6	R123	RASAII FLOW LINES PVT LTD.	INDIA	
7	X001	XOMOX SANMAR LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50IA		**Description :** VALVE NEEDLE		
Approved Suppliers				
1	A288	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
2	L004	LEADER VALVES LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50LA		**Description :** VALVE FOOT/AIR		
Approved Suppliers				
1	M184	MINOTI ENGINEERING WORKS	INDIA	
2	S076	SHIVA DURGA IRON WORKS (P) LTD	INDIA	
3	I042	INDIAN VALVE PVT. LTD.	INDIA	
4	L004	LEADER VALVES LTD	INDIA	
On Holiday				
1	V078	VENUS PUMP & ENGINEERING WORKS	INDIA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50X-		**Description :** VALVE SPECIAL CATEGORY		
Approved Suppliers				
1	F193	FLOWSERVE INDIA CONTROLS PVT LTD.	INDIA	
2	S149	SchuF Speciality valves India Pvt Ltd	INDIA	
3	H656	HANGZHOU NEW TIME VALVE CO. LTD.	CHINA	
4	E571	ENPRO SYSTEMS INC	UNITED STATES	
5	G544	GESTRA AG	GERMANY	
6	G545	GUICHON VALVES	FRANCE	
7	S793	SPX VALVES & CONTROLS (FORMERLY DEZURIK)	UNITED STATES	
8	A706	ADAMS ARMATUREN GMBH	GERMANY	
9	27477	VELAN INC	CANADA	
10	27459	TOTAL ENGINEERING CO.,LTD	KOREA, REPUBLIC OF	
11	Z507	Z & J TECHNOLOGIES GMBH	GERMANY	
12	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
13	S748	SCHUF-ARMATUREN UND APPARATEBAU GMBH	GERMANY	
On Holiday				
1	C715	CONTROL SEAL BV	NETHERLANDS	HOLD RFQ/PBO/PO DUE TO SHIFTING OF WORKS (EXCEPT NIT CASES)
2	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50XA		**Description :** VALVE TANK BOTTOM/FLUSH BOTTOM		
Approved Suppliers				
1	M094	MICROFINISH VALVES PVT LIMITED	INDIA	
2	S748	SCHUF-ARMATUREN UND APPARATEBAU GMBH	GERMANY	
3	A715	AMPO, S.COOP	SPAIN	
4	S149	SchuF Speciality valves India Pvt Ltd	INDIA	
5	27459	TOTAL ENGINEERING CO.,LTD	KOREA, REPUBLIC OF	
6	S621	STRAHMAN VALVES INC.	UNITED STATES	
7	A389	AMPO VALVES INDIA PVT LTD	INDIA	
8	G545	GUICHON VALVES	FRANCE	
9	H656	HANGZHOU NEW TIME VALVE CO. LTD.	CHINA	
On Holiday				
1	W608	WUZHOU VALVE CO LTD	CHINA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50XB		**Description :** VALVE CHECK TILTING DISC		
Approved Suppliers				
1	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
2	A706	ADAMS ARMATUREN GMBH	GERMANY	
3	L001	L & T VALVES LIMITED	INDIA	
On Holiday				
1	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50XC		**Description :** VALVE CHECK PISTON		
Approved Suppliers				
1	L001	L & T VALVES LIMITED	INDIA	
2	4009	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	
On Holiday				
1	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50XD		**Description :** VALVE SAMPLING		
Approved Suppliers				
1	G545	GUICHON VALVES	FRANCE	
2	27459	TOTAL ENGINEERING CO.,LTD	KOREA, REPUBLIC OF	
3	S621	STRAHMAN VALVES INC.	UNITED STATES	
4	S748	SCHUF-ARMATUREN UND APPARATEBAU GMBH	GERMANY	
5	S149	SchuF Speciality valves India Pvt Ltd	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 50Y-		**Description :** VALVE-DUPLEX / SUPER DUPLEX SS		
Approved Suppliers				
1	L001	L & T VALVES LIMITED	INDIA	
2	4200	SHALIMAR VALVES PVT LTD	INDIA	
3	A288	ASSOCIATED TOOLINGS INDIA PVT LTD	INDIA	
4	D679	DOUGLAS CHERO SPA	ITALY	
5	L567	LVF SPA	ITALY	
6	A315	ADVANCE VALVES PVT LTD.	INDIA	
7	F178	FLOVEL VALVES PVT.LTD.	INDIA	
On Holiday				
1	N016	NITON VALVE INDUSTRIES PRIVATE LTD .	INDIA	Ground-XVIII (Quality Failure at shop/ site)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 51A-		**Description :** VALVES-FOREIGN STOCKIST		
Approved Suppliers				
1	G616	GERAB NATIONAL ENTERPRISE L.L.C	UNITED ARAB EMIRATES	
2	27576	INRADA O.G.R.S. B.V.	NETHERLANDS	
3	27562	SCORE EUROPE LIMITED	UNITED KINGDOM	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 55A-		**Description :** FLANGE-FOREIGN STOCKIST		
Approved Suppliers				
1	27576	INRADA O.G.R.S. B.V.	NETHERLANDS	
2	27583	AMT CO., LTD	KOREA, REPUBLIC OF	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 55AA		**Description :** FLANGE- CARBON STEEL		
Approved Suppliers				
1	3628	JAI AUTO PVT LTD.	INDIA	
2	27473	JIANGYIN ZHONGNAN HEAVY INDUSTRIES CO. LTD	CHINA	
3	S394	BF INDUSTRIAL TECHNOLOGY & SOLUTIONS LIMITED	INDIA	
4	J067	METAVAL ENGINEERING PRIVATE LIMITED	INDIA	
5	H172	HILTON METAL FORGING LIMITED	INDIA	
6	A074	ABASI ENGINEERING WORKS	INDIA	
7	G182	GOODLUCK INDIA LIMITED	INDIA	
8	R205	R D F ENGINEERING PRIVATE LIMITED	INDIA	
9	4288	STEEL FLANGE MANUFACTURING CO	INDIA	
10	K108	KUNJ FORGINGS PVT LTD	INDIA	
11	P215	PRADEEP METAL LIMITED	INDIA	
12	C142	CD ENGINEERING CO.	INDIA	
13	M680	OFFICINE AMBROGIO MELESI & C. S.R.L.	ITALY	
14	3914	BALKRISHNA STEEL FORGE PVT LTD	INDIA	
15	V633	VILMAR SA	ROMANIA	
16	27485	ELITE PIPING MANUFACTURE CO.,LTD.	CHINA	
17	3617	BRITEX ENGINEERING WORKS	INDIA	
18	A066	ANANDMAYEE FORGINGS PVT LTD 066053052053	INDIA	
19	U537	ULMA FORJA S.COOP.	SPAIN	
20	C159	KISAAN ENGINEERING WORKS PRIVATE LIMITED	INDIA	
21	P242	PARAMOUNT SPECIALITY FORGINGS LIMITED	INDIA	
22	4242	SIDDHI FORGINGS INDUSTRIES	INDIA	
23	M011	METAL FORGINGS PVT LTD	INDIA	
24	U116	UTSAH ENGINEERING PRIVATE LIMITED	INDIA	
25	F180	FIVEBROS FORGINGS PVT.LTD.	INDIA	
26	P242A	PARAMOUNT SPECIALITY FORGINGS LIMITED	INDIA	
27	O595	OFFICINE SANTAFEDE SRL	ITALY	
28	B745	BRUCK GMBH ENSHEIM	GERMANY	
29	R186	R.N.GUPTA & CO. LTD	INDIA	
30	C044	CHW FORGE PVT LTD (FR. CHAUDHRY HAMMER)	INDIA	
31	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
32	K189	KISAAN DIETECH PVT LTD	INDIA	
33	V608A	VALVITALIA SPA-TECNOFORGE DIVISION	ITALY	
34	3800	BFN FORGINGS PRIVATE LIMITED	INDIA	
35	K180	KISAAN STEELS PRIVATE LIMITED	INDIA	
36	M057	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
37	T245	TRIVENI REFRACTORIES PVT LTD	INDIA	
38	4267	R.N.GUPTA & CO. LTD	INDIA	
39	K638	KOREA FLANGE CO., LTD.	KOREA, REPUBLIC OF	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 55AA		**Description :** FLANGE- CARBON STEEL		
40	M308	WILHELM MAASS INDIA PVT LTD	INDIA	
41	N593	OFFICINE NICOLA GALPERTI & FIGLIO S.P.A.	ITALY	
42	L089	LAL METAL FORGE PRIVATE LIMITED	INDIA	
43	27501	TAEWOONG CO. LTD.	KOREA, REPUBLIC OF	
On Holiday				
1	B020	BHARAT FORGE LTD.	INDIA	DORMANT (NOT TO BE CONSIDERED)
2	P708	PROMAT BD LTD MIDDLE EAST	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 55AB		**Description :** FLANGE-ALLOY STEEL		
Approved Suppliers				
1	P242	PARAMOUNT SPECIALITY FORGINGS LIMITED	INDIA	
2	M057	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
3	27485	ELITE PIPING MANUFACTURE CO.,LTD.	CHINA	
4	V608A	VALVITALIA SPA-TECNOFORGE DIVISION	ITALY	
5	L089	LAL METAL FORGE PRIVATE LIMITED	INDIA	
6	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
7	F180	FIVEBROS FORGINGS PVT.LTD.	INDIA	
8	K638	KOREA FLANGE CO., LTD.	KOREA, REPUBLIC OF	
9	A066	ANANDMAYEE FORGINGS PVT LTD	INDIA	
10	M680	OFFICINE AMBROGIO MELESI & C. S.R.L.	ITALY	
11	U537	ULMA FORJA S.COOP.	SPAIN	
12	G182	GOODLUCK INDIA LIMITED	INDIA	
13	C159	KISAAN ENGINEERING WORKS PRIVATE LIMITED	INDIA	
14	M308	WILHELM MAASS INDIA PVT LTD	INDIA	
15	N593	OFFICINE NICOLA GALPERTI & FIGLIO S.P.A.	ITALY	
16	M011	METAL FORGINGS PVT LTD	INDIA	
17	27501	TAEWOONG CO. LTD.	KOREA, REPUBLIC OF	
18	V633	VILMAR SA	ROMANIA	
19	J067	METAVAL ENGINEERING PRIVATE LIMITED	INDIA	
20	C044	CHW FORGE PVT LTD (FR. CHAUDHRY HAMMER)	INDIA	
21	T245	TRIVENI REFRACTORIES PVT LTD	INDIA	
22	B745	BRUCK GMBH ENSHEIM	GERMANY	
23	4242	SIDDHI FORGINGS INDUSTRIES	INDIA	
24	R205	R D F ENGINEERING PRIVATE LIMITED	INDIA	
25	K108	KUNJ FORGINGS PVT LTD	INDIA	
26	S394	BF INDUSTRIAL TECHNOLOGY & SOLUTIONS LIMITED	INDIA	
27	U116	UTSAH ENGINEERING PRIVATE LIMITED	INDIA	
28	C142	CD ENGINEERING CO.	INDIA	
29	K189	KISAAN DIETECH PVT LTD	INDIA	
30	K180	KISAAN STEELS PRIVATE LIMITED	INDIA	
On Holiday				
1	B020	BHARAT FORGE LTD.	INDIA	DORMANT (NOT TO BE CONSIDERED)
2	M726	MAASS FLANGE CORPORATION	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 55AC		**Description :** FLANGE-STAINLESS STEEL		
Approved Suppliers				
1	N593	OFFICINE NICOLA GALPERTI & FIGLIO S.P.A.	ITALY	
2	J067	METAVAL ENGINEERING PRIVATE LIMITED	INDIA	
3	4267	R.N.GUPTA & CO. LTD	INDIA	
4	K108	KUNJ FORGINGS PVT LTD	INDIA	
5	S394	BF INDUSTRIAL TECHNOLOGY & SOLUTIONS LIMITED	INDIA	
6	K180	KISAAN STEELS PRIVATE LIMITED	INDIA	
7	A066	ANANDMAYEE FORGINGS PVT LTD	INDIA	
8	C142	CD ENGINEERING CO.	INDIA	
9	V633	VILMAR SA	ROMANIA	
10	4176	SURAJ LIMITED	INDIA	
11	U116	UTSAH ENGINEERING PRIVATE LIMITED	INDIA	
12	T245	TRIVENI REFRACTORIES PVT LTD	INDIA	
13	K638	KOREA FLANGE CO., LTD.	KOREA, REPUBLIC OF	
14	P242A	PARAMOUNT SPECIALITY FORGINGS LIMITED	INDIA	
15	4288	STEEL FLANGE MANUFACTURING CO	INDIA	
16	P215	PRADEEP METAL LIMITED	INDIA	
17	V608A	VALVITALIA SPA-TECNOFORGE DIVISION	ITALY	
18	B745	BRUCK GMBH ENSHEIM	GERMANY	
19	L089	LAL METAL FORGE PRIVATE LIMITED	INDIA	
20	U537	ULMA FORJA S.COOP.	SPAIN	
21	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
22	4242	SIDDHI FORGINGS INDUSTRIES	INDIA	
23	3800	BFN FORGINGS PRIVATE LIMITED	INDIA	
24	O595	OFFICINE SANTAFEDE SRL	ITALY	
25	27485	ELITE PIPING MANUFACTURE CO.,LTD.	CHINA	
26	C159	KISAAN ENGINEERING WORKS PRIVATE LIMITED	INDIA	
27	M308	WILHELM MAASS INDIA PVT LTD	INDIA	
28	27473	JIANGYIN ZHONGNAN HEAVY INDUSTRIES CO. LTD	CHINA	
29	R205	R D F ENGINEERING PRIVATE LIMITED	INDIA	
30	3628	JAI AUTO PVT LTD.	INDIA	
31	27501	TAEWOONG CO. LTD.	KOREA, REPUBLIC OF	
32	3617	BRITEX ENGINEERING WORKS	INDIA	
33	F180	FIVEBROS FORGINGS PVT.LTD.	INDIA	
34	G182	GOODLUCK INDIA LIMITED	INDIA	
35	H172	HILTON METAL FORGING LIMITED	INDIA	
36	M011	METAL FORGINGS PVT LTD	INDIA	
37	C044	CHW FORGE PVT LTD (FR. CHAUDHRY HAMMER)	INDIA	
38	K189	KISAAN DIETECH PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 55AC **Description :** FLANGE-STAINLESS STEEL				
39	3914	BALKRISHNA STEEL FORGE PVT LTD	INDIA	
40	V189	VIRAJ PROFILES PRIVATE LIMITED	INDIA	
41	M680	OFFICINE AMBROGIO MELESI & C. S.R.L.	ITALY	
42	3881	CHANDAN STEEL LTD	INDIA	
43	P242	PARAMOUNT SPECIALITY FORGINGS LIMITED	INDIA	
On Holiday				
1	B020	BHARAT FORGE LTD.	INDIA	DORMANT (NOT TO BE CONSIDERED)
2	M726	MAASS FLANGE CORPORATION	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 55AD		**Description :** FLANGES-EXOTIC		
Approved Suppliers				
1	C044	CHW FORGE PVT LTD (FR. CHAUDHRY HAMMER)	INDIA	
2	U537	ULMA FORJA S.COOP.	SPAIN	
3	K638	KOREA FLANGE CO., LTD.	KOREA, REPUBLIC OF	
4	M011	METAL FORGINGS PVT LTD	INDIA	
5	G182	GOODLUCK INDIA LIMITED	INDIA	
6	K189	KISAAN DIETECH PVT LTD	INDIA	
7	P242	PARAMOUNT SPECIALITY FORGINGS LIMITED	INDIA	
8	M726	MAASS FLANGE CORPORATION	UNITED STATES	
9	N593	OFFICINE NICOLA GALPERTI & FIGLIO S.P.A.	ITALY	
10	27538	INOXFUCINE S.P.A.	ITALY	
11	M680	OFFICINE AMBROGIO MELESI & C. S.R.L.	ITALY	
12	O595	OFFICINE SANTAFEDE SRL	ITALY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 55AE		**Description :** COMPACT FLANGE		
Approved Suppliers				
1	V607	VECTOR INTERNATIONAL LIMITED	UNITED KINGDOM	
2	27518	AF GLOBAL CORPORATION	UNITED KINGDOM	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 55CA		**Description :** HAMMER BLIND		
Approved Suppliers				
1	3800	BFN FORGINGS PRIVATE LIMITED	INDIA	
2	S482	SHREEPAD ENGINEERING CO.	INDIA	
3	Y001	YAMUNA ENGG CO	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 55EA		**Description :** SIGHT FLOW INDICATORS (SIGHT GLASSES)		
Approved Suppliers				
1	4280	C-TRU PROCESS EQUIPMENTS	INDIA	
2	B110	BLISS ANAND PVT LTD	INDIA	
3	S036	SIGMA INSTRUMENTS CO	INDIA	
On Holiday				
1	L009	LEVCON INSTRUMENTS PVT LTD	INDIA	Ground-XIII (Negative networth or Financial constraints)
2	F628	FRIEDRICH KROMBACH GMBH & CO.KG	GERMANY	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60A-		**Description :** PIPES-FOREIGN STOCKIST		
Approved Suppliers				
1	27467	ARABIAN PIPELINE SUPPLY FZCO	UNITED ARAB EMIRATES	
2	K648	KIRTANLAL INTERNATIONAL DMCC	UNITED ARAB EMIRATES	
3	E631	EDGEN MURRAY FZE	UNITED ARAB EMIRATES	
4	P686	Peeraj General Trading CO (LLC)	UNITED ARAB EMIRATES	
5	M734	MEZON STAINLESS STEEL FZE	UNITED ARAB EMIRATES	
6	A753	AMERICAN PIPING PRODUCTS INC	UNITED STATES	
7	H648	HART BV	NETHERLANDS	
8	H549	HORST KURVERS GMBH	UNITED KINGDOM	
9	27576	INRADA O.G.R.S. B.V.	NETHERLANDS	
10	P698	PETROGAS PIPING MIDDLE EAST FZCO	UNITED ARAB EMIRATES	
11	27489	SUNWEN INDUSTRY WUXI CO LTD	CHINA	
12	G616	GERAB NATIONAL ENTERPRISE L.L.C	UNITED ARAB EMIRATES	
13	A748	ARROW PIPES & FITTINGS FZCO	UNITED ARAB EMIRATES	
14	C727	COMMERCIALE TUBI ACCIAIO SPA	ITALY	
15	O554	OFFSHORE ENGINEERING & MARKETING LTD.	UNITED ARAB EMIRATES	
On Holiday				
1	I609	INTERNATIONAL INDUSTRIAL EQPT FZCO.	UNITED ARAB EMIRATES	DORMANT (NOT TO BE CONSIDERED)
2	S743	SIDECO SPA	ITALY	DORMANT (NOT TO BE CONSIDERED)
3	B741	BUHLMANN ROHR-FITTINGS-STAHLHANDEL GMBH	GERMANY	DORMANT (NOT TO BE CONSIDERED)
4	M658	MARDALE PIPES PLUS LIMITED	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)
5	V569	VAN LEEUWEN BUIZEN	FRANCE	DORMANT (NOT TO BE CONSIDERED)
6	T696	TECHNICAL PARTS ESTABLISHMENT	UNITED ARAB EMIRATES	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AF		**Description :** PIPE-CARBON STEEL TO INDIAN STANDARDS		
Approved Suppliers				
1	4103	SHRI BAJRANG POWER AND ISPAT LIMITED	INDIA	
2	A332	ASIAN MILLS PVT LTD	INDIA	
3	4158	MKK METAL SECTIONS PRIVATE LIMITED	INDIA	
4	L127	LAL BABA SEAMLESS TUBES PVT. LTD	INDIA	
5	4250	SURINDRA ENGINEERING COMPANY PRIVATE LIMITED	INDIA	
6	J110A	JINDAL SAW LTD (KOSI WORKS)	INDIA	
7	G178	GAURANG PRODUCTS PVT LTD (AST GROUP)	INDIA	
8	J115	JINDAL (INDIA) LIMITED	INDIA	
9	G145	GOODLUCK INDIA LIMITED	INDIA	
10	W056A	WELSPUN CORP LIMITED (ANJAR)	INDIA	
11	4039	DEEP SEALS INDIA LIMITED	INDIA	
12	3696	RATNAMANI METALS AND TUBES LTD	INDIA	
13	J015	JINDAL PIPES LTD	INDIA	
14	3611	JCO GAS PIPE LIMITED	INDIA	
15	4041	HITECH SAW LIMITED	INDIA	
16	4240	VISHAL PIPES LIMITED	INDIA	
17	4142	SURINDRA ENGINEERING COMPANY PRIVATE LIMITED	INDIA	
18	W056	WELSPUN CORP LIMITED (DAHEJ)	INDIA	
19	I147	INDUS TUBES LIMITED	INDIA	
20	T234	MEGA PIPES PRIVATE LIMITED	INDIA	
21	3841	SURYA ROSHNI LTD	INDIA	
22	M188	MUKAT TANKS & VESSELS PVT LTD	INDIA	
23	A397	ASIAN TUBES PRIVATE LIMITED	INDIA	
24	S281	SURYA ROSHNI LTD	INDIA	
25	A380	APL APOLLO TUBES LTD (ER.BIHAR TUBES LTD	INDIA	
26	U105	UTKARSH INDIA LIMITED	INDIA	
27	3983	STEEL AUTHORITY OF INDIA LTD	INDIA	
28	N118	NEZONE TUBES LIMITED	INDIA	
29	E139	ARCELORMITTAL NIPPON STEEL INDIA LTD	INDIA	
30	3695	RATNAMANI METALS AND TUBES LTD	INDIA	
31	3980	GLOBAL SEAMLESS TUBES AND PIPES PRIVATE LIMITED	INDIA	
32	M187	MAHARASHTRA SEAMLESS LTD.	INDIA	
33	4249	BHUSHAN POWER & STEEL LIMITED	INDIA	
34	R198	RAVINDRA TUBES PRIVATE LIMITED	INDIA	
35	3989	MEGHA ENGINEERING & INFRASTRUCTURES LTD	INDIA	
36	M217A	MAN INDUSTRIES (INDIA) LTD	INDIA	
37	4024	CHETNA STEEL TUBES PVT. LTD.	INDIA	
38	D145	DADU PIPES (P) LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AF		**Description :** PIPE-CARBON STEEL TO INDIAN STANDARDS		
39	J111	JINDAL INDUSTRIES PVT. LTD.	INDIA	
40	L061	LALIT PIPES & PIPES PRIVATE LIMITED	INDIA	
On Holiday				
1	S214	SWASTIK PIPES LTD	INDIA	DORMANT (NOT TO BE CONSIDERED)
2	P312G	PSL LTD-JAIPUR	INDIA	Ground-XIII (Negative networth or Financial constraints)
3	A341	A.S.T. PIPES PVT. LTD.(AST GROUP)	INDIA	DORMANT (NOT TO BE CONSIDERED)
4	A366	ASRANI TUBES LIMITED	INDIA	DORMANT (NOT TO BE CONSIDERED)
5	N116	NORTH EASTERN TUBES LIMITED	INDIA	DORMANT (NOT TO BE CONSIDERED)
6	P317	PRATIBHA INDUSTRIES LIMITED	INDIA	DORMANT (NOT TO BE CONSIDERED)
7	P331	P S STEEL TUBES LTD	INDIA	DORMANT (NOT TO BE CONSIDERED)
8	R193	RAMA STEEL TUBES LTD.	INDIA	DORMANT (NOT TO BE CONSIDERED)
9	P283	CAPACITE STRUCTURES LTD.	INDIA	Ground-XIV (Rejected in Shop Survey)
10	M177	MUKAT PIPES LTD	INDIA	Ground-XIII (Negative networth or Financial constraints)
11	Z14	ZENITH BIRLA (INDIA) LIMITED	INDIA	Ground-XIII (Negative networth or Financial constraints)
12	P312D	PSL LTD (V1,V2)	INDIA	Ground-XIII (Negative networth or Financial constraints)
13	P312E	PSL LTD (CHENNAI)	INDIA	Ground-XIII (Negative networth or Financial constraints)
14	P312F	PSL LTD (VIZAG)	INDIA	Ground-XIII (Negative networth or Financial constraints)
15	S106	SAMSHI PIPE INDUSTRIES LIMITED	INDIA	DORMANT (NOT TO BE CONSIDERED)
16	3733	SWASTIK PIPES LTD	INDIA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AG		**Description :** PIPES & TUBULARS TO A.P.I.STANDARDS		
Approved Suppliers				
1	G624	GIEMINOX TECTUBI RACCORDI SRL	ITALY	
2	27436	VALLOUREC TUBES FRANCE	GERMANY	
3	3696	RATNAMANI METALS AND TUBES LTD	INDIA	
4	M188	MUKAT TANKS & VESSELS PVT LTD	INDIA	
5	B015	BHARAT HEAVY ELECTRICALS LIMITED-TIRUCHIRAPALLI	INDIA	
6	3841	SURYA ROSHNI LTD	INDIA	
7	4142	SURINDRA ENGINEERING COMPANY PRIVATE LIMITED	INDIA	
8	3695	RATNAMANI METALS AND TUBES LTD	INDIA	
9	J015	JINDAL PIPES LTD	INDIA	
10	27429	VALLOUREC TUBES FRANCE	BRAZIL	
11	L061	LALIT PIPES & PIPES PRIVATE LIMITED	INDIA	
12	W056A	WELSPUN CORP LIMITED (ANJAR)	INDIA	
13	Y556	YANGZHOU LONTRIN STEEL TUBE CO.,LTD.	CHINA	
14	A751	ARCELORMITTAL TUBULAR PRODUCTS ROMAN SA	ROMANIA	
15	S563	Nippon Steel and Sumitomo Metal Corporation	JAPAN	
16	E633	EEW KOREA CO. LTD	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	
17	W056	WELSPUN CORP LIMITED (DAHEJ)	INDIA	
18	I181	ISMT LTD-BARAMATI	INDIA	
19	27444	VALLOUREC TUBES FRANCE	CHINA	
20	27438	VALLOUREC TUBES FRANCE	GERMANY	
21	H642	HYUNDAI RB CO.LTD	KOREA, REPUBLIC OF	
22	3983	STEEL AUTHORITY OF INDIA LTD	INDIA	
23	M187	MAHARASHTRA SEAMLESS LTD.	INDIA	
24	J110B	JINDAL SAW LTD (NASHIK WORKS)	INDIA	
25	S281	SURYA ROSHNI LTD	INDIA	
26	T669	TUBOS DE ACERO DE MEXICO SA(ENQ.TENARIS	MEXICO	
27	27437	VALLOUREC TUBES FRANCE	KOREA, REPUBLIC OF	
28	27453	HUBEI XINYEGANG STEEL CO.,LTD	CHINA	
29	S677	SIDERCA S.A.I.C. (ENQUIRY TO TENARIS)	ARGENTINA	
30	I036	ISMT LTD-AHMEDNGR	INDIA	
31	T566	TUBOS REUNIDOS SA	SPAIN	
32	H663	HENGYANG VALIN STEEL TUBE CO., LTD.	CHINA	
33	E627	EISENBAU KRAMER GMBH	GERMANY	
34	E139	ARCELORMITTAL NIPPON STEEL INDIA LTD	INDIA	
35	I583	INOX TECH. SPA	ITALY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AG		**Description :** PIPES & TUBULARS TO A.P.I.STANDARDS		
1	P704	PANGANG GROUP CHENGDU STEEL & VANADIUM C	CHINA	DORMANT (NOT TO BE CONSIDERED)
2	27445	VALLOUREC TUBES FRANCE	CHINA	HOLD-ENQ/PO/BID OP.
3	T752	TATA STEEL UK LIMITED(FORMERLY C702)	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)
4	B740	BAOSTEEL GROUP CORPORATION	CHINA	DORMANT (NOT TO BE CONSIDERED)
5	U533	UMRAN STEEL PIPE INC (TURKEY)	TURKEY	DORMANT (NOT TO BE CONSIDERED)
6	P312D	PSL LTD (V1,V2)	INDIA	Ground-XIII (Negative networth or Financial constraints)
7	P312G	PSL LTD-JAIPUR	INDIA	Ground-XIII (Negative networth or Financial constraints)
8	V591	VALCOVNY TRUB CHOMUTOV	CZECH REPUBLIC	DORMANT (NOT TO BE CONSIDERED)
9	Z599	ZHEJIANG GROSS SEAMLESS STEEL TUBE COLTD	CHINA	DORMANT (NOT TO BE CONSIDERED)
10	D534	DALMINE SPA (ENQUIRY TO TENARIS)	ITALY	DORMANT (NOT TO BE CONSIDERED)
11	I565	ILVA LAMIERE E TUBI SRL(ENQ TO ILVA SPA)	ITALY	DORMANT (NOT TO BE CONSIDERED)
12	P317	PRATIBHA INDUSTRIES LIMITED	INDIA	DORMANT (NOT TO BE CONSIDERED)
13	P312F	PSL LTD (VIZAG)	INDIA	Ground-XIII (Negative networth or Financial constraints)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AH		**Description :** PIPE/TUBE-C S (SEAMLESS)TO ASTM STDS		
Approved Suppliers				
1	27438	VALLOUREC TUBES FRANCE	GERMANY	
2	27453	HUBEI XINYEGANG STEEL CO.,LTD	CHINA	
3	3980	GLOBAL SEAMLESS TUBES AND PIPES PRIVATE LIMITED	INDIA	
4	J557A	JFE STEEL CORPORATION	JAPAN	
5	27429	VALLOUREC TUBES FRANCE	BRAZIL	
6	C719	CHANGSHU SEAMLESS STEEL TUBE CO. LTD	CHINA	
7	S563	Nippon Steel and Sumitomo Metal Corporation	JAPAN	
8	H663	HENGYANG VALIN STEEL TUBE CO., LTD.	CHINA	
9	4030	M/S. RAJKOT SEAMLESS TUBE PRIVATE LIMITED	INDIA	
10	J152	JR SEAMLESS PVT.LTD	INDIA	
11	Y556	YANGZHOU LONTRIN STEEL TUBE CO.,LTD.	CHINA	
12	27437	VALLOUREC TUBES FRANCE	KOREA, REPUBLIC OF	
13	Y555	YANGZHOU CHENGDE STEEL PIPE CO LTD	CHINA	
14	A751	ARCELORMITTAL TUBULAR PRODUCTS ROMAN SA	ROMANIA	
15	3756	HEAVY METAL AND TUBES (INDIA) PRIVATE LIMITED	INDIA	
16	A359	AVON TUBETECH PVT LTD	INDIA	
17	H086	HEAVY METAL AND TUBES (INDIA) PRIVATE LIMITED	INDIA	
18	3955	MAHARASHTRA SEAMLESS LTD	INDIA	
19	4209	JINDAL SAW LTD	INDIA	
20	A387	ANAND SEAMLESS LIMITED	INDIA	
21	J670	JIANGSU CHENGDE STEEL TUBE SHARE CO. LTD	CHINA	
22	R196	RATNADEEP METAL TUBES LTD.	INDIA	
23	M187A	MAHARASHTRA SEAMLESS LTD.	INDIA	
24	B015	BHARAT HEAVY ELECTRICALS LIMITED-TIRUCHIRAPALLI	INDIA	
25	J110B	JINDAL SAW LTD (NASHIK WORKS)	INDIA	
26	P300	Patels Airflow Ltd.	INDIA	
27	27436	VALLOUREC TUBES FRANCE	GERMANY	
28	M187	MAHARASHTRA SEAMLESS LTD.	INDIA	
29	I181	ISMT LTD-BARAMATI	INDIA	
30	4191	RASHMI GREEN HYDROGEN STEEL PRIVATE LIMITED	INDIA	
31	L127	LAL BABA SEAMLESS TUBES PVT. LTD	INDIA	
32	27444	VALLOUREC TUBES FRANCE	CHINA	
33	S347	SAINEST TUBES PVT LTD	INDIA	
34	4177	ACCORD TUBES AND PROFILES LLP	INDIA	
35	I036	ISMT LTD-AHMEDNGR	INDIA	
36	T566	TUBOS REUNIDOS SA	SPAIN	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AH		**Description :** PIPE/TUBE-C S (SEAMLESS)TO ASTM STDS		
On Holiday				
1	D534	DALMINE SPA (ENQUIRY TO TENARIS)	ITALY	DORMANT (NOT TO BE CONSIDERED)
2	P704	PANGANG GROUP CHENGDU STEEL & VANADIUM C	CHINA	DORMANT (NOT TO BE CONSIDERED)
3	27445	VALLOUREC TUBES FRANCE	CHINA	HOLD-ENQ/PO/BID OP.
4	B740	BAOSTEEL GROUP CORPORATION	CHINA	DORMANT (NOT TO BE CONSIDERED)
5	P675	PRODUCTOS TUBULARES S.A.U.	SPAIN	Ground-XIII (Negative networth or Financial constraints)
6	M202	MAHALAXMI SEAMLESS LIMITED	INDIA	DORMANT (NOT TO BE CONSIDERED)
7	V591	VALCOVNY TRUB CHOMUTOV	CZECH REPUBLIC	DORMANT (NOT TO BE CONSIDERED)
8	W614	WYMAN GORDON FORGINGS	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
9	Z599	ZHEJIANG GROSS SEAMLESS STEEL TUBE COLTD	CHINA	DORMANT (NOT TO BE CONSIDERED)
10	K503	KASCO	KOREA, REPUBLIC OF	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AI		**Description :** PIPE-CARBON STEEL(WELDED)TO ASTM STDS		
Approved Suppliers				
1	H642	HYUNDAI RB CO.LTD	KOREA, REPUBLIC OF	
2	M188	MUKAT TANKS & VESSELS PVT LTD	INDIA	
3	S563	Nippon Steel and Sumitomo Metal Corporation	JAPAN	
4	E139	ARCELORMITTAL NIPPON STEEL INDIA LTD	INDIA	
5	4103	SHRI BAJRANG POWER AND ISPAT LIMITED	INDIA	
6	E633	EEW KOREA CO. LTD	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	
7	M217A	MAN INDUSTRIES (INDIA) LTD	INDIA	
8	3695	RATNAMANI METALS AND TUBES LTD	INDIA	
9	3696	RATNAMANI METALS AND TUBES LTD	INDIA	
10	E627	EISENBAU KRAMER GMBH	GERMANY	
11	L061	LALIT PIPES & PIPES PRIVATE LIMITED	INDIA	
12	I583	INOX TECH. SPA	ITALY	
13	4142	SURINDRA ENGINEERING COMPANY PRIVATE LIMITED	INDIA	
On Holiday				
1	M177	MUKAT PIPES LTD	INDIA	Ground-XIII (Negative networth or Financial constraints)
2	T752	TATA STEEL UK LIMITED(FORMERLY C702)	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AJ		**Description :** PIPE/TUBE- A S (SEAMLESS)TO ASTM STDS		
Approved Suppliers				
1	27436	VALLOUREC TUBES FRANCE	GERMANY	
2	H663	HENGYANG VALIN STEEL TUBE CO., LTD.	CHINA	
3	J557A	JFE STEEL CORPORATION	JAPAN	
4	P300	Patels Airflow Ltd.	INDIA	
5	Y555	YANGZHOU CHENGDE STEEL PIPE CO LTD	CHINA	
6	4191	RASHMI GREEN HYDROGEN STEEL PRIVATE LIMITED	INDIA	
7	J110B	JINDAL SAW LTD (NASHIK WORKS)	INDIA	
8	Y556	YANGZHOU LONTRIN STEEL TUBE CO.,LTD.	CHINA	
9	27453	HUBEI XINYEGANG STEEL CO.,LTD	CHINA	
10	I597	IBF S P A	ITALY	
11	J152	JR SEAMLESS PVT.LTD	INDIA	
12	J670	JIANGSU CHENGDE STEEL TUBE SHARE CO. LTD	CHINA	
13	S563	Nippon Steel and Sumitomo Metal Corporation	JAPAN	
14	T566	TUBOS REUNIDOS SA	SPAIN	
15	M187	MAHARASHTRA SEAMLESS LTD.	INDIA	
16	27437	VALLOUREC TUBES FRANCE	KOREA, REPUBLIC OF	
17	3756	HEAVY METAL AND TUBES (INDIA) PRIVATE LIMITED	INDIA	
18	S347	SAINEST TUBES PVT LTD	INDIA	
19	I181	ISMT LTD-BARAMATI	INDIA	
20	4209	JINDAL SAW LTD	INDIA	
21	B015	BHARAT HEAVY ELECTRICALS LIMITED-TIRUCHIRAPALLI	INDIA	
22	27429	VALLOUREC TUBES FRANCE	BRAZIL	
23	H086	HEAVY METAL AND TUBES (INDIA) PRIVATE LIMITED	INDIA	
24	C719	CHANGSHU SEAMLESS STEEL TUBE CO. LTD	CHINA	
25	27438	VALLOUREC TUBES FRANCE	GERMANY	
26	A387	ANAND SEAMLESS LIMITED	INDIA	
27	R196	RATNADEEP METAL TUBES LTD.	INDIA	
28	I036	ISMT LTD-AHMEDNGR	INDIA	
29	L127	LAL BABA SEAMLESS TUBES PVT. LTD	INDIA	
30	T669	TUBOS DE ACERO DE MEXICO SA(ENQ.TENARIS	MEXICO	
31	C738	CHANGSHU WALSIN SPECIALTY STEEL CO.,LTD	CHINA	
On Holiday				
1	K503	KASCO	KOREA, REPUBLIC OF	DORMANT (NOT TO BE CONSIDERED)
2	M202	MAHALAXMI SEAMLESS LIMITED	INDIA	DORMANT (NOT TO BE CONSIDERED)
3	V591	VALCOVNY TRUB CHOMUTOV	CZECH REPUBLIC	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AJ		**Description :** PIPE/TUBE- A S (SEAMLESS)TO ASTM STDS		
4	W614	WYMAN GORDON FORGINGS	UNITED STATES	DORMANT (NOT TO BE CONSIDERED)
5	P675	PRODUCTOS TUBULARES S.A.U.	SPAIN	Ground-XIII (Negative networth or Financial constraints)
6	D534	DALMINE SPA (ENQUIRY TO TENARIS)	ITALY	DORMANT (NOT TO BE CONSIDERED)
7	P704	PANGANG GROUP CHENGDU STEEL & VANADIUM C	CHINA	DORMANT (NOT TO BE CONSIDERED)
8	27445	VALLOUREC TUBES FRANCE	CHINA	HOLD-ENQ/PO/BID OP.
9	B740	BAOSTEEL GROUP CORPORATION	CHINA	DORMANT (NOT TO BE CONSIDERED)
10	Z599	ZHEJIANG GROSS SEAMLESS STEEL TUBE COLTD	CHINA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AK		**Description :** PIPE/TUBE-SS(S.LESS & WELDED)TO ASTM STD		
Approved Suppliers				
1	Z598	TSINGSHAN STEEL PIPE CO. LTD.	CHINA	
2	S594	SANDVIK AB	SWEDEN	
3	3897	JINDAL SAW LTD (KOSI WORKS)	INDIA	
4	4218	STANCOR TUBULAR PRODUCTS PRIVATE LIMITED	INDIA	
5	S563	Nippon Steel and Sumitomo Metal Corporation	JAPAN	
6	J110D	JINDAL SAW LTD - SAMAGOGHA	INDIA	
7	C738	CHANGSHU WALSIN SPECIALTY STEEL CO.,LTD	CHINA	
8	3685	HEAVY METAL & TUBES (INDIA) PRIVATE LTD	INDIA	
9	C227	CHANDAN STEEL LTD	INDIA	
10	3892	INOX PIPE & FITTINGS INDUSTRIES	INDIA	
11	Z515	ZHEJIANG JIULI HI-TECH METALS CO., LTD.	CHINA	
12	S445	Alleima India Private Limited	INDIA	
13	3906	WELSPUN SPECIALTY SOLUTIONS LIMITED	INDIA	
14	R066	RATNAMANI METALS AND TUBES LTD	INDIA	
15	4274	MLTI PRIVATE LIMITED	INDIA	
16	4275	PRAKASH STEELAGE LIMITED	INDIA	
17	S857	SANDVIK MATERIALS TECHNOLOGY (CHINA),CO. LTD.	CHINA	
18	S842	SALZGITTER MANNESMANN ST DEUTSCHLANDGMBH	FRANCE	
19	G624	GIEMINOX TECTUBI RACCORDI SRL	ITALY	
20	27493	ZHEJIANG JIULI HI-TECH METALS CO., LTD [P.R. CHINA]	CHINA	
21	27447	HUADI STEEL GROUP CO.,LTD	CHINA	
22	3855	VENUS PIPES & TUBES LIMITED	INDIA	
23	27457	SEAH STEEL CORPORATION	KOREA, REPUBLIC OF	
24	W510	WILH SCHULZ GmbH	GERMANY	
25	3686	ASR MET TECH PVT LTD	INDIA	
26	3836	S PLUS TUBE TECH	INDIA	
27	4191	RASHMI GREEN HYDROGEN STEEL PRIVATE LIMITED	INDIA	
28	4209	JINDAL SAW LTD	INDIA	
29	S406	SURAJ LIMITED	INDIA	
30	M287	MAXIM TUBES COMPANY PVT LTD	INDIA	
31	R127	REMI EDELSTAHL TUBULARS LTD (FORM RMIL)	INDIA	
32	27443	CENTRAVIS PRODUCTION UKRAINE PJSC	UKRAINE	
33	T551	TUBACEX TUBOS INOXIDABLES SAU	SPAIN	
34	M307	MBM TUBES PVT LTD	INDIA	
35	I597	IBF S P A	ITALY	
36	S499	SCORODITE STAINLESS (INDIA) PVT. LTD.	INDIA	
37	P260	TUBACEX TUBES AND PIPES PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AK		**Description :** PIPE/TUBE-SS(S.LESS & WELDED)TO ASTM STD		
38	I583	INOX TECH. SPA	ITALY	
39	S202	SHUBHLAXMI METALS AND TUBES PVT. LTD	INDIA	
40	3649	DIVINE TUBES PVT LTD	INDIA	
41	3665	SHALCO INDUSTRIES PVT LTD	INDIA	
42	R196	RATNADEEP METAL TUBES LTD.	INDIA	
43	K186	KRYSTAL GLOBAL ENGINEERING LIMITED	INDIA	
44	3696	RATNAMANI METALS AND TUBES LTD	INDIA	
45	S098	SCODA TUBES LTD	INDIA	
46	P300	Patels Airflow Ltd.	INDIA	
47	J628	JIANGSU WUJIN STAINLESS STEEL PIPE GROUP CO., LTD	CHINA	
48	3930	SUN MARK STAINLESS PRIVATE LIMITED	INDIA	
On Holiday				
1	S732	SCHOELLER-BLECKMANN EDELSTAHLROHR	AUSTRIA	DORMANT (NOT TO BE CONSIDERED)
2	S823	SOSTA GMBH	GERMANY	DORMANT (NOT TO BE CONSIDERED)
3	S357	HELLIOS TUBEALLOYS PVT. LTD	INDIA	Ground-XIII (Negative networth or Financial constraints)
4	B194	BHANDARI FOILS AND TUBES LTD.	INDIA	Ground-XII (Labour unrest/stoppage of production/Lockout)
5	P675	PRODUCTOS TUBULARES S.A.U.	SPAIN	Ground-XIII (Negative networth or Financial constraints)
6	A275	APEX TUBES PVT LTD	INDIA	DORMANT (NOT TO BE CONSIDERED)
7	H651	HAILONG (ZHANGJIAGANG) INDUSTRY CO., LTD	CHINA	DORMANT (NOT TO BE CONSIDERED)
8	S129	STEAMLINE INDUSTRIES Ltd	INDIA	DORMANT (NOT TO BE CONSIDERED)
9	A262	ARVIND PIPES & FITTINGS IND PVT LTD	INDIA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AL		**Description :** PIPE/TUBE-S.LESS(DUPLEX/SUPER DUPLEX SS)		
Approved Suppliers				
1	3696	RATNAMANI METALS AND TUBES LTD	INDIA	
2	Z515	ZHEJIANG JIULI HI-TECH METALS CO., LTD.	CHINA	
3	P260	TUBACEX TUBES AND PIPES PRIVATE LIMITED	INDIA	
4	T551	TUBACEX TUBOS INOXIDABLES SAU	SPAIN	
5	S857	SANDVIK MATERIALS TECHNOLOGY (CHINA),CO. LTD.	CHINA	
6	R196	RATNADEEP METAL TUBES LTD.	INDIA	
7	S202	SHUBHLAXMI METALS AND TUBES PVT. LTD	INDIA	
8	S406	SURAJ LIMITED	INDIA	
9	S842	SALZGITTER MANNESMANN ST DEUTSCHLANDGMBH	FRANCE	
10	M287	MAXIM TUBES COMPANY PVT LTD	INDIA	
11	S445	Alleima India Private Limited	INDIA	
12	C227	CHANDAN STEEL LTD	INDIA	
13	R066	RATNAMANI METALS AND TUBES LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AM		**Description :** PIPE/TUBE-NICKEL ALLOYS (S.LESS & WELDED)		
Approved Suppliers				
1	P260	TUBACEX TUBES AND PIPES PRIVATE LIMITED	INDIA	
2	R066	RATNAMANI METALS AND TUBES LTD	INDIA	
3	R620	RIVIT SPA	ITALY	
4	K186	KRYSTAL GLOBAL ENGINEERING LIMITED	INDIA	
5	S842	SALZGITTER MANNESMANN ST DEUTSCHLANDGMBH	FRANCE	
6	3665	SHALCO INDUSTRIES PVT LTD	INDIA	
7	S445	Alleima India Private Limited	INDIA	
8	C738	CHANGSHU WALSIN SPECIALTY STEEL CO.,LTD	CHINA	
9	I583	INOX TECH. SPA	ITALY	
10	27443	CENTRAVIS PRODUCTION UKRAINE PJSC	UKRAINE	
11	Z515	ZHEJIANG JIULI HI-TECH METALS CO., LTD.	CHINA	
12	C227	CHANDAN STEEL LTD	INDIA	
13	T551	TUBACEX TUBOS INOXIDABLES SAU	SPAIN	
14	G624	GIEMINOX TECTUBI RACCORDI SRL	ITALY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AN		**Description :** PIPING SYSTEM-LINED (PTFE/PFA)		
Approved Suppliers				
1	4021	AGARWAL TANKS & ALLIED WORKS	INDIA	
2	H101	HORIZON POLYMER ENGG. LTD.	INDIA	
3	3938	MIL INDUSTRIES LIMITED	INDIA	
4	D165	D.V.POLYMERS INDIA (P) LTD	INDIA	
5	3658	SUPER INDUSTRIAL LINING PVT LTD	INDIA	
6	P163	PLASTRULON PROCESSORS LTD	INDIA	
7	4239	TRANSFLOW PROCESS SYSTEMS PRIVATE LIMITED	INDIA	
On Holiday				
1	D097	DIP-FLON ENGINEERING & CO.	INDIA	HOLD RFQ/PBO/PO DUE TO SHIFTING OF WORKS (EXCEPT NIT CASES)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AO		**Description :** PIPES -SS WELDED TO A 358		
Approved Suppliers				
1	3855	VENUS PIPES & TUBES LIMITED	INDIA	
2	3946	ANGEL PIPES AND TUBES PVT. LTD	INDIA	
3	4189	AADITYA STAINLESS PRIVATE LIMITD	INDIA	
4	O578	OUTOKUMPU STAINLESS TUBULAR P.AB(FRMA553	SWEDEN	
5	I583	INOX TECH. SPA	ITALY	
6	S823	SOSTA GMBH	GERMANY	
7	S563	Nippon Steel and Sumitomo Metal Corporation	JAPAN	
8	R620	RIVIT SPA	ITALY	
9	27457	SEAH STEEL CORPORATION	KOREA, REPUBLIC OF	
10	3696	RATNAMANI METALS AND TUBES LTD	INDIA	
11	J628	JIANGSU WUJIN STAINLESS STEEL PIPE GROUP CO., LTD	CHINA	
12	H639	H.BUTTING GMBH & CO.KG	GERMANY	
13	E633	EEW KOREA CO. LTD	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	
14	G624	GIEMINOX TECTUBI RACCORDI SRL	ITALY	
15	27558	LS METAL CO., LTD.	KOREA, REPUBLIC OF	
16	27458	SEAH STEEL CORPORATION	KOREA, REPUBLIC OF	
17	J110D	JINDAL SAW LTD - SAMAGOGHA	INDIA	
18	27493	ZHEJIANG JIULI HI-TECH METALS CO., LTD [P.R. CHINA]	CHINA	
19	4275	PRAKASH STEELAGE LIMITED	INDIA	
20	3892	INOX PIPE & FITTINGS INDUSTRIES	INDIA	
21	R127	REMI EDELSTAHL TUBULARS LTD (FORM RMIL)	INDIA	
On Holiday				
1	B194	BHANDARI FOILS AND TUBES LTD.	INDIA	Ground-XII (Labour unrest/stoppage of production/Lockout)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AP		**Description :** DUPLEX/SUPER DUPLEX SS WELDED PIPES		
Approved Suppliers				
1	3696	RATNAMANI METALS AND TUBES LTD	INDIA	
2	H639	H.BUTTING GMBH & CO.KG	GERMANY	
3	G624	GIEMINOX TECTUBI RACCORDI SRL	ITALY	
4	R620	RIVIT SPA	ITALY	
5	S823	SOSTA GMBH	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60AQ		**Description :** 3LPE COATED PIPES(EXTRUDED/ SINTERED)		
Approved Suppliers				
1	T234	MEGA PIPES PRIVATE LIMITED	INDIA	
2	M187A	MAHARASHTRA SEAMLESS LTD.	INDIA	
3	3696	RATNAMANI METALS AND TUBES LTD	INDIA	
4	M188	MUKAT TANKS & VESSELS PVT LTD	INDIA	
5	L061	LALIT PIPES & PIPES PRIVATE LIMITED	INDIA	
6	M187	MAHARASHTRA SEAMLESS LTD.	INDIA	
7	4253	INFA ENGINEERS PRIVATE LIMITED	INDIA	
8	3841	SURYA ROSHNI LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60B-		**Description :** PIPES- INDIAN STOCKIST		
Approved Suppliers				
1	3811	BHARAT ENTERPRISES	INDIA	
2	3720	KWALITY TUBES	INDIA	
3	3609	SHIB DASS AND SONS PRIVATE LIMITED	INDIA	
4	3878	SUPERIOR STEEL INDUSTRIES	INDIA	
5	4259	DUGAR TUBES PRIVATE LIMITED	INDIA	
6	3816	MOKSHI INDUSTRIES PRIVATE LIMITED	INDIA	
7	3799	N-PIPE SOLUTIONS INC.	INDIA	
8	3772	CHAMPAK STEEL & ENGINEERING CO.	INDIA	
9	E214	EVERGREEN SEAMLESS PIPES & TUBES PVT. LT	INDIA	
10	3743	VINAYAK PIPES AND TUBES PVT LTD	INDIA	
11	3912	TUBACEX SERVICE SOLUTIONS INDIA PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60C-		**Description :** PIPE-CLADDED		
Approved Suppliers				
1	27452	FTV PROCLAD L.L.C.	UNITED ARAB EMIRATES	
2	E627	EISENBAU KRAMER GMBH	GERMANY	
3	E583	NOBELCLAD	UNITED STATES	
4	G624	GIEMINOX TECTUBI RACCORDI SRL	ITALY	
5	J502	JAPAN STEEL WORKS LTD	JAPAN	
6	27411	Cladtek Middle East FZC	INDONESIA	
7	3746	CRYSTAL INDUSTRIAL SYNDICATE PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60NB		**Description :** PIPE-WELDED ALLOY STEEL		
Approved Suppliers				
1	3696	RATNAMANI METALS AND TUBES LTD	INDIA	
2	3695	RATNAMANI METALS AND TUBES LTD	INDIA	
3	M188	MUKAT TANKS & VESSELS PVT LTD	INDIA	
4	E627	EISENBAU KRAMER GMBH	GERMANY	
5	I583	INOX TECH. SPA	ITALY	
6	H642	HYUNDAI RB CO.LTD	KOREA, REPUBLIC OF	
7	E633	EEW KOREA CO. LTD	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	
8	L061	LALIT PIPES & PIPES PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60PT		**Description :** PRE-INSULATED TUBING		
Approved Suppliers				
1	27499	OBCORP LLC	UNITED STATES	
2	27500	KWANG SHIN IST CO.LTD	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	
3	27498	THERMON INC	UNITED STATES	
4	4146	TECHWIN INTERNATIONAL	INDIA	
5	4184	THERMOPADS PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60WB		**Description :** PIPE-PVDF/FRP		
Approved Suppliers				
1	P218	PRAVEEN REINFORCED PLASTICS PVT LTD	INDIA	
2	S251	SUNRISE INDUSTRIES (INDIA) LTD	INDIA	
3	G005	GANDHI & ASSOCIATES	INDIA	
4	3884	SANGIR PLASTICS PVT. LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60XA		**Description :** PIPE-FRP		
Approved Suppliers				
1	C023	CHEMICAL PROCESS EQPTS. PVT. LTD.	INDIA	
2	P218	PRAVEEN REINFORCED PLASTICS PVT LTD	INDIA	
3	D066	DOLF INDUSTRIES PRIVATE LIMITED	INDIA	
4	R194	RUIA CHEMICALS P. LTD.	INDIA	
5	P028	POLY PLAST CHEMI-PLANT (I) LTD.	INDIA	
6	G005	GANDHI & ASSOCIATES	INDIA	
7	S251	SUNRISE INDUSTRIES (INDIA) LTD	INDIA	
8	I164	INDUSTRIAL SERVICES	INDIA	
9	C154	CARBON EVERFLOW LTD.	INDIA	
10	S472	STRATEGIC ENGINEERING (P) LTD	INDIA	
11	C747	COMPOSITE PIPES INDUSTRY L.L.C	OMAN	
On Holiday				
1	3865	EPP COMPOSITE PVT LTD	INDIA	HOLD RFQ/PBO/PO DUE TO SHIFTING OF WORKS (EXCEPT NIT CASES)
2	E216	EPP COMPOSITE PVT LTD	INDIA	HOLD RFQ/PBO/PO DUE TO SHIFTING OF WORKS (EXCEPT NIT CASES)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 60YB		**Description :** PIPE-TITANIUM		
Approved Suppliers				
1	S861	SHANGHAI HUAXIA INTERNATIONAL TRADING CO	CHINA	
2	X663	XUYI TITAN AND MATERIAL CO LTD	CHINA	
3	27542	JIANGSU HONGBAO HIGH-PRECISE PIPE&TUBE CO.,LTD	CHINA	
4	R620	RIVIT SPA	ITALY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 61AA		**Description :** PIPING SYSTEM-CLAD(SHOP FABRICATED)		
Approved Suppliers				
1	B015	BHARAT HEAVY ELECTRICALS LIMITED-TIRUCHIRAPALLI	INDIA	
2	L032	LARSEN & TOUBRO LTD	INDIA	
3	G057	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
4	B010	BHARAT HEAVY ELECTRICALS LIMITED-HPVP(VISAKHAPATNAM)	INDIA	
5	I006	ISGEC HEAVY ENGINEERING LTD	INDIA	
6	27411	Cladtek Middle East FZC	INDONESIA	
7	3746	CRYSTAL INDUSTRIAL SYNDICATE PVT LTD	INDIA	
8	3598	TECHNO PROCESS EQUIPMENTS (INDIA) PVT. LTD	INDIA	
9	C751	CLADTEK MIDDLE EAST FZC	INDONESIA	
10	27452	FTV PROCLAD L.L.C.	UNITED ARAB EMIRATES	
11	T123	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
On Holiday				
1	I023	INDUS PROJECTS LIMITED	INDIA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 61AB		**Description :** PRE-FABRICATED PIPING SPOOL		
Approved Suppliers				
1	G125	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
2	3838	BEND JOINTS PVT. LTD.	INDIA	
3	3968	PRECITECH EQUIPMENTS INDIA PRIVATE LIMITED	INDIA	
4	3893	RSA TURBOTECH PRIVATE LIMITED	INDIA	
5	4126	VITECH HEAVY EQUIPMENTS PVT. LTD.	INDIA	
6	I006	ISGEC HEAVY ENGINEERING LTD	INDIA	
7	Y634	YINGKOU LIAOHE PIPE FITTINGS CO. LTD	CHINA	
8	N720	NASS INDUSTRIAL SERVICES	UNITED ARAB EMIRATES	
9	U144	U I PIPE FITTINGS PVT LTD	INDIA	
10	B220	BHARAT HEAVY ELECTRICALS LIMITED-PODUKOTAI	INDIA	
11	L032	LARSEN & TOUBRO LTD	INDIA	
12	3966	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 61AC		**Description :** HOT INDUCTION BEND		
Approved Suppliers				
1	I006	ISGEC HEAVY ENGINEERING LTD	INDIA	
2	Y634	YINGKOU LIAOHE PIPE FITTINGS CO. LTD	CHINA	
3	B220	BHARAT HEAVY ELECTRICALS LIMITED-PODUKOTAI	INDIA	
4	4215	DYNAMIC FORGE & FITTINGS INDIA PVT LTD	INDIA	
5	L032	LARSEN & TOUBRO LTD	INDIA	
6	D111	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 61AD		**Description :** PIPING SYSTEM-GRE/GRP/FRP/PVDF/PTFE LINED		
Approved Suppliers				
1	S251	SUNRISE INDUSTRIES (INDIA) LTD	INDIA	
2	4052	MEGHA FIBRE GLASS INDUSTRIES LIMITED	INDIA	
3	C747	COMPOSITE PIPES INDUSTRY L.L.C	OMAN	
4	3758	CHEMICAL PROCESS PIPING PVT LTD	INDIA	
5	4170	EPP COMPOSITES PVT LTD	INDIA	
6	4231	GRAPHITE INDIA LIMITED (GRP DIVISION)	INDIA	
On Holiday				
1	E216	EPP COMPOSITE PVT LTD	INDIA	HOLD RFQ/PBO/PO DUE TO SHIFTING OF WORKS (EXCEPT NIT CASES)
2	3865	EPP COMPOSITE PVT LTD	INDIA	HOLD RFQ/PBO/PO DUE TO SHIFTING OF WORKS (EXCEPT NIT CASES)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 61AE		**Description :** CLOSED LOOP SAMPLING SYSTEM		
Approved Suppliers				
1	4125	SPIRARE ENERGY PVT. LTD.	INDIA	
2	4268	CHEMTRON SCIENCE LABORATORIES PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 70A-		**Description :** FITTINGS-FOREIGN STOCKIST		
Approved Suppliers				
1	H648	HART BV	NETHERLANDS	
2	E631	EDGEN MURRAY FZE	UNITED ARAB EMIRATES	
3	H549	HORST KURVERS GMBH	UNITED KINGDOM	
4	27576	INRADA O.G.R.S. B.V.	NETHERLANDS	
5	P686	Peeraj General Trading CO (LLC)	UNITED ARAB EMIRATES	
6	O554	OFFSHORE ENGINEERING & MARKETING LTD.	UNITED ARAB EMIRATES	
7	A753	AMERICAN PIPING PRODUCTS INC	UNITED STATES	
8	P698	PETROGAS PIPING MIDDLE EAST FZCO	UNITED ARAB EMIRATES	
9	G616	GERAB NATIONAL ENTERPRISE L.L.C	UNITED ARAB EMIRATES	
On Holiday				
1	B741	BUHLMANN ROHR-FITTINGS-STAHLHANDEL GMBH	GERMANY	DORMANT (NOT TO BE CONSIDERED)
2	M658	MARDALE PIPES PLUS LIMITED	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)
3	V569	VAN LEEUWEN BUIZEN	FRANCE	DORMANT (NOT TO BE CONSIDERED)
4	I609	INTERNATIONAL INDUSTRIAL EQPT FZCO.	UNITED ARAB EMIRATES	DORMANT (NOT TO BE CONSIDERED)
5	S743	SIDECO SPA	ITALY	DORMANT (NOT TO BE CONSIDERED)
6	A685	AUSTIN STROUD & CO LTD	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)
7	T696	TECHNICAL PARTS ESTABLISHMENT	UNITED ARAB EMIRATES	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 71AA		**Description :** FITTING BLOCK FORGED-CARBON STEEL		
Approved Suppliers				
1	F624	FITTINOX SRL	ITALY	
2	M057	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
3	3719	VAIBHAV FITTING INDIA PVT LTD	INDIA	
4	F130	FLASH FORGE PVT LTD	INDIA	
5	E060	EBY FASTENERS	INDIA	
6	H172	HILTON METAL FORGING LIMITED	INDIA	
7	3996	KISAAN TECHNO FORGE PRIVATE LIMITED	INDIA	
8	4005	SHAKTI FORGE INDUSTRIES PVT LTD	INDIA	
9	C209	CSA FITTINGS	INDIA	
10	C724	CHERO PIPING SPA	ITALY	
11	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
12	3806	TUBE TURN (INDIA) PVT LTD	INDIA	
13	T746	TK CORPORATION	KOREA, REPUBLIC OF	
14	K645	KEONSAE HIGH PRESSURE CO.LTD.	KOREA, REPUBLIC OF	
15	V157	VIJAY CYCLE & STEEL INDUSTRIES	INDIA	
16	L004	LEADER VALVES LTD	INDIA	
17	3970	SKY FORGE PVT LTD	INDIA	
18	T226	TUBE TURN (INDIA) PVT LTD	INDIA	
19	W510	WILH SCHULZ GmbH	GERMANY	
On Holiday				
1	T050	TUBE BEND (CALCUTTA) PVT LTD	INDIA	DORMANT (NOT TO BE CONSIDERED)
2	M731	M.E.G.A SPA	ITALY	DORMANT (NOT TO BE CONSIDERED)
3	P708	PROMAT BD LTD MIDDLE EAST	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 71AB		**Description :** FITTING BLOCK FORGED-ALLOY STEEL		
Approved Suppliers				
1	M057	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
2	F624	FITTINOX SRL	ITALY	
3	F130	FLASH FORGE PVT LTD	INDIA	
4	E060	EBY FASTENERS	INDIA	
5	3996	KISAAN TECHNO FORGE PRIVATE LIMITED	INDIA	
6	3806	TUBE TURN (INDIA) PVT LTD	INDIA	
7	C209	CSA FITTINGS	INDIA	
8	3719	VAIBHAV FITTING INDIA PVT LTD	INDIA	
9	T746	TK CORPORATION	KOREA, REPUBLIC OF	
10	T226	TUBE TURN (INDIA) PVT LTD	INDIA	
11	C724	CHERO PIPING SPA	ITALY	
12	3970	SKY FORGE PVT LTD	INDIA	
13	W510	WILH SCHULZ GmbH	GERMANY	
14	L004	LEADER VALVES LTD	INDIA	
15	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
16	K645	KEONSAE HIGH PRESSURE CO.LTD.	KOREA, REPUBLIC OF	
On Holiday				
1	M731	M.E.G.A SPA	ITALY	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 71AC		**Description :** FITTING BLOCK FORGED-STAINLESS STEEL		
Approved Suppliers				
1	F624	FITTINOX SRL	ITALY	
2	C209	CSA FITTINGS	INDIA	
3	3970	SKY FORGE PVT LTD	INDIA	
4	F130	FLASH FORGE PVT LTD	INDIA	
5	C724	CHERO PIPING SPA	ITALY	
6	K645	KEONSAE HIGH PRESSURE CO.LTD.	KOREA, REPUBLIC OF	
7	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
8	M057	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
9	H172	HILTON METAL FORGING LIMITED	INDIA	
10	T746	TK CORPORATION	KOREA, REPUBLIC OF	
11	W510	WILH SCHULZ GmbH	GERMANY	
12	3996	KISAAN TECHNO FORGE PRIVATE LIMITED	INDIA	
13	L004	LEADER VALVES LTD	INDIA	
14	4005	SHAKTI FORGE INDUSTRIES PVT LTD	INDIA	
15	E060	EBY FASTENERS	INDIA	
16	3719	VAIBHAV FITTING INDIA PVT LTD	INDIA	
On Holiday				
1	M731	M.E.G.A SPA	ITALY	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 71AD		**Description :** O-LETS		
Approved Suppliers				
1	K645	KEONSAE HIGH PRESSURE CO.LTD.	KOREA, REPUBLIC OF	
2	3970	SKY FORGE PVT LTD	INDIA	
3	F130	FLASH FORGE PVT LTD	INDIA	
4	3719	VAIBHAV FITTING INDIA PVT LTD	INDIA	
5	L089	LAL METAL FORGE PRIVATE LIMITED	INDIA	
6	C724	CHERO PIPING SPA	ITALY	
7	C209	CSA FITTINGS	INDIA	
8	4005	SHAKTI FORGE INDUSTRIES PVT LTD	INDIA	
9	E060	EBY FASTENERS	INDIA	
10	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
11	F624	FITTINOX SRL	ITALY	
12	27434	VIAR S.P.A	ITALY	
13	M057	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
14	T746	TK CORPORATION	KOREA, REPUBLIC OF	
On Holiday				
1	M731	M.E.G.A SPA	ITALY	DORMANT (NOT TO BE CONSIDERED)
2	P708	PROMAT BD LTD MIDDLE EAST	UNITED KINGDOM	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 71AE		**Description :** FITTINGS BLOCK FORGED-EXOTIC MATLS.		
Approved Suppliers				
1	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
2	F624	FITTINOX SRL	ITALY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 72AA		**Description :** FITTINGS FROM SEAMLESS PIPE-CARBON STEEL		
Approved Suppliers				
1	I597	IBF S P A	ITALY	
2	T019	TEEKAY TUBES PVT LTD	INDIA	
3	E060	EBY FASTENERS	INDIA	
4	M057	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
5	3747	SIDDARTH AND GAUTAM ENGINEERS PVT. LTD.	INDIA	
6	S102	SAWAN ENGINEERS PVT LTD	INDIA	
7	S810	SUNGKWANG BEND CO. LTD	KOREA, REPUBLIC OF	
8	W510	WILH SCHULZ GmbH	GERMANY	
9	3992	SIVANANDHA PIPE FITTINGS LIMITED	INDIA	
10	A732	ALLIED INTERNATIONAL S.R.L.	ITALY	
11	P340	PATTECH FITWELL TUBE COMPONENTS LIMITED	INDIA	
12	T221	TOPAZ PIPING INDUSTRIES	INDIA	
13	3949	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
14	J615	LONGSHAN PIPE SOLUTIONS CO. LTD.	CHINA	
15	3996	KISAAN TECHNO FORGE PRIVATE LIMITED	INDIA	
16	3913	PERAMOUNT FORGE AND FITTINGS PRIVATE LIMITED	INDIA	
17	K218	K.S.PIPE FITTINGS (P) LTD	INDIA	
18	S265	SIDHARTH & GAUTAM ENGINEERS	INDIA	
19	P325	PETRO CHEM PIPING TECHNOLOGIES PRIVATE LIMITED	INDIA	
20	G125	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
21	J614	JIANGYIN TIANNING METAL PIPE FITTING CO	CHINA	
22	27474	JIANGYIN ZHONGNAN HEAVY INDUSTRIES CO. LTD	CHINA	
23	T226	TUBE TURN (INDIA) PVT LTD	INDIA	
24	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
25	R607	RACCORTUBI SPA	ITALY	
26	4294	SAWAN ENGINEERS PVT LTD	INDIA	
27	C209	CSA FITTINGS	INDIA	
28	3806	TUBE TURN (INDIA) PVT LTD	INDIA	
29	V608A	VALVITALIA SPA-TECNOFORGE DIVISION	ITALY	
30	Y634	YINGKOU LIAOHE PIPE FITTINGS CO. LTD	CHINA	
31	T746	TK CORPORATION	KOREA, REPUBLIC OF	
32	3637	FITTECH INDUSTRIES PVT. LTD.	INDIA	
33	U144	U I PIPE FITTINGS PVT LTD	INDIA	
On Holiday				
1	P694	PIANA S.P.A	ITALY	DORMANT (NOT TO BE CONSIDERED)
2	A755	APCO PIPE FITTINGS CO LTD	CHINA	HOLD-ENQ/PO/BID OP.
3	T050	TUBE BEND (CALCUTTA) PVT LTD	INDIA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 72AA		**Description :** FITTINGS FROM SEAMLESS PIPE-CARBON STEEL		
4	A687	AWAJI MATERIA (THAILAND) CO. LTD.	THAILAND	DORMANT (NOT TO BE CONSIDERED)
5	E630	EZEFLOW INC.	CANADA	DORMANT (NOT TO BE CONSIDERED)
6	V594	VIRGILIO CENA & FIGLI S.p.A.	ITALY	DORMANT (NOT TO BE CONSIDERED)
7	W615	WEIFANG HUODA PIPE FITTINGS MANUFACTURE	CHINA	DORMANT (NOT TO BE CONSIDERED)
8	E588	ERNE FITTINGS GMBH	AUSTRIA	DORMANT (NOT TO BE CONSIDERED)
9	A755	APCO PIPE FITTINGS CO LTD	CHINA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 72AB		**Description :** FITTINGS FROM SEAMLESS PIPE- ALLOY STEEL		
Approved Suppliers				
1	3949	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
2	W510	WILH SCHULZ GmbH	GERMANY	
3	T019	TEEKAY TUBES PVT LTD	INDIA	
4	A732	ALLIED INTERNATIONAL S.R.L.	ITALY	
5	J615	LONGSHAN PIPE SOLUTIONS CO. LTD.	CHINA	
6	S810	SUNGKWANG BEND CO. LTD	KOREA, REPUBLIC OF	
7	T226	TUBE TURN (INDIA) PVT LTD	INDIA	
8	Y634	YINGKOU LIAOHE PIPE FITTINGS CO. LTD	CHINA	
9	R607	RACCORTUBI SPA	ITALY	
10	S102	SAWAN ENGINEERS PVT LTD	INDIA	
11	T746	TK CORPORATION	KOREA, REPUBLIC OF	
12	T221	TOPAZ PIPING INDUSTRIES	INDIA	
13	S265	SIDHARTH & GAUTAM ENGINEERS	INDIA	
14	V608A	VALVITALIA SPA-TECNOFORGE DIVISION	ITALY	
15	3806	TUBE TURN (INDIA) PVT LTD	INDIA	
16	C209	CSA FITTINGS	INDIA	
17	J614	JIANGYIN TIANNING METAL PIPE FITTING CO	CHINA	
18	3637	FITTECH INDUSTRIES PVT. LTD.	INDIA	
19	3747	SIDDARTH AND GAUTAM ENGINEERS PVT. LTD.	INDIA	
20	E060	EBY FASTENERS	INDIA	
21	3992	SIVANANDHA PIPE FITTINGS LIMITED	INDIA	
22	3913	PERAMOUNT FORGE AND FITTINGS PRIVATE LIMITED	INDIA	
23	3996	KISAAN TECHNO FORGE PRIVATE LIMITED	INDIA	
24	27490	SHANGHAI FEITING PIPE MANUFACTURE CO.LTD	CHINA	
25	4294	SAWAN ENGINEERS PVT LTD	INDIA	
26	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
27	I597	IBF S P A	ITALY	
28	K218	K.S.PIPE FITTINGS (P) LTD	INDIA	
29	G125	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
30	U144	U I PIPE FITTINGS PVT LTD	INDIA	
31	27474	JIANGYIN ZHONGNAN HEAVY INDUSTRIES CO. LTD	CHINA	
On Holiday				
1	E588	ERNE FITTINGS GMBH	AUSTRIA	DORMANT (NOT TO BE CONSIDERED)
2	W615	WEIFANG HUODA PIPE FITTINGS MANUFACTURE	CHINA	DORMANT (NOT TO BE CONSIDERED)
3	E630	EZEFLOW INC.	CANADA	DORMANT (NOT TO BE CONSIDERED)
4	P694	PIANA S.P.A	ITALY	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 72AB		**Description :** FITTINGS FROM SEAMLESS PIPE- ALLOY STEEL		
5	V594	VIRGILIO CENA & FIGLI S.p.A.	ITALY	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 72AC		**Description :** FITTINGS FROM SEAMLESS PIPE- S.S.		
Approved Suppliers				
1	Y634	YINGKOU LIAOHE PIPE FITTINGS CO. LTD	CHINA	
2	3806	TUBE TURN (INDIA) PVT LTD	INDIA	
3	3996	KISAAN TECHNO FORGE PRIVATE LIMITED	INDIA	
4	I597	IBF S P A	ITALY	
5	M057	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
6	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
7	K218	K.S.PIPE FITTINGS (P) LTD	INDIA	
8	S406	SURAJ LIMITED	INDIA	
9	3949	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
10	T226	TUBE TURN (INDIA) PVT LTD	INDIA	
11	3637	FITTECH INDUSTRIES PVT. LTD.	INDIA	
12	T019	TEEKAY TUBES PVT LTD	INDIA	
13	A732	ALLIED INTERNATIONAL S.R.L.	ITALY	
14	R607	RACCORTUBI SPA	ITALY	
15	V608A	VALVITALIA SPA-TECNOFORGE DIVISION	ITALY	
16	Z515	ZHEJIANG JIULI HI-TECH METALS CO., LTD.	CHINA	
17	T746	TK CORPORATION	KOREA, REPUBLIC OF	
18	4294	SAWAN ENGINEERS PVT LTD 066053052053	INDIA	
19	S102	SAWAN ENGINEERS PVT LTD	INDIA	
20	27490	SHANGHAI FEITING PIPE MANUFACTURE CO.LTD	CHINA	
21	U144	U I PIPE FITTINGS PVT LTD	INDIA	
22	T221	TOPAZ PIPING INDUSTRIES	INDIA	
23	S265	SIDHARTH & GAUTAM ENGINEERS	INDIA	
24	S810	SUNGKWANG BEND CO. LTD	KOREA, REPUBLIC OF	
25	E060	EBY FASTENERS	INDIA	
26	C209	CSA FITTINGS	INDIA	
27	P325	PETRO CHEM PIPING TECHNOLOGIES PRIVATE LIMITED	INDIA	
28	27474	JIANGYIN ZHONGNAN HEAVY INDUSTRIES CO. LTD	CHINA	
29	3913	PERAMOUNT FORGE AND FITTINGS PRIVATE LIMITED	INDIA	
30	W510	WILH SCHULZ GmbH	GERMANY	
31	J614	JIANGYIN TIANNING METAL PIPE FITTING CO	CHINA	
32	G125	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
33	J615	LONGSHAN PIPE SOLUTIONS CO. LTD.	CHINA	
On Holiday				
1	P694	PIANA S.P.A	ITALY	DORMANT (NOT TO BE CONSIDERED)
2	E588	ERNE FITTINGS GMBH	AUSTRIA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 72AC **Description :** FITTINGS FROM SEAMLESS PIPE- S.S.				
3	E630	EZEFLOW INC.	CANADA	DORMANT (NOT TO BE CONSIDERED)
4	T755	TOPPER (SHANGHAI) PIPING MATERIALS CO LT	CHINA	DORMANT (NOT TO BE CONSIDERED)
5	V594	VIRGILIO CENA & FIGLI S.p.A.	ITALY	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 72AD		**Description :** FITTINGS FROM S/LESS PIPES-EXOTIC MATLS		
Approved Suppliers				
1	W510	WILH SCHULZ GmbH	GERMANY	
2	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
3	3949	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
4	A732	ALLIED INTERNATIONAL S.R.L.	ITALY	
5	R607	RACCORTUBI SPA	ITALY	
6	4294	SAWAN ENGINEERS PVT LTD	INDIA	
7	S810	SUNGKWANG BEND CO. LTD	KOREA, REPUBLIC OF	
8	G125	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
9	S102	SAWAN ENGINEERS PVT LTD	INDIA	
On Holiday				
1	E588	ERNE FITTINGS GMBH	AUSTRIA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 72AF		**Description :** FIITINGS CROSS-FROM SEAMLESS PIPES		
Approved Suppliers				
1	G125	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
2	M057	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
3	V608A	VALVITALIA SPA-TECNOFORGE DIVISION	ITALY	
4	S102	SAWAN ENGINEERS PVT LTD	INDIA	
5	4294	SAWAN ENGINEERS PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 72FA		**Description :** FITTINGS - FRP		
Approved Suppliers				
1	I164	INDUSTRIAL SERVICES	INDIA	
2	G005	GANDHI & ASSOCIATES	INDIA	
3	3758	CHEMICAL PROCESS PIPING PVT LTD	INDIA	
4	C747	COMPOSITE PIPES INDUSTRY L.L.C	OMAN	
5	S472	STRATEGIC ENGINEERING (P) LTD	INDIA	
6	D066	DOLF INDUSTRIES PRIVATE LIMITED	INDIA	
7	P028	POLY PLAST CHEMI-PLANT (I) LTD.	INDIA	
8	S251	SUNRISE INDUSTRIES (INDIA) LTD	INDIA	
9	C023	CHEMICAL PROCESS EQPTS. PVT. LTD.	INDIA	
On Holiday				
1	3865	EPP COMPOSITE PVT LTD	INDIA	HOLD RFQ/PBO/PO DUE TO SHIFTING OF WORKS (EXCEPT NIT CASES)
2	E216	EPP COMPOSITE PVT LTD	INDIA	HOLD RFQ/PBO/PO DUE TO SHIFTING OF WORKS (EXCEPT NIT CASES)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 73E-		**Description :** FITTINGS TO IS-1239		
Approved Suppliers				
1	E060	EBY FASTENERS	INDIA	
2	3970	SKY FORGE PVT LTD	INDIA	
3	C209	CSA FITTINGS	INDIA	
4	M057	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
5	V157	VIJAY CYCLE & STEEL INDUSTRIES	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 74AA		**Description :** FITTINGS FABRICATED FROM PLATE - C.S.		
Approved Suppliers				
1	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
2	3996	KISAAN TECHNO FORGE PRIVATE LIMITED	INDIA	
3	3807	TUBE TURN (INDIA) PVT LTD	INDIA	
4	G125	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
5	J615	LONGSHAN PIPE SOLUTIONS CO. LTD.	CHINA	
6	P325	PETRO CHEM PIPING TECHNOLOGIES PRIVATE LIMITED	INDIA	
7	S265	SIDHARTH & GAUTAM ENGINEERS	INDIA	
8	S810	SUNGKWANG BEND CO. LTD	KOREA, REPUBLIC OF	
9	V608A	VALVITALIA SPA-TECNOFORGE DIVISION	ITALY	
10	T221	TOPAZ PIPING INDUSTRIES	INDIA	
11	A732	ALLIED INTERNATIONAL S.R.L.	ITALY	
12	T746	TK CORPORATION	KOREA, REPUBLIC OF	
13	I597	IBF S P A	ITALY	
14	4294	SAWAN ENGINEERS PVT LTD	INDIA	
15	R607	RACCORTUBI SPA	ITALY	
16	27490	SHANGHAI FEITING PIPE MANUFACTURE CO.LTD	CHINA	
17	Y634	YINGKOU LIAOHE PIPE FITTINGS CO. LTD	CHINA	
18	S102	SAWAN ENGINEERS PVT LTD	INDIA	
19	U144	U I PIPE FITTINGS PVT LTD	INDIA	
20	D111	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
21	T019	TEEKAY TUBES PVT LTD	INDIA	
22	J614	JIANGYIN TIANNING METAL PIPE FITTING CO	CHINA	
On Holiday				
1	E630	EZEFLOW INC.	CANADA	DORMANT (NOT TO BE CONSIDERED)
2	P694	PIANA S.P.A	ITALY	DORMANT (NOT TO BE CONSIDERED)
3	W615	WEIFANG HUODA PIPE FITTINGS MANUFACTURE	CHINA	DORMANT (NOT TO BE CONSIDERED)
4	A687	AWAJI MATERIA (THAILAND) CO. LTD.	THAILAND	DORMANT (NOT TO BE CONSIDERED)
5	Y502	YINGKOU NORTH PIPE FITTINGS CO LTD	CHINA	DORMANT (NOT TO BE CONSIDERED)
6	T050	TUBE BEND (CALCUTTA) PVT LTD	INDIA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 74AB		**Description :** FITTINGS FABRICATED FROM PLATE - A.S.		
Approved Suppliers				
1	J615	LONGSHAN PIPE SOLUTIONS CO. LTD.	CHINA	
2	R607	RACCORTUBI SPA	ITALY	
3	A732	ALLIED INTERNATIONAL S.R.L.	ITALY	
4	T746	TK CORPORATION	KOREA, REPUBLIC OF	
5	S810	SUNGKWANG BEND CO. LTD	KOREA, REPUBLIC OF	
6	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
7	G125	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
8	27490	SHANGHAI FEITING PIPE MANUFACTURE CO.LTD	CHINA	
9	I597	IBF S P A	ITALY	
10	V608A	VALVITALIA SPA-TECNOFORGE DIVISION	ITALY	
11	T221	TOPAZ PIPING INDUSTRIES	INDIA	
12	J614	JIANGYIN TIANNING METAL PIPE FITTING CO	CHINA	
13	S265	SIDHARTH & GAUTAM ENGINEERS	INDIA	
14	S102	SAWAN ENGINEERS PVT LTD	INDIA	
15	4294	SAWAN ENGINEERS PVT LTD	INDIA	
16	3807	TUBE TURN (INDIA) PVT LTD	INDIA	
17	T019	TEEKAY TUBES PVT LTD	INDIA	
18	3949	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
19	D111	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
On Holiday				
1	E630	EZEFLOW INC.	CANADA	DORMANT (NOT TO BE CONSIDERED)
2	P694	PIANA S.P.A	ITALY	DORMANT (NOT TO BE CONSIDERED)
3	Y502	YINGKOU NORTH PIPE FITTINGS CO LTD	CHINA	DORMANT (NOT TO BE CONSIDERED)
4	W615	WEIFANG HUODA PIPE FITTINGS MANUFACTURE	CHINA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 74AC		**Description :** FITTINGS FABRICATED FROM PLATE - S.S.		
Approved Suppliers				
1	27490	SHANGHAI FEITING PIPE MANUFACTURE CO.LTD	CHINA	
2	A732	ALLIED INTERNATIONAL S.R.L.	ITALY	
3	4294	SAWAN ENGINEERS PVT LTD	INDIA	
4	J614	JIANGYIN TIANNING METAL PIPE FITTING CO	CHINA	
5	T221	TOPAZ PIPING INDUSTRIES	INDIA	
6	Y634	YINGKOU LIAOHE PIPE FITTINGS CO. LTD	CHINA	
7	Z515	ZHEJIANG JIULI HI-TECH METALS CO., LTD.	CHINA	
8	I597	IBF S P A	ITALY	
9	T019	TEEKAY TUBES PVT LTD	INDIA	
10	S265	SIDHARTH & GAUTAM ENGINEERS	INDIA	
11	J615	LONGSHAN PIPE SOLUTIONS CO. LTD.	CHINA	
12	W510	WILH SCHULZ GmbH	GERMANY	
13	S102	SAWAN ENGINEERS PVT LTD	INDIA	
14	S810	SUNGKWANG BEND CO. LTD	KOREA, REPUBLIC OF	
15	T746	TK CORPORATION	KOREA, REPUBLIC OF	
16	R607	RACCORTUBI SPA	ITALY	
17	V608A	VALVITALIA SPA-TECNOFORGE DIVISION	ITALY	
18	D111	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
19	3949	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
20	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
21	P325	PETRO CHEM PIPING TECHNOLOGIES PRIVATE LIMITED	INDIA	
22	G125	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
On Holiday				
1	P694	PIANA S.P.A	ITALY	DORMANT (NOT TO BE CONSIDERED)
2	E630	EZEFLOW INC.	CANADA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 74AD		**Description :** FITTINGS FAB. FROM PLATES-EXOTIC MATLS.		
Approved Suppliers				
1	I597	IBF S P A	ITALY	
2	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
3	4294	SAWAN ENGINEERS PVT LTD	INDIA	
4	G125	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
5	S810	SUNGKWANG BEND CO. LTD	KOREA, REPUBLIC OF	
6	S102	SAWAN ENGINEERS PVT LTD	INDIA	
7	R607	RACCORTUBI SPA	ITALY	
8	W510	WILH SCHULZ GmbH	GERMANY	
9	D111	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
10	A732	ALLIED INTERNATIONAL S.R.L.	ITALY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 74AE		**Description :** FITTINGS FABRICATED FROM PLATE - CLADDED		
Approved Suppliers				
1	T221	TOPAZ PIPING INDUSTRIES	INDIA	
2	4294	SAWAN ENGINEERS PVT LTD	INDIA	
3	G125	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
4	S102	SAWAN ENGINEERS PVT LTD	INDIA	
5	27411	Cladtek Middle East FZC	INDONESIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 74AF		**Description :** FITTINGS CROSS-FABRICATED FROM PLATES		
Approved Suppliers				
1	4294	SAWAN ENGINEERS PVT LTD	INDIA	
2	S102	SAWAN ENGINEERS PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 75AA		**Description :** FITTINGS PIPE CAP (C S)		
Approved Suppliers				
1	J615	LONGSHAN PIPE SOLUTIONS CO. LTD.	CHINA	
2	P325	PETRO CHEM PIPING TECHNOLOGIES PRIVATE LIMITED	INDIA	
3	3913	PERAMOUNT FORGE AND FITTINGS PRIVATE LIMITED	INDIA	
4	3949	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
5	K218	K.S.PIPE FITTINGS (P) LTD	INDIA	
6	W510	WILH SCHULZ GmbH	GERMANY	
7	T746	TK CORPORATION	KOREA, REPUBLIC OF	
8	S102	SAWAN ENGINEERS PVT LTD	INDIA	
9	T221	TOPAZ PIPING INDUSTRIES	INDIA	
10	T226	TUBE TURN (INDIA) PVT LTD	INDIA	
11	4294	SAWAN ENGINEERS PVT LTD	INDIA	
12	G125	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
13	M057	M.S. FITTINGS MFG. CO PVT LTD	INDIA	
14	T019	TEEKAY TUBES PVT LTD	INDIA	
15	Y634	YINGKOU LIAOHE PIPE FITTINGS CO. LTD	CHINA	
16	3747	SIDDARTH AND GAUTAM ENGINEERS PVT. LTD.	INDIA	
17	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
18	3996	KISAAN TECHNO FORGE PRIVATE LIMITED	INDIA	
19	S810	SUNGKWANG BEND CO. LTD	KOREA, REPUBLIC OF	
20	C209	CSA FITTINGS	INDIA	
21	A732	ALLIED INTERNATIONAL S.R.L.	ITALY	
22	3992	SIVANANDHA PIPE FITTINGS LIMITED	INDIA	
23	S265	SIDHARTH & GAUTAM ENGINEERS	INDIA	
24	V608A	VALVITALIA SPA-TECNOFORGE DIVISION	ITALY	
25	3637	FITTECH INDUSTRIES PVT. LTD.	INDIA	
26	I597	IBF S P A	ITALY	
27	P340	PATTECH FITWELL TUBE COMPONENTS LIMITED	INDIA	
On Holiday				
1	T050	TUBE BEND (CALCUTTA) PVT LTD	INDIA	DORMANT (NOT TO BE CONSIDERED)
2	A687	AWAJI MATERIA (THAILAND) CO. LTD.	THAILAND	DORMANT (NOT TO BE CONSIDERED)
3	W615	WEIFANG HUODA PIPE FITTINGS MANUFACTURE	CHINA	DORMANT (NOT TO BE CONSIDERED)
4	E630	EZEFLOW INC.	CANADA	DORMANT (NOT TO BE CONSIDERED)
5	P694	PIANA S.P.A	ITALY	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 75AB		**Description :** FITTINGS PIPE CAP (A S)		
Approved Suppliers				
1	K218	K.S.PIPE FITTINGS (P) LTD	INDIA	
2	S265	SIDHARTH & GAUTAM ENGINEERS	INDIA	
3	S810	SUNGKWANG BEND CO. LTD	KOREA, REPUBLIC OF	
4	I597	IBF S P A	ITALY	
5	J615	LONGSHAN PIPE SOLUTIONS CO. LTD.	CHINA	
6	T019	TEEKAY TUBES PVT LTD	INDIA	
7	T226	TUBE TURN (INDIA) PVT LTD	INDIA	
8	3637	FITTECH INDUSTRIES PVT. LTD.	INDIA	
9	V608A	VALVITALIA SPA-TECNOFORGE DIVISION	ITALY	
10	G125	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
11	4294	SAWAN ENGINEERS PVT LTD	INDIA	
12	S102	SAWAN ENGINEERS PVT LTD	INDIA	
13	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
14	3913	PERAMOUNT FORGE AND FITTINGS PRIVATE LIMITED	INDIA	
15	3747	SIDDARTH AND GAUTAM ENGINEERS PVT. LTD.	INDIA	
16	3949	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
17	W510	WILH SCHULZ GmbH	GERMANY	
18	3996	KISAAN TECHNO FORGE PRIVATE LIMITED	INDIA	
19	C209	CSA FITTINGS	INDIA	
20	A732	ALLIED INTERNATIONAL S.R.L.	ITALY	
21	T746	TK CORPORATION	KOREA, REPUBLIC OF	
22	T221	TOPAZ PIPING INDUSTRIES	INDIA	
On Holiday				
1	E630	EZEFLOW INC.	CANADA	DORMANT (NOT TO BE CONSIDERED)
2	P694	PIANA S.P.A	ITALY	DORMANT (NOT TO BE CONSIDERED)
3	W615	WEIFANG HUODA PIPE FITTINGS MANUFACTURE	CHINA	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 75AC		**Description :** FITTINGS PIPE CAP (S S)		
Approved Suppliers				
1	S810	SUNGKWANG BEND CO. LTD	KOREA, REPUBLIC OF	
2	S102	SAWAN ENGINEERS PVT LTD	INDIA	
3	V608A	VALVITALIA SPA-TECNOFORGE DIVISION	ITALY	
4	A732	ALLIED INTERNATIONAL S.R.L.	ITALY	
5	P325	PETRO CHEM PIPING TECHNOLOGIES PRIVATE LIMITED	INDIA	
6	3949	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
7	C209	CSA FITTINGS	INDIA	
8	I597	IBF S P A	ITALY	
9	S265	SIDHARTH & GAUTAM ENGINEERS	INDIA	
10	W510	WILH SCHULZ GmbH	GERMANY	
11	3996	KISAAN TECHNO FORGE PRIVATE LIMITED	INDIA	
12	G125	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
13	R607	RACCORTUBI SPA	ITALY	
14	4294	SAWAN ENGINEERS PVT LTD	INDIA	
15	3637	FITTECH INDUSTRIES PVT. LTD.	INDIA	
16	K218	K.S.PIPE FITTINGS (P) LTD	INDIA	
17	T221	TOPAZ PIPING INDUSTRIES	INDIA	
18	T746	TK CORPORATION	KOREA, REPUBLIC OF	
19	T019	TEEKAY TUBES PVT LTD	INDIA	
20	P315	P.K.TUBES & FITTINGS PVT.LTD.	INDIA	
On Holiday				
1	E630	EZEFLOW INC.	CANADA	DORMANT (NOT TO BE CONSIDERED)
2	P694	PIANA S.P.A	ITALY	DORMANT (NOT TO BE CONSIDERED)

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 75AD		**Description :** FITTINGS PIPE CAP (EXOTIC)		
Approved Suppliers				
1	S102	SAWAN ENGINEERS PVT LTD	INDIA	
2	S810	SUNGKWANG BEND CO. LTD	KOREA, REPUBLIC OF	
3	R607	RACCORTUBI SPA	ITALY	
4	G125	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
5	3949	DEE DEVELOPMENT ENGINEERS LIMITED	INDIA	
6	4294	SAWAN ENGINEERS PVT LTD	INDIA	

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VENDOR LIST
STATIC & MACHINERY EQUIPMENT

COOLING TOWER PACKAGE
TENDER No.: C050-1U68-81-45-PB-T-8010

PROJECT : **EPCM SERVICES FOR POLYPROPLENE PROJECT AT NUMALIGARH REFINERY**

UNIT : **RECIRCULATING COOLING WATER SYSTEM**

CLIENT : **M/s NUMALIGARH REFINERY LIMITED(NRL)**

EPCM : **M/s ENGINEERS INDIA LIMITED (EIL)**

JOB NO. : **C050**

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
A	13.08.2025	ISSUED WITH TENDER	RPT	ME	TK

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VENDOR LIST: ROTATING EQUIPMENT

SL. NO.	ITEM DESCRIPTION	VENDOR'S NAME
A.	ROTATING EQUIPMENT	
1.	PUMP-CENTRIFUGAL.HORIZONTAL (GENERAL WATER SERVICE)	As defined in group item code: 04AC of enclosed EIL's approved supplier list
2.	PUMP-CENTRIFUGAL.HORIZONTAL (LARGE CAPACITY WATER SERVICE)	As defined in group item code: 04AD of enclosed EIL's approved supplier list
3.	PUMP-CENTRIFUGAL.VERTICAL (GENERAL WATER SERVICE)	As defined in group item code: 04BC of enclosed EIL's approved supplier list
4.	PUMP-CENTRIFUGAL.HORIZONTAL (GENERAL PURPOSE PROCESS)	As defined in group item code: 04AA of enclosed EIL's approved supplier list
5.	PUMP-RECIPROCATING (API 675, PLUNGER/DIAPHRAGM)	As defined in group item code: 04FA of enclosed EIL's approved supplier list
6.	DOSING PACKAGE (SKID MOUNTED)	As defined in group item code: 04NB of enclosed EIL's approved supplier list
7.	MECHANICAL SEAL FOR PUMPS	As defined in group item code: 04MH of enclosed EIL's approved supplier list

GENERAL NOTES:

1) CONTRACTOR shall necessarily procure all the material/ equipment forming permanent part of the package from OWNER/ CONSULTANT approved vendors only. This shall include sub- ordered items/ components also. The "Approved Vendors" shall be item specific.

2) OWNER/ CONSULTANT approved vendor list for the various items is enclosed in this section.

3) CONTRACTOR may procure material from any of OWNER/ CONSULTANT approved vendors. However, current validity, holiday status and range of approval as per enlistment letter, work load, stability and solvency need to be verified by the vendor before placement of order.

4) CONTRACTOR is also required to ensure that equipment experience criteria, specified elsewhere in the tender document, are also simultaneously met.

5) Vendors on OWNER/ CONSULTANT holiday list shall not be considered for ordering. VENDOR shall comply with this requirement without any time or cost implication to the OWNER. If a vendor is put on OWNER/ CONSULTANT holiday list subsequent to CONTRACTOR placing an order, it shall be CONTRACTOR's responsibility to ensure quality work and timely supply from the vendor.

6) For items not covered in the above list, the vendors list shall be approved by OWNER/ CONSULTANT prior to placement of order by CONTRACTOR. CONTRACTOR shall list down the proposed suppliers/ vendors for such items and submit the same for OWNER/ CONSULTANT review/ approval along with necessary documents/ credentials. "Approval status" documents/ credentials to be furnished by the vendors in such cases shall solely be the responsibility of the CONTRACTOR. OWNER/ CONSULTANT decision on approval shall be final and non- negotiable. Non acceptance of a particular

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proposed vendor due to any reasons whatsoever shall not be a cause of schedule and cost implication.

7) CONTRACTOR shall make an independent assessment of capability of all the vendors for timely deliveries of material/ equipment. Any delays in deliveries by vendor(s) shall not be a cause of schedule and cost implication.

8) At any stage of the project, if it comes to the notice of OWNER/ CONSULTANT that CONTRACTOR has procured material/ equipment, intentionally or unintentionally whatsoever, from an unapproved vendor and/ or items not falling in approved range of vendor(s), the same shall be rejected forthwith and CONTRACTOR shall be liable to replace such material/ plant/ machinery without any schedule and cost implication to the OWNER.

9) It is understood that in case the name of Vendor be changed due to change in their Company or Corporate shareholding, OWNER may accept such vendors under its new name with prior approval. Any such approval shall however, not absolve the CONTRACTOR from any of his obligations under the contract; neither shall any such approval signify nominations or instruction to use such a vendor. All approved vendors are deemed to have been freely chosen by the VENDOR at his own risk.

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

Suppliers List for EPCM Services for setting up Polypropylene Unit at NRL

Date :18/08/2025 16:26:41

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04AA		**Description :** PUMP_CENT.HOR(GPP)		
Approved Suppliers				
1	27504	RUHRPUMPEN INC.	UNITED STATES	
2	3767	KSB LIMITED	INDIA	
3	4128	SULZER PUMPS INDIA PRIVATE LIMITED	INDIA	
4	3760	C.R.I. PUMPS PRIVATE LIMITED	INDIA	
5	4272	RUHRPUMPEN INDIA PRIVATE LIMITED	INDIA	
6	3629	RUHRPUMPEN INDIA PRIVATE LIMITED	INDIA	
7	4260	VARAT PUMP & MACHINERY PVT. LTD.	INDIA	
8	27455	HYOSUNG GOODSPRINGS INC.	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	
9	3863	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
10	K003	KIRLOSKAR BROTHERS LTD	INDIA	
11	C725	CLYDE UNION LIMITED (FRMLY T722 & W518)	UNITED KINGDOM	
12	T756	TMP S.P.A TERMOMECCANICA POMPE	ITALY	
13	M013	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
14	F156	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
15	R611	RUHRPUMPEN GMBH(FORMERLY THYSSENT509)	GERMANY	
16	S014	SU MOTORS PVT LTD	INDIA	
17	T535	FLOWSERVE(THOMPSONS KELLY&LEWIS PTY LTD)	AUSTRALIA	
18	E501	EBARA CORPORATION (JAPAN)	JAPAN	
19	F635	FLOWSERVE CORPORATION (FORMERLY I571)	UNITED STATES	
20	I198	ITT CORPORATION INDIA PVT LTD	INDIA	
21	S401	SULZER PUMPS INDIA PRIVATE LIMITED	INDIA	
22	A550	ARAI PUMP MANUFACTURING COMPANY LTD	JAPAN	
23	S065	SAM TURBO INDUSTRYPVT. LTD(ENQ-ACE MKTG)	INDIA	
24	S684	SHIN NIPPON MACHINERY CO LTD	JAPAN	
25	K018	KSB LIMITED	INDIA	
26	K087	KIRLOSKAR EBARA PUMPS LTD	INDIA	
27	D501	DMW CORPORATION	JAPAN	
28	G510	GOULDS PUMPS INC	UNITED STATES	
29	S744	SULZER PUMPS (US) INC	UNITED STATES	
30	3739	KSB LIMITED	INDIA	
31	27505	RUHRPUMPEN S.A DE C.V	MEXICO	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04AC		**Description :** PUMP-CENT.HOR(GWS)		
Approved Suppliers				
1	3767	KSB LIMITED	INDIA	
2	3629	RUHRPUMPEN INDIA PRIVATE LIMITED	INDIA	
3	27505	RUHRPUMPEN S.A DE C.V	MEXICO	
4	4128	SULZER PUMPS INDIA PRIVATE LIMITED	INDIA	
5	3804	FLOWMORE LIMITED	INDIA	
6	3760	C.R.I. PUMPS PRIVATE LIMITED	INDIA	
7	4272	RUHRPUMPEN INDIA PRIVATE LIMITED	INDIA	
8	4260	VARAT PUMP & MACHINERY PVT. LTD.	INDIA	
9	27455	HYOSUNG GOODSPRINGS INC.	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	
10	3863	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
11	K003	KIRLOSKAR BROTHERS LTD	INDIA	
12	W012	WPIL LTD	INDIA	
13	C725	CLYDE UNION LIMITED (FRMLY T722 & W518)	UNITED KINGDOM	
14	G510	GOULDS PUMPS INC	UNITED STATES	
15	S014	SU MOTORS PVT LTD	INDIA	
16	S744	SULZER PUMPS (US) INC	UNITED STATES	
17	F127	FLOWMORE LIMITED	INDIA	
18	T535	FLOWSERVE(THOMPSONS KELLY&LEWIS PTY LTD)	AUSTRALIA	
19	T756	TMP S.P.A TERMOMECCANICA POMPE	ITALY	
20	K018	KSB LIMITED	INDIA	
21	S065	SAM TURBO INDUSTRYPVT. LTD(ENQ-ACE MKTG)	INDIA	
22	D501	DMW CORPORATION	JAPAN	
23	I198	ITT CORPORATION INDIA PVT LTD	INDIA	
24	S684	SHIN NIPPON MACHINERY CO LTD	JAPAN	
25	F635	FLOWSERVE CORPORATION (FORMERLY I571)	UNITED STATES	
26	M013	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
27	R611	RUHRPUMPEN GMBH(FORMERLY THYSSENT509)	GERMANY	
28	S401	SULZER PUMPS INDIA PRIVATE LIMITED	INDIA	
29	E501	EBARA CORPORATION (JAPAN)	JAPAN	
30	F156	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
31	3739	KSB LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04AD		**Description :** PUMP-CENT.HOR(LCWS)		
Approved Suppliers				
1	W012	WPIL LTD	INDIA	
2	G510	GOULDS PUMPS INC	UNITED STATES	
3	K003	KIRLOSKAR BROTHERS LTD	INDIA	
4	T756	TMP S.P.A TERMOMECCANICA POMPE	ITALY	
5	T535	FLOWSERVE(THOMPSONS KELLY&LEWIS PTY LTD)	AUSTRALIA	
6	S684	SHIN NIPPON MACHINERY CO LTD	JAPAN	
7	S744	SULZER PUMPS (US) INC	UNITED STATES	
8	F127	FLOWMORE LIMITED	INDIA	
9	E501	EBARA CORPORATION (JAPAN)	JAPAN	
10	M013	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
11	R611	RUHRPUMPEN GMBH(FORMERLY THYSSENT509)	GERMANY	
12	D501	DMW CORPORATION	JAPAN	
13	F156	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
14	F635	FLOWSERVE CORPORATION (FORMERLY I571)	UNITED STATES	
15	C725	CLYDE UNION LIMITED (FRMLY T722 & W518)	UNITED KINGDOM	
16	3804	FLOWMORE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04BC		**Description :** PUMP-CENT.VERT.(GWS)		
Approved Suppliers				
1	3629	RUHRPUMPEN INDIA PRIVATE LIMITED	INDIA	
2	4260	VARAT PUMP & MACHINERY PVT. LTD.	INDIA	
3	27455	HYOSUNG GOODSPRINGS INC.	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	
4	M013	WILO MATHER AND PLATT PUMPS PVT. LTD.	INDIA	
5	C725	CLYDE UNION LIMITED (FRMLY T722 & W518)	UNITED KINGDOM	
6	D501	DMW CORPORATION	JAPAN	
7	S684	SHIN NIPPON MACHINERY CO LTD	JAPAN	
8	S744	SULZER PUMPS (US) INC	UNITED STATES	
9	K003	KIRLOSKAR BROTHERS LTD	INDIA	
10	S065	SAM TURBO INDUSTRYPVT. LTD(ENQ-ACE MKTG)	INDIA	
11	S401	SULZER PUMPS INDIA PRIVATE LIMITED	INDIA	
12	F156	FLOWSERVE INDIA CONTROLS PVT LTD	INDIA	
13	W012	WPIL LTD	INDIA	
14	S014	SU MOTORS PVT LTD	INDIA	
15	E501	EBARA CORPORATION (JAPAN)	JAPAN	
16	G510	GOULDS PUMPS INC	UNITED STATES	
17	K001	KISHOR PUMPS PVT LTD.	INDIA	
18	T535	FLOWSERVE(THOMPSONS KELLY&LEWIS PTY LTD)	AUSTRALIA	
19	T756	TMP S.P.A TERMOMECCANICA POMPE	ITALY	
20	F127	FLOWMORE LIMITED	INDIA	
21	K018	KSB LIMITED	INDIA	
22	F635	FLOWSERVE CORPORATION (FORMERLY I571)	UNITED STATES	
23	I198	ITT CORPORATION INDIA PVT LTD	INDIA	
24	R611	RUHRPUMPEN GMBH(FORMERLY THYSSENT509)	GERMANY	
25	3725	WPIL LTD	INDIA	
26	3739	KSB LIMITED	INDIA	
27	3767	KSB LIMITED	INDIA	
28	3804	FLOWMORE LIMITED	INDIA	
29	4272	RUHRPUMPEN INDIA PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04FA		**Description :** PUMP-RECIPRO(API 675,PLUNGER/DIAPHRAGM)		
Approved Suppliers				
1	27524	SEKO SPA	ITALY	
2	27481	TEIKOKU ELECTRIC MGF. CO., LTD.	JAPAN	
3	O505	ORLITA GMBH & CO KG	GERMANY	
4	P563	PULSA FEEDER (UNIT OF IDEX CORP)	UNITED STATES	
5	W602	WEIR MINERALS NETHERLANDS BV (FMLY E620)	NETHERLANDS	
6	W570	WILLIAMS INSTRUMENT COMPANY INC	UNITED STATES	
7	B522	BRAN + LUEBBE LTD	GERMANY	
8	N505	NIKKISO CO LTD (NIKKISO K.K.)	JAPAN	
9	L620	LEWA GMBH	GERMANY	
10	3776	SWELORE ENGG. (P) LTD	INDIA	
11	M709	MILTON ROY EUROPE	FRANCE	
12	4044	IDEX INDIA PRIVATELIMITED	INDIA	
13	O632	OFFICINE MECCANICHE GALLARATESI SPA	ITALY	
14	S012	SHAPOTOOLS	INDIA	
15	S024	SWELORE ENGG. (P) LTD	INDIA	
16	V005	V K PUMP INDUSTRIES PVT. LTD.	INDIA	
17	P328	POSITIVE METERING PUMPS (I) PVT LTD	INDIA	
18	M242	MILTONROY INDIA PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04MH		**Description :** MECH.SEAL FOR PUMPS/AGITATORS		
Approved Suppliers				
1	F149	FLOWSERVE SANMAR PRIVATE LIMITED	INDIA	
2	C753	CHETRA DICHTUNGSTECHNIK AG	GERMANY	
3	3858	SEALMATIC INDIA LIMITED	INDIA	
4	E153	EAGLEBURGMANN INDIA PRIVATE LIMITED	INDIA	
5	3754	EAGLEBURGMANN INDIA PRIVATE LIMITED	INDIA	
6	4150	HI-FAB ENGINEERS PRIVATE LIMITED	INDIA	
7	A750	AESSEAL PLC	UNITED KINGDOM	
8	L060	LEAK PROOF ENGG (I) PVT. LTD	INDIA	
9	J078	JOHN CRANE SEALING SYSTEMS INDIA PVT. LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 04NB		**Description :** DOSING PACKAGE (SKID MOUNTED)		
Approved Suppliers				
1	4223	UNITED ENGINEERING & TECHNOLOGIES PVT. LTD.	INDIA	
2	4224	DENCIL PUMPS AND SYSTEMS PVT LTD	INDIA	
3	3965	POSITIVE METERING PUMPS (I) PVT LTD	INDIA	
4	4190	PRORITES EQUIPMENTS PRIVATE LIMITED	INDIA	
5	3776	SWELORE ENGG. (P) LTD	INDIA	
6	E183	ENPRO INDUSTRIES PVT LTD	INDIA	
7	I117	INDCON PROJECTS AND EQUIPMENT LTD	INDIA	
8	M242	MILTONROY INDIA PRIVATE LIMITED	INDIA	
9	S024	SWELORE ENGG. (P) LTD	INDIA	
10	V005	V K PUMP INDUSTRIES PVT. LTD.	INDIA	
11	O632	OFFICINE MECCANICHE GALLARATESI SPA	ITALY	
12	P701	PETRONASH FZE	UNITED ARAB EMIRATES	

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VENDOR LIST

(STATIC & MACHINERY EQUIPMENT DIVISION)

ANNEXURE-A-STATIC EQUIPMENT

TENDER No. C050-1U68-81-45-PB-T-8010

PROJECT	**:**	**EPCM SERVICES FOR SETTING UP POLYPROPYLENE UNIT AT NRL**
OWNER	**:**	**NUMALIGARH REFINERY LIMITED (NRL)**
EPCM	**:**	**ENGINEERS INDIA LIMITED**
EIL JOB No.	**:**	**C050**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
0	25.08.2025	ISSUED WITH TENDER INPUT	CK	RKM	TK

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GENERAL GUIDELINES

1. CONTRACTOR shall necessarily procure all the material / equipment forming permanent part of the unit / plant from OWNER / EIL approved vendors only. This shall include sub-ordered items / components also. The "Approved Vendors" shall be item specific.

2. OWNER / EIL approved vendor list for the various items is enclosed in this section. Vendor to quote as per enlistment capabilities with EIL.

3. CONTRACTOR may procure material from any of OWNER / EIL approved vendors. However, current validity, holiday status and range of approval as per EIL enlistment letter, workload, stability and solvency need to be verified by the CONTRACTOR with vendor before placement of order. CONTRACTOR is also required to ensure that equipment qualification criteria, specified elsewhere in the bid document, are also simultaneously met.

4. Vendors on OWNER / EIL holiday list shall not be considered for ordering. CONTRACTOR shall comply with this requirement without any time or cost implication to the OWNER/EIL. If a vendor is put on OWNER / EIL's holiday list subsequent to CONTRACTOR placing an order, it shall be CONTRACTOR's responsibility to ensure quality work and timely supply from the vendor.

5. For items not covered in the above list, the CONTRACTOR shall approach OWNER / EIL for that list or the vendors list shall be approved by OWNER / EIL prior to placement or order by CONTRACTOR. CONTRACTOR shall list down the proposed suppliers / vendors for such items and submit the same for OWNER / EIL's review / approval along with necessary documents / credentials. "Approval status" documents / credentials to be furnished by the vendors in such cases shall solely be the responsibility of the CONTRACTOR. OWNER / EIL's decision on above shall be final and non-negotiable. Acceptance or non-acceptance of a particular proposed vendor due to any reasons whatsoever shall not be a cause of schedule and cost implication.

6. CONTRACTOR shall make an independent assessment of capability of all the vendors for timely deliveries of material / equipment. Any delays in deliveries by vendor(s) shall not be a cause of schedule and cost implication.

7. At any stage of the project, if it comes to the notice of OWNER / EIL that CONTRACTOR has procured material / equipment, intentionally or unintentionally whatsoever, from an unapproved vendor and / or items not falling in approved range of vendor(s), the same shall be rejected fort with and CONTRACTOR shall be liable to replace such material / plant / machinery without any schedule and cost implication to the OWNER/EIL.

8. List of vendors appearing anywhere else in the contract document in case of duplication of the items at two or more places shall not be considered by CONTRACTOR and shall be superseded by the vendor list enclosed herewith. And if in this vendor list also, items seems to be duplicated / repeated then CONTRACTOR shall get clarified the issue by OWNER / EIL before proceeding ahead for procurement activity.

9. It is understood that should the name of vendor be changed due to change in their company or corporate shareholding, OWNER/EIL may accept such vendors under its new name with prior approval.

   Any such approval shall however, not absolve the CONTRACTOR from any of his obligations under the contract; neither shall any such approval signify nominations or instruction to use such a vendor. All approved vendors are deemed to have been freely chosen by the CONTRACTOR at his own risk.

10. The vendor list shall govern as per applicable policies in public procurement as notified Government of India from time to time.

Any Vendor on Client / EIL Holiday List shall not be considered

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SUPPLIERS FOR CS (UP TO 25 MM-01AA) IN EIL-MSL Dated 25.08.2025

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code: 01AA		**Description:** PRESSURE VESSEL -CS (UP TO 25MM)		
Approved Suppliers				
1	G125	GUJARAT INFRAPIPES PVT. LIMITED	INDIA	
2	J120	JINDAL STEEL & POWER LTD	INDIA	
3	M180	MULTIMAX ENGINEERING WORKS PVT LTD	INDIA	
4	H028	GMM PFAUDLER LTD	INDIA	
5	4025	FUNKE HEATEX ENGINEERING INDIA PVT LTD	INDIA	
6	3598	TECHNO PROCESS EQUIPMENTS (INDIA) PVT. LTD	INDIA	
7	R174	RAJ ENGINEERING COMPANY	INDIA	
8	T113	TEAM HIITEC EQPT PRIVATE LIMITED	INDIA	
9	E183	ENPRO INDUSTRIES PVT LTD	INDIA	
10	T123	TECHNO PROCESS EQUIPMENTS (INDIA) PV LTD	INDIA	
11	4124	KGC ENGINEERING PROJECTS PVT LTD	INDIA	
12	3643	SUDHIR BROTHERS	INDIA	
13	B168	BTL EPC LIMITED	INDIA	
14	3680	CHANDERPUR INDUSTRIES PVT. LTD.	INDIA	
15	R053	R. D. ENGINEERS (INDIA) PVT. LTD	INDIA	
16	F183	FAB-TECH WORKS & CONSTN. PVT LTD.	INDIA	
17	4207	SPARK ENGINEERS	INDIA	
18	I117	INDCON PROJECTS AND EQUIPMENT LTD	INDIA	
19	3988	INDCON PROJECTS AND EQUIPMENT LTD	INDIA	
20	4144	SPARKON ENGINEERS	INDIA	
21	3950	INDUSTRIAL MANUFACTURERS, UNIT 2 MAHAPE	INDIA	
22	F006	FACT ENGINEERING WORKS	INDIA	
23	3699	TEMA INDIA LIMITED	INDIA	
24	A017	GE POWER INDIA LIMITED	INDIA	
25	E115	EXPO GAS CONTAINERS LTD.	INDIA	
26	G155	GEECY ENGINEERING PVT LTD	INDIA	
27	N150	NUBERG ENGINEERING LTD	INDIA	
28	4192	MECH ENGINEERS	INDIA	
29	T193	TECHNIP ENERGIES INDIA LIMITED	INDIA	
30	3924	ARTSON ENGINEERING LTD	INDIA	
31	3842	MULTITEX FILTRATION ENGINEERS LTD	INDIA	
32	4156	ALBAJ ENGINEERING CORPORATION PVT. LTD.	INDIA	
33	N006	NEW FIELD INDUSTRIAL EQUIPMENT PVT LTD	INDIA	
34	3621	OSWAL ENERGIES LIMITED	INDIA	
35	3691	INDCON PROJECTS AND EQUIPMENT LTD	INDIA	
36	G211	GAS PROCESSING EQUIPMENT PVT. LTD	INDIA	
37	S354	SHARP TANKS & STRUCTURALS (P) LTD	INDIA	
38	R219	RADIANT HEAT EXCHANGER PVT.LTD.	INDIA	

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39	3753	SHREE ISHAN EQUIPMENT PVT. LTD.	INDIA	
40	L087	LOYAL EQUIPMENTS LIMITED	INDIA	
41	L040	LLOYDS ENGINEERING WORKS LIMITED	INDIA	
42	C206	COPERION IDEAL PVT. LTD.	INDIA	
43	3942	ATV PROJECTS INDIA LIMITED	INDIA	
44	P209	PRECISION EQUIPMENTS (CHENNAI) PVT LTD	INDIA	
45	P249	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
46	4216	ELITE ENGINEERING INDUSTRIES	INDIA	
47	4237	FIL SEP EQUIPMENTS PVT LTD	INDIA	
48	3972	LARSEN & TOUBRO LTD.	INDIA	
49	3746	CRYSTAL INDUSTRIAL SYNDICATE PVT LTD	INDIA	
50	3874	RAVI INDUSTRIES	INDIA	
51	4208	SPARK ENGINEERS	INDIA	
52	3925	PRECISION GASIFICATION SERVICES PRIVATE	INDIA	
53	A192	AERO ENGINEERS PRIVATE LIMITED	INDIA	
54	M163	MEENAKSHI ASSOCIATES PVT LTD	INDIA	
55	3995	CONSOLIDATED CHEMEQUIP (MFR) PRIVATE	INDIA	
56	3655	SREE RAMAKRISHNA ENGINEERING ENTERPRISES	INDIA	
57	P203	PRAJ INDUSTRIES LIMITED	INDIA	
58	K035	THE KCP LIMITED	INDIA	
59	4134	MAGIRSHA INDUSTRIES PRIVATE LIMITED	INDIA	
60	3879	RAJ ENGINEERING COMPANY	INDIA	
61	V015	VIJAY TANKS & VESSELS PVT LTD	INDIA	
62	J149	JASMINO POLYMERTECH PVT.LTD.	INDIA	
63	4219	NEW FIELD INDUSTRIAL EQUIPMENT PVT LTD	INDIA	
64	3956	NEO STRUCTO CONSTRUCTION PVT. LTD.	INDIA	
65	B215	BEEKAY ENGINEERING CORPORATION	INDIA	
66	T239	TEMSONN VESELEX INDIA PVT. LTD.	INDIA	
67	4271	SUDHIR BROTHERS	INDIA	
68	P249A	PHILS HEAVY ENGINEERING PVT LIMITED	INDIA	
69	A004	THE ANUP ENGINEERING LIMITED	INDIA	
70	4143	FLOWCHEM PROCESS EQUIPMENTS	INDIA	
71	B216	BARODA EQUIPMENT AND VESSELS PVT LTD	INDIA	
72	4037	MAHATHI INFRA SERVICES PRIVATE LIMITED	INDIA	
73	A205	SISCO ENERGY PRIVATE LIMITED	INDIA	
74	3656	SRI LAKSHMI PRABHA ENGG INDUSTRIES P LTD	INDIA	
75	M027	MULTITEX FILTRATION ENGINEERS LTD.	INDIA	
76	3738	HEMALATHAA HI-TECH INDUSTRIES	INDIA	
77	I196	SHREE ISHAN EQUIPMENT PVT. LTD.	INDIA	
78	P168	PRABHA STEEL INDUSTRIES	INDIA	
79	3718	KAY BOUVET ENGINEERING LIMITED	INDIA	
80	R146	RELIANCE FABRICATIONS PVT LTD	INDIA	
81	G118	GRAND PRIX ENGINEERING PVT LTD.	INDIA	
82	4247	TEKNOFLOW GREEN EQUIPMENTS PVT. LTD.	INDIA	
83	G057	GR ENGINEERNG PRIVATE LTD (TARAPORE)	INDIA	
84	3941	PARAMOUNT LIMITED	INDIA	
85	3603	Chintamani Thermal Tech Pvt Ltd	INDIA	

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86	3595	TECHNO PROCESS EQUIPMENTS (INDIA) PVT. LTD.	INDIA	
87	F169	FABTECH PROJECTS & ENGINEERS PRIVATE LIMITED	INDIA	
88	4115	TEMSONN VESELEX INDIA PVT. LTD.	INDIA	
89	A311	AKSHAR PRECISION TUBES PVT LIMITED	INDIA	
90	4051	THERMTRANSFER EQUIPMENT PRIVATE LIMITED	INDIA	
91	G003	GMM PFAUDLER LTD	INDIA	
92	4010	KRR ENGINEERING PVT LTD	INDIA	
93	I128	INDUSTRIAL MANUFACTURERS	INDIA	
94	4248	SHRENO ENGINEERING LIMITED	INDIA	
95	3701	TEMA INDIA LIMITED	INDIA	
96	R216	RAVI INDUSTRIES	INDIA	
97	3953	VIJAY TANKS & VESSELS PVT LTD	INDIA	
98	F175	FIL SEP EQUIPMENTS PVT LTD	INDIA	
99	3736	UNITED COOLING SYSTEMS (P) LIMITED	INDIA	
100	3894	PRABHA STEEL INDUSTRIES [RANIA, SAVLI]	INDIA	
101	4047	SAKSHAM INDUSTRIES	INDIA	
102	3750	CRYOSTAR TANKS AND VESSELS PVT. LTD	INDIA	
103	3673	VIJAY TANKS & VESSELS PVT LTD	INDIA	
104	S133	Shree Satyanarayan Ind. Supp. Pvt. Ltd	INDIA	
105	F007	FURNACE FABRICA (INDIA) LIMITED	INDIA	
106	3918	MEGHA ENGINEERING & INFRASTRUCTURES LTD	INDIA	
107	G174	GEMINI ENGI-FAB PRIVATE LIMITED	INDIA	
108	4126	VITECH HEAVY EQUIPMENTS PVT. LTD.	INDIA	
109	P086	PATELS AIRTEMP (INDIA) LTD	INDIA	
110	4053	ENPROU TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	
111	A043	ADOR WELDING LTD.	INDIA	
112	U114	UNITED HEAT TRANSFER PVT LTD	INDIA	

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Annexure-B
VENDOR LIST
(SMED - PACKAGED EQUIPMENT)

COOLING TOWER PACKAGE

TENDER No. C050-1U68-81-45-PB-T-8010

PROJECT	**:**	**EPCM SERVICES FOR SETTING UP POLYPROPYLENE UNIT AT NRL**
OWNER	**:**	**NUMALIGARH REFINERY LIMITED (NRL)**
EPCM	**:**	**ENGINEERS INDIA LIMITED**
EIL JOB No.	**:**	**C050**

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
0	26.08.2025	ISSUED WITH TENDER	AS	VMG	PD

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 07AB		**Description :** CRANE H.O.T. (HAND OPERATED)		
Approved Suppliers				
1	S377	SAFEX ELECTROMECH PVT LTD	INDIA	
2	G183	GRIP ENGINEERS PVT.LTD	INDIA	
3	M248	MEEKA MACHINERY PVT LTD	INDIA	
4	E072	EDDYCRANES ENGINEERS PVT LTD	INDIA	
5	S138	SAFEX ENERGY PVT LTD	INDIA	
6	3875	MEEKA MACHINERY PVT LTD	INDIA	
7	W005	BRADY & MORRIS ENGINEERING CO. LTD.	INDIA	

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 07AF		**Description :** ELECTRIC HOISTS		
Approved Suppliers				
1	H129	Indef Manufacturing Limited	INDIA	
2	E072	EDDYCRANES ENGINEERS PVT LTD	INDIA	
3	W005	BRADY & MORRIS ENGINEERING CO. LTD.	INDIA	
4	M248	MEEKA MACHINERY PVT LTD	INDIA	
5	4149	REVA INDUSTRIES INDIA PVT. LTD.	INDIA	
6	3875	MEEKA MACHINERY PVT LTD	INDIA	
7	3619	TECHNO INDUSTRIES	INDIA	
8	S853	STAHL CRANE SYSTEMS GMBH	GERMANY	
9	G183	GRIP ENGINEERS PVT.LTD	INDIA	
10	S256	SAFEX ENGINEERS P. LTD.	INDIA	

Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 07AH		**Description :** CHAIN PULLEY BLOCK		
Approved Suppliers				
1	W005	BRADY & MORRIS ENGINEERING CO. LTD.	INDIA	
2	H129	Indef Manufacturing Limited	INDIA	
3	T038	TRACTEL TIRFOR (I) PVT LTD	INDIA	
4	3921	BAKELITE ELECTRICAL MFG CO.PVT LTD	INDIA	

Item: Split AC

- Blue star
- Carrier
- Daikin
- Hitachi
- LG
- Lloyds
- Mitsubishi
- Panasonic
- Sharp
- Videocon
- Voltas

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15AA		**Description :** TUBE FITTINGS		
Approved Suppliers				
1	3931	HP VALVES & FITTINGS INDIA PRIVATE LTD	INDIA	
2	E008	EXCELSIOR ENGG. WORKS	INDIA	
3	3745	MET-LOK VALVES AND FITTINGS	INDIA	
4	C714	CRANE INSTRUMENTATION & SAMPLING PFT CORP.	UNITED STATES	
5	A345	ARYA CRAFTS & ENGINEERING PVT LTD	INDIA	
6	27559	DK-LOK CORPORATION	KOREA, REPUBLIC OF	
7	27440	FITOK INCORPORATED	CHINA	
8	S816	SSP FITTINGS CORPORATION	UNITED STATES	
9	T761	TK FUJIKIN CORPORATION	KOREA, REPUBLIC OF	
10	3937	SHREEMARUTI INSTRUMENTS PVT LIMITED	INDIA	
11	C220	COMFIT & VALVES PVT. LTD.	INDIA	
12	H634	HAM-LET (ISRAEL-CANADA) LTD.	ISRAEL	
13	M058	MULTIMETAL INDUSTRIES	INDIA	
14	A240	ASTEC VALVES & FITTINGS PVT. LTD.	INDIA	
15	3694	PRECISION ENGINEERING INDUSTRIES	INDIA	
16	E104	EXCEL HYDRO PNEUMATICS PVT LTD	INDIA	
17	4286	SHARP ENGINEERING	INDIA	
18	F146	FLUID CONTROLS PVT LTD	INDIA	
19	P303	PRIME ENGINEERS	INDIA	
20	27408	SWAGELOK COMPANY	UNITED STATES	
21	P671	PARKER HANNIFIN CORPORATION	UNITED STATES	
22	4011	APTEK INSTRUMENTATION PVT LTD	INDIA	
23	4057	MET-LOK VALVES AND FITTINGS	INDIA	
24	S146	SEALEXCEL (INDIA) PVT. LTD.	INDIA	
25	4167	ASTEC VALVES & FITTINGS PVT. LTD.	INDIA	
26	3871	PANAM ENGINEERS LIMITED	INDIA	
27	4120	TUBEFIT ENGINEERS	INDIA	
28	3630	WESMEC ENGINEERING PRIVATE LIMITED	INDIA	
29	3737	HAVI ENGINEERING INDIA PVT LTD	INDIA	
30	S303	SWASTIK ENGINEERING WORKS	INDIA	
31	P240	PRECISION ENGINEERING INDUSTRIES	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15AB		**Description :** INSTRUMENT TUBING		
Approved Suppliers				
1	P260	TUBACEX TUBES AND PIPES PRIVATE LIMITED	INDIA	
2	27559	DK-LOK CORPORATION	KOREA, REPUBLIC OF	
3	K186	KRYSTAL GLOBAL ENGINEERING LIMITED	INDIA	
4	S202	SHUBHLAXMI METALS AND TUBES PVT. LTD	INDIA	
5	3685	HEAVY METAL & TUBES (INDIA) PRIVATE LTD	INDIA	
6	S406	SURAJ LIMITED	INDIA	
7	M287	MAXIM TUBES COMPANY PVT LTD	INDIA	
8	R127	REMI EDELSTAHL TUBULARS LTD (FORM RMIL)	INDIA	
9	R066	RATNAMANI METALS AND TUBES LTD	INDIA	
10	T761	TK FUJIKIN CORPORATION	KOREA, REPUBLIC OF	
11	J110A	JINDAL SAW LTD (KOSI WORKS)	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15BA		**Description :** AIR FILTER REGULATORS		
Approved Suppliers				
1	V019	VELJAN HYDRAIR PVT LTD	INDIA	
2	S242	SHAH PNEUMATICS	INDIA	
3	S091	SCHRADER DUNCAN LIMITED	INDIA	
4	M710	MARSH BELLOFRAM	UNITED STATES	
5	P293	PLACKA INSTRUMENTS INDIA P LTD	INDIA	
6	J092	JANATICS INDIA PVT LTD	INDIA	
7	D077	DIVYA CONTROL ELEMENTS PVT LTD	INDIA	
8	T745	THOMPSON VALVES LTD	UNITED KINGDOM	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15BB		**Description :** MACHINE MONITORING SYSTEMS		
Approved Suppliers				
1	27513	MEGGITT SA	SWITZERLAND	
2	27464	PROGNOST SYSTEMS GMBH	GERMANY	
3	R178	ROCKWELL AUTOMATION INDIA PVT LTD	INDIA	
4	S814	SHINKAWA SENSOR TECHNOLOGY, INC	JAPAN	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15CA		**Description :** THERMO COUPLE EXTENSION CABLES		
Approved Suppliers				
1	3669	KEI INDUSTRIES LIMITED	INDIA	
2	T243	T C COMMUNICATION PVT. LTD.	INDIA	
3	A034	ASSOCIATED CABLES PVT LTD	INDIA	
4	K082	KEI INDUSTRIES LIMITED	INDIA	
5	C145	CORDS CABLE INDUSTRIES LTD	INDIA	
6	3796	PARAMOUNT COMMUNICATIONS LTD	INDIA	
7	A132	ASSOCIATED FLEXIBLES & WIRES [P] LTD	INDIA	
8	3724	CORDS CABLE INDUSTRIESLTD.	INDIA	
9	3773	TEMPSENS INSTRUMENTS (I) PVT. LTD.	INDIA	
10	3765	THERMO CABLES LTD.	INDIA	
11	T212	THERMO CABLES LTD (FORM. T-150)	INDIA	
12	D012	DELTON CABLES LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15CB		**Description :** SIGNAL CABLES		
Approved Suppliers				
1	3663	LAPP INDIA PVT LTD	INDIA	
2	K082	KEI INDUSTRIES LIMITED	INDIA	
3	L612	LEONI KERPEN GMBH	GERMANY	
4	3796	PARAMOUNT COMMUNICATIONS LTD	INDIA	
5	3662	ELEGAR KERPEN KABEL INDIA PRIVATE LIMITED	INDIA	
6	3782	POLYCAB INDIA LIMITED	INDIA	
7	4001	RAVI INDUSTRIES	INDIA	
8	3722	POLYCAB INDIA LIMITED	INDIA	
9	3773	TEMPSENS INSTRUMENTS (I) PVT. LTD.	INDIA	
10	S304	SUYOG ELECTRICALS LTD	INDIA	
11	3602	Special Cables Pvt. Ltd.	INDIA	
12	C145	CORDS CABLE INDUSTRIES LTD	INDIA	
13	A034	ASSOCIATED CABLES PVT LTD	INDIA	
14	G156	GEMSCAB INDUSTRIES LTD	INDIA	
15	T243	T C COMMUNICATION PVT. LTD.	INDIA	
16	4135	PAGODA CABLES PRIVATE LIMITED	INDIA	
17	D012	DELTON CABLES LIMITED	INDIA	
18	3669	KEI INDUSTRIES LIMITED	INDIA	
19	T212	THERMO CABLES LTD (FORM. T-150)	INDIA	
20	3765	THERMO CABLES LTD.	INDIA	
21	K190B	KEC INETRNATIONAL - MYSORE	INDIA	
22	E063	ELKAY TELELINKS LTD.-	INDIA	
23	R203	LKB ENGINEERING PRIVATE LIMITED	INDIA	
24	H060	HAVELLS INDIA LTD	INDIA	
25	3724	CORDS CABLE INDUSTRIESLTD.	INDIA	
26	A132	ASSOCIATED FLEXIBLES & WIRES [P] LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15CC		**Description :** OPTICAL FIBRE CABLE & ASSOC.ITEM		
Approved Suppliers				
1	3752	APAR INDUSTRIES LTD	INDIA	
2	K190B	KEC INETRNATIONAL - MYSORE	INDIA	
3	H138	HFCL LIMITED	INDIA	
4	S387	WEST COAST PAPER MILLS LIMITED (DIVISION: WEST COAST OPTILINKS)	INDIA	
5	U099	U M CABLES LTD	INDIA	
6	P610	PIRELLI CAVI SPA	ITALY	
7	A400	AKSH OPTIFIBRE LIMITED	INDIA	
8	K615	KABEL RHEYDT	GERMANY	
9	V092	VINDHYA TELELINKS LIMITED	INDIA	
10	B155	BIRLA CABLE LIMITED	INDIA	
11	4140	HTL LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15CD		**Description :** FIELD BUS SIGNAL CABLES		
Approved Suppliers				
1	C145	CORDS CABLE INDUSTRIES LTD	INDIA	
2	S304	SUYOG ELECTRICALS LTD	INDIA	
3	3663	LAPP INDIA PVT LTD	INDIA	
4	3662	ELEGAR KERPEN KABEL INDIA PRIVATE LIMITED	INDIA	
5	T212	THERMO CABLES LTD (FORM. T-150)	INDIA	
6	L612	LEONI KERPEN GMBH	GERMANY	
7	B735	BELDEN INC	UNITED STATES	
8	A132	ASSOCIATED FLEXIBLES & WIRES [P] LTD	INDIA	
9	3724	CORDS CABLE INDUSTRIESLTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15CE		**Description :** SIGNAL CABLE - FIRE RESISTANT		
Approved Suppliers				
1	R203	LKB ENGINEERING PRIVATE LIMITED	INDIA	
2	3724	CORDS CABLE INDUSTRIESLTD.	INDIA	
3	S304	SUYOG ELECTRICALS LTD	INDIA	
4	C145	CORDS CABLE INDUSTRIES LTD	INDIA	
5	3669	KEI INDUSTRIES LIMITED	INDIA	
6	3782	POLYCAB INDIA LIMITED	INDIA	
7	T212	THERMO CABLES LTD (FORM. T-150)	INDIA	
8	3722	POLYCAB INDIA LIMITED	INDIA	
9	E063	ELKAY TELELINKS LTD.-	INDIA	
10	K082	KEI INDUSTRIES LIMITED	INDIA	
11	A132	ASSOCIATED FLEXIBLES & WIRES [P] LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15CG		**Description :** SPECIAL LEVEL INSTRUMENTS (TUNNING FORK)		
Approved Suppliers				
1	A727	AMETEK DREXELBROOK	UNITED STATES	
2	E232	ENDRESS+HAUSER (I) AUTO. INSTR. PVT. LTD	INDIA	
3	V590	VENTURE MEASUREMENT COMPANY	UNITED STATES	
4	M715	MOBREY LTD (FORM. S-578)	UNITED KINGDOM	
5	S209	SAPCON INSTRUMENTS PVT LTD	INDIA	
6	N025	NIVO CONTROLS PVT LTD	INDIA	
7	V518	VEGA GRIESHABER KG	GERMANY	
8	A759	ABB INC (FORMLY K622)	UNITED STATES	
9	E657	ENDRESS+HAUSER SE+CO. KG	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15CI		**Description :** CORROSION MONITORS		
Approved Suppliers				
1	P687	PT. KOROSI SPECINDO	INDONESIA	
2	27497	ROHRBACK COSASCO SYSTEMS INC.	UNITED STATES	
3	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
4	C704	CAPROCO INTERNATIONAL LTD	CANADA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15DB		**Description :** COPPER TUBES(COATED,BARE)		
Approved Suppliers				
1	3805	MEHTA TUBES LIMITED	INDIA	
2	M048	MULTIMETALS LIMITED	INDIA	
3	M288	MEHTA TUBES LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EA		**Description :** SOLENOID VALVES		
Approved Suppliers				
1	A555	ASCO JOUCOMATIC LTD	UNITED KINGDOM	
2	A721	ASCO JOUCOMATIC SA	FRANCE	
3	3661	ROTEX AUTOMATION LTD.	INDIA	
4	H554	HERION WERKE	GERMANY	
5	T745	THOMPSON VALVES LTD	UNITED KINGDOM	
6	4029	IMI NORGREN HERION PVT. LTD	INDIA	
7	A167	EMERSON PROCESS MANAGEMENT CHENNAI PVT. LTD.	INDIA	
8	P217	PRECISION INSTRUMENT COMPANY	INDIA	
9	A052	AVCON CONTROLS PVT. LTD.	INDIA	
10	S091	SCHRADER DUNCAN LIMITED	INDIA	
11	4153	UFLOW AUTOMATION	INDIA	
12	A588	ALCON ALEXANDER CONTROLS LIMITED	UNITED KINGDOM	
13	V542	VERSA BV	NETHERLANDS	
14	R021	ROTEX AUTOMATION LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EB		**Description :** CONTROL VALVES		
Approved Suppliers				
1	A529	ARCA REGLER GMBH	GERMANY	
2	F151	FORBES MARSHALL ARCA P LTD.(FORMRLY A214	INDIA	
3	K624	KENT INTROL UK LTD (FORM. A-718)	UNITED KINGDOM	
4	I172	INSTRUMENTATION LTD. (PALGHAT)	INDIA	
5	D127	GE Oil & Gas India Pvt. Ltd.	INDIA	
6	E179A	EMERSON PROCESS MANGMNT CHENNAI PVT. LTD	INDIA	
7	M055	KSB MIL CONTROLS LIMITED	INDIA	
8	S442	SAMSON CONTROLS PVT LTD	INDIA	
9	S023	SEVERN GLOCON VALVES PRIVATE LIMITED	INDIA	
10	S793	SPX VALVES & CONTROLS (FORMERLY DEZURIK)	UNITED STATES	
11	C032	CONTINENTAL VALVE LTD	INDIA	
12	D649	DRESSER PRODUITS INDUSTRIELS	FRANCE	
13	M561	MOTOYAMA ENGG WORKS LTD	JAPAN	
14	F176	FLOWSERVE INDIA CONTROL PVT LTD-BANGALOR	INDIA	
15	W5941	WEIR VALVES & CONTROLS UK LTD	UNITED KINGDOM	
16	M015	MASCOT VALVES PVT LIMITED (FMLY VALFLO)	INDIA	
17	27461	BELLINO SRL	ITALY	
18	S505	SEVERN GLOCON LTD	UNITED KINGDOM	
19	A761	AST APPARECCHI DI SICUREZZA E TENUTA SPA	ITALY	
20	S510	SAMSON AKTIENGESELLSCHAFT	GERMANY	
21	K179A	KOSO INDIA PVT LTD (FORM.K176)	INDIA	
22	C731	CCI VALVE TECHNOLOGY GMBH	CZECH REPUBLIC	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EC		**Description :** PRESSURE RELIEF VALVE		
Approved Suppliers				
1	F103	LESER INDIA PRIVATE LIMITED	INDIA	
2	3774	UNI KLINGER LIMITED	INDIA	
3	B110	BLISS ANAND PVT LTD	INDIA	
4	T181	Anderson Greenwood Crosby Sanmar Limited	INDIA	
5	N541	NAKAKITA SEISAKUSHO CO LTD	JAPAN	
6	N088	NIRMAL INDUSTRIAL CONTROL PVT. LTD.	INDIA	
7	A761	AST APPARECCHI DI SICUREZZA E TENUTA SPA	ITALY	
8	D523	DRESSER INC.	UNITED STATES	
9	L569	LESER GMBH & CO. KG	GERMANY	
10	B015	BHARAT HEAVY ELECTRICALS LIMITED-TIRUCHIRAPALLI	INDIA	
11	A710	ANDERSON GREENWOOD CROSBY	UNITED STATES	
12	C700	CURTISS WRIGHT FLOW CONTROL CORPORATION	CANADA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15ED		**Description :** INSTRUMENT VALVES& MANIFOLDS		
Approved Suppliers				
1	3745	MET-LOK VALVES AND FITTINGS	INDIA	
2	27409	SWAGELOK LIMITED	UNITED KINGDOM	
3	4167	ASTEC VALVES & FITTINGS PVT. LTD.	INDIA	
4	A710	ANDERSON GREENWOOD CROSBY	UNITED STATES	
5	3694	PRECISION ENGINEERING INDUSTRIES	INDIA	
6	E104	EXCEL HYDRO PNEUMATICS PVT LTD	INDIA	
7	E008	EXCELSIOR ENGG. WORKS	INDIA	
8	27414	SWAGELOK COMPANY	UNITED STATES	
9	S303	SWASTIK ENGINEERING WORKS	INDIA	
10	3937	SHREEMARUTI INSTRUMENTS PVT LIMITED	INDIA	
11	C220	COMFIT & VALVES PVT. LTD.	INDIA	
12	F146	FLUID CONTROLS PVT LTD	INDIA	
13	A345	ARYA CRAFTS & ENGINEERING PVT LTD	INDIA	
14	3630	WESMEC ENGINEERING PRIVATE LIMITED	INDIA	
15	A240	ASTEC VALVES & FITTINGS PVT. LTD.	INDIA	
16	3737	HAVI ENGINEERING INDIA PVT LTD	INDIA	
17	H634	HAM-LET (ISRAEL-CANADA) LTD.	ISRAEL	
18	3931	HP VALVES & FITTINGS INDIA PRIVATE LTD	INDIA	
19	P240	PRECISION ENGINEERING INDUSTRIES	INDIA	
20	T761	TK FUJIKIN CORPORATION	KOREA, REPUBLIC OF	
21	P303	PRIME ENGINEERS	INDIA	
22	B213	BAUMER TECHNOLOGIES INDIA PVT.LTD(W058)	INDIA	
23	4057	MET-LOK VALVES AND FITTINGS	INDIA	
24	C714	CRANE INSTRUMENTATION & SAMPLING PFT CORP.	UNITED STATES	
25	3871	PANAM ENGINEERS LIMITED	INDIA	
26	J067	METAVAL ENGINEERING PRIVATE LIMITED	INDIA	
27	M010	WIKA PROCESS SOLUTIONS INDIA PRIVATE LIMITED	INDIA	
28	C015	CHEMTROLS INDUSTRIES PVT. LTD.	INDIA	
29	4286	SHARP ENGINEERING	INDIA	
30	P671	PARKER HANNIFIN CORPORATION	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EE		**Description :** TANK PR. PROTECT. DEVICES / FLAME ARRSTR		
Approved Suppliers				
1	S797	SAFETY SYSTEMS UK LTD	UNITED KINGDOM	
2	L562	L & J TECHNOLOGIES	UNITED STATES	
3	P205	PROTEGO INDIA PVT LTD	INDIA	
4	G568	GROTH CORPORATION	UNITED STATES	
5	A710	ANDERSON GREENWOOD CROSBY	UNITED STATES	
6	P318	PRESSURE &FLOW CONTROL INDUSTRIES	INDIA	
7	3917	GROTH CONTINENTAL MANUFACTURING PRIVATE LIMITED	INDIA	
8	A733	ANDERSON GREENWOOD VAREC	UNITED STATES	
9	B537	BRAUNSCHWEIGER FLAMMENFILTER	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EF		**Description :** ON-OFF VALVES		
Approved Suppliers				
1	F176	FLOWSERVE INDIA CONTROL PVT LTD-BANGALOR	INDIA	
2	W092	BDK VALVE PRIVATE LIMITED	INDIA	
3	T198	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED	INDIA	
4	K179B	KOSO INDIA PVT. LIMITED	INDIA	
5	K620	KITZ CORPORATION OF EUROPE S.A.	SPAIN	
6	3613	BRAY CONTROLS INDIA PVT LTD	INDIA	
7	E141	EL-O-MATIC INDIA (PVT) LTD.	INDIA	
8	M561	MOTOYAMA ENGG WORKS LTD	JAPAN	
9	27465	VALVTECHNOLOGIES INC.	UNITED STATES	
10	M055	KSB MIL CONTROLS LIMITED	INDIA	
11	3887	INTERVALVE POONAWALLA PRIVATE LIMITED	INDIA	
12	S510	SAMSON AKTIENGESELLSCHAFT	GERMANY	
13	A315	ADVANCE VALVES PVT LTD.	INDIA	
14	I586	ITALVALV S.R.L	ITALY	
15	W5941	WEIR VALVES & CONTROLS UK LTD	UNITED KINGDOM	
16	3679	VALMET FLOW CONTROL PRIVATE LIMITED	INDIA	
17	D146	DELVAL FLOW CONTROLS PRIVATE LIMITED	INDIA	
18	27477	VELAN INC	CANADA	
19	M094	MICROFINISH VALVES PVT LIMITED	INDIA	
20	S793	SPX VALVES & CONTROLS (FORMERLY DEZURIK)	UNITED STATES	
21	C032	CONTINENTAL VALVE LTD	INDIA	
22	K511	KITAMURA VALVE MANUFACTURING CO LTD	JAPAN	
23	A715	AMPO, S.COOP	SPAIN	
24	S442	SAMSON CONTROLS PVT LTD	INDIA	
25	3623	NILON VALVES PRIVATE LIMITED	INDIA	
26	L001	L & T VALVES LIMITED	INDIA	
27	P689	PERRIN GMBH	GERMANY	
28	C718	CAMERON ITALY SRL (FORM. D659)	ITALY	
29	O538	ORTON S.R.L	ITALY	
30	P544	PIBIVIESSE S. R. L.	ITALY	
31	4118	PHBB VALVES PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EG		**Description :** SELF ACTUATED PR.CONTROL VALVES		
Approved Suppliers				
1	S442	SAMSON CONTROLS PVT LTD	INDIA	
2	E626	ELSTER-INSTROMET NV-FORMER. I563	BELGIUM	
3	D127	GE Oil & Gas India Pvt. Ltd.	INDIA	
4	E6231	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
5	3631	EMERSONPROCESSMANAGEMENT CHENNAI PVT LTD	INDIA	
6	G603	GORTER CONTROLS B.V.	NETHERLANDS	
7	D649	DRESSER PRODUITS INDUSTRIELS	FRANCE	
8	R610	RICHARDS INDUSTRIALS, INC.	UNITED STATES	
9	N088	NIRMAL INDUSTRIAL CONTROL PVT. LTD.	INDIA	
10	S510	SAMSON AKTIENGESELLSCHAFT	GERMANY	
11	R539	RMG REGEL+MESSTECHNIK GMBH	GERMANY	
12	P538	PIETRO FIORENTINI SPA	ITALY	
13	E534	ESME VALVES LTD.	UNITED KINGDOM	
14	M055	KSB MIL CONTROLS LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EH		**Description :** CONTROL VALVE WITH ELECTRO-HYDRAULIC ACTUATOR		
Approved Suppliers				
1	N510	NUOVO PIGNONE INTERNATIONAL S.R.L.	ITALY	
2	K624	KENT INTROL UK LTD (FORM. A-718)	UNITED KINGDOM	
3	S023	SEVERN GLOCON VALVES PRIVATE LIMITED	INDIA	
4	K179A	KOSO INDIA PVT LTD (FORM.K176)	INDIA	
5	W5941	WEIR VALVES & CONTROLS UK LTD	UNITED KINGDOM	
6	M055	KSB MIL CONTROLS LIMITED	INDIA	
7	F176	FLOWSERVE INDIA CONTROL PVT LTD-BANGALOR	INDIA	
8	D649	DRESSER PRODUITS INDUSTRIELS	FRANCE	
9	F636	FLOWSERVE PTE LTD	SINGAPORE	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EI		**Description :** SP CONTROL VALVES (ECC. DISC HI PERF)		
Approved Suppliers				
1	K179B	KOSO INDIA PVT. LIMITED	INDIA	
2	M561	MOTOYAMA ENGG WORKS LTD	JAPAN	
3	D649	DRESSER PRODUITS INDUSTRIELS	FRANCE	
4	W5941	WEIR VALVES & CONTROLS UK LTD	UNITED KINGDOM	
5	T719A	EMERSON AUTOMATION SOLUTIONS FINAL CONTROL ITALIA S.R.L.	ITALY	
6	E179A	EMERSON PROCESS MANGMNT CHENNAI PVT. LTD	INDIA	
7	F176	FLOWSERVE INDIA CONTROL PVT LTD-BANGALOR	INDIA	
8	I586	ITALVALV S.R.L	ITALY	
9	O538	ORTON S.R.L	ITALY	
10	M055	KSB MIL CONTROLS LIMITED	INDIA	
11	S510	SAMSON AKTIENGESELLSCHAFT	GERMANY	
12	S793	SPX VALVES & CONTROLS (FORMERLY DEZURIK)	UNITED STATES	
13	3679	VALMET FLOW CONTROL PRIVATE LIMITED	INDIA	
14	E6232	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
15	T198	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EJ		**Description :** SPECIAL CONTROL VALVES (BUTTERFLY)		
Approved Suppliers				
1	F176	FLOWSERVE INDIA CONTROL PVT LTD-BANGALOR	INDIA	
2	M015	MASCOT VALVES PVT LIMITED (FMLY VALFLO)	INDIA	
3	T198	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED	INDIA	
4	S510	SAMSON AKTIENGESELLSCHAFT	GERMANY	
5	3679	VALMET FLOW CONTROL PRIVATE LIMITED	INDIA	
6	O538	ORTON S.R.L	ITALY	
7	M561	MOTOYAMA ENGG WORKS LTD	JAPAN	
8	E179A	EMERSON PROCESS MANGMNT CHENNAI PVT. LTD	INDIA	
9	E6232	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
10	W5941	WEIR VALVES & CONTROLS UK LTD	UNITED KINGDOM	
11	D649	DRESSER PRODUITS INDUSTRIELS	FRANCE	
12	S442	SAMSON CONTROLS PVT LTD	INDIA	
13	M055	KSB MIL CONTROLS LIMITED	INDIA	
14	I586	ITALVALV S.R.L	ITALY	
15	S023	SEVERN GLOCON VALVES PRIVATE LIMITED	INDIA	
16	S793	SPX VALVES & CONTROLS (FORMERLY DEZURIK)	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EK		**Description :** SELF ACTUATED FLOW CONTROL VALVES		
Approved Suppliers				
1	W574	WA KATES COMPANY	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EL		**Description :** DESUPERHEATERS & PRDS		
Approved Suppliers				
1	B221	BOMAFA SPECIAL VALVE SOLUTIONS PVT. LTD.	INDIA	
2	S510	SAMSON AKTIENGESELLSCHAFT	GERMANY	
3	S7931	SPX VALVES & CONTROLS	UNITED KINGDOM	
4	F151	FORBES MARSHALL ARCA P LTD.(FORMRLY A214	INDIA	
5	3958	CONTROL COMPONENT INDIA PVT LTD	INDIA	
6	M055	KSB MIL CONTROLS LIMITED	INDIA	
7	M015	MASCOT VALVES PVT LIMITED (FMLY VALFLO)	INDIA	
8	W5941	WEIR VALVES & CONTROLS UK LTD	UNITED KINGDOM	
9	I593	IMTECH SYSTEMS BV (FORMERLY K-611)	NETHERLANDS	
10	27461	BELLINO SRL	ITALY	
11	H610	HOLTER REGELARMATURE N GMBH &CO.KG(HORA)	GERMANY	
12	A529	ARCA REGLER GMBH	GERMANY	
13	C015	CHEMTROLS INDUSTRIES PVT. LTD.	INDIA	
14	C226	CIRCOR FLOW TECHNOLOGIES INDIA PVT LTD	INDIA	
15	K179A	KOSO INDIA PVT LTD (FORM.K176)	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EM		**Description :** PR.REGULATOR & SLAM SHUT VALVES		
Approved Suppliers				
1	E6231	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
2	M644	MOKVELD VALVES BV	NETHERLANDS	
3	G603	GORTER CONTROLS B.V.	NETHERLANDS	
4	R539	RMG REGEL+MESSTECHNIK GMBH	GERMANY	
5	N088	NIRMAL INDUSTRIAL CONTROL PVT. LTD.	INDIA	
6	P538	PIETRO FIORENTINI SPA	ITALY	
7	E626	ELSTER-INSTROMET NV-FORMER. I563	BELGIUM	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EN		**Description :** SPECIAL CONTROL VALVES-MIXED		
Approved Suppliers				
1	E6232	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
2	K511	KITAMURA VALVE MANUFACTURING CO LTD	JAPAN	
3	E179A	EMERSON PROCESS MANGMNT CHENNAI PVT. LTD	INDIA	
4	T198	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED	INDIA	
5	S510	SAMSON AKTIENGESELLSCHAFT	GERMANY	
6	W5941	WEIR VALVES & CONTROLS UK LTD	UNITED KINGDOM	
7	M055	KSB MIL CONTROLS LIMITED	INDIA	
8	K179B	KOSO INDIA PVT. LIMITED	INDIA	
9	M561	MOTOYAMA ENGG WORKS LTD	JAPAN	
10	D649	DRESSER PRODUITS INDUSTRIELS	FRANCE	
11	S793	SPX VALVES & CONTROLS (FORMERLY DEZURIK)	UNITED STATES	
12	I586	ITALVALV S.R.L	ITALY	
13	F176	FLOWSERVE INDIA CONTROL PVT LTD-BANGALOR	INDIA	
14	D127	GE Oil & Gas India Pvt. Ltd.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EO		**Description :** PILOT OPERATED SAFETY VALVES		
Approved Suppliers				
1	W597	TRILLIUM FLOW TECHNOLOGIES FRANCE SAS	FRANCE	
2	L569	LESER GMBH & CO. KG	GERMANY	
3	A761	AST APPARECCHI DI SICUREZZA E TENUTA SPA	ITALY	
4	D523	DRESSER INC.	UNITED STATES	
5	B110	BLISS ANAND PVT LTD	INDIA	
6	F103	LESER INDIA PRIVATE LIMITED	INDIA	
7	A710	ANDERSON GREENWOOD CROSBY	UNITED STATES	
8	T181	Anderson Greenwood Crosby Sanmar Limited	INDIA	
9	C700	CURTISS WRIGHT FLOW CONTROL CORPORATION	CANADA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EP		**Description :** SAFETY VALVES BOILER SERVICE		
Approved Suppliers				
1	B110	BLISS ANAND PVT LTD	INDIA	
2	3774	UNI KLINGER LIMITED	INDIA	
3	C700	CURTISS WRIGHT FLOW CONTROL CORPORATION	CANADA	
4	A710	ANDERSON GREENWOOD CROSBY	UNITED STATES	
5	T181	Anderson Greenwood Crosby Sanmar Limited	INDIA	
6	D523	DRESSER INC.	UNITED STATES	
7	F103	LESER INDIA PRIVATE LIMITED	INDIA	
8	B015	BHARAT HEAVY ELECTRICALS LIMITED-TIRUCHIRAPALLI	INDIA	
9	N088	NIRMAL INDUSTRIAL CONTROL PVT. LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EQ		**Description :** SURGE RELIEF VALVE		
Approved Suppliers				
1	D509	EMERSON PROCESS MANAGEMENT ASIA PACIFIC PTE LTD	UNITED STATES	
2	D143	EMERSON MEASUREMENT SYSTEMS AND SOLUTIONS (INDIA) PRIVATE LIMITED	INDIA	
3	M644	MOKVELD VALVES BV	NETHERLANDS	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15ER		**Description :** SPECIAL CONTROL VALVES (ECC.ROTARY PLUG)		
Approved Suppliers				
1	D127	GE Oil & Gas India Pvt. Ltd.	INDIA	
2	I172	INSTRUMENTATION LTD. (PALGHAT)	INDIA	
3	E179A	EMERSON PROCESS MANGMNT CHENNAI PVT. LTD	INDIA	
4	E6232	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
5	F176	FLOWSERVE INDIA CONTROL PVT LTD-BANGALOR	INDIA	
6	M055	KSB MIL CONTROLS LIMITED	INDIA	
7	D649	DRESSER PRODUITS INDUSTRIELS	FRANCE	
8	S510	SAMSON AKTIENGESELLSCHAFT	GERMANY	
9	F636	FLOWSERVE PTE LTD	SINGAPORE	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15ES		**Description :** SPECIAL CONTROL VALVES (SEGMENTAL)		
Approved Suppliers				
1	F176	FLOWSERVE INDIA CONTROL PVT LTD-BANGALOR	INDIA	
2	T198	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED	INDIA	
3	I586	ITALVALV S.R.L	ITALY	
4	E6232	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
5	E179A	EMERSON PROCESS MANGMNT CHENNAI PVT. LTD	INDIA	
6	M015	MASCOT VALVES PVT LIMITED (FMLY VALFLO)	INDIA	
7	K179B	KOSO INDIA PVT. LIMITED	INDIA	
8	S793	SPX VALVES & CONTROLS (FORMERLY DEZURIK)	UNITED STATES	
9	D649	DRESSER PRODUITS INDUSTRIELS	FRANCE	
10	3679	VALMET FLOW CONTROL PRIVATE LIMITED	INDIA	
11	M055	KSB MIL CONTROLS LIMITED	INDIA	
12	K511	KITAMURA VALVE MANUFACTURING CO LTD	JAPAN	
13	S510	SAMSON AKTIENGESELLSCHAFT	GERMANY	
14	D127	GE Oil & Gas India Pvt. Ltd.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15ET		**Description :** SPECIAL CONTROL VALVES (PLUG)		
Approved Suppliers				
1	F176	FLOWSERVE INDIA CONTROL PVT LTD-BANGALOR	INDIA	
2	E179A	EMERSON PROCESS MANGMNT CHENNAI PVT. LTD	INDIA	
3	A761	AST APPARECCHI DI SICUREZZA E TENUTA SPA	ITALY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EU		**Description :** SPECIAL CONTROL VALVES (BALL CONTROL)		
Approved Suppliers				
1	P544	PIBIVIESSE S. R. L.	ITALY	
2	3679	VALMET FLOW CONTROL PRIVATE LIMITED	INDIA	
3	F176	FLOWSERVE INDIA CONTROL PVT LTD-BANGALOR	INDIA	
4	M055	KSB MIL CONTROLS LIMITED	INDIA	
5	K179B	KOSO INDIA PVT. LIMITED	INDIA	
6	K511	KITAMURA VALVE MANUFACTURING CO LTD	JAPAN	
7	E179A	EMERSON PROCESS MANGMNT CHENNAI PVT. LTD	INDIA	
8	T198	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED	INDIA	
9	I586	ITALVALV S.R.L	ITALY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EV		**Description :** SPECIAL CONTROL VALVES (AXIAL)		
Approved Suppliers				
1	M644	MOKVELD VALVES BV	NETHERLANDS	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EW		**Description :** SPECIAL CONTROL VALVES (VARIABLE CV)		
Approved Suppliers				
1	D649	DRESSER PRODUITS INDUSTRIELS	FRANCE	
2	M055	KSB MIL CONTROLS LIMITED	INDIA	
3	D127	GE Oil & Gas India Pvt. Ltd.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EX		**Description :** SPECIAL CONTROL VALVES (LOW CV)		
Approved Suppliers				
1	S510	SAMSON AKTIENGESELLSCHAFT	GERMANY	
2	D127	GE Oil & Gas India Pvt. Ltd.	INDIA	
3	D649	DRESSER PRODUITS INDUSTRIELS	FRANCE	
4	E179A	EMERSON PROCESS MANGMNT CHENNAI PVT. LTD	INDIA	
5	I172	INSTRUMENTATION LTD. (PALGHAT)	INDIA	
6	M055	KSB MIL CONTROLS LIMITED	INDIA	
7	F636	FLOWSERVE PTE LTD	SINGAPORE	
8	E6232	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EY		**Description :** SPECIAL CONTROL VALVES (PISTON)		
Approved Suppliers				
1	S748	SCHUF-ARMATUREN UND APPARATEBAU GMBH	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15EZ		**Description :** SPECIAL CONTROL VALVE (FLUSH BOTTOM)		
Approved Suppliers				
1	S748	SCHUF-ARMATUREN UND APPARATEBAU GMBH	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FA		**Description :** PROCESS STREAM ANALYSER(ELECTROCHEM-O2)		
Approved Suppliers				
1	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
2	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
3	G623	BAKER HUGHES EMEA UNLIMITED COMPANY	IRELAND	
4	S746	SERVOMEX GROUP LTD.	UNITED KINGDOM	
5	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
6	A200	ABB INDIA LTD (BANGALORE)	INDIA	
7	M730	METTLER - TOLEDO AG	SWITZERLAND	
8	A682	ABB AUTOMATION LTD	UNITED KINGDOM	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FB		**Description :** WATER QUALITY ANALYSERS (SILICA)		
Approved Suppliers				
1	H638	HACH COMPANY	UNITED STATES	
2	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
3	4062	HACH OTT INDIA PVT. LTD.	INDIA	
4	H621	HONEYWELL INC.	UNITED STATES	
5	E656	ENDRESS+HAUSER CONDUCTA GMBH+CO. KG	GERMANY	
6	S657	SERES OL	FRANCE	
7	27515	AWA INSTRUMENTS PTE. LTD.	SINGAPORE	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FC		**Description :** WATER QUALITY ANALYSER-DISSOLVED OXYGEN		
Approved Suppliers				
1	27529	TETHYS INSTRUMENTS SAS	FRANCE	
2	H621	HONEYWELL INC.	UNITED STATES	
3	M730	METTLER - TOLEDO AG	SWITZERLAND	
4	B739	B&C ELECTRONICS SRL	ITALY	
5	4062	HACH OTT INDIA PVT. LTD.	INDIA	
6	E656	ENDRESS+HAUSER CONDUCTA GMBH+CO. KG	GERMANY	
7	Y006	YOKOGAWA INDIA LIMITED	INDIA	
8	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
9	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
10	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
11	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
12	F181	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
13	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
14	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
15	A200	ABB INDIA LTD (BANGALORE)	INDIA	
16	I590	INVENSYS SOFTWARE SYSTEMS (S) PTE LTD	SINGAPORE	
17	H638	HACH COMPANY	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FD		**Description :** WATER QUALITY ANALYSER SYSTEMS		
Approved Suppliers				
1	M730	METTLER - TOLEDO AG	SWITZERLAND	
2	F181	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
3	H621	HONEYWELL INC.	UNITED STATES	
4	3891	ANALYSER INSTRUMENT CO PVT LTD	INDIA	
5	4062	HACH OTT INDIA PVT. LTD.	INDIA	
6	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
7	E656	ENDRESS+HAUSER CONDUCTA GMBH+CO. KG	GERMANY	
8	27529	TETHYS INSTRUMENTS SAS	FRANCE	
9	S657	SERES OL	FRANCE	
10	A200	ABB INDIA LTD (BANGALORE)	INDIA	
11	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
12	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
13	Y006	YOKOGAWA INDIA LIMITED	INDIA	
14	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
15	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FE		**Description :** PROCESS STREAM ANALYSERS (O2-ZIRCONIA)		
Approved Suppliers				
1	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
2	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
3	Y006	YOKOGAWA INDIA LIMITED	INDIA	
4	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
5	G623	BAKER HUGHES EMEA UNLIMITED COMPANY	IRELAND	
6	A5102	AMETEK	UNITED STATES	
7	S5241	SIEMENS AG	GERMANY	
8	A200	ABB INDIA LTD (BANGALORE)	INDIA	
9	S746	SERVOMEX GROUP LTD.	UNITED KINGDOM	
10	27550	ENOTEC GMBH	GERMANY	
11	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
12	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
13	S452	SECO CONTROLS PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FF		**Description :** PROCESS STREAM ANALYSER-MOISTURE/ DEW PT		
Approved Suppliers				
1	M723	MICHELL INSTRUMENTS LTD	UNITED KINGDOM	
2	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
3	C749	COSA XENTAUR CORPORATION	UNITED STATES	
4	A5101	AMETEK	UNITED STATES	
5	G623	BAKER HUGHES EMEA UNLIMITED COMPANY	IRELAND	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FG		**Description :** PROCESS STREAM ANALYSER(PARAMAGNETIC-O2)		
Approved Suppliers				
1	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
2	27509	ENDRESS+HAUSER SICK GMBH+CO. KG	GERMANY	
3	A200	ABB INDIA LTD (BANGALORE)	INDIA	
4	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
5	Y006	YOKOGAWA INDIA LIMITED	INDIA	
6	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
7	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
8	G623	BAKER HUGHES EMEA UNLIMITED COMPANY	IRELAND	
9	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
10	S5241	SIEMENS AG	GERMANY	
11	S746	SERVOMEX GROUP LTD.	UNITED KINGDOM	
12	H616	HORIBA LTD	JAPAN	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FH		**Description :** WATER QUALITY ANALYSERS (PH)		
Approved Suppliers				
1	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
2	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
3	I590	INVENSYS SOFTWARE SYSTEMS (S) PTE LTD	SINGAPORE	
4	Y006	YOKOGAWA INDIA LIMITED	INDIA	
5	27529	TETHYS INSTRUMENTS SAS	FRANCE	
6	M730	METTLER - TOLEDO AG	SWITZERLAND	
7	A200	ABB INDIA LTD (BANGALORE)	INDIA	
8	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	
9	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
10	F181	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
11	H638	HACH COMPANY	UNITED STATES	
12	4062	HACH OTT INDIA PVT. LTD.	INDIA	
13	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
14	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
15	E656	ENDRESS+HAUSER CONDUCTA GMBH+CO. KG	GERMANY	
16	H621	HONEYWELL INC.	UNITED STATES	
17	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FI		**Description :** GAS CHROMATOGRAPH (PROCESS)		
Approved Suppliers				
1	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
2	Y006	YOKOGAWA INDIA LIMITED	INDIA	
3	S5241	SIEMENS AG	GERMANY	
4	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
5	A758	APPLIED INSTRUMENTS TECHNOLOGIES INC.	UNITED STATES	
6	A200	ABB INDIA LTD (BANGALORE)	INDIA	
7	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
8	A682	ABB AUTOMATION LTD	UNITED KINGDOM	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FJ		**Description :** PROCESS STREAM ANALYSER(HYDROGEN-TCD)		
Approved Suppliers				
1	27509	ENDRESS+HAUSER SICK GMBH+CO. KG	GERMANY	
2	H616	HORIBA LTD	JAPAN	
3	S5241	SIEMENS AG	GERMANY	
4	A200	ABB INDIA LTD (BANGALORE)	INDIA	
5	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
6	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
7	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
8	G623	BAKER HUGHES EMEA UNLIMITED COMPANY	IRELAND	
9	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FK		**Description :** PRODUCT QUALITY ANALYSER SYSTEMS		
Approved Suppliers				
1	A200	ABB INDIA LTD (BANGALORE)	INDIA	
2	C015	CHEMTROLS INDUSTRIES PVT. LTD.	INDIA	
3	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
4	Y006	YOKOGAWA INDIA LIMITED	INDIA	
5	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
6	27433	THERMO ONIX LIMITED	UNITED KINGDOM	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FL		**Description :** AUTOMATIC GAS SAMPLER		
Approved Suppliers				
1	27416	CAMERON MEASUREMENT SYSTEMS	UNITED STATES	
2	27478	KIMMAN PROCESS SOLUTIONS B. V.	NETHERLANDS	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FM		**Description :** STACK GAS ANALYSER SYSTEMS (EXTRACTIVE)		
Approved Suppliers				
1	Y006	YOKOGAWA INDIA LIMITED	INDIA	
2	S5241	SIEMENS AG	GERMANY	
3	S768	SIGNAL GROUP LTD	UNITED KINGDOM	
4	S746	SERVOMEX GROUP LTD.	UNITED KINGDOM	
5	E608	ENVEA	FRANCE	
6	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
7	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
8	T223	THERMO FISHER SCIENTIFIC INDIA PVT. LTD.	INDIA	
9	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
10	27509	ENDRESS+HAUSER SICK GMBH+CO. KG	GERMANY	
11	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
12	4220	ACOEM ECOTECH INDUSTRIES PRIVATE LIMITED	INDIA	
13	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
14	H616	HORIBA LTD	JAPAN	
15	C015	CHEMTROLS INDUSTRIES PVT. LTD.	INDIA	
16	A200	ABB INDIA LTD (BANGALORE)	INDIA	
17	3891	ANALYSER INSTRUMENT CO PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FN		**Description :** GAS CHROMATOGRAPH (NATURAL GAS)		
Approved Suppliers				
1	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
2	E626	ELSTER-INSTROMET NV-FORMER. I563	BELGIUM	
3	A200	ABB INDIA LTD (BANGALORE)	INDIA	
4	D509	EMERSON PROCESS MANAGEMENT ASIA PACIFIC PTE LTD	UNITED STATES	
5	D143	EMERSON MEASUREMENT SYSTEMS AND SOLUTIONS (INDIA) PRIVATE LIMITED	INDIA	
6	R539	RMG REGEL+MESSTECHNIK GMBH	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FO		**Description :** AMBIENT AIR ANALYSER SYSTEMS		
Approved Suppliers				
1	T223	THERMO FISHER SCIENTIFIC INDIA PVT. LTD.	INDIA	
2	E608	ENVEA	FRANCE	
3	3911	ADAGE AUTOMATION PRIVATE LIMITED	INDIA	
4	T738	TELEDYNE MONITOR LABS (FORM. M-679)	UNITED STATES	
5	3891	ANALYSER INSTRUMENT CO PVT LTD	INDIA	
6	C015	CHEMTROLS INDUSTRIES PVT. LTD.	INDIA	
7	S768	SIGNAL GROUP LTD	UNITED KINGDOM	
8	4220	ACOEM ECOTECH INDUSTRIES PRIVATE LIMITED	INDIA	
9	O541	OPSIS AB	SWEDEN	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FP		**Description :** WATER QUALITY ANALYSERS (TURBIDITY)		
Approved Suppliers				
1	B739	B&C ELECTRONICS SRL	ITALY	
2	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
3	4062	HACH OTT INDIA PVT. LTD.	INDIA	
4	M730	METTLER - TOLEDO AG	SWITZERLAND	
5	H638	HACH COMPANY	UNITED STATES	
6	E656	ENDRESS+HAUSER CONDUCTA GMBH+CO. KG	GERMANY	
7	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
8	F181	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
9	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
10	A200	ABB INDIA LTD (BANGALORE)	INDIA	
11	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
12	Y006	YOKOGAWA INDIA LIMITED	INDIA	
13	S657	SERES OL	FRANCE	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FQ		**Description :** WATER QUALITY ANALYSERS (CONDUCTIVITY)		
Approved Suppliers				
1	M730	METTLER - TOLEDO AG	SWITZERLAND	
2	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
3	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	
4	H621	HONEYWELL INC.	UNITED STATES	
5	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
6	H638	HACH COMPANY	UNITED STATES	
7	F181	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
8	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
9	A200	ABB INDIA LTD (BANGALORE)	INDIA	
10	I590	INVENSYS SOFTWARE SYSTEMS (S) PTE LTD	SINGAPORE	
11	E656	ENDRESS+HAUSER CONDUCTA GMBH+CO. KG	GERMANY	
12	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
13	27529	TETHYS INSTRUMENTS SAS	FRANCE	
14	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
15	Y006	YOKOGAWA INDIA LIMITED	INDIA	
16	4062	HACH OTT INDIA PVT. LTD.	INDIA	
17	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FR		**Description :** ANALYSER SHELTER		
Approved Suppliers				
1	4175	AXIS ENGINEERING INDIA PVT LTD	INDIA	
2	4028	AXIS SOLUTIONS LIMITED	INDIA	
3	3891	ANALYSER INSTRUMENT CO PVT LTD	INDIA	
4	C015	CHEMTROLS INDUSTRIES PVT. LTD.	INDIA	
5	3944	STEAM EQUIPMENTS PVT LTD	INDIA	
6	Y006	YOKOGAWA INDIA LIMITED	INDIA	
7	A200	ABB INDIA LTD (BANGALORE)	INDIA	
8	3911	ADAGE AUTOMATION PRIVATE LIMITED	INDIA	
9	P214	PYROTECH ELECTRONICS PVT LTD	INDIA	
10	A361	AXIS SOLUTIONS LIMITED	INDIA	
11	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FS		**Description :** PROCESS STREAM ANALYSER(IR/UV)		
Approved Suppliers				
1	27509	ENDRESS+HAUSER SICK GMBH+CO. KG	GERMANY	
2	A758	APPLIED INSTRUMENTS TECHNOLOGIES INC.	UNITED STATES	
3	Y006	YOKOGAWA INDIA LIMITED	INDIA	
4	S768	SIGNAL GROUP LTD	UNITED KINGDOM	
5	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
6	S5241	SIEMENS AG	GERMANY	
7	H616	HORIBA LTD	JAPAN	
8	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
9	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
10	A200	ABB INDIA LTD (BANGALORE)	INDIA	
11	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
12	S746	SERVOMEX GROUP LTD.	UNITED KINGDOM	
13	A682	ABB AUTOMATION LTD	UNITED KINGDOM	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FT		**Description :** PROCESS STREAM ANALYSER(H.C.-TCD/FID)		
Approved Suppliers				
1	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
2	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
3	S5241	SIEMENS AG	GERMANY	
4	A200	ABB INDIA LTD (BANGALORE)	INDIA	
5	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
6	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FU		**Description :** ANALYSER SYSTEMS		
Approved Suppliers				
1	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
2	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
3	C015	CHEMTROLS INDUSTRIES PVT. LTD.	INDIA	
4	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
5	A758	APPLIED INSTRUMENTS TECHNOLOGIES INC.	UNITED STATES	
6	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
7	S5241	SIEMENS AG	GERMANY	
8	4028	AXIS SOLUTIONS LIMITED	INDIA	
9	A200	ABB INDIA LTD (BANGALORE)	INDIA	
10	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
11	3911	ADAGE AUTOMATION PRIVATE LIMITED	INDIA	
12	Y006	YOKOGAWA INDIA LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FV		**Description :** STACK GAS ANALYSER SYSTEMS (INSITU)		
Approved Suppliers				
1	S803	ENDRESS+HAUSER SICK GMBH+CO. KG	GERMANY	
2	K651	KITTIWAKE PROCAL LTD	UNITED KINGDOM	
3	C015	CHEMTROLS INDUSTRIES PVT. LTD.	INDIA	
4	S5241	SIEMENS AG	GERMANY	
5	F181	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FW		**Description :** STACK GAS ANALYSERS (SPM)		
Approved Suppliers				
1	F181	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
2	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
3	27475	FIVES PILLARD	FRANCE	
4	E608	ENVEA	FRANCE	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FX		**Description :** WATER QUALITY ANALYSER-OIL IN H20 TOC/TC		
Approved Suppliers				
1	H638	HACH COMPANY	UNITED STATES	
2	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
3	4062	HACH OTT INDIA PVT. LTD.	INDIA	
4	S657	SERES OL	FRANCE	
5	S758	SHIMADZU CORPORATION	JAPAN	
6	F181	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	
7	27529	TETHYS INSTRUMENTS SAS	FRANCE	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FY		**Description :** WATER QUALITY ANALYSER-OIL IN H20 DISLVD		
Approved Suppliers				
1	B616	BRISTOL BABCOCK LTD	AUSTRALIA	
2	27529	TETHYS INSTRUMENTS SAS	FRANCE	
3	R624	RIVERTRACE ENGINEERING LTD	UNITED KINGDOM	
4	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
5	4062	HACH OTT INDIA PVT. LTD.	INDIA	
6	F181	FORBES MARSHALL PVT. LTD.- PUNE	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15FZ		**Description :** WATER QUALITY ANALYSERS(CHLORINE)		
Approved Suppliers				
1	27529	TETHYS INSTRUMENTS SAS	FRANCE	
2	Y006	YOKOGAWA INDIA LIMITED	INDIA	
3	A200	ABB INDIA LTD (BANGALORE)	INDIA	
4	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
5	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
6	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
7	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
8	4062	HACH OTT INDIA PVT. LTD.	INDIA	
9	H638	HACH COMPANY	UNITED STATES	
10	E656	ENDRESS+HAUSER CONDUCTA GMBH+CO. KG	GERMANY	
11	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
12	B739	B&C ELECTRONICS SRL	ITALY	
13	S657	SERES OL	FRANCE	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15GA		**Description :** ORIFICE PLATES & FLANGES		
Approved Suppliers				
1	M313	MINCO (I) FLOW ELEMENT P. LTD. (GIC CO.)	INDIA	
2	M045	MINCO (INDIA) PVT LTD (GEN. INST.)	INDIA	
3	P514	PETROL VALVES SPA	ITALY	
4	T516	TM TECNOMATIC SPA	ITALY	
5	P538	PIETRO FIORENTINI SPA	ITALY	
6	E022	EUREKA INDUSTRIAL EQUIPMENTS (P) LTD.	INDIA	
7	27415	CAMERON CANADA CORPORATION	CANADA	
8	3867	DYNAFLUID VALVES AND FLOW CONTROLS P LTD	INDIA	
9	G016	GURU NANAK ENGG WORKS	INDIA	
10	M010	WIKA PROCESS SOLUTIONS INDIA PRIVATE LIMITED	INDIA	
11	3936	ADITYA ENGINEERING WORKS	INDIA	
12	27512	CANALTA CONTROLS LIMITED	CANADA	
13	C201	CHEMTROLS SAMIL (INDIA) PVT LTD	INDIA	
14	3648	HYDROPNEUMATICS PVT. LTD	INDIA	
15	T095	TEMP-TECH	INDIA	
16	J067	METAVAL ENGINEERING PRIVATE LIMITED	INDIA	
17	C220	COMFIT & VALVES PVT. LTD.	INDIA	
18	D509	EMERSON PROCESS MANAGEMENT ASIA PACIFIC PTE LTD	UNITED STATES	
19	S286	STAR-MECH CONTROLS (INDIA) PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15GB		**Description :** FLOW ELEMENTS-WEDGE TYPE		
Approved Suppliers				
1	T516	TM TECNOMATIC SPA	ITALY	
2	J067	METAVAL ENGINEERING PRIVATE LIMITED	INDIA	
3	M010	WIKA PROCESS SOLUTIONS INDIA PRIVATE LIMITED	INDIA	
4	A200	ABB INDIA LTD (BANGALORE)	INDIA	
5	M313	MINCO (I) FLOW ELEMENT P. LTD. (GIC CO.)	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15GC		**Description :** FLOW ELEMENTS:(VENTURI,FLOW NOZZLES)		
Approved Suppliers				
1	T516	TM TECNOMATIC SPA	ITALY	
2	3867	DYNAFLUID VALVES AND FLOW CONTROLS P LTD	INDIA	
3	M313	MINCO (I) FLOW ELEMENT P. LTD. (GIC CO.)	INDIA	
4	C201	CHEMTROLS SAMIL (INDIA) PVT LTD	INDIA	
5	M045	MINCO (INDIA) PVT LTD (GEN. INST.)	INDIA	
6	E022	EUREKA INDUSTRIAL EQUIPMENTS (P) LTD.	INDIA	
7	S286	STAR-MECH CONTROLS (INDIA) PVT LTD	INDIA	
8	J067	METAVAL ENGINEERING PRIVATE LIMITED	INDIA	
9	3648	HYDROPNEUMATICS PVT. LTD	INDIA	
10	M010	WIKA PROCESS SOLUTIONS INDIA PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15HB		**Description :** OPTICAL PYROMETERS		
Approved Suppliers				
1	L705	LUMASENSE TECHNOLOGIES GMBH	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15HD		**Description :** TEMP.ELEMENTS,THERMOWELLS		
Approved Suppliers				
1	G622	GAYESCO-WIKA USA, LP	UNITED STATES	
2	D004	DETRIV INSTRUMENTATION & ELECTRONICS LTD	INDIA	
3	A206	ALTOP INDUSTRIES LTD.	INDIA	
4	T516	TM TECNOMATIC SPA	ITALY	
5	T514	THERMO ELECTRIC CO. INC.	UNITED STATES	
6	W061	WIKA INSTRUMENTS INDIA PVT LTD	INDIA	
7	T095	TEMP-TECH	INDIA	
8	3744	TOSHNIWAL INDUSTRIES PVT LTD	INDIA	
9	W589	WIKA ALEXANDER WIEGAND & CO GMBH	GERMANY	
10	D677	DAILY THERMETRICS CORPORATION	UNITED STATES	
11	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
12	T232	TECHNO INSTRUMENTS	INDIA	
13	P190	PYRO-ELECTRIC INSTRUMENTS GOA PVT LTD	INDIA	
14	T241	THERMAL INSTRUMENT (I) P LTD (GEN.INST.)	INDIA	
15	3638	GAUGES BOURDON (I) PVT LTD (GEN. INST)	INDIA	
16	T146	TEMPSENS INSTRUMENTS INDIA PVT LTD	INDIA	
17	B213	BAUMER TECHNOLOGIES INDIA PVT.LTD(W058)	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15HF		**Description :** SKIN THERMOCOUPLES		
Approved Suppliers				
1	T514	THERMO ELECTRIC CO. INC.	UNITED STATES	
2	P190	PYRO-ELECTRIC INSTRUMENTS GOA PVT LTD	INDIA	
3	T241	THERMAL INSTRUMENT (I) P LTD (GEN.INST.)	INDIA	
4	T146	TEMPSENS INSTRUMENTS INDIA PVT LTD	INDIA	
5	T232	TECHNO INSTRUMENTS	INDIA	
6	D677	DAILY THERMETRICS CORPORATION	UNITED STATES	
7	4050	YAMARI INDIA TEMPERATURE SENSOR PVT LTD	INDIA	
8	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
9	G622	GAYESCO-WIKA USA, LP	UNITED STATES	
10	T516	TM TECNOMATIC SPA	ITALY	
11	3638	GAUGES BOURDON (I) PVT LTD (GEN. INST)	INDIA	
12	D004	DETRIV INSTRUMENTATION & ELECTRONICS LTD	INDIA	
13	W061	WIKA INSTRUMENTS INDIA PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15HG		**Description :** SPECIAL TEMPERATURE ELEMENTS		
Approved Suppliers				
1	T516	TM TECNOMATIC SPA	ITALY	
2	3638	GAUGES BOURDON (I) PVT LTD (GEN. INST)	INDIA	
3	G622	GAYESCO-WIKA USA, LP	UNITED STATES	
4	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
5	W061	WIKA INSTRUMENTS INDIA PVT LTD	INDIA	
6	P190	PYRO-ELECTRIC INSTRUMENTS GOA PVT LTD	INDIA	
7	T514	THERMO ELECTRIC CO. INC.	UNITED STATES	
8	T241	THERMAL INSTRUMENT (I) P LTD (GEN.INST.)	INDIA	
9	D677	DAILY THERMETRICS CORPORATION	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15IA		**Description :** GAS DETECTION SYSTEMS		
Approved Suppliers				
1	3903	UNIPHOS ENVIROTRONIC PVT LTD	INDIA	
2	H637	HONEYWELL ANALYTICS LIMITED	UNITED KINGDOM	
3	27495	GASTRON CO LIMITED	KOREA, REPUBLIC OF	
4	N621	NET SAFETY MONITORING INC	CANADA	
5	D621	DETECTOR ELECTRONICS CORP.(KIDDE CO.)	UNITED STATES	
6	M595	MINE SAFETY APPLIANCES COMPANY	UNITED STATES	
7	D651	DRAGER SAFETY AG & CO. KGAA	GERMANY	
8	3870	ENDEE ENGINEERS PVT LTD	INDIA	
9	27486	JSC ELECTRONSTANDART-PRIBOR(ESP CO)	RUSSIAN FEDERATION	
10	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
11	27548	GENERAL MONITORS IRELAND LIMITED	IRELAND	
12	R710	RESPO PRODUCTS	UNITED STATES	
13	C648	CROWCON DETECTION INSTRUMENTS LTD	UNITED KINGDOM	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15IB		**Description :** FIRE & GAS DETECTION SYSTEMS		
Approved Suppliers				
1	D621	DETECTOR ELECTRONICS CORP.(KIDDE CO.)	UNITED STATES	
2	27486	JSC ELECTRONSTANDART-PRIBOR(ESP CO)	RUSSIAN FEDERATION	
3	M595	MINE SAFETY APPLIANCES COMPANY	UNITED STATES	
4	27548	GENERAL MONITORS IRELAND LIMITED	IRELAND	
5	N621	NET SAFETY MONITORING INC	CANADA	
6	D694	DETCON INC	UNITED STATES	
7	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
8	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
9	H637	HONEYWELL ANALYTICS LIMITED	UNITED KINGDOM	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15IC		**Description :** PRODUCT QUALITY ANALYSERS (NIR)		
Approved Suppliers				
1	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
2	B726	BARTEC GMBH	GERMANY	
3	Y006	YOKOGAWA INDIA LIMITED	INDIA	
4	A758	APPLIED INSTRUMENTS TECHNOLOGIES INC.	UNITED STATES	
5	A200	ABB INDIA LTD (BANGALORE)	INDIA	
6	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
7	M720	MODCON SYSTEMS LTD.	ISRAEL	
8	G625	GUIDED WAVE INCORPORATED	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15ID		**Description :** PRODUCT QUALITY ANALYSERS (VISCOSITY)		
Approved Suppliers				
1	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
2	P688	PAC LP	UNITED STATES	
3	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15IF		**Description :** PRODUCT QUALITY ANALYSERS (FLASH POINT)		
Approved Suppliers				
1	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
2	A682	ABB AUTOMATION LTD	UNITED KINGDOM	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15IG		**Description :** PRODUCT QUALITY ANALYSERS (DISTILLATION)		
Approved Suppliers				
1	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
2	P688	PAC LP	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15IH		**Description :** PRODUCT QUALITY ANALYSER (SULPHUR)		
Approved Suppliers				
1	A200	ABB INDIA LTD (BANGALORE)	INDIA	
2	27433	THERMO ONIX LIMITED	UNITED KINGDOM	
3	P688	PAC LP	UNITED STATES	
4	S815	SPECTRO ANALYTICAL INSTRUMENTS INC	UNITED STATES	
5	G606	GALVANIC APPLIED SCIENCES INC.	CANADA	
6	A682	ABB AUTOMATION LTD	UNITED KINGDOM	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15IJ		**Description :** STACK GAS ANALYSERS (O2-ZIRCONIA)		
Approved Suppliers				
1	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
2	27550	ENOTEC GMBH	GERMANY	
3	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
4	A200	ABB INDIA LTD (BANGALORE)	INDIA	
5	A5102	AMETEK	UNITED STATES	
6	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
7	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
8	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
9	S746	SERVOMEX GROUP LTD.	UNITED KINGDOM	
10	Y006	YOKOGAWA INDIA LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15IK		**Description :** ANALYSER-DENSITY/SP. GRAVITY (NUCLEONIC)		
Approved Suppliers				
1	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	
2	O522	OHMART/VEGA CORPORATION	UNITED STATES	
3	E657	ENDRESS+HAUSER SE+CO. KG	GERMANY	
4	A724	ABB AUTOMATION-REFER A746	NETHERLANDS	
5	B710	BERTHOLD TECHNOLOGIES GMBH & CO.KG	GERMANY	
6	R540	RONAN ENGINEERING COMPANY	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15IL		**Description :** ANALYSER-DENSITY/SP GRAVTY (VIB CYLINDR)		
Approved Suppliers				
1	B617	BOPP & REUTHER MESSTECHNIK GMBH	GERMANY	
2	M715	MOBREY LTD (FORM. S-578)	UNITED KINGDOM	
3	T7361	THERMO FISHER SCIENTIFIC	UNITED STATES	
4	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15IM		**Description :** ANALYSER-DENSITY/SP GRAVITY (CORIOLIS)		
Approved Suppliers				
1	27469	KROHNE LIMITED	UNITED KINGDOM	
2	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
3	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
4	3599	Endress+Hauser Flowtec (India) Pvt Ltd	INDIA	
5	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	
6	E525	ENDRESS + HAUSER FLOWTEC AG	SWITZERLAND	
7	Y006	YOKOGAWA INDIA LIMITED	INDIA	
8	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15IN		**Description :** AUTOMATIC LIQUID SAMPLER		
Approved Suppliers				
1	27478	KIMMAN PROCESS SOLUTIONS B. V.	NETHERLANDS	
2	J539	JISKOOT LTD	UNITED KINGDOM	
3	27416	CAMERON MEASUREMENT SYSTEMS	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15IR		**Description :** PRODUCT QUALITY ANALYSERS (RVP)		
Approved Suppliers				
1	A200	ABB INDIA LTD (BANGALORE)	INDIA	
2	B726	BARTEC GMBH	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15IT		**Description :** WOBBE METERS		
Approved Suppliers				
1	H664	HOBRE INSTRUMENTS	NETHERLANDS	
2	C749	COSA XENTAUR CORPORATION	UNITED STATES	
3	S5241	SIEMENS AG	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15JA		**Description :** PROGRAMMABLE LOGIC CONTROLLERS		
Approved Suppliers				
1	R612	ROCKWELL AUTOMATION INC.	UNITED STATES	
2	R178	ROCKWELL AUTOMATION INDIA PVT LTD	INDIA	
3	I574	ICS TRIPLEX (EMEA) PLC	UNITED KINGDOM	
4	Y006	YOKOGAWA INDIA LIMITED	INDIA	
5	H621	HONEYWELL INC.	UNITED STATES	
6	H632	HIMA PAUL HILDEBRANDT GMBH + CO KG	GERMANY	
7	A661	ASEA BROWN BOVERY LTD (ABB LTD)	SWITZERLAND	
8	A200	ABB INDIA LTD (BANGALORE)	INDIA	
9	4069	SIEMENS LTD.	INDIA	
10	I590	INVENSYS SOFTWARE SYSTEMS (S) PTE LTD	SINGAPORE	
11	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
12	3985	YOKOGAWA INDIA LIMITED	INDIA	
13	L001A	SCHNEIDER ELECTRIC INDIA PVT LTD	INDIA	
14	G143	EMERSON AUTOMATION SOLUTIONS INTELLIGENT PLATFORMS PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15KA		**Description :** PRESSURE GAUGES		
Approved Suppliers				
1	B696	BADOTHERM PROCESS INSTRUMENTS B.V.	NETHERLANDS	
2	W589	WIKA ALEXANDER WIEGAND & CO GMBH	GERMANY	
3	B213	BAUMER TECHNOLOGIES INDIA PVT.LTD(W058)	INDIA	
4	T241	THERMAL INSTRUMENT (I) P LTD (GEN.INST.)	INDIA	
5	F114	FORBES MARSHALL (HYD) PVT. LTD	INDIA	
6	W061	WIKA INSTRUMENTS INDIA PVT LTD	INDIA	
7	3994	ITEC MEASURES PVT. LTD.	INDIA	
8	W064	WALCHANDNAGAR INDUSTRIES LTD(TIWAC DIVN)	INDIA	
9	G115	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	
10	A362	PRECISION MASS PRODUCTS PVT. LTD.	INDIA	
11	H081	H GURU INSTRUMENTS(SOUTH INDIA)PVT. LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15KB		**Description :** DRAFT GAUGES		
Approved Suppliers				
1	B696	BADOTHERM PROCESS INSTRUMENTS B.V.	NETHERLANDS	
2	A362	PRECISION MASS PRODUCTS PVT. LTD.	INDIA	
3	W589	WIKA ALEXANDER WIEGAND & CO GMBH	GERMANY	
4	S087	SWITZER PROCESS INSTRUMENTS PVT. LTD.	INDIA	
5	G115	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15KD		**Description :** DIFFERENTIAL PRESSURE GAUGES		
Approved Suppliers				
1	A362	PRECISION MASS PRODUCTS PVT. LTD.	INDIA	
2	F114	FORBES MARSHALL (HYD) PVT. LTD	INDIA	
3	G115	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	
4	S087	SWITZER PROCESS INSTRUMENTS PVT. LTD.	INDIA	
5	B213	BAUMER TECHNOLOGIES INDIA PVT.LTD(W058)	INDIA	
6	W061	WIKA INSTRUMENTS INDIA PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15LA		**Description :** TEMP.GAUGES(BI METALLIC,FILLED SYSTEM)		
Approved Suppliers				
1	B213	BAUMER TECHNOLOGIES INDIA PVT.LTD(W058)	INDIA	
2	F114	FORBES MARSHALL (HYD) PVT. LTD	INDIA	
3	B696	BADOTHERM PROCESS INSTRUMENTS B.V.	NETHERLANDS	
4	W589	WIKA ALEXANDER WIEGAND & CO GMBH	GERMANY	
5	A362	PRECISION MASS PRODUCTS PVT. LTD.	INDIA	
6	T241	THERMAL INSTRUMENT (I) P LTD (GEN.INST.)	INDIA	
7	H081	H GURU INSTRUMENTS(SOUTH INDIA)PVT. LTD	INDIA	
8	G115	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	
9	W064	WALCHANDNAGAR INDUSTRIES LTD(TIWAC DIVN)	INDIA	
10	W061	WIKA INSTRUMENTS INDIA PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15MB		**Description :** VARIABLE AREA FLOW METERS(I,T)		
Approved Suppliers				
1	T530	TOKYO KEISO CO LTD	JAPAN	
2	A682A	ABB AUTOMATION PRODUCTS GMBH	GERMANY	
3	K582	KROHNE MESSTECHNIK GMBH	GERMANY	
4	B510	BROOKS INSTRUMENT	UNITED STATES	
5	P293	PLACKA INSTRUMENTS INDIA P LTD	INDIA	
6	E022	EUREKA INDUSTRIAL EQUIPMENTS (P) LTD.	INDIA	
7	C015	CHEMTROLS INDUSTRIES PVT. LTD.	INDIA	
8	R515	ROTA YOKOGAWA GMBH & CO. KG	GERMANY	
9	Y006	YOKOGAWA INDIA LIMITED	INDIA	
10	A623	ASA SPA	ITALY	
11	I030	INSTRUMENTATION ENGINEERS PVT. LTD.	INDIA	
12	K105	KROHNE MARSHALL PVT. LTD	INDIA	
13	A172	ALFLOW GLASS EQUIPMENTS	INDIA	
14	H626	HEINRICHS MESSTECHNIK GMBH	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15NA		**Description :** MAGNETIC FLOW METERS		
Approved Suppliers				
1	Y006	YOKOGAWA INDIA LIMITED	INDIA	
2	A682A	ABB AUTOMATION PRODUCTS GMBH	GERMANY	
3	I590	INVENSYS SOFTWARE SYSTEMS (S) PTE LTD	SINGAPORE	
4	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
5	3599	Endress+Hauser Flowtec (India) Pvt Ltd	INDIA	
6	27471	KROHNE ALTOMETER	NETHERLANDS	
7	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	
8	27541	ENDRESS + HAUSER FLOWTEC AG	FRANCE	
9	I030	INSTRUMENTATION ENGINEERS PVT. LTD.	INDIA	
10	H626	HEINRICHS MESSTECHNIK GMBH	GERMANY	
11	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
12	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
13	K105	KROHNE MARSHALL PVT. LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15NB		**Description :** TERMINAL AUTOMATION SYSTEM		
Approved Suppliers				
1	L001A	SCHNEIDER ELECTRIC INDIA PVT LTD	INDIA	
2	C015	CHEMTROLS INDUSTRIES PVT. LTD.	INDIA	
3	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
4	A363	ADVANCED SYS-TEK LIMITED	INDIA	
5	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
6	Y006	YOKOGAWA INDIA LIMITED	INDIA	
7	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15NC		**Description :** POSITIVE DISPLACEMENT METERS		
Approved Suppliers				
1	B617	BOPP & REUTHER MESSTECHNIK GMBH	GERMANY	
2	T218	TOSHNIWAL HYVAC PVT. LTD.	INDIA	
3	O523	OVAL CORPORATION	JAPAN	
4	F640	FMC MEASUREMENT SOLUTIONS	UNITED STATES	
5	P631	PETROL INSTRUMENTS SRL	ITALY	
6	27415	CAMERON CANADA CORPORATION	CANADA	
7	I200	IDEX FLUID & METERING P.LTD-FORM. L053	INDIA	
8	T116	TELTECH INSTRUMENTATION PVT.LTD.	INDIA	
9	4165	FLUIDYNE CONTROL SYSTEMS PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15ND		**Description :** ULTRASONIC FLOW METER		
Approved Suppliers				
1	4291	EXIMP MEASUREMENT PRIVATE LIMITED		
2	F661	FLEXIM FLEXIBLE INDUSTRIEMESSTECNIK GMBH	GERMANY	
3	27545	TRANSUS INSTRUMENTS BV	NETHERLANDS	
4	27433	THERMO ONIX LIMITED	UNITED KINGDOM	
5	S5241	SIEMENS AG	GERMANY	
6	27471	KROHNE ALTOMETER	NETHERLANDS	
7	F528	FAURE HERMAN	FRANCE	
8	D143	EMERSON MEASUREMENT SYSTEMS AND SOLUTIONS (INDIA) PRIVATE LIMITED	INDIA	
9	27579	FLUENTA AS	POLAND	
10	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	
11	G623	BAKER HUGHES EMEA UNLIMITED COMPANY	IRELAND	
12	D509	EMERSON PROCESS MANAGEMENT ASIA PACIFIC PTE LTD	UNITED STATES	
13	E525	ENDRESS + HAUSER FLOWTEC AG	SWITZERLAND	
14	R539	RMG REGEL+MESSTECHNIK GMBH	GERMANY	
15	E626	ELSTER-INSTROMET NV-FORMER. I563	BELGIUM	
16	27508	ENDRESS+HAUSER SICK GMBH+CO. KG	GERMANY	
17	F640A	FMC MEASUREMENT SOLUTIONS-UK	UNITED KINGDOM	
18	C720	CAMERON TECHNOLOGIES US, INC	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15NF		**Description :** VORTEX FLOW METER		
Approved Suppliers				
1	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
2	A682A	ABB AUTOMATION PRODUCTS GMBH	GERMANY	
3	K582	KROHNE MESSTECHNIK GMBH	GERMANY	
4	27541	ENDRESS + HAUSER FLOWTEC AG	FRANCE	
5	O523	OVAL CORPORATION	JAPAN	
6	Y006	YOKOGAWA INDIA LIMITED	INDIA	
7	R539	RMG REGEL+MESSTECHNIK GMBH	GERMANY	
8	3599	Endress+Hauser Flowtec (India) Pvt Ltd	INDIA	
9	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
10	B617	BOPP & REUTHER MESSTECHNIK GMBH	GERMANY	
11	K105	KROHNE MARSHALL PVT. LTD	INDIA	
12	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
13	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15NG		**Description :** TURBINE FLOW METERS		
Approved Suppliers				
1	D509	EMERSON PROCESS MANAGEMENT ASIA PACIFIC PTE LTD	UNITED STATES	
2	F528	FAURE HERMAN	FRANCE	
3	B617	BOPP & REUTHER MESSTECHNIK GMBH	GERMANY	
4	H507	HOFFER FLOW CONTROLS INC	UNITED STATES	
5	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
6	R058	ROCKWIN FLOWMETER INDIA (P) LTD	INDIA	
7	R539	RMG REGEL+MESSTECHNIK GMBH	GERMANY	
8	27416	CAMERON MEASUREMENT SYSTEMS	UNITED STATES	
9	F640	FMC MEASUREMENT SOLUTIONS	UNITED STATES	
10	S809	SENSUS METERING SYSTEMS INC (FORM. I589)	UNITED STATES	
11	E626	ELSTER-INSTROMET NV-FORMER. I563	BELGIUM	
12	V606	VEMMTEC MESSTECHNIK GMBH	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15NI		**Description :** MASS FLOW METERS		
Approved Suppliers				
1	F641	FOX THERMAL INSTRUMENT INC.	UNITED STATES	
2	H626	HEINRICHS MESSTECHNIK GMBH	GERMANY	
3	M508	MAGNETROL INTERNATIONAL N.V	BELGIUM	
4	K616	KURZ INSTRUMENTS INC	UNITED STATES	
5	3599	Endress+Hauser Flowtec (India) Pvt Ltd	INDIA	
6	Y006	YOKOGAWA INDIA LIMITED	INDIA	
7	R604	RHEONIK MESSTECHNIK GMBH	GERMANY	
8	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
9	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	
10	B510	BROOKS INSTRUMENT	UNITED STATES	
11	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
12	27469	KROHNE LIMITED	UNITED KINGDOM	
13	A682A	ABB AUTOMATION PRODUCTS GMBH	GERMANY	
14	B621	BRONKHORST HIGH TECH BV	NETHERLANDS	
15	R515	ROTA YOKOGAWA GMBH & CO. KG	GERMANY	
16	F576	FLUID COMPONENTS INTERNATIONAL LLC	UNITED STATES	
17	E525	ENDRESS + HAUSER FLOWTEC AG	SWITZERLAND	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15OA		**Description :** GAUGE GLASSES & COCKS		
Approved Suppliers				
1	B110	BLISS ANAND PVT LTD	INDIA	
2	N141	NISAN SCIENTIFIC PROCESS EQUIP. P LTD	INDIA	
3	3638	GAUGES BOURDON (I) PVT LTD (GEN. INST)	INDIA	
4	J543	JERGUSON GAUGE & VALVE	UNITED STATES	
5	C201	CHEMTROLS SAMIL (INDIA) PVT LTD	INDIA	
6	S036	SIGMA INSTRUMENTS CO	INDIA	
7	N520	NIHON KLINGAGE CO LTD	JAPAN	
8	K637	KLINGER SPA	ITALY	
9	P239	PUNE TECHTROL PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15OB		**Description :** DRUM LEVEL INSTRUMENTS (ELECTRONIC)		
Approved Suppliers				
1	M715	MOBREY LTD (FORM. S-578)	UNITED KINGDOM	
2	4232	HI-TECH SYSTEMS & SERVICES LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15OC		**Description :** DRUM LEVEL INSTRUMENTS (BI-COLOUR GAUGE)		
Approved Suppliers				
1	J543	JERGUSON GAUGE & VALVE	UNITED STATES	
2	N520	NIHON KLINGAGE CO LTD	JAPAN	
3	4232	HI-TECH SYSTEMS & SERVICES LTD	INDIA	
4	K637	KLINGER SPA	ITALY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15OD		**Description :** TANK LEVEL INSTRUMENTS (FLOAT OPERATED)		
Approved Suppliers				
1	S036	SIGMA INSTRUMENTS CO	INDIA	
2	T530	TOKYO KEISO CO LTD	JAPAN	
3	E550	ENRAF B.V. (GR. COMPANY OF HONEYWELL)	NETHERLANDS	
4	L562	L & J TECHNOLOGIES	UNITED STATES	
5	N025	NIVO CONTROLS PVT LTD	INDIA	
6	S006	SBEM PVT LTD	INDIA	
7	E625	ENDRESS+HAUSER YAMANASHI CO. LTD.	JAPAN	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15OF		**Description :** MAGNETIC LEVEL INSTRUMENTS		
Approved Suppliers				
1	A759	ABB INC (FORMLY K622)	UNITED STATES	
2	K105	KROHNE MARSHALL PVT. LTD	INDIA	
3	K637	KLINGER SPA	ITALY	
4	C015	CHEMTROLS INDUSTRIES PVT. LTD.	INDIA	
5	B110	BLISS ANAND PVT LTD	INDIA	
6	P239	PUNE TECHTROL PVT LTD	INDIA	
7	3638	GAUGES BOURDON (I) PVT LTD (GEN. INST)	INDIA	
8	3977	WIKA INSTRUMENTS INDIA PVT. LTD.	INDIA	
9	27470	KROHNE S.A.S.	FRANCE	
10	S148	SHRIDHAN AUTOMATION PVT LTD	INDIA	
11	S036	SIGMA INSTRUMENTS CO	INDIA	
12	V047	V AUTOMAT & INSTRUMENTS PVT LTD	INDIA	
13	C201	CHEMTROLS SAMIL (INDIA) PVT LTD	INDIA	
14	M508	MAGNETROL INTERNATIONAL N.V	BELGIUM	
15	N520	NIHON KLINGAGE CO LTD	JAPAN	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15OG		**Description :** SPL. LEVEL INSTRUMENTS-GUIDED WAVE RADAR		
Approved Suppliers				
1	A759	ABB INC (FORMLY K622)	UNITED STATES	
2	27470	KROHNE S.A.S.	FRANCE	
3	V518	VEGA GRIESHABER KG	GERMANY	
4	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
5	M508	MAGNETROL INTERNATIONAL N.V	BELGIUM	
6	E657	ENDRESS+HAUSER SE+CO. KG	GERMANY	
7	4246	VEGA INDIA LEVEL & PRESSURE MEASUREMENT PVT. LTD.	INDIA	
8	L562	L & J TECHNOLOGIES	UNITED STATES	
9	E232	ENDRESS+HAUSER (I) AUTO. INSTR. PVT. LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15OH		**Description :** TANK FARM MANAGEMENT SYSTEM		
Approved Suppliers				
1	R616	ROSEMOUNT TANK RADAR AB (FORM. S691)	SWEDEN	
2	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
3	S006	SBEM PVT LTD	INDIA	
4	E550	ENRAF B.V. (GR. COMPANY OF HONEYWELL)	NETHERLANDS	
5	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	
6	E657	ENDRESS+HAUSER SE+CO. KG	GERMANY	
7	L562	L & J TECHNOLOGIES	UNITED STATES	
8	T530	TOKYO KEISO CO LTD	JAPAN	
9	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15OS		**Description :** TANK LEVEL INSTRUMENT (SERVO TYPE)		
Approved Suppliers				
1	L562	L & J TECHNOLOGIES	UNITED STATES	
2	E550	ENRAF B.V. (GR. COMPANY OF HONEYWELL)	NETHERLANDS	
3	E625	ENDRESS+HAUSER YAMANASHI CO. LTD.	JAPAN	
4	S006	SBEM PVT LTD	INDIA	
5	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	
6	T530	TOKYO KEISO CO LTD	JAPAN	
7	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15PA		**Description :** SPECIAL LEVEL INSTRUMENTS (RF TYPE)		
Approved Suppliers				
1	A727	AMETEK DREXELBROOK	UNITED STATES	
2	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	
3	M508	MAGNETROL INTERNATIONAL N.V	BELGIUM	
4	M715	MOBREY LTD (FORM. S-578)	UNITED KINGDOM	
5	A759	ABB INC (FORMLY K622)	UNITED STATES	
6	E657	ENDRESS+HAUSER SE+CO. KG	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15PB		**Description :** SPECIAL LEVEL INSTRUMENTS (CAP.& COND.)		
Approved Suppliers				
1	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	
2	A727	AMETEK DREXELBROOK	UNITED STATES	
3	S006	SBEM PVT LTD	INDIA	
4	E657	ENDRESS+HAUSER SE+CO. KG	GERMANY	
5	M508	MAGNETROL INTERNATIONAL N.V	BELGIUM	
6	V518	VEGA GRIESHABER KG	GERMANY	
7	V590	VENTURE MEASUREMENT COMPANY	UNITED STATES	
8	M715	MOBREY LTD (FORM. S-578)	UNITED KINGDOM	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15PC		**Description :** LEVEL SWITCHES(DISPLACER/FLOAT)		
Approved Suppliers				
1	M715	MOBREY LTD (FORM. S-578)	UNITED KINGDOM	
2	S006	SBEM PVT LTD	INDIA	
3	S036	SIGMA INSTRUMENTS CO	INDIA	
4	D027	DAG PROCESS INSTRUMENTS PVT LTD	INDIA	
5	V047	V AUTOMAT & INSTRUMENTS PVT LTD	INDIA	
6	E657	ENDRESS+HAUSER SE+CO. KG	GERMANY	
7	T530	TOKYO KEISO CO LTD	JAPAN	
8	M508	MAGNETROL INTERNATIONAL N.V	BELGIUM	
9	P239	PUNE TECHTROL PVT LTD	INDIA	
10	B110	BLISS ANAND PVT LTD	INDIA	
11	S552	SOR INC.	UNITED STATES	
12	C201	CHEMTROLS SAMIL (INDIA) PVT LTD	INDIA	
13	E6232	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15PH		**Description :** NUCLEONIC LEVEL INSTRUMENTS		
Approved Suppliers				
1	E657	ENDRESS+HAUSER SE+CO. KG	GERMANY	
2	B710	BERTHOLD TECHNOLOGIES GMBH & CO.KG	GERMANY	
3	R540	RONAN ENGINEERING COMPANY	UNITED STATES	
4	T753	TRACERCO LTD	UNITED KINGDOM	
5	O522	OHMART/VEGA CORPORATION	UNITED STATES	
6	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15PI		**Description :** PRESSURE SWITCHES		
Approved Suppliers				
1	R526	ROBERTSHAW CONTROLS CO	UNITED STATES	
2	D027	DAG PROCESS INSTRUMENTS PVT LTD	INDIA	
3	P608	PYROPRESS LIMITED	UNITED KINGDOM	
4	S573	SIRCO CONTROLS LIMITED	UNITED KINGDOM	
5	U503	UNITED ELECTRIC CONTROLS CO	UNITED STATES	
6	A555	ASCO JOUCOMATIC LTD	UNITED KINGDOM	
7	R613	REGULATEURS GEORGIN S.A	FRANCE	
8	S087	SWITZER PROCESS INSTRUMENTS PVT. LTD.	INDIA	
9	I132	INDFOS INDUSTRIES LIMITED	INDIA	
10	K175	KAUSTUBHA UDYOG	INDIA	
11	D510	DELTA CONTROLS LTD	UNITED KINGDOM	
12	3638	GAUGES BOURDON (I) PVT LTD (GEN. INST)	INDIA	
13	S552	SOR INC.	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15QA		**Description :** CLOSED CIRCUIT TV		
Approved Suppliers				
1	3802	NEURAL INTEGRATED SYSTEMS PVT LTD	INDIA	
2	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
3	3744	TOSHNIWAL INDUSTRIES PVT LTD	INDIA	
4	E004	ELECTRONIC CORPORATION OF INDIA LTD.	INDIA	
5	3801	TECHNOCRATS SECURITY SYSTEMS PVT LTD	INDIA	
6	3945	IMAGENOUS ENGINEERING PVT. LTD.	INDIA	
7	T242	TRANSIT ELECTRONICS LTD.	INDIA	
8	4198	ASCENT NETWORKS PRIVATE LIMITED	INDIA	
9	C193	COMMTEL NETWORKS PVT LTD	INDIA	
10	4243	TRANS VIRTUAL PVT LTD	INDIA	
11	4227	WILLSTRONG SOLUTIONS PVT. LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15RA		**Description :** LOOP POWERED INDICATORS		
Approved Suppliers				
1	E641	ENDRESS+HAUSER WETZER GMBH+ CO.KG	GERMANY	
2	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
3	B713	BEKA ASSOCIATES LTD	UNITED KINGDOM	
4	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
5	Y006	YOKOGAWA INDIA LIMITED	INDIA	
6	3615	ENDRESS + HAUSER WETZER INDIA PVT LTD	INDIA	
7	M154	MTL INSTRUMENTS PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15RD		**Description :** FIELD INSTRUMENTS (P,DP,F,L,T,TD)		
Approved Suppliers				
1	H621	HONEYWELL INC.	UNITED STATES	
2	F644	FUJI ELECTRIC SYSTEMS CO. LTD	JAPAN	
3	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
4	Y006	YOKOGAWA INDIA LIMITED	INDIA	
5	E657	ENDRESS+HAUSER SE+CO. KG	GERMANY	
6	E232	ENDRESS+HAUSER (I) AUTO. INSTR. PVT. LTD	INDIA	
7	A682A	ABB AUTOMATION PRODUCTS GMBH	GERMANY	
8	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
9	E641	ENDRESS+HAUSER WETZER GMBH+ CO.KG	GERMANY	
10	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
11	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
12	3615	ENDRESS + HAUSER WETZER INDIA PVT LTD	INDIA	
13	A200	ABB INDIA LTD (BANGALORE)	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15TC		**Description :** TANK LEVEL INSTRUMENT (RADAR,ULTRASONIC)		
Approved Suppliers				
1	27470	KROHNE S.A.S.	FRANCE	
2	M508	MAGNETROL INTERNATIONAL N.V	BELGIUM	
3	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
4	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
5	H622	HAWK MEASUREMENT SYSTEM PTY LTD	AUSTRALIA	
6	M715	MOBREY LTD (FORM. S-578)	UNITED KINGDOM	
7	V518	VEGA GRIESHABER KG	GERMANY	
8	R616	ROSEMOUNT TANK RADAR AB (FORM. S691)	SWEDEN	
9	A727	AMETEK DREXELBROOK	UNITED STATES	
10	E550	ENRAF B.V. (GR. COMPANY OF HONEYWELL)	NETHERLANDS	
11	L562	L & J TECHNOLOGIES	UNITED STATES	
12	E232	ENDRESS+HAUSER (I) AUTO. INSTR. PVT. LTD	INDIA	
13	S5241	SIEMENS AG	GERMANY	
14	4054	EIP ENVIRO LEVEL CONTROLS PRIVATE LIMITED	INDIA	
15	E657	ENDRESS+HAUSER SE+CO. KG	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15TE		**Description :** SPEED TANSMITTERS		
Approved Suppliers				
1	27506	PEPPERL + FUCHS ASIA PTE. LTD.	SINGAPORE	
2	A661	ASEA BROWN BOVERY LTD (ABB LTD)	SWITZERLAND	
3	J531	JAPAN SERVO CO LTD	JAPAN	
4	H620	HANS TURCK GMBH & CO. KG	GERMANY	
5	P649	PEPPERL + FUCHS GMBH	GERMANY	
6	27507	PEPPERL + FUCHS, INC.	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15TJ		**Description :** INFRARED TEMP MEASUREMENT SYSTEM		
Approved Suppliers				
1	W575	WAHL INSTRUMENTS INC.	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15UA		**Description :** CONTROL PANEL & ACCESSORIES		
Approved Suppliers				
1	I206	IRIS AUTOMATION PVT LTD	INDIA	
2	D129	SIEMENS ENERGY INDUSTRIAL TURBOMACHINERY INDIA PRIVATE LIMITED	INDIA	
3	3902	PREI POLAR ENGINEERING PVT LTD	INDIA	
4	4138	PREI POLAR ENGINEERING PVT LTD	INDIA	
5	A212	ACCUSONIC CONTROLS PVT LTD	INDIA	
6	3626	CONTROL SYSTEMS ENGINEERS	INDIA	
7	E184	ELECTRONIC INSTRMNTATION & CONTROL P LTD	INDIA	
8	P134	POSITRONICS PVT LTD	INDIA	
9	E004	ELECTRONIC CORPORATION OF INDIA LTD.	INDIA	
10	P214	PYROTECH ELECTRONICS PVT LTD	INDIA	
11	R084	RADHA KRISHNA CONTROLS	INDIA	
12	P213	PRIMA AUTOMATION INDIA PVT LTD	INDIA	
13	I010	INDUSTRIAL CONTROLS & APPLIANCES PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15UB		**Description :** PREFABRICATED INSTRUMENT HOOKUPS		
Approved Suppliers				
1	4167	ASTEC VALVES & FITTINGS PVT. LTD.	INDIA	
2	27488	ARMATURENFABRIK FRANZ SCHNEIDER GMBH CO.	GERMANY	
3	F146	FLUID CONTROLS PVT LTD	INDIA	
4	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
5	3737	HAVI ENGINEERING INDIA PVT LTD	INDIA	
6	A240	ASTEC VALVES & FITTINGS PVT. LTD.	INDIA	
7	C220	COMFIT & VALVES PVT. LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15UC		**Description :** ACCESS CONTROL SYSTEM		
Approved Suppliers				
1	3945	IMAGENOUS ENGINEERING PVT. LTD.	INDIA	
2	4198	ASCENT NETWORKS PRIVATE LIMITED	INDIA	
3	4243	TRANS VIRTUAL PVT LTD	INDIA	
4	T242	TRANSIT ELECTRONICS LTD.	INDIA	
5	3802	NEURAL INTEGRATED SYSTEMS PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15VA		**Description :** SP. CONTROL VALVE (KNIFE GATE)		
Approved Suppliers				
1	O104	ORBINOX INDIA PVT. LTD	INDIA	
2	T198	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15VB		**Description :** FIRE PROTECTION SYSTEM (VALVES & ACC.)		
Approved Suppliers				
1	27412	DARCHEM ENGINEERING LIMITED	UNITED KINGDOM	
2	27410	MOV Limited	KOREA, REPUBLIC OF	
3	3604	MBM AUTOMATION AND ROBOTICS	INDIA	
4	27546	BILCO ANTIFIRE ENGINEERING SRL	ITALY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15WA		**Description :** ANALYSR-DENSTY/SP.GRAVTY(V.CYLNDR,CORLIS		
Approved Suppliers				
1	M715	MOBREY LTD (FORM. S-578)	UNITED KINGDOM	
2	B617	BOPP & REUTHER MESSTECHNIK GMBH	GERMANY	
3	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	
4	27469	KROHNE LIMITED	UNITED KINGDOM	
5	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
6	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
7	T7361	THERMO FISHER SCIENTIFIC	UNITED STATES	
8	Y006	YOKOGAWA INDIA LIMITED	INDIA	
9	E657	ENDRESS+HAUSER SE+CO. KG	GERMANY	
10	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15WB		**Description :** ANALYSER (AIR DEMAND/TOTAL SULPHUR)		
Approved Suppliers				
1	G606	GALVANIC APPLIED SCIENCES INC.	CANADA	
2	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
3	A5101	AMETEK	UNITED STATES	
4	27462	APPLIED ANALYTICS	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15WC		**Description :** AVERAGING PITOT TUBES		
Approved Suppliers				
1	M045	MINCO (INDIA) PVT LTD (GEN. INST.)	INDIA	
2	V581	VERIS INC.	UNITED STATES	
3	T703	TORBAR FLOWMETERS LTD	UNITED KINGDOM	
4	M010	WIKA PROCESS SOLUTIONS INDIA PRIVATE LIMITED	INDIA	
5	3867	DYNAFLUID VALVES AND FLOW CONTROLS P LTD	INDIA	
6	S286	STAR-MECH CONTROLS (INDIA) PVT LTD	INDIA	
7	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
8	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
9	J067	METAVAL ENGINEERING PRIVATE LIMITED	INDIA	
10	E022	EUREKA INDUSTRIAL EQUIPMENTS (P) LTD.	INDIA	
11	M313	MINCO (I) FLOW ELEMENT P. LTD. (GIC CO.)	INDIA	
12	T516	TM TECNOMATIC SPA	ITALY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15WD		**Description :** ANALYSERS (HYDROGEN SULPHIDE)		
Approved Suppliers				
1	27509	ENDRESS+HAUSER SICK GMBH+CO. KG	GERMANY	
2	27529	TETHYS INSTRUMENTS SAS	FRANCE	
3	27462	APPLIED ANALYTICS	UNITED STATES	
4	S5241	SIEMENS AG	GERMANY	
5	27433	THERMO ONIX LIMITED	UNITED KINGDOM	
6	A5101	AMETEK	UNITED STATES	
7	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15WE		**Description :** VISCOSITY METER		
Approved Suppliers				
1	M715	MOBREY LTD (FORM. S-578)	UNITED KINGDOM	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15WF		**Description :** TDLS ANALYSERS		
Approved Suppliers				
1	S746	SERVOMEX GROUP LTD.	UNITED KINGDOM	
2	27522	ENDRESS+HAUSER OPTICAL ANALYSIS, INC.	UNITED STATES	
3	S5241	SIEMENS AG	GERMANY	
4	T526	TELEDYNE ANALYTICAL INSTRUMENTS	UNITED STATES	
5	Y006	YOKOGAWA INDIA LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15YA		**Description :** ALARM ANNUNCIATORS		
Approved Suppliers				
1	P014	PROCON INSTRUMENTATION PVT LTD	INDIA	
2	M171	MINILEC (INDIA) PVT LTD	INDIA	
3	I545	IDEC IZUMI CORPORATION	JAPAN	
4	I083	INSTALARM INSTRUMENTS PVT LTD.	INDIA	
5	E004	ELECTRONIC CORPORATION OF INDIA LTD.	INDIA	
6	R540	RONAN ENGINEERING COMPANY	UNITED STATES	
7	M154	MTL INSTRUMENTS PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15ZA		**Description :** RUPTURE DISCS		
Approved Suppliers				
1	B017	BS & B SAFETY SYSTEMS (INDIA) LTD	INDIA	
2	27582	ELFAB LIMITED	UNITED KINGDOM	
3	F575	FIKE CORPORATION-USA	UNITED STATES	
4	R519	REMBE GMBH SAFETY+CONTROL	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16AA		**Description :** METER PROVERS		
Approved Suppliers				
1	F640	FMC MEASUREMENT SOLUTIONS	UNITED STATES	
2	D509	EMERSON PROCESS MANAGEMENT ASIA PACIFIC PTE LTD	UNITED STATES	
3	S716	SKELTONHALL LTD	UNITED KINGDOM	
4	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
5	B617	BOPP & REUTHER MESSTECHNIK GMBH	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16AB		**Description :** GAS PRESSURE REDUCING SKIDS		
Approved Suppliers				
1	C015	CHEMTROLS INDUSTRIES PVT. LTD.	INDIA	
2	27510	VALVITALIA SPA	ITALY	
3	M027	MULTITEX FILTRATION ENGINEERS LTD.	INDIA	
4	E626	ELSTER-INSTROMET NV-FORMER. I563	BELGIUM	
5	P538	PIETRO FIORENTINI SPA	ITALY	
6	D143	EMERSON MEASUREMENT SYSTEMS AND SOLUTIONS (INDIA) PRIVATE LIMITED	INDIA	
7	3843	MULTITEX FILTRATION ENGINEERS LTD	INDIA	
8	P633	PETROGAS, GAS SYSTEMS B.V.	NETHERLANDS	
9	R539	RMG REGEL+MESSTECHNIK GMBH	GERMANY	
10	E208	ELSTER-INSTROMET INDIA P LTD	INDIA	
11	3621	OSWAL ENERGIES LIMITED	INDIA	
12	D509	EMERSON PROCESS MANAGEMENT ASIA PACIFIC PTE LTD	UNITED STATES	
13	E613	EN-FAB INC	UNITED STATES	
14	N088	NIRMAL INDUSTRIAL CONTROL PVT. LTD.	INDIA	
15	R058	ROCKWIN FLOWMETER INDIA (P) LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16AC		**Description :** GAS METERING SYSTEM (ULTRASONIC)		
Approved Suppliers				
1	N088	NIRMAL INDUSTRIAL CONTROL PVT. LTD.	INDIA	
2	F640B	FMC MEASUREMENT SOLUTIONS-KONGSBERG	NORWAY	
3	E208	ELSTER-INSTROMET INDIA P LTD	INDIA	
4	D143	EMERSON MEASUREMENT SYSTEMS AND SOLUTIONS (INDIA) PRIVATE LIMITED	INDIA	
5	R539	RMG REGEL+MESSTECHNIK GMBH	GERMANY	
6	C015	CHEMTROLS INDUSTRIES PVT. LTD.	INDIA	
7	E626	ELSTER-INSTROMET NV-FORMER. I563	BELGIUM	
8	D509	EMERSON PROCESS MANAGEMENT ASIA PACIFIC PTE LTD	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16AD		**Description :** GAS METERING SYSTEM (TURBINE)		
Approved Suppliers				
1	C015	CHEMTROLS INDUSTRIES PVT. LTD.	INDIA	
2	E208	ELSTER-INSTROMET INDIA P LTD	INDIA	
3	R058	ROCKWIN FLOWMETER INDIA (P) LTD	INDIA	
4	N088	NIRMAL INDUSTRIAL CONTROL PVT. LTD.	INDIA	
5	D509	EMERSON PROCESS MANAGEMENT ASIA PACIFIC PTE LTD	UNITED STATES	
6	D143	EMERSON MEASUREMENT SYSTEMS AND SOLUTIONS (INDIA) PRIVATE LIMITED	INDIA	
7	S809	SENSUS METERING SYSTEMS INC (FORM. I589)	UNITED STATES	
8	E626	ELSTER-INSTROMET NV-FORMER. I563	BELGIUM	
9	R539	RMG REGEL+MESSTECHNIK GMBH	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16AE		**Description :** GAS METERING SYSTEM -DUAL CHAMBR ORIFICE		
Approved Suppliers				
1	27415	CAMERON CANADA CORPORATION	CANADA	
2	F640B	FMC MEASUREMENT SOLUTIONS-KONGSBERG	NORWAY	
3	D143	EMERSON MEASUREMENT SYSTEMS AND SOLUTIONS (INDIA) PRIVATE LIMITED	INDIA	
4	D509	EMERSON PROCESS MANAGEMENT ASIA PACIFIC PTE LTD	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16AF		**Description :** LIQUID METERING SYSTEM (ULTRASONIC)		
Approved Suppliers				
1	D143	EMERSON MEASUREMENT SYSTEMS AND SOLUTIONS (INDIA) PRIVATE LIMITED	INDIA	
2	P835	PROGETTI EUROPA & GLOBAL S.P.A	ITALY	
3	27471	KROHNE ALTOMETER	NETHERLANDS	
4	D509	EMERSON PROCESS MANAGEMENT ASIA PACIFIC PTE LTD	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16AG		**Description :** LIQUID METERING SYSTEM (TURBINE)		
Approved Suppliers				
1	F640	FMC MEASUREMENT SOLUTIONS	UNITED STATES	
2	B617	BOPP & REUTHER MESSTECHNIK GMBH	GERMANY	
3	D509	EMERSON PROCESS MANAGEMENT ASIA PACIFIC PTE LTD	UNITED STATES	
4	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
5	H507	HOFFER FLOW CONTROLS INC	UNITED STATES	
6	R058	ROCKWIN FLOWMETER INDIA (P) LTD	INDIA	
7	F528	FAURE HERMAN	FRANCE	
8	D143	EMERSON MEASUREMENT SYSTEMS AND SOLUTIONS (INDIA) PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16AH		**Description :** LIQUID METERING SYSTEM (P D METERS)		
Approved Suppliers				
1	F640	FMC MEASUREMENT SOLUTIONS	UNITED STATES	
2	B617	BOPP & REUTHER MESSTECHNIK GMBH	GERMANY	
3	P631	PETROL INSTRUMENTS SRL	ITALY	
4	O523	OVAL CORPORATION	JAPAN	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16AI		**Description :** LIQUID METERING SYSTEM (MASS FLOW METER)		
Approved Suppliers				
1	D509	EMERSON PROCESS MANAGEMENT ASIA PACIFIC PTE LTD	UNITED STATES	
2	E525	ENDRESS + HAUSER FLOWTEC AG	SWITZERLAND	
3	F640	FMC MEASUREMENT SOLUTIONS	UNITED STATES	
4	H626	HEINRICHS MESSTECHNIK GMBH	GERMANY	
5	D143	EMERSON MEASUREMENT SYSTEMS AND SOLUTIONS (INDIA) PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16AJ		**Description :** CITY DISTRIBUTION METERING SYSTEM		
Approved Suppliers				
1	D509	EMERSON PROCESS MANAGEMENT ASIA PACIFIC PTE LTD	UNITED STATES	
2	R539	RMG REGEL+MESSTECHNIK GMBH	GERMANY	
3	N088	NIRMAL INDUSTRIAL CONTROL PVT. LTD.	INDIA	
4	R058	ROCKWIN FLOWMETER INDIA (P) LTD	INDIA	
5	3621	OSWAL ENERGIES LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16DB		**Description :** DISPLACER LEVEL INSTRUMENTS		
Approved Suppliers				
1	T530	TOKYO KEISO CO LTD	JAPAN	
2	E6232	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
3	C015	CHEMTROLS INDUSTRIES PVT. LTD.	INDIA	
4	E179A	EMERSON PROCESS MANGMNT CHENNAI PVT. LTD	INDIA	
5	D127	GE Oil & Gas India Pvt. Ltd.	INDIA	
6	F637	FOXBORO ECKARDT GMBH	GERMANY	
7	D649	DRESSER PRODUITS INDUSTRIELS	FRANCE	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16EA		**Description :** DISTRIBUTED CONTROL SYSTEMS		
Approved Suppliers				
1	I177	SCHNEIDER ELECTRIC SYSTEMS INDIA PRIVATE LIMITED	INDIA	
2	Y006	YOKOGAWA INDIA LIMITED	INDIA	
3	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
4	I590	INVENSYS SOFTWARE SYSTEMS (S) PTE LTD	SINGAPORE	
5	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
6	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
7	A200	ABB INDIA LTD (BANGALORE)	INDIA	
8	H621	HONEYWELL INC.	UNITED STATES	
9	B054	BHARAT HEAVY ELECTRICALS LIMITED-BANGALORE	INDIA	
10	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
11	3985	YOKOGAWA INDIA LIMITED	INDIA	
12	S003A	SIEMENS LTD - NASHIK	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16EC		**Description :** TRAINING SIMULATOR SYSTEM		
Approved Suppliers				
1	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	
2	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
3	Y006	YOKOGAWA INDIA LIMITED	INDIA	
4	T706	TRIDENT COMPUTER RESOURCES	UNITED STATES	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16ED		**Description :** TELECOMMUNICATION SYSTEM		
Approved Suppliers				
1	A358	ABB INDIA LIMITED	INDIA	
2	T219	TEJAS NETWORKS LTD	INDIA	
3	S524	SIEMENS AG	GERMANY	
4	S003	SIEMENS LIMITED	INDIA	
5	C193	COMMTEL NETWORKS PVT LTD	INDIA	
6	F182	FIBCOM INDIA LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16EE		**Description :** BLENDING AUTOMATION SYSTEMS		
Approved Suppliers				
1	Y006	YOKOGAWA INDIA LIMITED	INDIA	
2	I177	SCHNEIDER ELECTRIC SYSTEMS INDIA PRIVATE LIMITED	INDIA	
3	A200	ABB INDIA LTD (BANGALORE)	INDIA	
4	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	
5	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16EG		**Description :** SCADA SYSTEMS		
Approved Suppliers				
1	L001A	SCHNEIDER ELECTRIC INDIA PVT LTD	INDIA	
2	E004	ELECTRONIC CORPORATION OF INDIA LTD.	INDIA	
3	A200	ABB INDIA LTD (BANGALORE)	INDIA	
4	3985	YOKOGAWA INDIA LIMITED	INDIA	
5	I177	SCHNEIDER ELECTRIC SYSTEMS INDIA PRIVATE LIMITED	INDIA	
6	Y006	YOKOGAWA INDIA LIMITED	INDIA	
7	R178	ROCKWELL AUTOMATION INDIA PVT LTD	INDIA	
8	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
9	S003A	SIEMENS LTD - NASHIK	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16EH		**Description :** WIRELESS TETRA COMMUNICATION SYSTEM		
Approved Suppliers				
1	F182	FIBCOM INDIA LTD.	INDIA	
2	C193	COMMTEL NETWORKS PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16EI		**Description :** EPABX SYSTEM (DIGITAL)		
Approved Suppliers				
1	4183	CORAL TELECOM LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16HA		**Description :** TURNKEY INSTRUMENTATION		
Approved Suppliers				
1	G143	EMERSON AUTOMATION SOLUTIONS INTELLIGENT PLATFORMS PRIVATE LIMITED	INDIA	
2	R178	ROCKWELL AUTOMATION INDIA PVT LTD	INDIA	
3	L001A	SCHNEIDER ELECTRIC INDIA PVT LTD	INDIA	
4	Y006	YOKOGAWA INDIA LIMITED	INDIA	
5	A200	ABB INDIA LTD (BANGALORE)	INDIA	
6	4266	ATC ENGINEERING SYSTEMS PVT. LTD.	INDIA	
7	E004	ELECTRONIC CORPORATION OF INDIA LTD.	INDIA	
8	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	
9	4129	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	
10	3698	ICON CONTROLS PVT. LTD.	INDIA	
11	S003A	SIEMENS LTD - NASHIK	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16KA		**Description :** THERMAL FUSE		
Approved Suppliers				
1	G014	GRAAB ELECTROMECHS INDIA	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16KB		**Description :** GROUND MONITORING SYSTEMS		
Approved Suppliers				
1	A363	ADVANCED SYS-TEK LIMITED	INDIA	
2	R175	R STAHL PVT LTD	INDIA	
3	R506	R STAHL SCHALTGERATE GMBH	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16ZA		**Description :** INTERFACE DEVICES		
Approved Suppliers				
1	I599	IFM ELECTRONIC GMBH	GERMANY	
2	G634	GM INTERNATIONAL SRL	ITALY	
3	27507	PEPPERL + FUCHS, INC.	UNITED STATES	
4	O031	OSNA ELECTRONICS PVT LTD	INDIA	
5	27506	PEPPERL + FUCHS ASIA PTE. LTD.	SINGAPORE	
6	M154	MTL INSTRUMENTS PVT LTD	INDIA	
7	R506	R STAHL SCHALTGERATE GMBH	GERMANY	
8	P649	PEPPERL + FUCHS GMBH	GERMANY	
9	C517	CAMILLE BAUER MESSINSTRUMENTE AG	SWITZERLAND	
10	H620	HANS TURCK GMBH & CO. KG	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16ZX		**Description :** SPECIAL LEVEL INSTRUMENTS (HF ENERGY ABSORPTION TYPE)		
Approved Suppliers				
1	27543	AGARCORP SDN. BHD.	UNITED STATES	

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POLYPROPYLENE PLANT

PROPOSED VENDOR LIST (INSTRUMENTATION)

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D1	29-10-2022	For BEDP	AP		VK		SM	
Rev.	**Date**	**Revision Description**	Init.	Sign.	Init.	Sign.	Init.	Sign.
			Prepared		**Checked**		**Approved**	

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- General overview of Instrumentation suppliers.
- The supplier has to be checked in detail during detail engineering / procurement.
- This list shall give the buyer only an overview of possible vendors and has no demand to be complete.
- The vendors are listed according to the alphabet.

Rheometer (MFI)

Dynisco Europe GmbH	Germany	www.dynisco.com
Goettfert Werkstoff-Pruefmaschinen GmbH	Germany	www.goettfert.de

Infrared Analyzer

ABB	International	http://www.abb.com
Bruker	Germany	http://www.bruker.de
Fisher Rosemount	International	http://www.emersonprocess.com
Fuji	Japan	http://www.fujielectric.com
Maihak	International/ Germany	http://www.sick-maihak.com
Servomex	UK	http://www.servomex.com
Siemens	International	http://www.siemens.com
Yokogawa	Japan	http://www.yokogawa.com

Viscosity Measurement

Dynisco	USA	http://www.dynisco.com
Göttfert	Germany	http://www.gottfert.de
TA Instruments (formerly Rheometrics)	USA	http://tainstruments.com
Progression	USA	http://www.progression-systems.com

Weighing Systems/Scales

Schenck Process	Germany	http://www.schenckprocess.de
K-Tron	International	http://www.ktron.com
Mettler Toledo	International	http://www.mt.com
Brabender	Germany	http://www.brabender-mt.de

Load Cells

Kistler Morse	USA	http://www.kistlermorse.com
Schenck Process	Germany	http://www.schenckprocess.de
Mettler Toledo	International	http://www.mt.com
Siemens	Germany	http://www.siemens.com

VENDOR LIST

FOR

STRUCTURAL WORKS

PROJECT : POLYPROPYLENE (PP) UNIT PROJECT

OWNER : M/s NUMALIGARH REFINERY LTD.

LOCATION : NUMALIGARH, ASSAM

JOB No. : C050

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
A	18.08.2025	ISSUED FOR BIDS	VP	RD	VKG

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GENERAL NOTES/ INSTRUCTIONS

1. ONLY '**FIRST**' QUALITY MATERIALS SHALL BE USED.
2. **OWNER/ EIL** RESERVE THE RIGHT TO CHOOSE ANY OF THE APPROVED PRODUCT/ BRAND/ MANUFACTURER AS PER THIS LIST.
3. **SPECIFICATION OF PRODUCT SHALL BE CHECKED AGAINST TENDER SPECIFICATIONS BEFORE SELECTING ANY PRODUCT/ BRAND. IN CASE OF ANY DISCREPANCY, TENDER ITEM/ SPECIFICATION SHALL PREVAIL, AND ANY SUCH PRODUCT/ BRAND SHALL NOT BE USED WHICH IS NOT CONFORMING TO TENDER SPECIFICATIONS EVEN IF IT IS APPEARING IN THIS LIST.**
4. DOSING OF ADMIXTURES, WHEREVER NOT MENTIONED IN THIS LIST, SHALL BE AS PER MANUFACTURER'S SPECIFICATIONS.
5. INCASE OF NON-AVAILABLITY OF ANY PRODUCT AMONG APPROVED PRODUCTS/ BRAND AT A PARTICULAR SITE/ REGION, ALTERNATE PRODUCT/ BRAND NAME SHALL BE PROPOSED BY RCM TO EIL-HO FOR APPROVAL, ALONG WITH THE DETAILS OF THE PROPOSED PRODUCT/ BRAND.
6. THE PRODUCTS ARE LISTED IN ALPHABETICAL ORDER OF THEIR NAME.
7. PRODUCTS CARRYING "ISI" CERTIFICATION MARK OF BIS ALONG WITH RELAVANT STANDARD NUMBER "IS:_____" AND THE SEVEN DIGIT LICENCE NUMBER "CM/L*******)" AND LISTED AT BIS WEBSITE "http://www.bis.org.in" ARE DEEMED TO BE CONSIDERED AS APPROVED FOR USAGE.
8. IN ADDITION TO PRODUCTS MENTIONED IN THIS LIST, PRODUCTS APPROVED AFTER ISSUE OF THIS REVISION SHALL ALSO BE CONSIDERED FOR USE BASED ON PRODUCT APPROVAL LETTER ISSUED TO THE MANUFACTURER.

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
Department : STRUCTURE - LIST OF APPROVED PRODUCTS					
Area of Experience: Other					
Item : A. INTEGRAL WATER-PROOFING COMPOUNDS FOR CONCRETE (AS PER IS:2645)					
1	Refer Remark	INDIA	, ,	NA	All Integral Waterproofing Compounds for Concrete which carry "ISI" certification mark of BIS along with standard number "IS 2645" and the license number "CM/L**....*)" and listed at BIS website "https://www.bis.gov.in".
Item : B. CONCRETE ADMIXTURES -(AS PER IS:9103)					
1	Refer Remark	INDIA	, ,	NA	All Accelerating, Retarding, Water-reducing, Air-entraining & Super-plastizing Admixtures for Concrete which carry "ISI" certification mark of BIS along with standard number "IS 9103" and the license number "CM/L**....*)" and listed at BIS website "https://www.bis.gov.in".
Item : C. BI-POLAR CONCRETE PENETRATING CORROSION INHIBITING ADMIXTURE (AS PER EIL STD SPEC NO 6-68-0017)					
1	APPLE CHEMIE INDIA PVT LTD	NAGPUR	+91 9607001014, ,	www.applechemie.com	PRODUCT NAME-AC CORROGUARD-BP
2	CHRYSO INDIA PRIVATE LIMITED	NAVI MUMBAI	022 2768 5991, ,	info.india@chryso.com	BRAND NAME-CHRYSO CORROCRETE
3	CLEAN COATS PVT LTD	THANE	, ,		PRODUCT NAME-CONPROOF IA (DOSAGE 1% W/W OF CEMENT)
4	FAIRMATE CHEMICALS PRIVATE LIMITED	VADODARA	, , 9879613004	nandan@fairmate.net	PRODUCT NAME- FAIRCRETE C
5	FOSROC CHEMICALS (INDIA) PVT LTD	BENGALURU	+91 8042521900, ,	enquiry.india@fosroc.com	BRAND NAME-AURAMIX BCI
6	HINDCON CHEMICALS LTD	KOLKATA	, ,	NA	BRAND NAME- HIND CORROGUARD
7	KRISHNA CONCHEM PRODUCTS PVT LTD	NAVI MUMBAI	, ,		PRODUCT NAME-EPCO KP-200 (DOSAGE 1% W/W OF CEMENT)
8	MASTER BUILDERS SOLUTIONS INDIA PVT LTD	NAVI MUMBAI	, ,	NA	PRODUCT NAME- MASTERLIFE CI 220 (DOSAGE 1% W/W OF CEMENT)
9	NORMET INDIA PVT LTD	NOIDA, U.P.	+91 120 4504800, ,	india.info@normet.com	PRODUCT NAME-TamCem BPCI
10	SP CONCARE PVT. LTD.	SANGLI	, ,	NA	BRAND NAME:ADDMIX 109 PCCI

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
11	STP LTD.	DELHI	, ,	NA	PRODUCT NAME-SHALIPLAST MCI (DOSAGE 1% W/W OF CEMENT)
12	SUNANDA SPECIALITY COATING PVT LTD	MUMBAI	, ,		PRODUCT NAME-POLYALK CP 293 (DOSAGE 1% W/W OF CEMENT)
Item : D. POLYSULPHIDE SEALANTS (TWO PART, AS PER IS:12118)					
1	APPLE CHEMIE INDIA PVT LTD	NAGPUR	+91 9607001014, ,	www.applechemie.com	PRODUCT NAME-AC POLYSEAL (PG)
2	CHOWKSEY CHEMICALS PVT LTD	MUMBAI	, ,		PRODUCT NAME-TECHSEAL 940/941
3	CICO TECHNOLOGIES LIMITED	DELHI	, ,		PRODUCT NAME-CICO SEAL T680
4	DON CONSTRUCTION CHEMICALS INDIA LTD	CHENNAI	, ,	NA	BRAND NAME- 1. FLEXSEAL PS660 (GUN GRADE) 2. FLEXSEAL PS660 (POUR GRADE)
5	DURA BUILD CARE PVT LTD	DELHI	, ,	NA	PRODUCT NAME- DURASIL PPS (POURING GRADE)
6	FOSROC CHEMICALS (INDIA) PVT LTD	BENGALURU	+91 8042521900, ,	enquiry.india@fosroc.com	PRODUCT NAME-THIOFLEX 600
7	HINDCON CHEMICALS LTD	KOLKATA	, ,	NA	BRAND NAME- 1. HIND SEALANT PS (POUR GRADE). 2. HIND SEALANT PS (GUN GRADE)
8	JAY CHEMICAL INDUSTRIES PVT LTD	AHMEDABAD	, ,	NA	PRODUCT NAME- K2 POLYSEAL 22P (POUR GRADE)
9	KANSAI NEROLAC PAINTS LIMITED	MUMBAI	9999100064, ,	preetirohatgi@nerolac.com	PRODUCT NAME- 1. PERMA POLYSEAL (GUN GRADE) 2. PERMA POLYSEAL (POUR GRADE)
10	PIDILITE INDUSTRIES LTD (DR. FIXIT)	MUMBAI	, ,	NA	PRODUCT NAME-1. PIDISEAL PS41G, 2. PIDISEAL PS42P
11	SIKA INDIA PVT LTD	KOLKATA	, ,		BRAND NAME- 1. SIKA POLYSULPHIDE (SIKALASTIC) 2. SIKAFLEX CONSTRUCTION 3. IGAS Ih
12	STP LIMITED	NEW DELHI	, ,		PRODUCT NAME- SHALISEAL PS

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
13	ZZ-Refer Remarks (ZZ inserted to maintain the alphabetic chronology)	INDIA	, ,	NA	All other Polysulphide Sealants (Two Parts) which carry "ISI" certification mark of BIS along with standard number "IS 12118" and the license number "CM/L**....*)" and listed at BIS website "https://www.bis.gov.in".
Item : E. ANCHOR FASTENERS - CHEMICAL TYPE (EOTA / DIBt/ FM/ ICBO-ES APPROVED). Note- Design of post-installed Anchors and Rebars shall be provided/ verified by the approved manufacturer with installation instructions and execution shall be done by an applicator trained by the approved manufacturer (preferably in the presence of manufacturer for critical applications/ structures).					
1	FISCHER FIXING SYSTEMS(MICO) LTD	BENGALURU	, ,		BRAND NAME-FISCHER ANCHORS
2	FOSROC CHEMICALS (INDIA) PVT LTD	BENGALURU	+91 8042521900, ,	enquiry.india@fosroc.com	CHEMICAL ANCHORING OF REBAR, BRANDS NAMES-LOKFIX E55, LOKFIX E77 & LOKFIX E45T
3	HILTI INDIA PVT LTD	DELHI	, ,		BRAND NAME-HILTI ANCHORS
4	INDO SPARK CONSTRUCTION SERVICES	KOLHAPUR	, , 066048053056	NA	BRAND NAME-ICFS CM VESF, CM VESF TROPICAL, CM SH, CM SH TROPICAL, CM 585 PE PRO, CM 385 PE PRO, CM 400 PE, CM 650 PE
5	MASTER BUILDERS SOLUTIONS INDIA PVT LTD	NAVI MUMBAI	, ,	NA	BRAND NAMES-MASTERFLOW 916 AN, 918 AN, 920 AN, 932 AN, 936 AN
6	MUNGO FIXINGS INDIA PVT LTD	BENGALURU	, ,	NA	BRAND NAME-MIT 700 RE, MIT SE PLUS, MIT TROPICAL, MIT SP & MVA CAPSULE
7	POWERS FASTENERS(THROUGH M/S KRAFT SALES & SERVICES (I) LTD.)	PUNE	, ,	NA	BRAND NAME-POWERS FASTENERS
8	UIP SYSTEMS (INDIA) PVT LTD	MUMBAI	, ,	NA	UIP FASTENERS
9	WUERTH INDIA PVT LTD	DELHI	, ,	NA	BRAND NAME-WUERTH ANCHORS
Item : F. ANCHOR FASTENERS - MECHANICAL TYPE (EOTA / DIBT/ FM/ ICBO-ES APPROVED). Note- Design of post-installed Anchors and Rebars shall be provided/ verified by the approved manufacturer with installation instructions and execution shall be done by an applicator trained by the approved manufacturer (preferably in the presence of manufacturer for critical applications/ structures).					
1	FISCHER FIXING SYSTEMS(MICO) LTD	BENGALURU	, ,		BRAND NAME-FISCHER ANCHORS
2	HILTI INDIA PVT LTD	DELHI	, ,		BRAND NAME-HILTI ANCHORS

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
3	INDO SPARK CONSTRUCTION SERVICES	KOLHAPUR	, ,	NA	BRAND NAME: (ICFS) INDO WEDGE ANCHOR IWA, IWA-A2, IWA-A4
4	MUNGO FIXINGS INDIA PVT LTD	BENGALURU	, ,	NA	BRAND NAME-M1 POWER GRIP, M1r POWER GRIP, M1T, M2, M2r, MCS, MEA
5	POWERS FASTENERS(THROUGH M/S KRAFT SALES & SERVICES (I) LTD.)	PUNE	, ,	NA	BRAND NAME-POWERS FASTENERS
6	UIP SYSTEMS (INDIA) PVT LTD	MUMBAI	, ,	NA	UIP FASTENERS
7	WUERTH INDIA PVT LTD	DELHI	, ,	NA	PRODUCT NAME- WUERTH ANCHORS
Item : G. ELECTRO-FORGED GALVANISED GRATINGS (AS PER EIL STD 7-68-0697, BS:4592)					
1	ABHYANT EFG & ENGINEERING PVT. LTD	RAIPUR	, ,	NA	TYPE-I & TYPE-II
2	ANKIT ELECTROGRATING	RAIPUR	, ,	NA	TYPE-I & TYPE-II
3	BHOLA RAM STEEL PVT LTD	PATNA	, ,		BRAND NAME-BHOLARAM GRATINGS
4	CELL COM TELESERVICES PVT LTD	SIKANDRABAD	, ,	NA	BRAND NAME-CELLCOM GRATINGS
5	FERROTECH STRUCTURALS (INDIA) PVT LTD	KANCHIPURAM & PUNE	+91 9840308880, ,	www.ferrotechindia.net	TYPE-I & TYPE-II
6	GREATWELD ENGINEERING PVT. LTD.	PUNE	+91 7350304304, ,	sumit.rungta@greatweld.com	BRAND NAME-GREATWELD GRATINGS, TYPE-I & TYPE-II
7	INDIANA GRATING PVT.LTD	MUMBAI	, ,		BRAND NAME-INDIANA GRATINGS
8	IRONWELD ENGINEERING PVT LTD	PUNE	, ,	NA	TYPE-I & TYPE-II
9	JACINTH ENGINEERING PVT LTD	MUMBAI	, ,	NA	BRAND NAME-JACINTH GRATINGS
10	KANADE ANAND UDYOG PVT LTD	MUMBAI	, ,		BRAND NAME-KANADE GRATINGS
11	LANCER VINIMAY PVT. LTD.	DURGAPUR, WB	+91 9331391910, ,	lancervinimay@gmail.com	TYPE-I & TYPE-II
12	LIONWELD MEISER LLC	DUBAI	, ,	NA	TYPE-I & TYPE-II
13	MEET ENGINEERING	VADODARA	, ,	NA	TYPE-I & TYPE-II
14	METALIC INDUSTRIES	VADODRA, GUJARAT	, , 9909255335	admin@metalic-industries.com	TYPE-I & TYPE-II
15	OMKAR GRATINGS PVT LTD	MUMBAI	, ,		BRAND NAME-OMKAR GRATINGS (FOR EIL TYPE-II GRATING ONLY)
16	PARCO ENGINEERS (MUMBAI) PVT LTD	Mumbai	9819278530, , 9819278530	info@parcoengineers.com	TYPE-I & TYPE-II

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
17	PINAX STEEL INDUSTRIES PVT LTD	KOLKATA	, ,		BRAND NAME-PINAX GRATINGS
18	PREMIER POWER PRODUCTS PVT LTD	KOLKATA	, ,		BRAND NAME-PREMIER GRATINGS
19	RATAN PROJECTS & ENGINEERING CO.PVT LTD.	KOLKATTA	, ,	sales@ratans.com	BRAND NAME- RATAN GRATINGS
20	SIGMA GALVANIZING PVT LTD	NAVI MUMBAI	, ,	NA	TYPE-I & TYPE-II
21	VINFAB GRATINGS	MUMBAI	, ,		BRAND NAME-VINFAB GRATINGS
22	WHEELS INDIA LTD	CHENNAI	, ,	NA	PRODUCT NAME-WHEELS GRATINGS
Item : H. INTEGRAL CRYSTALLINE ADMIXTURE FOR WATERPROOFING TREATMENT TO CONCRETE (AS PER CPWD SPECIFICATION 2019, CLAUSE 22.14)					
1	APPLE CHEMIE INDIA PVT LTD	NAGPUR	+91 9607001014, ,	www.applechemie.com	PRODUCT NAME-AC CRSYTACRETE
2	CHRYSO INDIA PRIVATE LIMITED	NAVI MUMBAI	022 2768 5991, ,	info.india@chryso.com	PRODUCT NAME-CHRYSO CWA10
3	FOSROC CHEMICALS (INDIA) PVT LTD	BENGALURU	+91 8042521900, ,	enquiry.india@fosroc.com	PRODUCT NAME-CONPLAST CRYSTALLINE
4	KRYTON BUILDMAT CO PVT LTD	GURUGRAM	0124 4381 140, ,	info@kryton.in	PRODUCT NAME-KRYSTOL INTERNAL MEMBRANE "KIM"
5	PENETRON INFRA PRODUCTS PVT LTD	NAVI MUMBAI	+91 7738444041, ,	inquiry@penetron.co.in	PRODUCT NAME-PENETRON ADMIX
6	SHALIMAR SEAL & TAR PRODUCTS PVT LTD	JAIPUR	+91 9829065184, ,	ocrd@shalimartar.com	PRODUCT NAME-KAVASSU CRYSTALLOMIX-PG
7	XYPEX	GAUTAM BUDH NAGAR	0120-4090900, ,	info@xypex.in	PRODUCT NAME-XYPEX ADMIX C-2000 NF

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VENDOR LIST
(ARCHITECTURAL)
FOR
EPC TENDER FOR COOLING TOWER PACKAGE

TENDER NO. C050-1U68-81-45-PB-T-8010

JOB NO. : **C050**

PROJECT : **EPCM SERVICES FOR POLYPROPYLENE (PP) PROJECT, NUMALIGARH REFINERY**

CLIENT : **M/S NUMALIGARH REFINERIES LIMITED**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	11.08.25	ISSUED FOR TENDER	KT	SS	GJK

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
Department : ARCHITECTURE					
Area of Experience: Other					
Item : 1.1 FLOOR FINISHING - CERAMIC TILES					
1	APARNA ENTERPRISES LIMITED	Hyderabad	, , NA	NA	BRAND NAME-VITERO
2	ASIAN GRANITO INDIA LIMITED	MATHURA	, ,		BRAND NAME-ASIAN
3	CERA SANITARYWARE LTD.	NEW DELHI	, ,	NA	BRAND NAME- CERA
4	H&R JOHNSON LIMITED	MUMBAI	, ,		BRAND NAME-JOHNSON
5	KAJARIA CERAMICS LIMITED	DELHI	, ,		BRAND NAME-KAJARIA
6	MURUDESHWAR CERAMICS LIMITED	HUBLI	, ,	"	BRAND NAME-NAVEEN
7	NITCO LIMITED	Mumbai	", ,	"	BRAND NAME-NITCO
8	ORIENT BELL CERAMICS & INDUSTRIES LTD.	DELHI	, ,		BRAND NAME-ORIENT
9	REGENCY CERAMICS LIMITED	HYDERABAD	, ,		BRAND NAME-REGENCY
10	SPL LIMITED	DELHI	, ,		BRAND NAME-SOMANY
11	VARMORA GRANITO PVT. LTD.	MUMBAI	, ,		BRAND NAME-VARMORA
Item : 1.2 FLOOR FINISHING - VITRIFIED TILES					
1	APARNA ENTERPRISES LIMITED	Hyderabad	, , NA	NA	BRAND NAME-VITERO
2	ASIAN GRANITO INDIA LIMITED	MATHURA	, ,		BRAND NAME-ASIAN
3	CERA SANITARYWARE LTD.	NEW DELHI	, ,	NA	BRAND NAME- CERA
4	EURO CERAMICS LIMITED	MUMBAI	, ,		BRAND NAME-EURO
5	H&R JOHNSON(I) LIMITED	MUMBAI	, ,		BRAND NAME-JOHNSON
6	KAJARIA CERAMICS LIMITED	DELHI	, ,		BRAND NAME-KERROGRES
7	MURUDESHWAR CERAMICS LTD.	HUBLI	, ,		BRAND NAME-NAVEEN
8	NITCO LIMITED	Mumbai	", ,	"	BRAND NAME--NITCO
9	ORIENT BELL CERAMICS & INDUSTRIES LTD.	DELHI	, ,		BRAND NAME-ORIENT
10	PAVIT CERAMICS PVT LTD	AHMEDABAD	, ,	NA	BRAND NAME- PAVIT
11	RAK CERAMICS INDIA PVT. LTD.	MUMBAI	, ,		
12	REGENCY CERAMICS LIMITED	HYDERABAD	, ,		BRAND NAME-REGENCY
13	REGENT GRANITO INDIA LTD.	GUJARAT	, ,		BRAND NAME-REGENT
14	SPL LIMITED	DELHI	, ,		BRAND NAME-SOMANY
15	VARMORA GRANITO PVT. LTD.	MUMBAI	, ,		BRAND NAME-VARMORA
Item : 1.3 FLOOR FINISHING - ACID RESISTANT TILES					
1	H & R JOHNSON(I) LTD.	MUMBAI	, ,		BRAND NAME-ENDURA
2	REGENCY CERAMICS LIMITED	HYDERABAD	, ,		BRAND NAME-REGENCY
Item : 1.4 FLOOR FINISHING - PVC TILES/ROLLS					

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
1	ALL MANUFACTURE'S LISTED BY BIS UNDER IS 3462		, ,		
Item : 1.5 FLOOR FINISHING - PVC TILES/ROLLS(ANTI STATIC)					
1	ARMSTRONG WORLD INDUSTRIES INDIA (P) LTD	MUMBAI	, ,		BRAND NAME-SOLIDLG1
2	PREMIER POLYFILM LTD.	DELHI	, ,		BRAND NAME-ANSTAT
Item : 1.6 FLOOR FINISHING - EPOXY COATING					
1	APURVA INDIA LIMITED	MUMBAI	, ,		
2	BASF CONSTRUCTION CHEMICALS (I) PVT.LIMITED	DELHI	, ,		BRAND NAME-MASTERTOP-1200 SERIES
3	BUILDTECH PRODUCTS(I) PVT LIMITED	DELHI	, ,		BRAND NAME-BUILDPOXY-SL
4	CICO TECHNOLOGIES	DELHI	, ,		BRAND NAME-CICO POXY TC 200
5	CIPY POLYURETHANES PVT.LIMITED	PUNE	, ,		BRAND NAME-CIPOXY SL 1000
6	FOSROC CHEMICALS (INDIA) PVT LTD	BANGALORE	+91 8042521900, ,	enquiry.india@fosroc.com	BRAND NAME-NITOFLOOR SL 2000/1000
7	LEADING EDGE INDUSTRIAL CORPORATION	NAGPUR	, , 066048048051	NA	BRAND NAME: 1. COROGUARD-KRAYON MAKE 2. KRAYON
8	PIDILITE INDUSTRIES LIMITED	New Delhi	, ,	NA	BRAND NAME-DR. FIXIT PIDIPOXY ESL
9	SIKA	KOLKATA	, ,		BRAND NAME-SIKA FLOOR
10	STP LIMITED	NEW DELHI	, ,		
11	SUNANDA SPECIALITY COATING PVT LTD	MUMBAI	, ,		BRAND NAME- SUNEPOXY-SL (Epoxy Coating)
12	SYNORGANIC PAINTS PVT LTD	Bhilai	, ,	'	BRAND NAME-INDUSCOAT EP COVER 100
Item : 1.7 FLOOR FINISHING - FLOOR HARDENER					
1	CHOKSEY CHEMICALS	MUMBAI	, ,		BRAND NAME-TECHFLOOR HT-200
2	CICO TECHNOLOGIES LTD.	DELHI	, ,		BRAND NAME-CICO SURFACE HARDENER
3	SAMROCK CHEMICALS (I) LTD.	AHMEDABAD	, ,		BRAND NAME-SAMHARD STD
4	STP LIMITED	NEW DELHI	, ,		
Item : 2.1 WOODWORK - BLOCK BOARD/FLUSH DOOR					
1	ALL MANUFACTURER'S LISTED BY BIS UNDER IS:2202		, ,		
Item : 2.2 WOODWORK - PLYWOOD					

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
1	ALL MANUFACTURER'S LISTED BY BIS UNDER IS:303	--	, ,		
Item : 2.3 WOODWORK - LAMINATES					
1	ALL MANUFACTURER'S LISTED BY BIS UNDER IS:2046		, ,		
Item : 2.4 WOODWORK - MDF BOARDS					
1	ALL MANUFACTURER'S LISTED BY BIS UNDER IS:12406	--	, ,		
Item : 2.5 WOODWORK - PARTICLE BOARD (Plain / Veneered / Pre-Laminated)					
1	ALL MANUFACTURER'S LISTED BY BIS UNDER IS:3087,IS:3097 & IS:12823(GRADE 1& 2)	--	, ,		
Item : 3.1 DOORS/ WINDOWS/ VENTILATORS - PRESSED STEEL					
1	DHIMAN STEEL	DELHI	, ,		
2	SHAKTI HORMANN PVT. LTD.	MEDCHAL MALKAGIRI	, ,	NA	BRAND NAME- SHAKTI HORMANN
3	SKS STEEL IND.	DELHI	, ,		
4	SUPER STEEL WINDOWS CO.	DELHI	, ,		
5	SUPREME METWOOD PVT LTD	Faridabad	, ,	NA	BRAND NAME-SUPREME METWOOD
Item : 3.2 ALUMINIUM EXTRUSION PROFILES FOR DOORS, WINDOWS AND VENTILATORS					
1	HINDALCO	MUMBAI	, ,		
2	JINDAL ALUMINIUM LTD.	BANGALORE	, ,		
3	OMALCO EXTRUSION (P) LTD	NEW DELHI	, ,	NA	BRAND NAME- OMALCO
Item : 3.3 DOORS/ WINDOWS/ VENTILATORS - FIRE RATED					
1	BHAWANI FIRE PROTECTION PRIVATE LIMITED	GHAZIABAD	, ,	NA	BRAND NAME- BHAWANI FIRE
2	GALAXY FIRE PROTECTION COMPANY	DELHI	, ,	"	BRAND NAME-FIRE CHECK
3	MPP TECHNOLOGIES PVT. LTD.	BANGALORE	, ,		
4	NAVAIR INTERNATIONAL LTD.	DELHI	, ,		
5	PACIFIC FIRE CONTROLS PRIVATE LIMITED	New Delhi	, ,	NA	BRAND NAME-PACIFIC
6	PAULSON INDUSTRIES	ERNAKULAM	, ,	NA	BRAND NAME- PAULSON INDUSTRIES
7	SHAKTI HORMANN PVT. LTD.	MEDCHAL MALKAGIRI	, ,	NA	BRAND NAME- SHAKTI HORMANN
8	SUPER STEEL WINDOWS CO.	DELHI	, ,		

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
9	SUPREME METWOOD PVT LTD	Faridabad	, ,	NA	BRAND NAME-SUPREME METWOOD
Item : 4.1 DOORS / WINDOWS FITTINGS - MORTICE LOCKS WITH HANDLES					
1	EVERITE AGENCIES (P) LTD.	DELHI	, ,		BRAND NAME-EVERITE
2	GODREJ & BOYCE	INDIA	, ,		BRAND NAME-GODREJ
3	GOLDEN INDUSTRIES	DELHI	, ,		BRAND NAME-GOLDEN
Item : 4.2 DOORS / WINDOWS FITTINGS - HYDRAULIC DOOR CLOSER (Overhead / Floor Mounted)					
1	ALL MANUFACTURER'S LISTED BY BIS UNDER IS:3564 FOR OVERHEAD TYPE & IS:6315 FOR FLOOR MOUNTED TYPE	--	, ,		
Item : 4.3 DOORS/ WINDOWS FITTINGS - MISC. DOOR FITTINGS e.g. Hinges, Tower Bolts, Latches, Stoppers etc					
1	ALL MANUFACTURER'S LISTED BY BIS UNDER IS:204 FOR TOWER BOLTS, IS 2681 FOR ALDROP,IS:1823 FOR STOPPE		, ,		
Item : 5.1 ROOF TREATMENT & WATERPROOFING - P.U. BASED (ONE COMPONENT)					
1	ASIAN PAINTS LIMITED	MUMBAI	, ,	NA	BRAND NAME-ASIAN PAINTS SMARTCARE PU MAGNUM
2	BASF CONSTRUCTION CHEMICAL (I) PVT. LTD.	DELHI	, ,		BRAND NAME-SONOSHIELD/ MASTERSEAL HLM 5000R
3	BERGER PAINTS INDIA LIMITED	New Delhi	, ,	NA	BRAND NAME-HOMESHIELD ELASTOSEAL NON UV 1K
4	CHRYSO INDIA PRIVATE LIMITED	NAVI MUMBAI	022 2768 5991, ,	info.india@chryso.com	BRAND NAME-CHRYSO ELASTOTHANE
5	CICO TECHNOLOGIES LTD.	DELHI	, ,		BRAND NAME-CORCHEM 2061
6	FOSROC CHEMICALS (INDIA) PVT LTD	BANGALORE	+91 8042521900, ,	enquiry.india@fosroc.com	BRAND NAME-NITOPROOF 600 PF
7	LLOYD INSULATIONS (I) LTD.	DELHI	, ,		BRAND NAME-ISOTHANE EMA
8	MAPEI CONSTRUCTION PRODUCTS INDIA PVT LTD	BANGALORE	, ,	"	BRAND NAME- PURTOP ONE IN
9	MYK ARMENT PVT LTD	HYDERABAD	, ,	"	BRAND NAME-AQUAARM SPU-SPL
10	PIDILITE INDUSTRIES LIMITED	New Delhi	, ,	NA	BRAND NAME- DR. FIXIT FLEXI PU 270 (l)
11	STP LIMITED	NEW DELHI	, ,		
12	SUNANDA SPECIALITY COATING PVT LTD	MUMBAI	, ,		BRAND NAME- FLEXIROOF PU/ SUNROOF PU - One component PU based waterproofing

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
13	SUPREME BITUCHEM INDIA PVT.LTD	NAGAPUR	, ,		
14	TECHNONICOL INDIA PVT LTD	MUMBAI	, ,	"	BRAND NAME-TECHNONICOL ULTRATHANE
Item : 5.2 ROOF TREATMENT & WATERPROOFING - P.U. BASED (TWO COMPONENT)					
1	BUILDTECH PRODUCTS INDIA PVT. LTD.	DELHI	, ,		BRAND NAME-BUILDTHENE IC
2	FOSROC CHEMICALS (INDIA) PVT LTD	BANGALORE	+91 8042521900, ,	enquiry.india@fosroc.com	BRAND NAME-BRUSHBOND
3	INDUSTRIAL PRODUCT MFG. CO.	PUNE	, ,		BRAND NAME-EZECOAT
4	SHIVALIK AGRO POLY PRODUCTS LTD.	DELHI	, ,		BRAND NAME-SHIVABOND 903
5	SIKA	KOLKATA	, ,		BRAND NAME-SIKALASTIC 450H
6	STP LIMITED	NEW DELHI	, ,		
Item : 5.3 ROOF TREATMENT & WATERPROOFING - APP MEMBRANE					
1	A.R. Industries	Vadodara	, ,	-	BRAND NAME- BITUSEAL (APP Waterproofing Membrane)
2	ALEX EXTRUSIONS LTD	KOLKATTA	, ,		
3	ASIAN PAINTS LIMITED	MUMBAI	, ,	NA	BRAND NAME-SMARTCARE
4	BERGER PAINTS INDIA LIMITED	New Delhi	, ,	NA	BRAND NAME-PROSHIELD P
5	BUILDTECH PRODUCTS PVT. (I) LTD.	DELHI	, ,		BRAND NAME-BUILDWRAP P
6	CHOKSEY CHEMICALS	MUMBAI	, ,		BRAND NAME-POLYMOD
7	CHRYSO INDIA PRIVATE LIMITED	NAVI MUMBAI	022 2768 5991, ,	info.india@chryso.com	BRAND NAME-CHRYSO ARMOURSHIELD
8	CICO TECHNOLOGIES LTD.	DELHI	, ,		BRAND NAME-CICO SHIELD
9	DELHI BUILDER'S STORES	DELHI	, ,		BRAND NAME-DERMABIT APP
10	FAIRMATE CHEMICALS PVT. LTD.	GUJARAT	, ,		BRAND NAME-WATERGAURD MEMBRANE APP G
11	FOSROC CHEMICALS (INDIA) PVT LTD	BANGALORE	+91 8042521900, ,	enquiry.india@fosroc.com	BRAND NAME-PROOFEX TORCHSEAL
12	IWL INDIA LTD.	CHENNAI	, ,		BRAND NAME-HYPERPLAS
13	LLOYD INSULATIONS (I) LTD.	DELHI	, ,		BRAND NAME-LLOYD PLASTOLAY
14	PIDILITE INDUSTRIES LTD.	MUMBAI	, ,		BRAND NAME-DR. FIXIT TORCHSHEILD P 4160
15	PURE LEATHERS PVT. LTD.	DELHI	, ,		BRAND NAME-ROOFSEAL
16	SHIVAM TAR PRODUCTS	KARNAL	, ,	NA	BRAND NAME- SUPERIOR MULTIPOLYPLAS-SHIVAM
17	SIKA	KOLKATA	, ,		BRAND NAME-SIKA WP SHIELD
18	STP LTD.	DELHI	, ,	NA	SUPER THERMOLAY

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
19	SUPREME BITUCHEM INDIA PVT. LTD.	NAGPUR	, ,		
20	TECHNONICOL INDIA PVT LTD	MUMBAI	, ,	"	BRAND NAME- ULTRAPLAST
21	TEXSA INDIA LTD.	GURUGRAM	, , "	"	BRAND NAME-MOPLY
22	TIKI TAR DANOSA (INDIA) PVT LTD	Vadodara	, ,	NA	BRAND NAME-HYDROSTOP
Item : 6.1 PAINTING WORKS - PLASTIC/ ACRYLIC EMULSION (INTERNAL AND EXTERNAL), DISTEMPER ETC					
1	ACROPAINTS LTD.	DELHI	, ,		
2	ASIAN PAINTS LIMITED	MUMBAI	, ,	NA	
3	BERGER PAINTS	KOLKATA	, ,		
4	GODAVARI PAINTS PVT. LTD.	MUMBAI	, ,		
5	ICI PAINTS/ICI INDIA LTD.	KOLKATA	, ,		
6	KAMDHENU ISPAT LTD.	GURUGRAM	, ,	"	
7	N.E. PAINT UDYOG	SIVASAGAR(ASSAM)	, ,		
8	NEROLAC PAINTS	MUMBAI	, ,		
9	SHALIMAR PAINTS	MUMBAI	, ,		
Item : 6.2 PAINTING WORKS - SYNTHETIC ENAMEL (FOR BUILDING WORKS)					
1	ASIAN PAINTS LIMITED	MUMBAI	, ,	NA	
2	BERGER PAINTS	KOLKATA	, ,		
3	BERGER PAINTS INDIA LIMITED, BRITISH PAINT DIVISION	NEW DELHI	, ,	NA	BRAND NAME- GLO HI-GLOSS ENAMEL
4	GODAVARI PAINTS PVT.LIMITED	MUMBAI	, ,		
5	ICI PAINTS/ICI INDIA LIMITED	KOLKATA	, ,		
6	KAMDHENU ISPAT LIMITED	GURUGRAM	, ,	"	
7	N.E PAINT UDYOG	SIVANAGAR(ASSAM)	, ,		
8	NEROLAC PAINTS	MUMBAI	, ,		
9	SHALIMAR PAINTS	MUMBAI	, ,		
Item : 6.3 PAINTING WORKS - WATERPROOF CEMENT					
1	ACRO PAINTS LTD.	DELHI	, ,		BRAND NAME-ACROCEM
2	GODAVARI PAINTS PVT. LTD.	MUMBAI	, ,		BRAND NAME-SUPEREMCEM
3	KAMDHENU ISPAT LTD.	GURUGRAM	, ,	"	BRAND NAME-DREAMZ COLOR
4	KILLICK NIXON LTD.	MUMBAI	, ,		BRAND NAME-SNOWCEM
5	RAJDOOT PAINTS	DELHI	, ,		BRAND NAME-XTRACEM 76 SUPERIOR CEMENT PAINT
6	SNOW WHITE INDUSTRIAL CORP.	CHENNAI	, ,		BRAND NAME-SUPERCEM
Item : 6.4 PAINTING WORKS - DECORATIVE TEXTURED COATING					
1	ACRO PAINTS LTD.	DELHI	, ,		BRAND NAME-ACROTEXTURES

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
2	BAKELITE HYLAM LTD	SECUNDRABAD	, ,		BRAND NAME-HARITAGE
3	KAMDHENU ISPAT LTD.	GURUGRAM	, ,	"	BRAND NAME-DREAMZ COLOR
4	LUXTURE SURFACE COATINGS PVT. LTD.	AJMER	, ,		BRAND NAME-LUXTURE
5	NCL ALLTEK AND SECCOLOR LTD	HYDERABAD	, ,		BRAND NAME-ALLTEK
6	SPECTRUM PAINTS	DELHI	, ,		BRAND NAME-SPECTRUM
7	UNITILE	DELHI	, ,		BRAND NAME-UNITILE
Item : 6.5 PAINTING WORKS - POLISHING (for Woodwork)					
1	ASIAN PAINTS LIMITED	MUMBAI	, ,	NA	
2	SHALIMAR PAINTS	MUMBAI	, ,		
Item : 6.6 PAINTING WORKS - WALL PUTTY					
1	BIRLA WHITE	DELHI	, ,		BRAND NAME-WALL CARE
2	JK CEMENT LTD	DELHI	, ,		BRAND NAME-JK WALL PUTYY
3	MANCHANDA ENTERPRISES	FARIDABAD	, ,		BRAND NAME-SARA
4	MYK LATRICRETE	LATA FINISH	, ,		BRAND NAME-LATA FINISH
5	NCL ALTEK & SECCOLOR LTD.	HYDERABAD	, ,		BRAND NAME-NCL SKIM COAT 1127
Item : 10 FALSE FLOORING					
1	AET FLEXIBLESPACE (I) PVT LTD	Mumbai	", ,	"	BRAND NAME-FLEXI
2	EVEREST INDUSTRIES LTD	NOIDA	", ,	"	BRAND NAME-EVEREST ACCESS FLOOR
3	LLOYD INSULATION (I) LTD	DELHI	, ,		
4	MULTI FLOORS	DELHI	, ,		
5	THE ELEMENTS	NEW DELHI	, ,	"	BRAND NAME-HI FLOOR
6	UNITED ACCESS FLOORS PVT LTD	MUMBAI	, ,		BRAND NAME- UNITILE
7	UNIVERSAL BUILDING PRODUCTS	DELHI	, ,		BRAND NAME-UNIFLOOR FS1500
Item : 11.1 INSULATION - UNDERDECK INSULATION					
1	BAKELITE HYLAM LTD	SECUNDRABAD	, ,		BRAND NAME-PHENOTHERM
2	LLOYD INSULATIONS (I) LTD	DELHI	, ,		BRAND NAME-ISOLLOYD NILFLAME
3	ROCKWOOL INDIA PVT LTD	HYDERABAD	, ,	"	BRAND NAME-ROCKINSUL
4	UP TWIGA FIBRE GLASS LTD	DELHI	, ,		BRAND NAME-TWIGA
Item : 11.2 INSULATION - OVERDECK INSULATION					
1	BASF CONSTRUCTION CHEMICALS (I) PVT LTD	DELHI	, ,		BRAND NAME-ELASTOSPRAY
2	BEST PLASTRONICS LTD	DELHI	, ,		BRAND NAME-BESTPLASTRONICS

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
3	LLOYD INSULATION (I) LTD	DELHI	, ,		BRAND NAME-LLOYD SPRAY FOAM
Item : 7.1 ROOFING SHEETS & ACCESSORIES - PRECOATED PROFILED G.I./ GALVALUME/ ZINCALUME SHEETS					
1	BDS PROJECTS	Rohtak	, ,	NA	BRAND NAME-BDS
2	COLOUR ROOF INDIA LTD.	MUMBAI	, ,		BRAND NAME-HISPAN
3	ERA BUILDING SYSTEMS LTD	DELHI	, ,		BRAND NAME-ERA
4	INTERARCH BUILDING PRODUCTS (P) LTD	NOIDA	, ,	NA	BRAND NAME-TRACDEK
5	JAPAN METAL BUILDING SYTEMS PVT LTD	BANGALORE	, ,		BRAND NAME-JMBS
6	LLOYD INSULATION (I) LTD	DELHI	, ,		BRAND NAME-LLOYDECK
7	METCO ROOF PVT LTD	CHENNAI	", ,	"	BRAND NAME-TOP GUARD
8	METECNO (INDIA) PVT LTD	CHENNAI	, ,		BRAND NAME-G6
9	MULTI COLOR STEEL (I0 PVT LTD	CHENNAI	, ,		BRAND NAME-MULTI CLAD
10	PHENIX CONSTRUCTION TECHNOLOGIES	AHMEDABAD	, ,	"	BRAND NAME-PHENIX
11	ROOFCLAD INFRA PVT LTD	PALWAL	, ,	NA	BRAND NAME- ROOFCLAD
12	SHIV SHAKTI FIBRE UDYOG	DELHI	, ,		
13	SHREE PRE FAB STEELS (P) LTD	AHEMDABAD	, ,	NA	BRAND NAME- PRIMEDEK 1015
14	SHREE PRECOATED STEELS LTD	MUMBAI	, ,		BRAND NAME-METACOLOUR
15	SUPERTECH (INDIA) PVT LTD	NOIDA	, ,	NA	BRAND NAME- SUPERTECH HI-RIB
16	TATA BLUESCOPE STEEL LTD	PUNE	, ,		BRAND NAME-TRIMDECK
Item : 12.1 MISCELLANEOUS ITEMS - INTEGRAL WATER PROOFING COMPOUND (IN PLASTER)					
1	CHOKSEY CHEMICALS	MUMBAI	, ,		BRAND NAME-MASTERPROOF IWP-1/ IWP-2
2	CICO TECHNOLOGIES LIMITED	DELHI	, ,		BRAND NAME-CICO NO 1
3	FAIRMATE CHEMICALS PRIVATE LIMITED	VADODARA	, , 9879613004	nandan@fairmate.net	BRAND NAME-FAIRPLAST IP
4	PIDILITE INDUSTRIES	MUMBAI	, ,		BRAND NAME-PIDIPROOF LW
5	SAMROCK MUREXIN CHEMICAL (I) LIMITED	GUJARAT	, ,		BRAND NAME-SAMPLAST LW 150/PW
6	STP LIMITED	NEW DELHI	, ,		
Item : 13.1 CONSTRUCTION SEALANTS - POLYSULPHIDE SEALANT					
1	CHOWKSEY CHEMICALS PVT LTD	MUMBAI	, ,		BRAND NAME-TECHSEAL 940/941
2	CICO TECHNOLOGIES LTD	DELHI	, ,		BRAND NAME-CICOSEALANT T680
3	FOSROC CHEMICALS (INDIA) PVT LTD	BANGALURU	+91 8042521900, ,	enquiry.india@fosroc.com	BRAND NAME-THIOFLEX 600

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
4	PIDILITE INDUSTRIES LTD (DR. FIXIT)	MUMBAI	, ,	NA	BRAND NAME-PIDISEAL PS41G/ PIDISEAL PS42P
5	STP LIMITED	NEW DELHI	, ,		
Item : 13.2 CONSTRUCTION SEALANTS - SILICON SEALANTS					
1	PIDILITE INDUSTRIES LTD (DR. FIXIT)	MUMBAI	, ,	NA	BRAND NAME-DR. FIXIT SILICON SEALANT WX
Item : 14.1 PRE ENGINEERED BUILDINGS (PEB)					
1	BALARKA FABRICON PRIVATE LIMITED	JHAJJAR	", ,	"	
2	BDS PROJECTS	Rohtak	, ,	NA	BRAND NAME-BDS
3	ECO TURNKEY SOLUTIONS PVT LTD	FARIDABAD	, ,	NA	BRAND NAME- ecopeb
4	EVEREST INDUSTRIES LTD	NOIDA	", ,	"	
5	INTERARCH BUILDING PRODUCTS (P) LTD	NOIDA	, ,	NA	
6	JINDAL MECTEC PVT LTD	GURUGRAM	", ,	"	
7	KIRBY BUILDING SYSTEMS	NEW DELHI	", ,	"	
8	LLOYD INSULATION (I) LTD	DELHI	, ,		
9	METCO ROOF PVT LTD	CHENNAI	", ,	"	
10	MGI INFRA PRIVATE LIMITED	NEW DELHI	, ,	"	
11	MOONWALK INFRAPROJECTS PVT. LTD.	NOIDA	, ,	NA	BRAND NAME- MOONWALK
12	MPIL STEEL STRUCTURES LIMITED	MUMBAI	, ,	"	
13	PENNAR ENGINEERED BUILDING SYSTEM LTD	HYDERABAD	", ,	"	
14	PHENIX CONSTRUCTION TECHNOLOGIES	AHMEDABAD	, ,	"	
15	PKM METAL BUILDINGS COMPANY PRIVATE LIMITED	CHENNAI	", , "	"	
16	RISHIKESH STRUCTURAL SOLUTIONS LLP	VADODARA	, ,	NOT AVAILABLE	
17	SAXENA MARINE TECH (P) LTD	NOIDA	, ,	"	
18	SHIV SHAKTI FIBER UDYOG	FARIDABAD	, ,		BRAND NAME- SHIV SHAKTI FIBER UDYOG
19	SHREE PRE FAB STEELS (P) LTD	AHEMDABAD	, ,	NA	
20	SUPER DISCO ISPAT PVT LTD	New Delhi	, ,	NA	
21	SUPERTECH (INDIA) PVT LTD	NOIDA	, ,	NA	
22	ZAMIL STEEL BUILDINGS INDIA PVT LTD	PUNE	, ,	NA	
Item : 15.1 ALUMINIUM COMPOSITE PANEL					

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
1	3A COMPOSITES INDIA PVT LTD	Mumbai	, ,	-	BRAND NAME- ALUCOBOND
2	ALSTONE INTERNATIONAL	New Delhi	, ,	NA	BRAND NAME-ALSTONE
3	ALUBOND DACS INDIA PVT LTD	Mumbai	, ,	NA	BRAND NAME- ALUBOND
4	ALUDECOR LAMINATION PVT LTD	New Delhi	, ,	NOT AVAILABLE	BRAND NAME- ALUDECOR
5	ALUTECH INDUSTRIES	New Delhi	, ,	NA	BRAND NAME-ALUTECH
6	EURO PANEL PRODUCTS PVT LTD	Mumbai	, ,	-	BRAND NAME- EUROBOND
7	PIONEER PANELS	MUMBAI	, ,	NA	BRAND NAME-PIONEER
8	REYNOBOND INDIA	NEW DELHI	, ,	'	BRAND NAME-REYNOARCH FR (PLUS)
9	SONIA PLASTICS PVT LTD	NEW DELHI	", ,	"	BRAND NAME-HYNADECOR
10	VIRGO LAMINATES LIMITED	New Delhi	, ,	NA	BRAND NAME-VIRGO
11	VIVA COMPOSITES PANEL PVT LTD	MUMBAI	, ,	-	BRAND NAME- VIVA
Item : 7.2 ROOFING SHEETS & ACCESSORIES - C.G.I. SHEET					
1	ISPAT INDUSTRIES LTD	DELHI	, ,		BRAND NAME-EVEREST
2	STEEL AUTHORITY OF INDIA LTD	--	, ,		BRAND NAME-SAIL
3	TATA STEEL	--	, ,		BRAND NAME-TISCO
Item : 16.1 TOILET CUBICLE/ TOILET PARTITION					
1	GREENLAM INDUSTRIES LTD	TINSUKIA	, ,	"	BRAND NAME- GREENLAM
2	INNER SPACE	MUMBAI	, ,	"	BRAND NAME- T-LINE
3	MERINO PANEL PRODUCTS LTD	NEW DELHI	, ,	"	BRAND NAME- MERINO
Item : 7.3 ROOFING SHEETS & ACCESSORIES - ALUMINIUM SHEET					
1	HINDALCO	MUMBAI	, ,		
2	JINDAL ALUMINIUM LTD	BANGALORE	, ,		
Item : 7.4 ROOFING SHEETS & ACCESSORIES - FIBER GLASS SHEET & PANELS					
1	ROOFCLAD INFRA PVT LTD	PALWAL	, ,	NA	BRAND NAME- ROOFCLAD
2	SHIV SHAKTI FIBER UDYOG	FARIDABAD	, ,		BRAND NAME-FRP SHEET
3	SIMBA FRP (P) LTD	DELHI	, ,		BRAND NAME-SIMCRYL
Item : 7.5 ROOFING SHEETS & ACCESSORIES - POLYCARBONATE ROOFING SHEET					
1	ROOFCLAD INFRA PVT LTD	PALWAL	, ,	NA	BRAND NAME- ROOFCLAD
2	SARASWATI PLASTOTECH INDIA PVT. LTD.	JAMMU	, ,	NA	BRAND NAME- ULTRALITE
3	SHIV SHAKTI FIBRE UDYOG	DELHI	, ,		BRAND NAME-SHIV SHAKTI
4	UNITED STEEL & STRUCTURES PVT LTD	CHENNAI	, ,		TUFLIFE
Item : 8.1 SANITARY, PLUMBING FITTINGS & FIXTURES - SANITARY FITTINGS					
1	ALL MANUFACTURER'S LISTED BY BIS UNDER IS:2556	--	, ,		
Item : 8.2 SANITARY, PLUMBING FITTINGS & FIXTURES - PLUMBING FITTINGS AND FIXTURES					

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
1	CERA SANITARYWARE LTD.	NEW DELHI	, ,	NA	BRAND NAME- CERA
2	GEM INTERNATIONAL	FARIDABAD	, ,		BRAND NAME-GEM
3	H&R JOHNSON INDIA	DELHI	, ,		BRAND NAME-JOHNSON
4	JAQUAR & COMPANY LTD	DELHI	, ,		BRAND NAME-JAQUAR
5	JUPITER AQUA LINES LTD	MOHALI	, ,		BRAND NAME-JUPITOR
6	ORIENT CERAMICS	DELHI	, ,		BRAND NAME-ORIENT
7	OTHELLO FAUCETS PVT LTD	DELHI	, ,		BRAND NAME-MAYUR
8	PARKASH BRASSWARE INDUSTRIES	DELHI	, ,		BRAND NAME-PARKO
9	PLASTOCRAFT SANITARY INDIA PVT LTD	DELHI	, ,		BRAND NAME-KINGSTON
10	PRAYAG POLYMERS (P) LTD	DELHI	, ,		BRAND NAME-H2O
Item : 8.3 SANITARY, PLUMBING FITTINGS & FIXTURES - MIRROR / GLASS					
1	ATUL GLASS	DELHI	, ,		BRAND NAME-ATUL
2	CERA SANITARYWARE LTD.	NEW DELHI	, ,	NA	BRAND NAME- CERA
3	CONTINENTAL FLOAT GLASS	DELHI	, ,		BRAND NAME-CONTINENTAL
4	GUJARAT GUARDIAN LTD	DELHI	, ,		BRAND NAME-MODIGUARD
5	HINDUSTAN SAFETY GLASS	KOLKATA	, ,		BRAND NAME-HINDUSTAN
6	TRIVENI GLASS	KOLKATA	, ,		BRAND NAME-TRIVENI
Item : 9.1 FALSE CEILING - ALUMINIUM STRIP/ TRAY TYPE					
1	AURA SYNERGY INDIA PVT LTD	NEW DELHI	, ,	NA	BRAND NAME- GRID SQUARE
2	COMPLETE INFRA STRCTURE PVT LTD	NEW DELHI	, ,	NA	BRAND NAME- BOLLARD
3	HUNTER DOUGLAS	DELHI	, ,		BRAND NAME-LUXALON
4	INTERARCH BUILDING PRODUCTS (P) LTD	NOIDA	, ,		BRAND NAME-TRAC
5	LLOYD INSULATION (I) LTD	DELHI	, ,		BRAND NAME-LLOYD LINEAL CEILINGS
6	MANRAJ CEILING PRODUCTS PVT LTD	Ghaziabad	, ,	NA	BRAND NAME- ROYAL KRAFT
7	MASCOT OVERSEAS	DELHI	, ,		BRAND NAME-METALIC/ TRULON
8	P. R. PRODUCTS	DELHI	, ,	"	BRAND NAME-Hi-Steel
9	P.R. CEILING PRODUCTS	AGRA	, ,	"	BRAND NAME- MCRA
Item : 9.2 FALSE CEILING - GYPSUM BOARD					
1	SAINT GOBAIN GYPROC INDIA LTD	MUMBAI	, ,		BRAND NAME-GYPBOARD
2	USG BORAL BUILDING (INDIA) PRIVATE LIMITED	GURUGRAM	, ,	"	BRAND NAME-LaGyp
Item : 9.3 FALSE CEILING SYSTEM- MINERAL FIBER					

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
1	ARMSTRONG WORLD INDUSTRIES INDIA (P) LTD	MUMBAI	, ,		
2	COMPLETE INFRA STRCTURE PVT LTD	NEW DELHI	, ,	NA	BRAND NAME- BOLLARD
3	USG BORAL BUILDING (INDIA) PRIVATE LIMITED	GURUGRAM	, ,	"	
Item : 17.1 SPRAYED PU FOAM INSULATION (FOR OVERDECK ROOF INSULATION CUM WATER PROOFING SYSTEM)					
1	ASIAN PAINTS LIMITED	MUMBAI	, ,	NA	BRAND NAME-ASIAN PAINTS (AP) SMART CARE (SC) PU INSULATOR
2	BERGER PAINTS INDIA LIMITED	New Delhi	, ,	NA	BRAND NAME-PU SPRAY PUF
3	CHRYSO INDIA PRIVATE LIMITED	NAVI MUMBAI	022 2768 5991, ,	info.india@chryso.com	BRAND NAME-CHRYSO ELASTOTHANE SF
4	MAPEI CONSTRUCTION PRODUCTS INDIA PVT LTD	BANGALORE	, ,	"	BRAND NAME-PURTOP FOAM 45 HFC
5	MYK ARMENT PVT LTD	HYDERABAD	, ,	"	BRAND NAME-AQUAARM INSUSPRAY PUF B2
6	PIDILITE INDUSTRIES LIMITED	New Delhi	, ,	NA	BRAND NAME-DR. FIXIT FOAM SHIELD
7	STP LIMITED	NEW DELHI	, ,		BRAND NAME-SHALI PUF SA
8	TECHNONICOL INDIA PVT LTD	MUMBAI	, ,	"	BRAND NAME-TECHNONICOL LOGICFOAM SPF
Item : 18.1 ABRASION RESISTANT EPOXY FLOOR COATING SYSTEM					
1	BERGER PAINTS INDIA LIMITED	New Delhi	, ,	NA	BRAND NAME- PRO SHIELD HS (PRIMER) + PRO EPISHIELD (FLOOR SCREED) + PRO EPISHIELD SL (COATING)
2	PIDILITE INDUSTRIES LIMITED	New Delhi	, ,	NA	BRAND NAME- DR. CIPY CIPOXY 17 (PRIMER, SCREED/ SCRATCH COAT) & DR. CIPY FLOORTOP 2000 (TOP COAT)
3	SYNORGANIC PAINTS PVT LTD	Bhilai	, ,	'	INDUSCOAT EP BOND 250 (PRIMER) & INDUSCOAT EP COVER 100 (SCREED/ SCRATCH COAT) & INDUSCOAT EP COVER 100 (SCREED) & INDUSCOAT EP COVER 100 (TOP COAT)
Item : 19.1 ABRASION & IMPACT RESISTANT POLYURETHANE FLOORING SYSTEM					

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Sr No	Supplier Name	City	Phone	E-Mail	Remarks
1	BERGER PAINTS INDIA LIMITED	New Delhi	, ,	NA	BRAND NAME-PRO EPISHIELD WB (PRIMER) + PRO POLYSHIELD CONCRETE (SCREED/SCRATCH COAT) + PRO POLYSHIELD CONCRETE (COATING)
2	PIDILITE INDUSTRIES LIMITED	New Delhi	, ,	NA	BRAND NAME- DR. CIPY AQUOXY 50 (PRIMER) & DR. CIPY DURACRETE MD (SCREED/ SCRATCH COAT & TOP COAT)
3	SYNORGANIC PAINTS PVT LTD	Bhilai	, ,	'	INDUSCOAT EP WB (PRIMER) & INDUSCOAT PU SHIELD 100 (SCREED/ SCRATCH COAT) & INDUSCOAT EP TOPCRETE 300 (TOP COAT)
Area of Experience:					
Item : 13.1 CONSTRUCTION SEALANTS - POLYSULPHIDE SEALANT					
1	SIKA INDIA PVT LTD	KOLKATA	, ,		

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VENDOR LIST

(ELECTRICAL)

FOR

COOLING TOWER PACKAGE

(TENDER NO.: C050-1U68-81-45-PB-T-8010)

PROJECT : **EPCM SERVICES FOR SETTING UP POLYPROPYLENE UNIT AT NRL**

CLIENT : **M/s NRL, NUMALIGARH**

PMC : **ENGINEERS INDIA LIMITED**

JOB NO : **C050**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	11.08.2025	ISSUED WITH TENDER	MS	AKG	VK

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PREAMBLE TO VENDOR LIST

1. OWNER/EIL approved vendor list for Electrical items is enclosed in this section. CONTRACTOR shall necessarily procure all the material/equipment forming permanent part of the unit/plant from OWNER/EIL approved vendor only. This shall include sub ordered items/components also. The "Approved Vendors" shall be item specific.

2. CONTRACTOR may procure material from any of OWNER/EIL approved vendors listed in this document. However current validity of vendor approval & their approved product range and the conditions imposed while according vendor approval as per EIL enlistment letter shall be verified by the CONTRACTOR before placement of order.

   - CONTRACTOR shall also verify the work load, stability and solvency status of the vendor prior to placement of order.
   - Vendors on OWNER/EIL holiday list shall not be considered for ordering, which need to be verified by the CONTRACTOR prior to placement of order. CONTRACTOR shall comply with this requirement without any time or cost implication to Owner.
   - In case any vendor is registered with EIL as an approved vendor subsequent to release of this vendor list, the same may also be considered by the CONTRACTOR with prior intimation to OWNER/EIL and obtain their concurrence prior to placement of order.
   - Wherever job specification calls for requisite proven track record, the same shall be complied and necessary documents to be submitted for EIL/Client/Licensor approval prior to ordering.

   CONTRACTOR shall comply with this requirement without any time or cost implication to the OWNER. If a vendor is put on OWNER/ EIL's holiday list subsequent to CONTRACTOR placing an order, it shall be CONTRACTOR's responsibility to ensure quality work and timely supply from the vendor.

3. Compliance to procurement of material from approved vendors is mandatory and shall be fully complied. No deviation to approved vendor list shall generally be acceptable.

4. For items not covered in document, the vendor list shall be approved by OWNER/EIL prior to placement of order by CONTRACTOR. CONTRACTOR shall list down the proposed suppliers/vendors for such items and submit the same for OWNER/EIL's review/approval along with necessary documents/credentials. Non-acceptance of a particular proposed vendor due to any reasons whatsoever shall not be a cause of schedule and cost implication.

5. CONTRACTOR shall have an independent assessment of capability of all the vendors for timely deliveries of material/equipment. Any delays in deliveries by vendor(s) shall not be a cause of schedule and cost implication.

6. At any stage of the project, if it comes to the notice of OWNER/EIL that CONTRACTOR has procured material/equipment, intentionally or unintentionally whatsoever, from an unapproved vendor and/or items not falling in approved product range of vendor(s), then the same shall be rejected forthwith and CONTRACTOR shall be liable to replace such material/plant/machinery within the contract price and without any time/schedule implication.

7. Make of equipment/component of foreign origin other than mentioned in the document shall be subject to EIL/OWNER review during detail engineering based on PTR to be submitted by vendor.

8. For items where range of the equipment/components is not indicated in the enlistment letter of vendor from EIL, the proposed vendor need to be approved by OWNER/EIL prior to placement of order by CONTRACTOR. CONTRACTOR shall list down the proposed suppliers/vendors for such items and submit the same for OWNER/EIL's review/approval along with necessary documents/credentials. Non-acceptance of a particular proposed vendor due to any reasons whatsoever shall not be a cause of schedule and cost implication.

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9. Exact numerical relay model and system architecture shall be selected by Bidder based on the project requirement. The model shall be subjected to approval by Owner/EIL during drawing review stage.

10. This document shall be read in conjunction with MR document.

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13BF		**Description :** LV SWITCHBOARD FIXED TYPE FOR PACKAGE EQUIPMENT		
Approved Suppliers				
1	L103	SCHNEIDER ELECTRIC INDIA PRIVATE LIMITED	INDIA	
2	Z011	ZENITH ENGINEERING CORP.	INDIA	
3	3837	MILESTONES SWITCHGEARS PVT LTD	INDIA	
4	M138	M.K. ENGINEERS & CONTROLS PVT. LTD.	INDIA	
5	A212	ACCUSONIC CONTROLS PVT LTD	INDIA	
6	4007	INTRELEC	INDIA	
7	M264	MAKTEL SYSTEMS	INDIA	
8	P289	POPULAR SWITCHGEARS PVT LTD	INDIA	
9	V124	VIDHYUT CONTROL (INDIA) PVT LTD	INDIA	
10	E209	ELECTRO ALLIED PRODUCTS	INDIA	
11	T114	TRICOLITE ELECTRICAL INDUSTRIES PVT LTD	INDIA	
12	N148	NITYA ELECTROCONTROLS PRIVATE LIMITED	INDIA	
13	3780	POSITRONICS PVT LTD	INDIA	
14	4203	ENGINEERS AND ENGINEERS (ELECTRICALS) PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13GA		**Description :** CONTROL STATIONS- WEATHERPROOF		
Approved Suppliers				
1	B024	BALIGA LIGHTING EQUIPMENTS (P) LIMITED	INDIA	
2	4012	TEKMEC SWITCHGEAR & CONTROLS	INDIA	
3	S158	SUDHIR SWITCHGEARS PVT LTD	INDIA	
4	E024	EX-PROTECTA	INDIA	
5	3681	FCG POWER INDUSTRIES PVT LTD	INDIA	
6	E111	ELECTRICAL EQUIPMENT CORPORATION	INDIA	
7	B002	BCH ELECTRIC LTD	INDIA	
8	F024	FLEXPRO ELECTRICALS PVT LTD	INDIA	
9	T166	TEKNIC ELECTRIC (I) PVT. LTD.	INDIA	
10	F036	FLAMEPROOF EQUIPMENTS PVT.LTD	INDIA	
11	G159	PEPPERL & FUCHS MANUFACTURING (INDIA) PRIVATE LIMITED	INDIA	
12	3706	PHOENIX MECANO INDIA PVT. LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13GB		**Description :** CONTROL STATIONS-FLAME PROOF		
Approved Suppliers				
1	3681	FCG POWER INDUSTRIES PVT LTD	INDIA	
2	S158	SUDHIR SWITCHGEARS PVT LTD	INDIA	
3	F036	FLAMEPROOF EQUIPMENTS PVT.LTD	INDIA	
4	B024	BALIGA LIGHTING EQUIPMENTS (P) LIMITED	INDIA	
5	K173	KAYSONS TECHNO EQUIPMENTS PVT. LTD.	INDIA	
6	3706	PHOENIX MECANO INDIA PVT. LTD.	INDIA	
7	G159	PEPPERL & FUCHS MANUFACTURING (INDIA) PRIVATE LIMITED	INDIA	
8	F024	FLEXPRO ELECTRICALS PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13JA		**Description :** MOTOR-INDUCTION-HV(INDUSTRIAL TYPE SAFE AREA)		
Approved Suppliers				
1	3707	TMEIC INDUSTRIAL SYSTEMS INDIA PRIVATE L	INDIA	
2	3672	CG POWER AND INDUSTRIAL SOLUTIONS LIMITED	INDIA	
3	A070	ABB INDIA LTD (BARODA)	INDIA	
4	B041C	BHARAT HEAVY ELECTRICALS LIMITED-BHOPAL	INDIA	
5	3714	WEG INDUSTRIES INDIA PVT LTD	INDIA	
6	3703	JEUMONT ELECTRIC INDIA PVT LTD	INDIA	
7	M282	MARATHON ELECTRIC MOTORS (INDIA) LTD.	INDIA	
8	B048	BHARAT BIJLEE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13JD		**Description :** MOTOR INDUCTION-MV (INDUSTRIAL TYPE SAFE AREA)		
Approved Suppliers				
1	A310	ABB INDIA LTD-FARIDABAD	INDIA	
2	3940	HEM INDUSTRIES	INDIA	
3	4157	ROTOMOTIVE POWERDRIVES INDIA LIMITED	INDIA	
4	L065	LAXMI HYDRAULICS PVT LTD	INDIA	
5	3668	CG POWER & INDUSTRIAL SOLUTIONS LTD.	INDIA	
6	S003	SIEMENS LIMITED	INDIA	
7	B048	BHARAT BIJLEE LIMITED	INDIA	
8	4199	MARATHON ELECTRIC MOTORS (INDIA) LTD.	INDIA	
9	3986	HAVELLS INDIA LTD	INDIA	
10	A200	ABB INDIA LTD (BANGALORE)	INDIA	
11	M282	MARATHON ELECTRIC MOTORS (INDIA) LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13JE		**Description :** MOTOR-INDUCTION-M.V(ZONE 2-TYPE e & n)		
Approved Suppliers				
1	A200	ABB INDIA LTD (BANGALORE)	INDIA	
2	B048	BHARAT BIJLEE LIMITED	INDIA	
3	3668	CG POWER & INDUSTRIAL SOLUTIONS LTD.	INDIA	
4	A310	ABB INDIA LTD-FARIDABAD	INDIA	
5	M282	MARATHON ELECTRIC MOTORS (INDIA) LTD.	INDIA	
6	L065	LAXMI HYDRAULICS PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13JF		**Description :** MOTOR-INDUCTION-M.V (FLAME PROOF)		
Approved Suppliers				
1	3668	CG POWER & INDUSTRIAL SOLUTIONS LTD.	INDIA	
2	M282	MARATHON ELECTRIC MOTORS (INDIA) LTD.	INDIA	
3	L065	LAXMI HYDRAULICS PVT LTD	INDIA	
4	3940	HEM INDUSTRIES	INDIA	
5	B048	BHARAT BIJLEE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13JK		**Description :** MOTORS - IMPORTED		
Approved Suppliers				
1	W598	WEG EQUIPAMENTOS ELETRICOS S.A.	BRAZIL	
2	G632	GENERAL ELECTRIC CANADA	CANADA	
3	C730	GE ENERGY POWER CONVERSION FRANCE SAS	FRANCE	
4	J511	JEUMONT SA / FRAMATONE ANP	FRANCE	
5	L575	LOHER GMBH	GERMANY	
6	L603	LLOYD DYNAMOWERKE GMBH & CO. KG	GERMANY	
7	C736	CEMP SRL	ITALY	
8	A717	NIDEC ASI SPA	ITALY	
9	T597	TOSHIBA CORPORATION	JAPAN	
10	H510	HITACHI LTD	JAPAN	
11	27420	TMEIC CORPORATION	JAPAN	
12	H641	HYUNDAI HEAVY INDUSTRIES CO. LTD	KOREA, PEOPLE'S DEMOCRATIC REPUBLIC OF	
13	W598A	WEGEURO - INDUSTRIA ELECTRICA S.A.	PORTUGAL	
14	A661	ASEA BROWN BOVERY LTD (ABB LTD)	SWITZERLAND	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13LA		**Description :** LIGHTING FIXTURE & ACCESSORIES-HAZARDOUS		
Approved Suppliers				
1	K173	KAYSONS TECHNO EQUIPMENTS PVT. LTD.	INDIA	
2	F036	FLAMEPROOF EQUIPMENTS PVT.LTD	INDIA	
3	3990	SHREYA EX-TECH PRIVATE LIMITED	INDIA	
4	4245	FCG HI-TECH PRIVATE LIMITED	INDIA	
5	B024	BALIGA LIGHTING EQUIPMENTS (P) LIMITED	INDIA	
6	3681	FCG POWER INDUSTRIES PVT LTD	INDIA	
7	S158	SUDHIR SWITCHGEARS PVT LTD	INDIA	
8	F024	FLEXPRO ELECTRICALS PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13LC		**Description :** FLP ELECTRICAL FITTINGS (IMPORTED)		
Approved Suppliers				
1	V548	VICTOR PRODUCTS PLC	UNITED KINGDOM	
2	R506	R STAHL SCHALTGERATE GMBH	GERMANY	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13MA		**Description :** JUNCTION BOXES (FLAME PROOF)		
Approved Suppliers				
1	S158	SUDHIR SWITCHGEARS PVT LTD	INDIA	
2	F036	FLAMEPROOF EQUIPMENTS PVT.LTD	INDIA	
3	B024	BALIGA LIGHTING EQUIPMENTS (P) LIMITED	INDIA	
4	F024	FLEXPRO ELECTRICALS PVT LTD	INDIA	
5	R175	R STAHL PVT LTD	INDIA	
6	K173	KAYSONS TECHNO EQUIPMENTS PVT. LTD.	INDIA	
7	3706	PHOENIX MECANO INDIA PVT. LTD.	INDIA	
8	3681	FCG POWER INDUSTRIES PVT LTD	INDIA	
9	G159	PEPPERL & FUCHS MANUFACTURING (INDIA) PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13MB		**Description :** LIGHTING & POWER PANELS (FLP)		
Approved Suppliers				
1	B024	BALIGA LIGHTING EQUIPMENTS (P) LIMITED	INDIA	
2	K173	KAYSONS TECHNO EQUIPMENTS PVT. LTD.	INDIA	
3	3681	FCG POWER INDUSTRIES PVT LTD	INDIA	
4	3706	PHOENIX MECANO INDIA PVT. LTD.	INDIA	
5	F024	FLEXPRO ELECTRICALS PVT LTD	INDIA	
6	F036	FLAMEPROOF EQUIPMENTS PVT.LTD	INDIA	
7	S158	SUDHIR SWITCHGEARS PVT LTD	INDIA	
8	3990	SHREYA EX-TECH PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13MC		**Description :** PLUGS/SOCKETS/HANDLAMPS (FLAME PROOF)		
Approved Suppliers				
1	K173	KAYSONS TECHNO EQUIPMENTS PVT. LTD.	INDIA	
2	F036	FLAMEPROOF EQUIPMENTS PVT.LTD	INDIA	
3	B024	BALIGA LIGHTING EQUIPMENTS (P) LIMITED	INDIA	
4	F024	FLEXPRO ELECTRICALS PVT LTD	INDIA	
5	S158	SUDHIR SWITCHGEARS PVT LTD	INDIA	
6	3815	VICTORY LUMINAIRES	INDIA	
7	3681	FCG POWER INDUSTRIES PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13OC		**Description :** CABLES-MEDIUM VOLTAGE-POWER-XLPE		
Approved Suppliers				
1	3854	CHANDRESH CABLES LIMITED	INDIA	
2	G156	GEMSCAB INDUSTRIES LTD	INDIA	
3	3969	SHIVPRIYA CABLES PRIVATE LIMITED	INDIA	
4	U003	UNIVERSAL CABLES LTD	INDIA	
5	4055	DYNAMIC CABLES LIMITED	INDIA	
6	3731	POLYCAB INDIA LIMITED	INDIA	
7	R203	LKB ENGINEERING PRIVATE LIMITED	INDIA	
8	S304	SUYOG ELECTRICALS LTD	INDIA	
9	4261	TORTEK INDIA PRIVATE LIMITED	INDIA	
10	3814	RR KABEL LIMITED	INDIA	
11	3602	Special Cables Pvt. Ltd.	INDIA	
12	4105	ULTRACAB (INDIA) LIMITED	INDIA	
13	K082	KEI INDUSTRIES LIMITED	INDIA	
14	3765	THERMO CABLES LTD.	INDIA	
15	4265	SVARN INFRATEL PRIVATE LIMITED	INDIA	
16	T124	TORRENT ELECTRICALS LIMITED	INDIA	
17	3796	PARAMOUNT COMMUNICATIONS LTD	INDIA	
18	4163	KLJ PARAFLEX INDIA LIMITED	INDIA	
19	3669	KEI INDUSTRIES LIMITED	INDIA	
20	C145	CORDS CABLE INDUSTRIES LTD	INDIA	
21	4164	SHRIRAM TELELINK	INDIA	
22	4234	LASER POWER & INFRA PRIVATE LIMITED	INDIA	
23	3781	POLYCAB INDIA LIMITED	INDIA	
24	H060	HAVELLS INDIA LTD	INDIA	
25	4281	SBEE CABLES INDIA LIMITED	INDIA	
26	K190A	KEC INTERNATIONAL LIMITED	INDIA	
27	4262	K C POWERTRACKS	INDIA	
28	4263	TIRUPATI PLASTOMATICS PRIVATE LIMITED	INDIA	
29	4104	ZENIUM CABLES LIMITED	INDIA	
30	3722	POLYCAB INDIA LIMITED	INDIA	
31	4264	SURAJ CABLES (INDIA) PRIVATE LIMITED	INDIA	
32	A132	ASSOCIATED FLEXIBLES & WIRES [P] LTD	INDIA	
33	4298	SHRIRAM TELELINK	INDIA	
34	3783	POLYCAB INDIA LIMITED	INDIA	
35	S025	SRIRAM CABLES PVT LTD	INDIA	
36	4137	INSUCON CABLES AND CONDUCTORS PRIVATE LIMITED	INDIA	
37	4001	RAVI INDUSTRIES	INDIA	
38	U085	APAR INDUSTRIES LTD	INDIA	
39	3732	POLYCAB INDIA LIMITED	INDIA	
40	D012	DELTON CABLES LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 13OE		**Description :** CABLES-FIRE ALARM, COMMUNICATION AND CONTROL PAIRED		
Approved Suppliers				
1	D012	DELTON CABLES LIMITED	INDIA	
2	3669	KEI INDUSTRIES LIMITED	INDIA	
3	C145	CORDS CABLE INDUSTRIES LTD	INDIA	
4	4136	SHRIRAM TELELINK	INDIA	
5	E063	ELKAY TELELINKS LTD.-	INDIA	
6	3724	CORDS CABLE INDUSTRIESLTD.	INDIA	
7	S304	SUYOG ELECTRICALS LTD	INDIA	
8	T212	THERMO CABLES LTD (FORM. T-150)	INDIA	
9	4135	PAGODA CABLES PRIVATE LIMITED	INDIA	
10	K082	KEI INDUSTRIES LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14AB		**Description :** AUXILIARY RELAYS		
Approved Suppliers				
1	3642	M/S JVS ELECTRONICS PVT LTD	INDIA	
2	A392	GE T&D INDIA LIMITED	INDIA	
3	3860	HITACHI ENERGY INDIA LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14BA		**Description :** BIMETAL RELAYS		
Approved Suppliers				
1	3791	C & S ELECTRIC LTD	INDIA	
2	B002	BCH ELECTRIC LTD	INDIA	
3	A200	ABB INDIA LTD (BANGALORE)	INDIA	
4	S003	SIEMENS LIMITED	INDIA	
5	S450A	SCHNEIDER ELECTRIC INDIA P LTD-HYDERABAD	INDIA	
6	L103	SCHNEIDER ELECTRIC INDIA PRIVATE LIMITED	INDIA	
7	G147	GE INDIA INDUSTRIAL PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14CA		**Description :** CABLE GLANDS (HAZARDOUS AREA)		
Approved Suppliers				
1	K173	KAYSONS TECHNO EQUIPMENTS PVT. LTD.	INDIA	
2	4244	METALMECH ENGINEERING	INDIA	
3	F024	FLEXPRO ELECTRICALS PVT LTD	INDIA	
4	4187	SIGMA INDUSTRIES	INDIA	
5	S375	STANDARD METAL INDUSTRIES	INDIA	
6	C205	COMET INDUSTRIES	INDIA	
7	S158	SUDHIR SWITCHGEARS PVT LTD	INDIA	
8	F036	FLAMEPROOF EQUIPMENTS PVT.LTD	INDIA	
9	B024	BALIGA LIGHTING EQUIPMENTS (P) LIMITED	INDIA	
10	C195	COMET BRASS PRODUCTS	INDIA	
11	3681	FCG POWER INDUSTRIES PVT LTD	INDIA	
12	27421	CMP PRODUCTS LIMITED	UNITED KINGDOM	
13	3890	AKSHAR BRASS INDUSTRIES	INDIA	
14	3704	METAL CRAFT INDUSTRIES	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14CB		**Description :** CABLE TERMINATION & JOINTING KIT		
Approved Suppliers				
1	4283	GALA SHRINK FIT	INDIA	
2	H168	HEATSHRINK TECHNOLOGIES LTD (FORM. R136)	INDIA	
3	3645	YAMUNA CABLE ACCESSORIES PVT. LTD.	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14CD		**Description :** CONTACTORS		
Approved Suppliers				
1	A200	ABB INDIA LTD (BANGALORE)	INDIA	
2	B002	BCH ELECTRIC LTD	INDIA	
3	S450A	SCHNEIDER ELECTRIC INDIA P LTD-HYDERABAD	INDIA	
4	G147	GE INDIA INDUSTRIAL PVT LTD	INDIA	
5	S003	SIEMENS LIMITED	INDIA	
6	3791	C & S ELECTRIC LTD	INDIA	
7	L103	SCHNEIDER ELECTRIC INDIA PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14CF		**Description :** CONTROL SWITCHES / SELECTOR SWITCHES		
Approved Suppliers				
1	K143	KAYCEE INDUSTRIES LTD.	INDIA	
2	R159	RELIABLE ELECTRONIC COMPONENTS PVT LTD	INDIA	
3	4012	TEKMEC SWITCHGEAR & CONTROLS	INDIA	
4	S003	SIEMENS LIMITED	INDIA	
5	H142	HOTLINE SWITCHGEAR & CONTROLS	INDIA	
6	L103	SCHNEIDER ELECTRIC INDIA PRIVATE LIMITED	INDIA	
7	4002	P.P. INDUSTRIES	INDIA	
8	S373	SWITRON DEVICES	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14EA		**Description :** EARTH LEAKAGE CIRCUIT BREAKER		
Approved Suppliers				
1	S003	SIEMENS LIMITED	INDIA	
2	L071	LEGRAND (INDIA) PVT. LTD (FORM. M-006)	INDIA	
3	3726	NOVATEUR ELECTRICAL & DIGITAL SYSTEMS PVT. LTD.	INDIA	
4	S450	SCHNEIDER ELECTRIC INDIA PVT LTD	INDIA	
5	G147	GE INDIA INDUSTRIAL PVT LTD	INDIA	
6	A372	ABB INDIA LTD	INDIA	
7	3824	HAVELLS INDIA LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14FA		**Description :** FUSES		
Approved Suppliers				
1	G147	GE INDIA INDUSTRIAL PVT LTD	INDIA	
2	I013	NOVATEUR ELECTRICAL & DIGITAL SYSTEMS P	INDIA	
3	S003	SIEMENS LIMITED	INDIA	
4	C194	EATON POWER QUALITY PRIVATE LIMITED	INDIA	
5	L103	SCHNEIDER ELECTRIC INDIA PRIVATE LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14HA		**Description :** HEAVY DUTY SWITCHES		
Approved Suppliers				
1	L103	SCHNEIDER ELECTRIC INDIA PRIVATE LIMITED	INDIA	
2	3790	C & S ELECTRIC LTD	INDIA	
3	S003	SIEMENS LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14IA		**Description :** INSTRUMENT TRANSFORMERS CT & PT (MV)		
Approved Suppliers				
1	N119	NARAYAN POWERTECH PVT LTD	INDIA	
2	P228	PRAGATI ELECTRICALS PVT LTD	INDIA	
3	G135	GILBERT & MAXWELL ELECTRICALS PVT LTD	INDIA	
4	3789	PRAGATI ELECTRICALS PVT LTD	INDIA	
5	K149	KALPA ELECTRIKAL PVT LTD	INDIA	
6	3901	NEWTEK ELECTRICALS	INDIA	
7	P237	PRECISE ELECTRICALS	INDIA	
8	4160	RECO TRANSFORMERS PRIVATE LIMITED	INDIA	
9	S372	SILKAANS ELECTRICALS MFG.CO.PVT.LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14LB		**Description :** LIGHTING FIXTURE & ACCESSORIES-NON HAZARDOUS		
Approved Suppliers				
1	3833	BAJAJ ELECTRICALS LTD	INDIA	
2	4214	CROMPTON GREAVES CONSUMER ELECTRICALS LIMITED	INDIA	
3	4245	FCG HI-TECH PRIVATE LIMITED	INDIA	
4	3687	PYROTECH TECHNOLOGIES PRIVATE LIMITED	INDIA	
5	3993	LIGHTING TECHNOLOGIES INDIA PRIVATE LIMITED	INDIA	
6	3986	HAVELLS INDIA LTD	INDIA	
7	3834	BAJAJ ELECTRICALS LTD	INDIA	
8	4036	HALONIX TECHNOLOGIES PRIVATE LIMITED	INDIA	
9	4211	SURYA ROSHNI LTD	INDIA	
10	4043	ORIENT ELECTRIC LIMITED	INDIA	
11	4068	FORTUNEARRT LED LIGHTING PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14LC		**Description :** LIGHTING & POWER PANELS (SAFE AREA)		
Approved Suppliers				
1	I013	NOVATEUR ELECTRICAL & DIGITAL SYSTEMS P	INDIA	
2	C007	C & S ELECTRIC LTD	INDIA	
3	A372	ABB INDIA LTD	INDIA	
4	3825	HAVELLS INDIA LIMITED	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14MA		**Description :** MCB		
Approved Suppliers				
1	S003	SIEMENS LIMITED	INDIA	
2	A372	ABB INDIA LTD	INDIA	
3	3726	NOVATEUR ELECTRICAL & DIGITAL SYSTEMS PVT. LTD.	INDIA	
4	3824	HAVELLS INDIA LIMITED	INDIA	
5	S450	SCHNEIDER ELECTRIC INDIA PVT LTD	INDIA	
6	I168	INDIANA CURRENT CONTROL LTD	INDIA	
7	3888	POLYCAB INDIA LIMITED	INDIA	
8	S393	STANDARD ELECTRICALS LTD	INDIA	
9	3793	C & S ELECTRIC LTD	INDIA	
10	L071	LEGRAND (INDIA) PVT. LTD (FORM. M-006)	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14MB		**Description :** MCCB		
Approved Suppliers				
1	G147	GE INDIA INDUSTRIAL PVT LTD	INDIA	
2	A200B	ABB INDIA LTD	INDIA	
3	S003	SIEMENS LIMITED	INDIA	
4	S450A	SCHNEIDER ELECTRIC INDIA P LTD-HYDERABAD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14MC		**Description :** METERS		
Approved Suppliers				
1	S141	SECURE METERS LIMITED	INDIA	
2	4233	ELMEASURE INDIA PRIVATE LIMITED	INDIA	
3	R042	RISHABH INSTRUMENTS LIMITED	INDIA	
4	A028A	AUTOMATIC ELECTRIC LTD.	INDIA	
5	N130	NIPPEN ELECTRICAL INSTRUMENTS CO.	INDIA	
6	M239	MECO INSTRUMENTS PVT LTD	INDIA	
7	3901	NEWTEK ELECTRICALS	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14PA		**Description :** PROTECTION RELAYS		
Approved Suppliers				
1	E143	EASUN REYROLLE LTD	INDIA	
2	A070	ABB INDIA LTD (BARODA)	INDIA	
3	A392	GE T&D INDIA LIMITED	INDIA	
4	S824	SCHWEITZER ENGINEERING LABORATORIES	UNITED STATES	
5	S450A	SCHNEIDER ELECTRIC INDIA P LTD-HYDERABAD	INDIA	
6	S003B	SIEMENS LTD - GOA	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14PB		**Description :** PUSH BUTTON AND INDICATING LAMPS		
Approved Suppliers				
1	P291	PRECIFINE PRODUCTS PVT. LTD.	INDIA	
2	4012	TEKMEC SWITCHGEAR & CONTROLS	INDIA	
3	4002	P.P. INDUSTRIES	INDIA	
4	B002	BCH ELECTRIC LTD	INDIA	
5	E173	ESSEN DEINKI	INDIA	
6	T166	TEKNIC ELECTRIC (I) PVT. LTD.	INDIA	
7	H142	HOTLINE SWITCHGEAR & CONTROLS	INDIA	
8	3791	C & S ELECTRIC LTD	INDIA	
9	S450A	SCHNEIDER ELECTRIC INDIA P LTD-HYDERABAD	INDIA	
10	S003	SIEMENS LIMITED	INDIA	
11	S365	SHRI TULSI SWITCHGEARS PVT LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14TA		**Description :** TIMERS		
Approved Suppliers				
1	L103	SCHNEIDER ELECTRIC INDIA PRIVATE LIMITED	INDIA	
2	E151	ELECTRONIC AUTOMATION PVT LTD	INDIA	
3	S003	SIEMENS LIMITED	INDIA	
4	B002	BCH ELECTRIC LTD	INDIA	

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INTRODUCTION, BRIEF DESCRIPTION AND SCOPE OF WORK FOR COOLING TOWER PACKAGE

(Tender No. : C050-1U68-81-45-PB-T-8010)

PROJECT	**:**	**EPCM SERVICES FOR 360 KTPA PPU AT NRL**
OWNER	**:**	**M/s NUMALIGARH REFINERY LTD.**
LOCATION	**:**	**NUMALIGARH, ASSAM**
JOB No.	**:**	**C050**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	08.08.2025	ISSUED FOR BIDS	SJ	VMF	GYAS

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1.0 INTRODUCTION

The cooling water system envisaged to cater the cooling water demand for the PP Project of NRL, Numaligarh is fresh water re-circulating type cooling tower. The cooling water system will cater to the requirements of Poly Propylene unit and associated offsite and utility systems.

The Cooling Tower Package includes cooling towers, cold water basin, channel and sump, cooling water re-circulating pumps, cooling water treatment facilities viz. chemical dosing for quality control, sulphuric acid for pH control etc. other auxiliary items and associated civil, structural, mechanical, instrumentation and electrical works.

1.1 ORDER OF PREFERENCE

In case of any conflict following order of precedence shall be followed:
i. P&ID, Process data sheet
ii. Scope drawing & Scope Matrix
iii. Job specification
iv. Standard specifications
v. Other International / national codes and standards referred to
However, contactor shall bring out the conflict to notice of the Owner/ EIL. Owner/EIL decision shall be final.

2.0 SCOPE OF WORK

The scope of work of Cooling Tower Package tender shall cover design, detailed engineering, procurement, supply of all materials, equipment, installation, construction, fabrication, erection, manufacture, receipt, storage, conservation and preservation of all materials at site, handling at site, assembly, painting, testing, commissioning of the entire system within package battery limit including testing and trial runs for 30 days after commissioning, performance guarantee test run for 72 hours and removal of unserviceable material, and guaranteeing of Cooling Water system comprising of **Cooling Tower and associated facilities**, which includes cold water basin, channel & sump, Cooling Water pump house, re-circulating cooling water pumps, cooling water supply and return piping, chemical dosing system for Cooling Water treatment, all civil, mechanical, electrical and instrumentation works including training of Owner's operating staff for a period of 30 days during trial runs and commissioning, including operation & maintenance of chemical dosing system for a period of six months after commissioning, including supply of all chemicals, lubricants and consumables including first fill required for equipment & lubricants required during commissioning, trial runs for 30 days, performance guarantee test run and six months chemical & lubricant consumption of plant operation after commissioning, and fulfilment of performance guarantee of the Cooling Tower on Turnkey basis as per bid document.

The brief scope of work is as mentioned below but not limited to same.

Cooling Tower shall comprise of 3 nos. of cells (2 working and 1 standby) as per process data sheets and P&ID's.

Cooling Tower Package shall consist of following but not limited to:

- Cooling tower of FRP construction
- Cooling Tower basin, sump and channel of RCC construction
- Cooling Water Re-circulating Pumps
- All associated piping including Cooling Water supply and return piping within scope limit

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- Cooling water treatment and dosing system consisting of Formulation dosing, Polymeric dispersant dosing, Biocide dosing, chemical dosing system such as H_2SO_4 dosing, Chlorine di Oxide dosing system & side stream filters as per Process P&IDs/Design Basis/specifications.
- Contractor shall engage a specialist sub vendor for design of chemical dosing system for cooling water treatment plant. Operation & Maintenance of Chemical Dosing System for period of six months after commissioning, including supplying all chemicals and lubricants for cooling water treatment and maintaining the complete cooling water treatment system for initial fill, pre-commissioning, commissioning, 30 days trial run and six months operation after commissioning.
- 3D modelling of cooling tower and other facilities within Package B/L including all piping, equipment, instrument, JBs, LCPs, cable trays/ducts, lighting systems, structures etc.
- All associated mechanical, instrumentation, electrical and civil/structural works.

Bidder shall visit the site to ascertain actual site condition to quantify/ assess the job himself before quoting rates. No extra claim at a later date shall be entertained due to non-familiarization of site.

Refer below matrix for detailed division of scope of works and supply:

SCOPE MATRIX

S.N.	Item	Design, Engineering and preparation of AFC drawings	Supply of all material	Erection and construction	Construction Supervision	Testing and commissioning
1.	Cooling Tower Basin and cold water channel (RCC)	CTC	CTC	CTC	CTC	CTC
2.	Cooling Tower (FRP) above basin including, frame work, casing, air inlet, fill, drift eliminator, partition wall, end wall, fan deck, fan stack, stairways, escape ladder, hand rail, cooling tower piping & hot water distribution, including all mechanical components like fan, gear reducers, drive shaft, motor and lifting devices	CTC	CTC	CTC	CTC	CTC
3.	Cooling Water Re-circulating Pumps	CTC	CTC	CTC	CTC	CTC
4.	Sluice gate in Cooling water basin at the outlet to cold water channel.	CTC	CTC	CTC	CTC	CTC
5.	½" and 10 mesh screens in cold water channel with suitable lifting device (Chain pulley block arrangement for lifting)	CTC	CTC	CTC	CTC	CTC
6.	Cooling water sump and Pump house	CTC	CTC	CTC	CTC	CTC
7.	RCC PAVEMENT within battery Limit	CTC	CTC	CTC	CTC	CTC
8.	Side stream filters and	CTC	CTC	CTC	CTC	CTC

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S.N.	Item	Design, Engineering and preparation of AFC drawings	Supply of all material	Erection and construction	Construction Supervision	Testing and commissioning
	associated Piping					
9.	ClO2 dosing system	CTC	CTC	CTC	CTC	CTC
10.	Formulation dosing, Polymeric dispersant dosing, Biocide dosing Systems	CTC	CTC	CTC	CTC	CTC
11.	H2SO4 storage and dosing system	CTC	CTC	CTC	CTC	CTC
12.	Corrosion Probe and Corrosion Coupon	CTC	CTC	CTC	CTC	CTC
13.	Civil and structural work within scope limit	CTC	CTC	CTC	CTC	CTC
14.	All the piping (above ground & under ground), support/ sleeper inside scope Battery Limit including all fittings, flanges, valves etc. as per P&IDs and Scope of Work	CTC	CTC	CTC	CTC	CTC
15.	Chemical Treatment Plant Building	CTC	CTC	CTC	CTC	CTC
16.	Shed for Chemical Storage	CTC	CTC	CTC	CTC	CTC
17.	All Instrumentation items, valves, analysers, flowmeters etc. with-in package battery limits including instrument hook-ups	CTC	CTC	CTC	CTC	CTC
18.	Chlorine detector/ FRC Analyser	CTC	CTC	CTC	CTC	CTC
19.	Package PLC for CLO2 dosing system located in CLO2 dosing room (with air conditioning) located within package battery limits	CTC	CTC	CTC	CTC	CTC
20.	All ISBL Instrumentation cabling, up to Instrumentation junction boxes, local panels within package battery limits.	CTC	CTC	CTC	CTC	CTC
21.	All Instrumentation cabling from field instruments / junction boxes to ClO_2 dosing package PLC located in ClO_2 dosing room (within package battery limits).	CTC	CTC	CTC	CTC	CTC
22.	Instrumentation Cable trays and cable ducts inside the package battery limits including its structural supports and its interface connectivity with purchaser's cable duct.	CTC	CTC	CTC	CTC	CTC
23.	All installation materials such as impulse tubes, pipes, valves and fittings for all field instruments, valves.	CTC	CTC	CTC	CTC	CTC
24.	All piping and pipe fittings, tubes and tube fittings for instrument air supply	CTC	CTC	CTC	CTC	CTC

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S.N.	Item	Design, Engineering and preparation of AFC drawings	Supply of all material	Erection and construction	Construction Supervision	Testing and commissioning
	distribution					
25.	DCS system	EIL	X	X	X	X
26.	Vibration transmitters (2oo2/ 2oo3 voting configuration in case of tripping)	CTC	CTC	CTC	CTC	CTC
27.	All Motors for the package	CTC	CTC	CTC	CTC	CTC
28.	All other electrical loads for the package	CTC	CTC	CTC	CTC	CTC
29.	Power Distribution Boards (for feeding single phase motors provided as part of package), Power Panels, plugs & sockets and Welding Receptacles	CTC	CTC	CTC	CTC	CTC
30.	Lighting Panel (for Normal & Emergency lighting), DCJB (for DC Lighting), Power panel	CTC	CTC	CTC	CTC	CTC
31.	Local Push button station/control station (both FLP & WP)	CTC	CTC	CTC	CTC	CTC
32.	Local gauge boards / Local Control Panel (as applicable)	CTC	CTC	CTC	CTC	CTC
33.	Cable Trays within Package Battery Limits (Electrical) including supports for the same	CTC	CTC	CTC	CTC	CTC
34.	Complete lighting (including AC emergency & DC critical lighting) within the Package Battery Limits including fixtures, lamps, control gear boxes, JBs, poles etc.	CTC	CTC	CTC	CTC	CTC
35.	Cabling (including supply, laying, termination at both ends) of cables from Vendor's PDB/PP/LP/ELP/DCJB to loads/vendor's accessories supplied by vendor.	CTC	CTC	CTC	CTC	CTC
36.	All power and control cabling from Owners switchboard to CW system package loads. (Refer Note -1)	X	X	X	CTC	CTC
37.	Earthing & Lighting Protection System includes earth pits & buried earth strips, earth plates, equipment earthing within Package Battery Limits. Earth pits (<1 Ohm), earthing cables, earth strips/plates etc for system earth for Package PLC and analyser system within package battery limits	CTC	CTC	CTC	CTC	CTC
38.	Cable Trenches inside Battery Limit (Electrical)	CTC	CTC	CTC	CTC	CTC
39.	All works required for installation of Contractor's electrical equipment, supports for cables/ cable trays etc., as	CTC	CTC	CTC	CTC	CTC

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S.N.	Item	Design, Engineering and preparation of AFC drawings	Supply of all material	Erection and construction	Construction Supervision	Testing and commissioning
	required for completion of electrical works.					
40.	Painting of all structural steel supports provided for installation of all electrical equipment, associated components, cables, earthing etc.,	CTC	CTC	CTC	CTC	CTC
41.	Tools and tackles for maintenance of all electrical & instrumentation equipment and systems.	CTC	CTC	NA	NA	NA
42.	3 D Modelling of cooling tower and all other facilities within Package B/L	CTC	NA	NA	NA	NA
43.	Oil Skimming system	CTC	CTC	CTC	CTC	CTC
44.	Electrical Load list (Refer Note- 2).	CTC	X	X	X	X
45.	Chemicals, lubricants & consumables for trial run, commissioning & 6 months of operation	NA	CTC	NA	NA	NA
46.	Mandatory Spares	NA	CTC	NA	NA	NA
47.	Spares for commissioning & start-up of Cooling Tower Package	NA	CTC	NA	NA	NA

LEGEND:

CTC:- SCOPE OF COOLING TOWER PACKAGE CONTRACTOR

NA:- NOT APPLICABLE

X:- OTHER'S SCOPE

NOTES:

1. Cable termination inside battery limit is included in CT Package Contractor scope.
2. CT Package Contractor to give electrical load data within 3 weeks from FOA indicating the load details for Cooling water pumps, cooling tower fans, all dosing package motors (pumps/agitators etc.), lighting load requirement, normal & emergency and UPS power requirements.
3. Contractor to also refer to Electrical Block Diagram (C050-1U68-16-50-SK-8010) attached with the tender.

2.1 BATTERY LIMIT CONDITIONS

The battery limits of Cooling Tower Vendor's scope of work are given in P&IDs No. C050-79-41-1U68-1111/1112/1113

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3.0 SCOPE OF SUPPLY

3.1 CLIENT'S SCOPE OF SUPPLY

Refer Scope Matrix

3.2 CONTRACTOR'S SCOPE OF SUPPLY

Refer Scope Matrix

For detailed scope of supply of for various disciplines, refer respective documents attached in the bid document

4.0 EXCLUSIONS

Refer Scope Matrix

5.0 SPARES

5.1 GENERAL

For successful pre-commissioning, commissioning /performance test, plant operation and during guarantee period of the plant, requirement of spares are to be provided by the Contractor and are to be listed in the bid. The cost aspect to be suitably taken care by the Contractor. The unutilized spares shall be the property of the owner.

5.2 MANDATORY SPARES

For details of mandatory spares refer elsewhere in the bid document

5.3 TWO YEARS OPERATIONAL SPARES

Contractor shall recommend spares required for two year normal operation along with unit price.

6.0 INTERFACE DOCUMENT

Interface document for various disciplines shall be identified during Kick off meeting.

7.0 OPERATION & MAINTENANCE CONTRACT

The scope of work shall also include operation & maintenance (O&M) of chemical dosing systems for cooling water treatment, ClO_2 dosing system etc. for a period on six (6) months after commissioning & 30 days of trial runs, including supply of all chemicals, consumables, lubricants, any other material as required, including all tools and tackles, supply of necessary manpower for smooth and trouble free running of various chemical dosing systems including ClO_2 dosing system for entire operation & maintenance period. O&M shall also include preventive & planned maintenance.

For manpower deployment, the following minimum number of personnel shall be deployed by the Cooling Tower Package Contractor during regular operation;

1. One (1) person per shift (total three shifts per day)
2. One (1) supervisor for general shift
3. One (1) supervisor for chemical handling for general shift

The personnel shall have prior work experience in relevant O&M activities.

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Additional manpower shall be provided during preventive / planned / shutdown maintenance, as per requirement. Spares required for maintenance shall be either from available mandatory spares or shall be provided by Owner.

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GENERAL CIVIL

SCOPE OF SUPPLY/ WORKS

FOR

COOLING TOWER PACKAGE

PROJECT : EPCM SERVICES FOR 360 KTPA PPU AT NRL

OWNER : M/s NUMALIGARH REFINERY LTD.

LOCATION : NUMALIGARH, ASSAM

EIL JOB No. : C050

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	19.08.25	Issued for Bids	SJ	VMF	GYAS

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1.0 INTRODUCTION

The cooling water system envisaged to cater the cooling water demand for the PP Project of NRL, Numaligarh is fresh water re-circulating type cooling tower. The cooling water system will cater to the requirements of Poly Propylene Unit and associated offsite and utility systems.

The Cooling Tower Package includes cooling towers, cold water basin, channel and sump, cooling water re-circulating pumps, cooling water pump house, cooling water treatment facilities viz. chemical dosing for quality control, sulphuric acid for pH control etc. other auxiliary items and associated civil, structural, mechanical, instrumentation and electrical works.

2.0 SCOPE OF WORK

The scope of work of Cooling Tower Package tender shall cover design, detailed engineering, procurement, supply of all materials, equipment, installation, construction, fabrication, erection, manufacture, receipt, storage, conservation and preservation of all materials at site, handling at site, assembly, painting, testing, commissioning of the entire system within package battery limit including testing and trial runs for 30 days after commissioning, performance guarantee test run for 72 hours and removal of unserviceable material, and guaranteeing of Cooling Water system comprising of **Cooling Tower and associated facilities**, which includes cold water basin, channel & sump, Cooling Water pump house, re-circulating cooling water pumps, cooling water supply and return piping, chemical dosing system for Cooling Water treatment, all civil, mechanical, electrical and instrumentation works including training of Owner's operating staff for a period of 30 days during trial runs and commissioning, including operation and maintenance of chemical dosing system for six months after commissioning, including supply of all chemicals, lubricants and consumables including first fill required for equipment & lubricants required during commissioning, trial runs for 30 days, performance guarantee test run and six months chemical & lubricant consumption of plant operation after commissioning, and fulfilment of performance guarantee of the Cooling Tower on Turnkey basis as per bid document.

Cooling Tower shall comprise of nos. of cells as per process data and P&ID.

Cooling Tower Package shall consist of following but not limited to:

a. FRP Cooling tower, RCC basin and cold-water channel

b. Cooling Water Re-Circulating Pumps

c. Cooling water sump and pump house along with all piping, electrical and instrumentation works all complete.

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d. CWTP Building, Chemical Storage shed, Operator cum PLC room & MCC.

e. Cooling water treatment and dosing system consisting of formulation dosing, Polymeric dispersant dosing, Biocide dosing such as H_2SO_4 dosing, Chlorine Dioxide dosing system & side stream filters etc.

f. Civil/Structural design, engineering and preparation of drawings of all facilities in Contractor's scope.

g. All piping, valves, fittings etc. within the Package battery limit as per P&IDs & scope drawing.

h. Contractor shall engage a specialist sub vendor for design of chemical dosing system for cooling water treatment. Operation and maintenance of chemical dosing system for six months after commissioning, including supplying all chemicals and lubricants for cooling water treatment required for initial fill, pre-commissioning, commissioning, 30 days trial run and six months operation after commissioning.

i. RCC Storm water drains shall be provided within scope limit & the same shall be connected to road side storm drains. Drains shall be provided with hot dipped galvanized (HDG) grating as per EIL Standard.

j. Electrical and Instrumentation trenches and Road Crossings (ERC/IRC)

k. Plumbing and sanitary system for buildings within the scope limit of Cooling tower package contractor

l. Sanitary sewer gravity network up to sanitary sewer B/L

m. Distribution network of Drinking water system for buildings, Safety shower & eye wash unit or any other places required within the contractor scope limit

n. Supply and installation of 9 kg DCP Type & 4.5 Kg CO_2 Type Portable Fire Extinguishers

o. Construction of hard stand and crane movement area required for fabrication and Installation of equipment etc.

p. Acid/ Alkali resistant lining in and around acid/ caustic and chemical storage and handling areas as applicable.

q. 3D modelling of cooling tower and other facilities within Package B/L including all piping, equipment, instruments, cable trays/ducts, lighting system, structures etc.

r. All mechanical, instrumentation, electrical and other civil works.

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The Bidder shall visit the site to assess the actual site conditions before quoting the rates. No additional claims will be entertained at a later date due to a lack of familiarity with the site.

Refer scope matrix for detailed division of scope of works and supply given elsewhere in bid document

3.0 DETAILED SCOPE OF WORK & SYSTEMS

3.1 BATTERY LIMIT CONDITIONS

The battery limits of Contractor's scope of work are given in P&IDs No. C050-79-41-IU68-1111/1112/1113 and scope limit drawing for Cooling Tower Package drawing no. C050-IU68-81-45-04801.

3.2 COOLING TOWER, BASIN, CHANNEL, SUMP AND PUMP HOUSE

The scope of work shall cover: -

a) Design, detail engineering, supply of all materials, erection, construction of the mechanical induced draft, counter flow FRP cooling tower having number of cells as per Process data sheet/ P&IDs for meeting the Project requirements. The requirements of the Cooling Tower including sump, basin & channel shall be as per specification no. C060-IU68-81-45-JS-8010.

b) The cooling tower cells shall be so designed so that each of them can be repaired, maintained and cleaned while the other cells are in operations. Oil skimming arrangement in the channel at entry for sump shall be provided to remove floating oil to OWS.

c) The cooling tower datasheet for all the instruments, fittings, etc. shall be developed by the Cooling Tower Package Contractor for review and approval by Owner/EIL.

d) Space allocated for cooling tower cell, as shown in scope drawing, is the maximum available space. Cooling Tower Package Contractor shall size the cooling tower accordingly.

e) A chain pulley block of suitable capacity with all necessary lifting arrangement shall be provided for maintenance work on cooling tower fan, gearbox and motor as per specifications given elsewhere in bid document.

f) Cooling tower Package contractor’s scope includes sizing, hydraulic design and preparation of General arrangement drawing and construction of cold-water channel, basin and sump considering the water requirement at cooling tower cells.

g) Partition wall shall be provided from the basin bottom to the top of basin and also partition shall be provided from top of basin to bottom of fan deck. End of cooling tower shall be kept closed

h) The basin shall be provided with an overflow and drainage arrangement from each cell, which

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shall be suitably connected, to the nearest storm water drain.

i) CFD analysis and incorporating its recommendation shall be in Cooling tower package contractor scope.

j) Cooling Tower Package Contractor's scope includes supply of all materials, erection, construction of cold-water channel, basin and sump as per scope drawing and scope of work.

k) The design, supply and testing & commissioning of "½ and 10 mesh screens" (as per P&ID) in cold water channel with suitable lifting device (chain pulley block arrangement for lifting & maintenance)" are in the scope of Cooling tower package contractor.

l) The cold water from the basin shall be conveyed through a sluice gate to the sump through cold-water channel covered with pre-cast RCC slabs. The sluice gate (as per IS: 13349) shall be provided at a level such that full flow occurs through the gate at minimum water level. Cooling Tower Package Contractor's scope includes sizing, hydraulic design, preparation of General arrangement drawing, erection of sluice gate and construction of cold-water channel considering the water requirement at cooling tower cells.

m) Return hot water from various units etc. is combined into a common line and shall be laid under ground from battery limit up to cooling tower and individual return water riser pipes shall be provided for each cooling tower cell and further taken into the cooling tower as per Contractor's design requirements for each cell. Main Cooling water return header and riser pipe to each cell within Battery limit shall be laid and provided by Cooling Tower Contractor. Contractor shall provide expansion bellow in the riser pipe before entering to Cooling Tower cell. Corrosion probe and corrosion coupon shall be provided by contractor in the return header near the cooling tower. Contractor to finalize Cooling Tower height and fan deck height according to the pressure available at grade level near cooling tower (as given in process data sheet) & design the hot water riser to suit the battery limit pressure conditions. Contractor to confirm the return header pressure in the offer.

n) Contractor to note that area available for proposed cooling tower, RCC cold water channel, cooling water sump & pump house and CWTP is marked on scope drawing and no extra space shall be made available to put up same. Contractor is required to visit site and make him self aware of actual site conditions.

o) Any other work required as per scope drawing and P&ID and required for the completion of the job in all respects.

3.3 CIVIL WORKS

a) Design, detail engineering, and construction of pavement, necessary supports, RCC cable trenches, RCC/ steel/ pipe supports, operating steel platforms with stairs, grating etc within the scope limits as per scope drawing.

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b) The graded area shall be handed over to the contractor. The entire area within the battery limit of package shall be RCC paved. Type-I RCC pavement shall be provided in all areas except under the basin & channel where Type-III RCC pavement shall be provided as per EIL standard 7-65-0404 (Standard for RCC pavement details).

c) Any other work required as per scope drawing and P&ID for the completion of the job in all respects.

d) Approach required for the cooling tower including providing all roads crossing like electrical/instrumentation road crossings, storm water culverts wherever required shall be provided by the Cooling tower package contractor. All approach roads shall be RCC Pavement Type-I as per EIL standard 7-65-0404 (Standard for RCC pavement details).

e) Cooling tower package contractor shall provide the approach required during construction period for the cooling tower including providing encasing and culvert wherever required as per the Engineering Design basis.

f) Reconstructing the facilities damaged during construction activity of the cooling tower (including the retaining wall, storm water drains, roads etc.) if any.

g) Design, detail engineering, and construction of Storm water drains within scope limit & connecting the same to road side storm drains. Storm culverts and drain below the approach road for crossing of existing/new storm water drain

h) Design, supply of all materials and construction of complete Internal Plumbing Work in the within Cooling Tower Package Contractor's scope. The contractor scope shall be design of plumbing works including making plumbing drawings, supply and installation of all plumbing fixtures, Internal water supply and vent piping from PUF insulated HDPE storage tank on roof of individual buildings as per piping materials specified in design basis etc.

i) Design sanitary sewage system for toilet block of within Cooling Tower Package Contractor's scope. Contractor to work out the exact size depending on the flow and velocity & submit the same for approval. However, size adopted shall not be smaller than "minimum size" specified in relevant IS codes, Construction of the sanitary sewage system including all fixtures, traps, fittings, piping, accessories, gully trap, inspection chamber etc. complete in all aspects, all testing and commissioning including performing hydro testing, flushing of lines etc.

j) Design, supply of all materials and construction of offsite Sanitary sewer network from all toilet blocks within Cooling tower package contractor's scope and collecting in a sanitary manhole at battery limit (Indicative location given in scope drawing and same shall be finalized during detailed engineering).

k) Hard stand for erection of heavy equipment's by cranes shall be ascertained by the Cooling tower package contractor & provided as required. Hard stand required for the erection of heavy equipment shall be designed as per erection loads by the contractor. Based on soil

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data, the hard stand required for erection of heavy equipment's to be designed and provided as per equipment erection philosophy/type of cranes to be used inside and outside the battery limit. Dismantling of hard stand if required, as per directions of Engineer-in-Charge.

l) Acid/ Alkali, Chemical resistance Lining over RCC flooring shall be provided as per Process requirement within and around chemical handling area. The tile lining shall be as per specification and manufacturer standard. Minimum 16 mm thick tiles shall be used. For vehicular movement area 64 mm thick tile/ brick shall be used.

3.4 PIPING WORKS

a) Supply and erection of all piping within the battery limit of Cooling Tower Package as per the scope drawing and P&ID shall be in the scope of the Contractor including, design, engineering & 3D modelling of the same. Piping shall be arranged as shown in P&ID. All piping, valves, flanges, fittings, instruments, gaskets, nuts, bolts etc. shall be as per process P&ID and piping material specifications. All underground piping shall be done as per specification attached with bid document.

b) Complete engineering, supply of materials, fabrication, installation, insulation, painting internal & external coating of piping, testing and commissioning within the battery limit of cooling tower package as per the scope drawing and P&ID shall be in Cooling Tower Package Contractor scope.

c) Cooling Water underground supply & return piping shall be externally 3 LPE coated as per specification attached with the bid document.

d) All in-line instruments on piping within Cooling Tower Package battery limit shall be in Cooling Tower Package Contractor scope.

e) Design, engineering, supply, fabrication, installation, insulation and painting of piping of all chemical dosing system as per process requirement.

f) Supplying, installation, testing and commissioning of safety showers & eye wash including supplying and laying of pipe up to battery limit of cooling tower package.

g) Cooling Tower Package Contractor shall provide combined safety shower and eyewash units as per attached specifications, at various places & maintenance area where an employee may be exposed to accidental contact with materials which may burn, irritate or in any case harmful to the tissue. Discharge from safety shower/ eye wash unit shall be connected to a neutralization pit and after neutralization, it shall be connected to storm water drainage system. Safety shower and Eyewash unit shall be given potable water supply. All design parameters, number and locations shall meet the requirements given in the above specification. All safety shower and eyewash units shall be made of SS (stainless steel) and ISI marked. All safety showers should have proper signboard with fluorescent letters for their

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locations

h) The size of main drinking water header at hook-up point (Piping battery limit) shall be 3" for the facilities under Cooling tower Package. A minimum dia 2" (exact size of pipes to be ascertained by contractor) for drinking water header to safety shower & eye wash units, drinking water post in Cooling tower Package area shall be provided. All above ground drinking water header shall be insulated as per specification.

i) Supply, fabrication & erection of supporting structural elements for piping such as shoes, clips, clamps, cradles, anchors, guides etc., and construction of RCC sleepers for running above-ground piping.

j) The Cooling Tower Package Contractor shall check the stresses and loading in the piping system, all within the allowable range.

k) The Cooling Tower Package Contractor shall carry out flushing and hydro-testing for piping up to the battery limit and shall perform radiography for butt welding joints and MP/DP test for other joints in consultation with the site in-charge & NDT specification.

l) Painting of pipes, structural steel, etc. as per specification for shop and field painting as per job specification including supply of all paints required and coloring as per color codes.

m) All other works not exclusively mentioned in the tender document, but are necessary to complete the system in all respects with respect to process requirements, P&ID, Scope drawings and data sheet etc. shall form a part of total scope of work.

4.5 COOLING WATER TREATMENT SYSTEM

a) The Cooling Tower Package Contractor's scope of work covers supply, design, detail engineering including preparation of mechanical data sheet, procurement, fabrication, supply, transport, handling, erection, mechanical, electrical and instrument works including testing, commissioning & guaranteeing of cooling water treatment and dosing system consisting of Sulphuric acid dosing, formulation dosing, Polymeric dispersant dosing, chemical dosing and side stream filters, all interconnecting piping works & piping from treatment plant up to dosing points. Contractor's scope shall include supply of all material and erection required for above chemical dosing systems for cooling water treatment.

b) All dosing packages shall be of modular skid type.

c) Contractor's scope shall also include operation & maintenance of chemical dosing system for period of six months after commissioning.

d) Contractor shall engage a specialist sub vendor for design of chemical dosing system for cooling water treatment plant and for operation & maintenance of chemical dosing system for period of six months after commissioning.

e) Cooling water treatment system shall be designed & engineered by the specialist vendor who

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has similar type of experience, the same shall be got approved from EIL/Owner prior to his engagement.

f) Contractor's scope shall include supplying all chemicals & lubricants for cooling water treatment for initial fill, pre-commissioning, commissioning, 30 days trial run and six months consumption of operation after commissioning.

g) The detailed scope of work shall be as per P&ID, Data sheets and specifications enclosed with the tender.

h) Cooling water treatment Plant building and cooling tower chemical storage shed shall be as per P&ID, Data sheets and specifications enclosed with the tender. Cooling tower contractor shall also provide general arrangement drawing indicating all the functional requirements.

i) Painting of all the modular skids, equipment, etc. shall be as per attached painting specifications.

j) Design, engineering and construction of dyke for full containment of H_2SO_4 tank with minimum free-board of 200mm.

k) All other works not exclusively mentioned in the tender document, but are necessary to complete the system in all respects with respect to process requirements, P&ID, scope drawings & data sheets etc. shall form a part of total scope of work.

4.0 COMMISSIONING OF THE SYSTEM

a) Commissioning of the entire system within scope of work including all equipments, etc. complete, including testing and trial runs for 30 days at no extra cost to Owner shall be in the scope of the Contractor.

b) On completion of the work, the Contractor shall remove and dispose off, all unserviceable materials and other unsightly materials leaving the premises and the Cooling Tower in good, safe and operable condition.

c) Owner or his authorised representative will have the right to inspect at any stage of manufacture and construction, all materials, components and workmanship and testing of materials. The contractor shall provide all facilities of inspection and testing without any extra cost to the owner.

d) It shall be clearly understood that the Contractor shall be responsible to complete and commission the entire work in all respects including the work not specifically mentioned in the scope of work or specifications or in drawings, but are necessary to achieve completion.

5.0 PERFORMANCE GUARANTEE & TESTS

a. The cooling tower and other associated facilities shall be tested and guaranteed to meet the performance requirement when tested in accordance with the procedure set forth in the latest

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revisions of the test procedure ATC-105 of CTI. The performance guarantee test run shall be conducted for 72 hours running.

b. If the performance test shows a deficiency, the Contractor shall rectify the defects without any additional cost to the Owner

c. Performance Guarantee test shall be performed on guaranteed power offered by Bidder for Cooling Tower System.

6.0 TECHNICAL EVALUATION CRITERIA FOR COOLING TOWER

COUNTER FLOW TOWERS

a. The offer of a counterflow tower shall be evaluated by Fulkerson's method using Fulkerson's demand curve and fill characteristic curves applicable to the case.

b. Bidder shall submit calculations in the enclosed Tower sizing format.

7.0 MISCELLANEOUS

a) The graded area shall be handed over to Contractor

b) Micro grading of the area after completion of all other works as per drawing.

c) The drawings enclosed with the bid are for tender purposes only and are of general requirements and scope of work.

d) Clearing and removal of all debris/unserviceable material from the site after completion of work and disposal of the same anywhere outside the Complex limit as directed. The disposal area for the same shall be arranged by the contractor at his own cost.

e) Disposal of surplus earth and serviceable material shall be within the complex limit by the cooling tower package contractor as per direction of engineer in charge.

f) The 3D modelling (including generation of Isometrics & GADs from 3D model) of complete Piping (A/G & U/G) system, other civil facilities such as drains, clean outs, sand trap, valve pit, sleepers/ supports, trenches, pavements etc.,

g) For detailed methodology of 3D modelling, refer to the relevant section/document of the tender document.

h) Documentation of “AS BUILT” drawings/ details for all works in native file format (AutoCAD etc.) (whether designed by Cooling tower package contractor or OWNER/ OWNER's representative)

i) Preparation of AS-BUILT mark-up prints on AFC drawing and subsequent updating of the same in soft copy (AutoCAD) of AFC drawing and submission of hardcopy and softcopy to Engineer-In-Charge as specified elsewhere in the bid package.

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j) Setting up of WORKSITE establishment and CONTRACTOR'S facilities.

k) Any other work not mentioned specifically above but required to complete the Job as per the scope drawing/document etc. and the directions of the Engineer-in-Charge shall be deemed to be in the Cooling tower package contractor scope.

l) Cooling Tower Package Contractor shall ensure compliance with the C&D Waste Management Rules 2016. All the C&D waste generated at the site shall be deposited at a collection center made by the local body or handover to the authorized processing facilities of construction and demolition waste, and ensure that there is no littering or deposition of construction and demolition waste to prevent obstruction to the traffic or the public or drains. All costs/charges associated with the same shall be borne by the Cooling Tower Package Contractor. Cooling Tower Package Contractor shall keep the Owner indemnified of any liability and/ or complaint from local authorities/ municipal bodies for the same.

m) Any other work not exclusively mentioned in the tender document, but is necessary to complete the system in all respects to process requirements, P&ID, scope drawings & data sheets etc. shall form a part of the total scope of work.

8.0 SPARES

9.1 MANDATORY SPARES

Refer bid document.

9.2 TWO YEARS OPERATIONAL SPARES

Contractor shall recommend spares required for two year normal operation along with unit price.

9.0 CHEMICALS

Supply of all chemicals, lubricants and consumables including first fill required during commissioning, trail runs for 30 days, & six months consumption of operation after completion of 30 days of trial run post commissioning.

10.0 SCOPE OF SUPPLY

OWNER'S SCOPE OF SUPPLY

Nil

COOLING TOWER PACKAGE CONTRACTOR'S SCOPE OF SUPPLY

All consumables and non-consumables including materials, tools, tackles, plant machinery, labor etc. for completion of tender works required for completion of tender scope of works shall be in the Cooling Tower Package Contractor's scope of supply.

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11.0 APPROVALS

a) The COOLING TOWER PACKAGE CONTRACTOR shall take into account and comply with various statutory requirements and local bodies requirement, standards and codes, as applicable including but not be limited to the following:

- Factories Act
- Indian Petroleum Rules
- Indian Electricity Act
- Indian Electricity Rules
- Central Electrical Authority (CEA)

b) COOLING TOWER PACKAGE CONTRACTOR to comply with the requirement of these authorities irrespective if it is mentioned or not in the bid package & shall form part of contractor's scope of work including preparation of required drawings/ documents. Contractor shall comply with the requirement of local bodies including preparation of required drawings/ documents. Any modification suggested/commented by statutory authorities/ local bodies shall be complied by Cooling tower package contractor without any time and cost implication

c) Any drawings/ documents required for obtaining statutory approvals before starting the job and during start-up are in the scope of the COOLING TOWER PACKAGE CONTRACTOR.

d) Deficiency pointed out (if any), by the internal & external audit team of OISD, OWNER/ EIL shall be rectified by COOLING TOWER PACKAGE CONTRACTOR at no extra cost and time implication to the OWNER. No extension of time shall be granted for meeting the requirement.

e) Obtaining statutory approval from local authorities such as Municipal Corporations, Development Authorities, Inspectors of Factories and any other concerned authorities required before starting the works at site.

f) SPCB approval for the C&D waste management at the site for all the C&D waste generated at the site shall be taken by the COOLING TOWER PACKAGE CONTRACTOR.

g) COOLING TOWER PACKAGE CONTRACTOR shall prepare detailed drawings and calculations to explain all salient features of their design and submit the same for approval of OWNER/ EIL. Final construction shall be done as per approved construction drawings released during the course of execution of the work to be prepared/ submitted by the COOLING TOWER PACKAGE CONTRACTOR and approved by OWNER/ EIL.

12.0 OPERATION & MAINTENANCE CONTRACT

The scope of work shall also include operation & maintenance (O&M) of chemical dosing systems for cooling water treatment, ClO2 dosing system etc. for a period on six (6) months after commissioning & 30 days of trial runs, including supply of all chemicals, consumables,

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lubricants, any other material as required, including all tools and tackles, supply of necessary manpower for smooth and trouble free running of various chemical dosing systems including ClO2 dosing system for entire operation & maintenance period. O&M shall also include preventive & planned maintenance.

For manpower deployment, the following minimum number of personnel shall be deployed by the Cooling Tower Package Contractor during regular operation;

1. One (1) person per shift (total three shifts per day)
2. One (1) supervisor for general shift
3. One (1) supervisor for chemical handling for general shift

The personnel shall have prior work experience in relevant O&M activities.

Additional manpower shall be provided during preventive / planned / shutdown maintenance, as per requirement. Spares required for maintenance shall be either from available mandatory spares or shall be provided by Owner.

13.0 INTERFACE DOCUMENT

The Interface document for various disciplines shall be provided during Kick-off meeting.

14.0 APPROVED VENDOR LIST

The Vendor List is provided in the tender document. The Contractor shall source the material from the Vendors identified in the Vendor List. For items not covered in the Vendor List, the Contractor shall get approval from Owner/EIL for the vendor proposed, prior to placement of order.

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PIPING SCOPE OF SUPPLY & WORK FOR COOLING TOWER PACKAGE

PROJECT : EPCM SERVICES FOR POLYPROPYLENE PROJECT AT NUMALIGARH REFINERY

CLIENT : NRL

JOB NO. : C050

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	08/08/2025	ISSUED WITH MR	VD	VD	LSJ

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1. GENERAL:

The specification given herein describes the minimum requirements and guidelines to the package vendor for complete piping system.

The package vendor's scope of work shall include complete design, detailed engineering, preparation of drawings and documents (including support standard), flexibility analysis, procurement & supply of all materials including bought out items, fabrication, supporting, non destructive testing, erection/installation, positive material identification, steam tracing/jacketing (if any), inspection, pressure testing, painting & insulation, cleaning, drying, passivation of all grades of SS, chemical cleaning, flushing, pre-commissioning & commissioning, complete in all respects.

3D Modeling of the package is in package vendor scope.

2. PIPING REQUIREMENTS:

a) Package vendor shall read the scope of work in conjunction with the marked-up P&ID attached with the MR.

b) All the utility lines shall be terminated at designated piping battery limit (B/L) by package vendor (utilities single point service wise, unless otherwise agreed). Piping inside package including piping of/between various skids, equipment etc. as well as interconnecting piping, drain/vent piping, instrument/sample piping etc. are in package vendor scope.

Exact location including sequence/elevation of the tie in points shall be finalized by package vendor in consultation with EIL during detail engineering.

c) All the lines shall be anchored by package vendor at the B/L, unless otherwise agreed. Anchor loads shall be furnished by package vendor for all the anchor points. Provisions shall be kept for loads on account of EIL piping at these anchor points.

d) Package vendor shall carry out the flexibility analysis (considering all the load cases) of the piping systems (wherever required) pertaining to piping in their scope using CAESAR-II software package, in accordance with the code requirements of ASME B31.3. The drawings pertaining to any portion of the EIL's piping required for carrying out the analysis shall be made available on request during detail engineering. Package vendor shall prepare critical line list. Package vendor to also note that seismic & wind analysis shall be carried out based on job specification, which shall be given to the Vendor during detail engineering, for compliance. In case of any conflict, the decision of Client/EIL shall be final and binding and is to be implemented without any cost and schedule implication.

e) All piping shall be adequately supported, guided or anchored so as to prevent undue vibration, deflection/ expansion or loads on connected equipment and leakage at flanged joints. Pedestal height for pipe supports on paved area shall be 150mm.

f) Package vendor is also responsible for design & supply of all pipe supports including spring support, T-support, resting member, secondary structure etc.; operating & maintenance platforms and other structure arrangements inside package battery limit.

g) The Tie-ins at battery limit shall be flanged. Gaskets and fasteners at battery limit shall be supplied by package vendor.

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h) Package vendor scope also includes providing utility hose stations with hose/cabinet at required locations covering all area within the package battery limit. Hose length shall be considered as 15m.

i) Package vendor shall ensure that the required operation & maintenance access are provided. Vendor shall also ensure proper operation & maintenance requirement like hoist/ monorail etc.

j) Package vendor shall procure materials as per Piping Material Specification, Piping design basis, Technical notes of piping items and any other standard specification attached with MR documents from EIL approved vendors list.

k) Package vendor to submit General Arrangement Drawings (GADs) and Isometrics including Bill of Material (Stress analyzed and support marked) generated from 3-D model for all the piping under their scope.

l) Painting and insulation shall be done as per respective specification.

m) Positive Material Identification (PMI) check shall be done as per the specification.

n) Vendor shall obtain statutory approval from IBR authority for IBR lines coming under their scope and any other statutory approval for completion of work.

o) Piping fabrication, inspection & testing (including NDT) shall be as per B31.3 and specification & standards attached with MR.

p) On pipe rack/sleeper, a clear spare space of 10% (of rack/sleeper width) shall be kept.

q) Chemical cleaning: The scope shall be as per MR requirement. Supply of chemicals, consumable, DM water (if available, will be provided by client on chargeable basis, however transportation for the same will be in contractor's scope), equipment boilers, testing equipment etc. required for chemical cleaning & pickling of lines. Making of temporary neutralization pit (conforming to HSE norms) for chemical cleaning / passivation & temporary piping for chemical cleaning / passivation i.e. Recirculation loops etc shall be in the vendor's scope. After chemical cleaning/ passivation neutralization of discharge in neutralization pit and disposal of same out of plant, taking approvals from concerned authorities regarding above shall be in vendor's scope. The chemical cleaning, passivation etc. shall be done as per job specifications.

r) In case of non-standard Tie-ins (2.5", 3.5", 5" etc.), companion flange along with gasket and fasteners at battery limit shall be supplied by package vendor.

s) For battery limit valving assemblies, a proper operating & maintenance platform with dual access (dual staircase/ staircase & ladder) shall be provided.

t) Any specification/standard not attached/mentioned with this specification, but required for the job shall be developed by the package vendor (if not provided to successful bidder) in accordance with latest codes & standards and to be furnished for Client/EIL review/information.

u) Package vendor shall supply gaskets with 200% spares and stud bolts/nuts with 25% (of each item) spares. Also, any other mandatory spare required for piping shall be supplied by the package vendor.

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v) Package vendor shall supply all commissioning spares, special tools & tackles, if any, required for the piping.

w) Lock open / Lock closed valves shall be with lever and padlock welded / connected to bonnet. Chain type locking is not acceptable.

x) Welding procedure qualification, welder's qualification, all welding work, equipment for welding, heat treatment, other auxiliary functions shall meet the requirements of specifications attached with MR and accepted code, international standards & practices.

y) All other incidental / auxiliary / ancillary / accessory or any enabling work / materials not specifically mentioned in the specifications but necessary for the execution and completion of work shall be in the scope of package vendor.

3. 3D MODEL REQUIREMENTS/ GUIDELINES:

- **General:**

a) 3D modelling shall be carried out using S3D version 13.1 with MS SQL Enterprise/ Standard 2019.

b) Package vendor shall prepare complete Piping, Equipment & other Engineering disciplines 3D modeling within the package.

c) Package vendor shall model all piping in their scope. Details shall include all pipes, valves, flanges, fittings, reducers, spectacle blinds, drains, temperature/pressure connections, sample points, drip legs etc. All piping special items like expansion bellows, special valves, Steam traps, strainers etc. All pipe supports along with concrete pedestals to be modeled in complete details and all spring hangers, roller supports, rotational stops, anchors, structural steel members used for the pipe supports to be modeled in complete details.

d) All skids, equipments including but not limited to manholes with davits, pipe davits on top platforms, nozzles, stiffener rings, bellows, break up flanges, platforms, ladders, handrails, lifting lugs etc. to be modeled.

e) 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.

f) All in-line instruments like control valve, safety valve, rotameter, orifice plate, flow meter etc. to be modeled.

g) Insulation like IH, IT, IS etc. with exact thickness to be shown.

h) Tagging of all Line nos., Instruments nos., Special items, Equipment nos. etc. shall be as per the P&IDs and other relevant documents.

i) Electrical and Instrumentation tray/duct etc. to be modeled.

j) All the modelling shall be done with exact geometry.

k) Modeling coordinates will be provided to successful bidder.

- **Line information required in model:**

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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/IC/IJ/IC etc.
- Line number label should be as per the P&ID:
- Pre-requisite attributes viz., PMS, Insulation and Model Zone (for hierarchy) to be ensured before creating Pipe as per Line List and Zone-Division.

- **Model Review**

3D model review with Client/EIL shall be carried out by package vendor. Client/EIL's comments shall be incorporated in 3D model by the package vendor without any time and cost implication.

Model review shall be conducted at following project progress stages:

30% Stage - After 30% modeling which includes all major equipments, major structure, foundations, major lines, cable trays and ducts, maintenance areas, roads and plot limits, critical instruments, escape routes etc.

60% Stage - After 60% modeling which includes all equipments, all piping (except small bore) and associated instruments, all structure and supports, all platforms and ladder/stairs.

90% Stage - After complete modeling with only minor Holds, if any.

Submission of Model in electronic format shall be done at least 7 days prior to scheduled review date. The review shall be carried out on the system.

- **System Backup**

Complete 3D model (as-built) along with all native files and Design Databases, catalogues, etc. shall be submitted to Client/EIL in electronic form.

4.0 PIPING SPECIFICATIONS / STANDARDS :

S. No.	Title	Specification /Standard No.	Remarks
1	ENGINEERING DESIGN BASIS (PIPING)	C050-999-16-43-EDB-1001	NOTE-3
2	JOB PIPING MATERIAL SPECIFICATIONS	C050-1U68-6-44-0005-4020	NOTE-1,3
3	PIPING MATERIAL SPECIFICATION GENERAL NOTES	C050-6-44-0005-A1	
4	JOB VALVE MATERIAL SPECIFICATIONS	C050-1U68-6-44-0006-4020	NOTE-2
5	WELDING SPECIFICATION CHARTS FOR PIPING CLASSES $	C050-000-06-41-WSC-0001	NOTE-3
6	GUIDELINES FOR 3D MODELING	8-76-0022	
7	PIPING VENDOR LIST	C050-1U68-16-43-VL-4020	
8	JOB SPECIFICATION FOR SURFACE PREPARATION AND PROTECTIVE COATING $	C050-000-06-42-PLS-01	
9	STANDARD SPECIFICATION FOR	6-44-0012	

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	FABRICATION AND ERECTION OF PIPING		
10	STANDARD SPECIFICATION FOR INSPECTION, FLUSHING AND TESTING OF PIPING SYSTEMS	6-44-0013	
11	TECHNICAL NOTES FOR PIPES	6-44-0051	
12	TECHNICAL NOTES FOR VALVES	6-44-0052	
13	TECHNICAL NOTES FOR FLANGES, SPECTACLE BLINDS AND DRIP RINGS	6-44-0053	
14	TECHNICAL NOTES FOR BUTT WELDED, SOCKET WELDED AND SCREWED FITTINGS	6-44-0054	
15	TECHNICAL NOTES FOR GASKETS	6-44-0056	
16	TECHNICAL NOTES FOR BOLTS AND NUTS	6-44-0057	
17	TECHNICAL NOTES FOR HOSES AND HOSE COUPLINGS (INCLUDING ANNEXURES)	6-44-0064	
18	TECHNICAL NOTES FOR STEAM AND AIR TRAPS, MANIFOLDS AND ASSEMBLIES	6-44-0066	
19	TECHNICAL NOTES FOR STRAINERS	6-44-0067	
20	TECHNICAL NOTES FOR SPRING SUPPORT ASSEMBLIES	6-44-0070	
21	STANDARD SPECIFICATION FOR APPLICATION OF TORQUE AND HYDRAULIC BOLT TENSION FOR FLANGE JOINTS	6-76-0002	NOTE-3
22	WELDING SPECIFICATION FOR FABRICATION OF PIPING	6-77-0001	
23	SPECIFICATION FOR QUALITY MANAGEMENT SYSTEM REQUIREMENTS FROM BIDDERS	6-78-0001	
24	SPECIFICATION FOR DOCUMENTATION REQUIREMENTS FROM CONTRACTORS	6-78-0002	
25	SPECIFICATION FOR DOCUMENTATION REQUIREMENTS FROM SUPPLIERS	6-78-0003	
26	STANDARD SPECIFICATION FOR HOT INSULATION OF VESSELS, PIPING AND EQUIPMENT	6-79-0026	
27	STANDARD SPECIFICATION FOR POSITIVE MATERIAL IDENTIFICATION (PMI) AT SUPPLIER'S WORK	6-81-0001	
28	ITP FOR WELDED PIPES $	6-81-0002	
29	ITP FOR SEAMLESS PIPES $	6-81-0003	
30	ITP FOR VALVES $	6-81-0004	
31	ITP FOR FORGED, SEAMLESS & WELDED FITTINGS $	6-81-0005	
32	ITP FOR FLANGES, SPECTACLE BLINDS AND DRIP RINGS $	6-81-0006	
33	ITP FOR BOLTING MATERIAL $	6-81-0007	
34	ITP FOR GASKETS $	6-81-0008	
35	ITP FOR STRAINERS $	6-81-0133	
36	INSPECTION AND TEST PLAN FOR HOSE PIPE AND COUPLING $	6-81-0135	
37	ITP FOR SPRING SUPPORT ASSEMBLIES $	6-81-0137	
38	STANDARD SPECIFICATION FOR POSITIVE MATERIAL IDENTIFICATION (PMI) AT CONSTRUCTION SITES	6-82-0002	

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39	STANDARD FOR SPACERS AND BLINDS > 26 IN. (150#, 300# AND 600# FF TO B 16.47 SERIES B)	7-44-0162	
40	T-STRAINER TYPE-1 2" - 4" (150CL RF, 300CL RF AND RTJ, 600CL RF AND RTJ)	7-44-0303	
41	T STRAINER TYPE-1 6"-24" (150# RF, 300# RF AND RTJ, 600# RF AND RTJ)	7-44-0304	
42	VENTS & DRAINS (ON LINES 1.5" AND BELOW)	7-44-0350	
43	VENTS & DRAINS (ON LINES 2.0" AND ABOVE)	7-44-0351	
44	ORIENTATION OF ORIFICE TAPS (CLASS 600 AND BELOW)	7-44-0352	
45	WELLS INSTALLATION 1 1/2" DIA TAPS (UP TO CLASS 600)	7-44-0353	
46	PRESSURE TAPPINGS (PA, PG, PC, PT, PIC ETC).	7-44-0354	
47	UTILITY HOSE STATION	7-44-0401	
48	DRIP LEG FOR STEAM LINES	7-44-0403	
49	CLEARANCES	7-44-0501	
50	ACCESSIBILITY FOR VALVES AND INSTRUMENTS	7-44-0502	
51	VALVE ACCESSIBILITY AND CLEARANCES	7-44-0503	
52	SUPPORTING ARRANGEMENT FOR ANGLE AND RELIEF VALVES TYPE-SP2.	7-44-0792	
53	SUPPORT FOR ORIFICE FLANGE TAP TYPE-SP4	7-44-0794	
54	EARTHING / BONDING OF PIPES AND PIPERACKS (IN HAZARDOUS AREA).	7-51-0112	
55	SPECIFICATION FOR INTERNAL COATING OF PIPING	NR-0ZZZZ-CV-SPE-0019	

$ - Attached elsewhere in MR documents.

Note-1: Any other PMS, if required during detail engineering shall be provided to successful bidder on demand and if the same is not available, package vendor to prepare the same and furnish for review/record.

Note-2: Valve, base metallurgy is mentioned in the PMS. VMS will be provided to successful bidder on demand and if the same is not available, package vendor to prepare the same and furnish for review/record.

Note-3: Updated document will be provided to successful bidder, if required.

Note-4: Specification for Chemical cleaning, attached elsewhere in MR document shall be referred.

Note-5: Specification for External Coating of underground piping, attached elsewhere in MR document shall be referred.

5.0 VENDOR DATA REQUIREMENT:

Piping vendor data requirement doc.no. C050-1U68-16-43-VDR-8010

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SCOPE OF WORK
(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	SS	RK	NK

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Sr. No.	Description	Scope By Contractor	Scope By EIL / Owner
1.0	**Overall scope of works and supply**		
1.1	Design, engineering, procurement, testing, factory acceptance, supply and transportation of all Instrumentation & Controls of package unit.	YES	-
1.2	Site activities e.g. site transport, site testing, installation, storage, conservation and preservation of all materials at site, handling at site, assembly, painting, calibration, pre-commissioning, loop checking, and commissioning of complete cooling tower package and associated facilities.	YES	-
1.3	Site assistance during site installation, testing, calibration, pre-commissioning, loop checking and commissioning.	YES	-
1.4	Overall responsibility of site acceptance test (SAT) and performance guarantee test runs (PGTR) of complete package, as applicable.	YES	-
2.0	**Detailed Scope of Works and Supply**		
2.1	Basic Engineering Activities		
2.1.1	Basic engineering such as design, sizing, selection (Type, material, range etc.), specifications / data sheets, of complete instrumentation including associated NDT requirements etc., as per package requirements.	YES	-
2.2	Design, Detailed engineering, procurement, supply and testing of all instrumentation items, control systems and related activities (as applicable). The scope shall include system configuration, system integration, factory testing & acceptance of the system.	YES	-
2.2.1	All instrumentation, gauges, transmitters, valves, analysers, flowmeters, control valves, safety valves, on-off valves, corrosion transmitters, vibration transmitters etc. as shown in Contractor scope in P&IDs attached in tender (including any Instrumentation added in final approved P&IDs) for complete cooling tower package and associated facilities.	YES	-
2.2.2	Instruments type- Smart HART	YES	-
2.2.3	Local Control Panel and local gauge boards complete with all instruments, Junction boxes as per package unit requirements.	YES	-
2.2.4	Package PLC for Chemical dosing system located in dosing room (with air conditioning) located within package battery limits.	YES	-
2.2.5	Main plant DCS and Main Plant ESD PLC for cooling	-	YES

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	tower package and associated facilities.		
2.2.6	3D modeling in software specified elsewhere (same as for package) for instrumentation items. As a minimum, following shall be covered: instrument cable ducts/trays, junction boxes, instruments with hookups, stanchions & canopy, gas detectors, analyzers, gauges, transmitters, flowmeters, accessories for valves & instruments, volume tanks etc., LCP, local gauge boards, fireproofing for ducts/trays, Instrument air manifolds etc.	YES	-
2.3	Submission of engineering drawings / documents as per vendor data requirements (Instrumentation)	YES	-
2.3.1	Preparation and submission of Instrument datasheets, I/O list, Cable Schedule, Instrument Index and Instrument loop diagram including JB wiring using Intergraph Smart Plant Instrumentation (SPI) v13.1 and oracle version 19c as per VDR. Exact version of SPI & oracle shall be informed after placement of order. All necessary SEED files shall be provided by the purchaser.	YES	-
2.3.2	All engineering documents required for DCS/PLC engineering like IO List, cable schedule, Functional Schematics, Logic Diagrams, loop wiring diagrams, graphics, cause and effect etc.	YES (Note-1)	-
2.3.3	The Purchase Requisition (PR) for each instrumentation item shall be prepared by vendors using ISA data sheet formats and shall contain all information including the make and model no. of each instrument, in addition to the material specification and other details. All documents and data sheets shall be in ISA Format.	YES	-
2.4	Complete application engineering of Package unit instrumentation as per package unit requirements for:		
2.4.1	Distributed Control System (Main plant)	-	YES
2.4.2	Programmable Logic Controller (Main plant ESD PLC)	-	YES
2.4.3	Package PLC for chemical dosing system	YES	-
2.4.4	SIL (system integrity level) verification / validation	YES (as per OEM recommendation)	-
2.4.5	Supply of Complete hardware's and software's for the fully engineered control system to meet operational & functional requirements of the package. a) Package Programmable Logic controller (**DMR/TMR or Quad**) for chemical dosing system including system cabinets, marshalling cabinets, MCC E&I Interface cabinets, Isolating IS barriers, alarm cards, terminals, relays with accessories duly mounted, wired & tested to meet complete requirements. The scope shall include the entire engineering, wiring, testing, integrated factory testing & acceptance.	YES (Note-1)	-

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	b) Main Plant Distributed control system (DCS) and ESD PLC	-	YES (Note-1)
	c) Package PLC Operator cum Engineering console workstation (one number) along with mouse & keyboard for operation & monitoring of the Chemical dosing system with all licensed software's & engineering licenses, to be located in Dosing room provided with furniture (metallic closed consoles for mounting workstation PCs, printers, etc. along with table and chairs).	YES	-
	d) Color Laser Printer A3 (one number)	YES	-
	e) HART interface system with all interface modules (HIM, HCM) & convertors/Modbus ports for interfacing with Purchaser's HART maintenance system.	YES	-
	f) Any other items, instruments not mentioned but required to meet functional requirements of package.	YES	-
2.5	Supply of all type of cables (e.g. signal, control, alarm, shutdown, detector, power, serial/OFC, etc.) as per specifications and actual requirements:		
	a) Signal, control, alarm, shutdown, power & any special cables upto JB / local panels within the Package Unit battery limits.	YES	-
	b) Multi-pair cables between Local Control panel/ Junction boxes and Owner's DCS/PLC located in Polypropylene control room (PCR).	-	YES
	c) Cables between Chemical Dosing Package PLC and Main Plant ESD PLC.	-	YES
	d) Multi-cables from junction boxes/ LCP upto Chemical Dosing package PLC.	YES	-
	e) Power cables between Polypropylene control room (PCR) and field mounted Instruments, Analyser cabinet, Package PLC cabinet, LCP etc.	-	YES
	f) All redundant armored serial cables/OFC/ special cables (with converters at both ends), within package battery limits and outside the package battery limits upto Polypropylene control room (PCR).	YES (Note-16)	-
	g) Interconnecting cables between Chemical Dosing package PLC system & its workstation console &	YES	-

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	printer. h) Cables between MCC and CLO2 Dosing package PLC system i) All System cables including prefab cables, Optical fiber cables & all other cables: a) Between all contractor supplied panels/cabinets/consoles. b) Between contractor supplied Package PLC panels/cabinets/consoles. c) All other cables for contractor supplied items like printers, workstations etc.	- YES YES	YES - - -
2.6	Supply of Flameproof type Junction Boxes (Non-fieldbus JB, Power JB)		
2.6.1	For interconnection between field and local panels.	YES	-
2.6.2	For interconnection between field/local Panels and Chemical Dosing system Package PLC.	YES	-
2.6.3	For interconnection between field/local panels and Polypropylene Control Room (PCR).	YES	-
2.7	Universal Type Hand held calibrator suitable for all makes/ model nos. of transmitters and Positioners	-	YES (Note-10)
2.8	All installation materials such as impulse tubes / pipes, valves and fittings for all field instruments.	YES	-
2.9	Prefabricated FRP Canopies for field mounted electronic/ electrical instruments, JB's, Temperature Elements, Local Panels, Analyzers, and Positioners	YES	-
2.10	Cable glands (for both branch & multi-pair cables at both ends), and PVC sleeves (cable shrouds), Lugs, Ferrules for different type of cables.	YES	-
2.11	Supply of Instrumentation Cable trays, perforated trays, angle trays, structural supports, consumables inside the Cooling tower package battery limits and interfacing it upto the Owner's cable ducts / trays.	YES	-
2.12	All erection materials such as instrument supports, stanchions all types of consumables for mounting of instruments, local panels, gauge boards, structural supports and consumables for cable laying.	YES	-
2.13	All piping and pipe fittings, tubes and tube fittings for instrument air supply distribution and steam tracing (wherever applicable) etc.	YES	-
2.14	Complete analyzers / analyzer system including CLO2 detectors, as necessary, as per package requirements.	YES (Note-11)	-
2.15	Supply & commissioning of Chemical Dosing Package PLC system (for control, interlock & shutdown system) in Dosing room.	YES	-

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2.16	Any other installation materials required for the cooling tower package and associated facilities.	YES	-
2.17	Any special tools or tackles for instrumentation required for the package	YES	-
2.18	Any additional instruments, valves required in the opinion of contractor for meeting functional requirements, safe and efficient operation of cooling tower package, which are not listed specifically in this document.	YES	-
2.19	Supply of all drawings and documents as listed in Vendor Data Requirement (Instrumentation)	YES	-
3.0	**Factory testing & calibration**		
3.1	Carrying out/ witnessing shop testing, calibration of Instrumentation items supplied by contractor and inspection & testing of all instruments, valves, package PLC, Analyzers, flowmeters, LCP etc. and related accessories.	YES	-
3.2	Participation in owner supplied DCS/PLC FAT for checking and verification of all I/Os, Loops, Graphics, Logics and Operation Sequence etc.	YES (Note-18,19)	-
4.0	**Installation related activities**		
4.1	Installation of all instruments, valves, gauges, transmitters, control valves, safety valves, on-off valves, flowmeters, temp. elements, flow elements, corrosion transmitters, vibration transmitters, junction boxes, analyzers and their accessories etc. in contractor's scope including instrument hook-ups; Installation of local control panel and gauge boards, as applicable		
4.1.1	Within the Package battery limits.	YES	-
4.1.2	Outside Package battery limits (shown in cooling water P&IDs).	-	YES
4.2	Installation of Package PLC and related accessories, supplied by contractor, as per package requirements.	YES	-
4.3	Laying and termination of all Instrumentation related cables supplied by Contractor including special cables, system cables, FO cables etc.		
4.3.1	Within package battery limits up to the interface junction boxes / LCP / Package PLC in Dosing room.	YES	-
4.3.2	From package battery limits upto Polypropylene Control Room (PCR).	-	YES
4.4	Instrument air distribution within package battery limit, as required.	YES	-
4.5	Utility distribution, as required, within the package battery limits (such as instrument air, cooling water, and steam) specifically required for Instrumentation activities.	YES	-
4.6	Earthing/ grounding system for package instrumentation items		
4.6.1	Instruments, analyzers, local panels, gauge board,	YES	-

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	junction boxes etc. supplied by contractor.		
4.6.2	Package PLC supplied by contractor	YES	-
4.6.3	Earth pit (<1 Ohm) for System earth for Package PLC and analyzer system	YES	-
4.6.4	Integration with plant earthing system.	-	YES
4.7	Auxiliary installation related activities necessary for instrumentation		
4.7.1	Heat tracing of impulse lines and instruments (as applicable) within package battery limits.	YES	-
4.7.2	Insulation of impulse lines and instruments as applicable within package battery limit.	YES	-
4.7.3	Painting of impulse lines, structural members, supports within the package battery limit	YES	-
4.8	**Power supply and its distribution:** a) Power distribution boards for distribution of 110 VAC UPS and 240VAC non-UPS to various contractor supplied equipment in chemical dosing room and field. b) Purchaser shall provide redundant feeders of 110VAC UPS (grounded power supply) and 240VAC non-UPS near Contractor supplied Package PLC cabinet in Dosing room. c) Distribution of power supply within the battery limit of package (e.g. for instruments, local control panel, sub-packaged items etc.) d) Distribution of power supply for all package items in Dosing room i) Within cabinets / panels / consoles supplied by Contractor. ii) Outside the cabinets / panels / consoles supplied by Contractor but within Dosing room, e) Distribution of power to various Contractor supplied equipment supplied by Contractor in field like local panel, instruments etc. and its derivation to any other voltage level (as required) in field shall be carried out by Contractor.	 YES (Note 13) - YES (Note 13) YES (Note 13) YES (Note 13) YES (Note 13) YES (Note 13)	 - YES (Note 13) - - - - -
5.0	**Field testing, calibration, loop checking, pre-commissioning and commissioning activities**		
5.1	Field testing, calibration of all contractor supplied instrumentation items, valves, transmitters, flowmeters, analysers, local panels etc.	YES	-
5.2	Loop checking of all instrumentation items connected to package PLC	YES	-
5.3	Loop checking of all items within package battery limits connected to Owner's Main Plant DCS/PLC	YES (Note-19)	YES
5.4	Pre-commissioning and commissioning of complete	YES	-

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	cooling tower package and associated facilities.		
5.5	Site acceptance testing for complete instrumentation items and package PLC fully integrated as per tender requirements.	YES	-
6.0	**Coordination activities**		
6.1	Coordination with purchaser during engineering, procurement, factory testing, site activities and site acceptance testing.	YES	-
6.2	Coordination with various vendors / contractors / manufacturers / sub packaged vendors etc. associated with package instrument supplies and services.	YES	-
6.3	Coordination with suppliers of special instruments / instrumentation items, analyzers, flowmeters, control system etc. for availability of their specialist during start up and commissioning of package.	YES	-
6.4	Coordination with Purchaser's DCS vendor during detail engineering and loop checking, logic checking of control system.	YES	-
6.5	Coordination with Site contractor	YES	-
7.0	Instrumentation Spares and spare parts (Note-21, 22, 23)		
7.1	Mandatory spares as per package requirements	YES	-
7.2	Consumable spare for six months operation (such as Printer Paper, Printer Cartridges) after system acceptance	YES	-
7.3	Startup and commissioning instrumentation spares as per package requirements.	YES	-
7.4	2 years recommended Instrumentation Operations & Maintenance spares.	YES	-
8.0	Training for Package PLC as per Job specifications	YES	-
9.0	Warranty for Instrumentation items for period as specified in commercial section.	YES	-
10.0	Post Warranty Annual Maintenance Contract (PWAMC): Post commissioning onsite support for system-oriented items for Package PLC, Analyzer System (except density analyzer, moisture analyzer (non-GC based), PH/conductivity analyzer), Special Control System etc. Non comprehensive, 2 Periodic visits of expert for each system (at least @5 days at site per visit) on mutually agreed interval/schedule with Owner. The validity of the contractual period shall be 3 years from the expiry of the warranty. Also, its shall be non-comprehensive.	YES	-
11.0	Participation in HAZOP and SIL Study	YES	-

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General Notes

Wherever package is mentioned, the same implies to complete package consisting of Cooling tower Package. The Contractor shall be responsible for carrying out the basic engineering for proceeding with detailed engineering for all instruments shown in P&IDs in the package, providing drawings, documents, mandatory spares for package. Residual engineering includes instrument sizing, Thermowell Wake frequency calculation, utility consumption, specifying derived data in process data sheets, type and material selection of instruments wherever required. Residual engineering shall also include actual transfer/ implementation of the information provided in the form of notes in P&IDs and instrument data sheets/ equipment data sheets and other documents provided in tender.

Notes:

1. Contractor shall provide dedicated **Programmable Logic controllers (DMR/TMR or Quad PLC)** for Chemical dosing package. This package PLC shall be located in CLO2 dosing room (with air conditioning) by the contractor.

   All instruments for interlock, safety/ shutdown or with complex or vendor proprietary logics shall be connected to the contractor supplied package PLC system (chemical dosing package PLC) as well as to Owner's main plant ESD PLC as per P&IDs. The same shall also be used for Control and Monitoring of the Package. This Package PLC system shall be serially connected to Purchaser's Distributed control system (DCS) for monitoring of the package operation from purchaser's DCS system located in PCR. That is, all signals shall be interfaced with DCS for monitoring purposes and mapped to DCS with dedicated graphics. The scope of interface/mapping shall be as defined elsewhere in Instrumentation specifications. However, preparation of dedicated graphics (downloadable/configurable in client's DCS) shall be done by Contractor. All signals/ parameters of the package PLCs shall be repeated/ available in the serial link to Purchaser's DCS located at PCR.

2. All serial links shall be redundant. Following Redundant serial/ OFC cables shall be supplied by Contractor

   a. Between any contractors supplied control systems like Package PLC.

   b. Between Purchaser's DCS control system and contractor supplied package PLC.

   c. For package PLC configuration Laptop, latest version (in contractor's scope).

   Standard redundant serial / OFC cables (OFC 8 core cables) along with all Connection hardware (FC-PC connectors), LIU/ media convertors, TBs, ports, Modbus convertors, patch cords etc. & any software as required, shall be provided by contractor at both ends (as applicable for their supplied systems). All Fibre optic cables shall be double armoured, single mode type.

   Sufficient number of ports for redundant serial communication shall also be considered by the Contractor.

3. Contractor shall provide factory testing and acceptance related activities for sub-vendor supplied items like Package PLC systems etc. Purchaser/Consultant will participate in the Package PLC FAT.

4. The assembly of instruments, probes / transducers, analysers, flowmeters, valves, junction boxes within the package shall be done by vendor and tested at shop. No assembly shall be carried out at site by contractor.

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5. All materials for Instrumentation items installation & mounting shall be supplied by the Contractor.

6. The local control panel and local gauge board shall be supplied fully assembled, tested, wired, complete with all instruments, items, terminals boxes and cable entries in installed condition.

7. All cabinets / panels / workstation consoles for Package PLC system, at dosing room shall be fully wired, installed and tested at shop by vendor. No assembly will be carried out at site by contractor. Only panel installation and termination shall be done at site by the contractor.

8. Contractor shall identify the cables with cable tags (identify with continuity check) till Junction Boxes. All instruments and valves shall be provided with SS tag plates.

9. Contractor shall carry out 3-D modelling, clash checking with other disciplines, including the following (as applicable):
   - All line mounted / equipment mounted instruments like control valves, on-off valves, safety valves, flow instruments, level instruments, temperature instruments, pressure instruments, gauges, transmitters, flowmeters and valve accessories like fire-jacketing for on-off valves (if applicable), volume tanks etc.
   - Instrument cable ducts with fittings like elbows, tees, reducers etc. & cable trays along with structural supports.
   - Analyzer cabinets/ rack and other field racks/ panels/ cabinets, local control panels, local gauge boards etc.
   - All type of junction boxes
   - Instrument stanchions, canopies
   - Instrument air manifolds
   - ESD Push button stations in field
   - Fire and Gas detectors, other detectors
   - For package units, where engineering is carried out by package vendor / other agencies - model, modelling shall be carried out by Contractor as a box with hook-up/ tie-in locations. Inside the box, it is the contractor's responsibility to ensure that vendor carries out the precise modelling. However, during 90% model review Contractor shall be responsible to superimpose the 3D model furnished by Package Vendor & resolve any clashes with the main plant unit 3D model, as applicable.
     Review of 3-D modelling for instrumentation items, mentioned above shall be carried out by Owner/PMC based on the requirements given elsewhere in the tender.

10. Universal Type Hand held calibrator of the Purchaser shall be suitable for all makes/ model nos. of transmitters and positioners supplied by the contractor. Otherwise, 1 number hand held configurator shall be supplied for each different type by the contractor.

11. Supply of HC/H2 Gas Detectors shall be in Owner's scope. Same shall be free issued to the Contractor for installation, loop checking and commissioning. All the installation materials for HC/H2 gas detectors shall be supplied by the contractor.

12. Contractor shall provide full assistance with manpower, tools and tackles during pre-commissioning and commissioning of all Instrumentation items in contractor's scope.

13. Owner shall provide redundant feeders of 5 KVA rating of 110 VAC UPS (power supply grounded) and Single feeder for 240V AC non-UPS near Contractor supplied package PLC cabinets in CLO2 dosing room. Further supply and distribution of power to various

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instruments, panels, LCP and its derivation to any other voltage level as required in CLO2 dosing room and in field, shall be carried out by contractor. Power Distribution Cabinet with glanding termination of cables shall be provided in dosing room by the contractor.

Contractor shall provide power consumption details along with Bid proposal. In case Contractor requirement is higher, Contractor shall provide the justification with detailed power consumption details. If Contractor doesn't provide any power consumption detail along with bid proposal, then it is confirmed that the given power is sufficient for the entire package.

14. Dynamic graphics of contractor's package shall also be implemented in purchaser's DCS in addition to the contractor supplied package PLC system.

15. Contractor shall prepare write-up for sequential startup and operation of cooling tower package and associated facilities. All the permissive, feedback, interface signals required from / to other upstream / downstream packages and purchaser's DCS /PLC systems shall be indicated in the startup and operation write-up of cooling tower package. This document is required for review and approval by the Owner.

16. Contractor shall be responsible for providing the complete Modbus address mapping details for serial interfacing of dosing package PLC to purchaser's DCS in the format which shall be provided during detail engineering.

17. Supply of vendor drawings and documents as listed in Instrumentation Vendor Data Requirement (VDR) shall be provided by Contractor.

18. Schedule for FAT of purchaser's control system (DCS/ PLC) shall be informed one week in advance and contractor shall make suitable arrangements accordingly for their participation in the same.

19. Contractor shall provide required assistance to Owner's DCS/ PLC vendor during logic checking and loop checking of instruments located within package battery limits.

20. Any items not covered in this section, which form part of the contractor's standard package and are required for ease of operation, control safety and interlock requirement shall be supplied by Contractor without any implications.

21. Mandatory spares shall be supplied as per attached list (C050-1U68-16-51-SL-8010). Contractor shall supply all instrumentation start-up and commissioning spares as required for package. Supply of all consumables for 6 months operations like printer paper, toner/ cartridge, calibration gas for analyzers etc shall be provided by the contractor.

22. All spare Instrumentation items such as spare fuses, lamps, terminals etc. required for start-up and commissioning shall be supplied by contractor.

23. Contractor shall also quote separately for recommended spares for two years operation for control and instrumentation system of the package. Price for the two years spares shall not be included in base price.

24. Glanding and termination of all instrumentation branch cables and multi-cables upto junction boxes / local panels/ package PLC withing package battery limits is in contractor's scope.

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SCOPE OF WORK

(ELECTRICAL)

FOR

COOLING TOWER PACKAGE

(TENDER NO.: C050-1U68-81-45-PB-T-8010)

PROJECT : EPCM SERVICES FOR SETTING UP POLYPROPYLENE UNIT AT NRL

CLIENT : M/s NRL, NUMALIGARH

PMC : ENGINEERS INDIA LIMITED

JOB NO : C050

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	11.08.2025	ISSUED WITH TENDER	MS	AKG	VK

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1. GENERAL

1.1 The specification defines the basic requirements of the electrical works in CONTRACTOR's scope for the Cooling Tower Package of PP Unit Project of M/s NRL - Numaligarh, Assam. Scope of Work document shall be read in conjunction with job specification, EIL standard specifications, data sheets and documents attached with the tender. In case of any conflict amongst various documents enclosed with tender, the most stringent requirement shall govern and Owner/EIL decision in this regard shall be final.

1.2 The equipment shall conform to this specification, enclosed data sheets and standard specifications.

2. SCOPE OF WORK

CONTRACTOR to refer to the scope division matrix as provided in document C050-1U68-81-45-SOW-8010 for division of scope of works & supply and the Electrical Block Diagram (C050-1U68-16-50-SK-8010) attached with the tender.

The detailed scope of work for electrical is as indicated below :

2.1 SCOPE OF ENGINEERING

Package contractor's scope shall include basic design and detailed Engineering as follows:-

2.1.1. Basic engineering calculations including sizing and selection of electrical equipment

2.1.2. Electrical Equipment and Motor List

2.1.3. 3D modeling for cable trenches, cable trays & supports, Power & lighting system items, electrical equipments, pushbutton station, etc.

2.1.4. Preparation of Electrical and Instrumentation interlock and interface requirements as per process/ operational requirements

2.1.5. Area-wise illumination level calculation and preparation of power supply distribution scheme for normal, emergency and critical lighting.

2.1.6. Calculations for cable sizing & voltage drop.

2.1.7. Calculations for plant earthing and lightning protection.

2.1.8. Preparation of electrical layouts such as equipment layouts, lighting layouts, cabling layouts, earthing layouts, lightning protection layouts, including equipment installation.

2.1.9. Preparation of cable schedules and interconnection diagram.

2.1.10. Preparation of bill of materials for lighting, earthing and miscellaneous items.

2.1.11. Collection of data from site/client as required for carrying out detailed engineering.

2.1.12. Lighting/ Power panel schedule.

2.1.13. Shop inspection and testing procedures and QA schedule.

2.1.14. Field testing and commissioning procedures

2.1.15. Preparation of as-built drawings on completion of the project for final records

2.1.16. Preparation of operation and maintenance schedule

2.1.17. Interface engineering and drawing required for hook-up with the client's power supply feeders in Substation.

2.1.18. All interface logic / scheme required for the driven equipment / load shall be provided by the Package contractor in his supplied equipments and potential free contacts required for interfacing with client's switchgears shall be made available by Package contractor for wiring to client's switchboards in Substation.

2.1.19. List of interface signals from package contractor/vendor PLC to client's switchboards, if applicable

2.1.20. Review & and submission of vendor drawing for CONTRACTOR supplied electrical equipment / panels.

2.1.21. Any special requirement/interlocks to be taken care in client's switchgear for package loads

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2.1.22. Any other work/ activity, which is not listed above, however is necessary for completeness of electrical system.

2.1.23. Coordination, as required, with other Package vendors working at site.

2.1.24. For testing & commissioning, also refer elsewhere in package.

2.2 STATUTORY APPROVALS

2.2.1. All hazardous area equipments (i.e. Motors, LCS, receptacles, heater etc) shall have valid test certificates issued by recognized independent test house (Baseefa / ATEX / LCIE / UL / FM or equivalent).

2.2.2. The Package contractor shall obtain approvals from all the concerned authorities/electrical inspectorate for supplied equipment. Complete Engineering of the electrical system and equipments covered is under the Package contractor's scope. Any modification or additional requirements of the concerned authorities/electrical inspectorate shall have to be carried out by the Package contractor at his own cost without affecting time schedule. Arranging for any other approvals required for the complex, from agencies relevant national /international agencies is included in the Package contractor's scope.

2.3 DRAWINGS & DOCUMENTS

The drawings / documents supplied with the bid package define the basic system design and distribution philosophy for the package.

2.3.1. Package contractor shall develop and update the power system design during detailed engineering and define this design by means of various deliverables as required but not limited to those defined in vendor data requirements document.

2.3.2. Package contractor shall follow current national/international specifications for the equipment that are not covered by bid package specification`s.

2.3.3. All the above items shall be updated to reflect any changes and modifications to "AS BUILT" status.

2.4 INTERFACE REQUIREMENT FROM PACKAGE CONTRACTOR

Following information shall be furnished by the Package contractor :

2.4.1. Load details and feeder requirements for package loads fed from client's switchboards (Normal and emergency).

2.4.2. Requirement of Space in client's cable trays.

2.4.3. DC supply requirement for critical lighting inside unit.

2.4.4. UPS power supply requirement, if any

Time line for submission of above information is as mentioned elsewhere in the tender document. For other information, timeline for submission shall be agreed during kick-off meeting.

2.5 SPARES

2.5.1. Mandatory Electrical spares as per List of Mandatory Spares attached with the TENDER are included in CONTRACTOR's scope of supply.

2.5.2. Commissioning spares for all electrical equipment are included in CONTRACTOR's scope of supply. List of the same shall be furnished post order.

2.5.3. CONTRACTOR shall submit a list with unit prices of recommended maintenance spares for two years of normal operation for all electrical equipment.

2.5.4. Recommended list of maintenance spares for two years operation shall include the following as a minimum for motors. CONTRACTOR shall ensure & quote for the same accordingly.

a) Bearing for DE/NDE-one set

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b) Terminal box cover with screws

c) Fan

d) Terminal block

For other equipment CONTRACTOR shall quote 2 years recommended O&M spares as per their standard requirements.

2.6 INSTALLATION, FIELD TESTING & COMMISSIONING

CONTRACTOR shall carry out the installation, field testing and commissioning of all items of electrical equipment including installation in field, testing and commissioning of free issue items in accordance with EIL installation standard & standard specification attached with tender

CONTRACTOR shall prepare commissioning reports and as-built documentation as necessary for all but not limited to equipment and systems specified above. Wherever required, support from OEM shall be arranged by the CONTRACTOR.

CONTRACTOR shall also obtain site acceptance testing (SAT) procedures from OEM and get them approved from employer/PMC before carrying out the site testing at site.

CONTRACTOR shall coordinate with manufacturers of other equipment wherever required and shall freely and readily supply all technical information for this purpose as and when called for.

CONTRACTOR shall comply with the requirements of Mechanical Completion as described in relevant section of Bid document.

Obtaining clearance for energizing the complete electrical facilities covered under this tender and approval of installation / drawings from central electrical inspector and any other concerned approving authority e.g. CCOE (PESO), OISD etc. shall be in the scope of the CONTRACTOR.

3. EXCLUSIONS

For items which are excluded from the scope of contractor, refer to the scope division matrix as provided in document C050-1U68-81-45-SOW-8010 and the Electrical Block Diagram (C050-1U68-16-50-SK-8010) attached with the tender.

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SCOPE OF WORKS/ SUPPLY (STRUCTURAL) FOR COOLING TOWER PACKAGE

TENDER No.: C050-1U68-81-45-PB-T-8010

PROJECT : PPU, NUMALIGARH, ASSAM

CLIENT : M/s NUMALIGARH REFINERY LTD.

PMC : M/s ENGINEERS INDIA LTD.

JOB NO. : C050

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	28.08.2025	ISSUED FOR PACKAGE	VP	RD	VKG

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1.0 SCOPE OF WORK

The scope of Civil and Structural works under this contract shall include design, detailing, supply and construction of all relevant civil and structural works required for successful completion of works for COOLING TOWER package of Polypropylene Project, NRL as per specifications enclosed with the Bid document.

Major Civil and Structural works involved shall include but not limited to the following:

a. Design, Detailing, Supply and Construction of foundations/ pile caps (including piling works, installation, testing etc. of piles as required), floor slabs, superstructure for all types of structures within scope battery limit of Cooling Tower Package are in the scope of this package. (unit battery limits shall be as per major functional discipline i.e. structure/piping/ mechanical/ electrical/ instrumentation scope). Some of the major structures are-

- Cooling Tower (FRP) structure above basin including, frame work, casing, air inlet, fill, drift eliminator, partition wall, end wall, fan deck, fan stack, stairways, escape ladder, hand rail, cable tray/ duct support, etc.
- RCC cooling water basin, water channel & sump including supply of sluice gate, ½" & 10" mesh screens, monorails etc. Water channel, cooling water basin & sump.
- Cooling water Pump House including foundations for pumps
- Chemical Treatment Plant building & Chemical storage shed.
- Monorails, EOT crane, HOT crane (as applicable) of required capacity for operation/ maintenance of equipment/pumps etc.
- Foundations for tanks, equipment, side stream filter, pumps, dosing system facilities etc. Foundations for acid handling tanks shall be protected with acid resistant tiles.
- Supporting structure for electrical cable tray, instrumentation ducts, pipes etc.
- Pipe supports, cable trays, operating/maintenance platforms, walkways, crossovers/ monorail
- Stairs, ladders, handrails, pits, channels, etc
- All types of trenches inside the battery limit.
- Any other structures not listed but required to complete the work.

b. Design and construction of all foundations/pile caps shall be in line with geotechnical specification attached elsewhere in the bid package.

c. Preparation of bar bending schedule for all RCC works before construction is taken up.

d. Preparation of fabrication drawings for all structural steel works.

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e. Painting/ coating/ lining of concrete & structural steel members (including primer) wherever required shall be as per the painting specifications C050-000-06-42-PLS-0001 (Job specification for surface preparation & protective coating) attached elsewhere in this bid document.

f. Providing hot dip galvanized electro-forged grating and handrails on platforms/ stairs.

g. Fabrication & placing/ erection of miscellaneous steel items like Anchor Bolts, Metal Insert Plates, chequered plates Pipe Sleeves, Hand railing, etc. as per EIL Specifications/as directed by Engineer-in-charge at any location wherever required.

h. Providing one side machined sliding plates, embedded in the grout over sliding support, under horizontal equipment.

i. Grouting of all equipment & Structural steel including supply of grouting material.

j. Waterproofing and damp proofing wherever specified/ directed by Engineer-in-charge.

k. Supplying and mixing of approved brand of bipolar concrete penetrating corrosion inhibiting admixture in concrete in superstructure and substructure as per manufacturer's specification for protection of reinforcement against corrosion as per Specification.

l. For all bolted connections, galvanized high strength bolts of property class of 8.8 (minimum) grade as per IS 3757 & IS 4000 shall be used. Nuts and washers shall conform to IS 6623 & IS 6649 respectively.

m. Providing interface details at the scope boundary limit.

n. Any temporary fixtures as required during construction /erection of structures.

o. Setting up of WORKSITE establishment and CONTRACTOR'S facilities.

p. Obtaining statutory approval from local authorities such as Municipal Corporation, Development authorities, Inspector of Factories and any other concerned authorities for starting the work, before starting the work at site.

Contractor to provide necessary assistance in documentation for statutory approvals taken by client.

q. Furnishing activity wise work programme and taking necessary approvals from the related department in the plant before carrying out any activity in existing structure. Any statutory approval, if required, shall also be taken.

r. 3-D modeling of all structures including foundation within package battery limit.

s. All the calculations & STAAD files shall be provided in Native software format (*.xls, *.std etc.). All supporting native files shall be attached as attachment to PDF design report before uploading in eDMS.

t. Preparation of AS-BUILT mark up prints on AFC drawing and subsequent updating of the same in soft copy (Auto CAD) of AFC drawing and submission of hardcopy and softcopy to Engineer-In-Charge as specified elsewhere in the bid package.

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u. All other civil-structural works forming part of scope of works of other engineering disciplines like Piping, General Civil, Static Equipment, Packaged Equipment, Electrical & Instrument, and as laid out elsewhere in this package for satisfactory and successful completion of all facilities under this contract.

v. Any other civil and structural works required/ directed by Owner/ Owner's representative/ Resident Construction Manager for the satisfactory and successful completion of the Project.

2.0 SCOPE OF SUPPLY OF MATERIALS

All materials (consumables/ non-consumables) required for execution of civil & structural works (including pilling works) under this contract shall be in the scope of Package Contractor.

3.0 SPECIFIC REQUIREMENTS:

Contractor shall strictly adhere to the conditions mentioned in the Engineering design basis (C050-999-81-41-EDB-1001), Seismic design basis (TP-1ZZZA-CV-BOD-0002_D1), Standard Specifications (6-68-0021, 6-68-0022 & 6-68-0023) along with other documents mentioned in list of attachments in this document.

The following shall also be strictly adhered to:-

1. Package contractor to ensure isolation of structures/ equipment with difference of temperature for free expansion while providing interconnecting platform and for connection to stair structures.

2. Material of construction & grade shall be as per Engineering Design Basis.

3. All designs, detailing & construction shall strictly conform to enclosed standards, specifications, drawings & engineering design basis..

4. Sequence of construction is to be shown on the AFC drawings by indicating construction joints wherever required.

5. Contractor shall make necessary arrangement for placing the anchor bolts in position before concreting. Whenever there are more than four foundation bolts, these shall be fixed by using template

6. Expansion joint shall be provided in concrete structure as per engineering design basis/relevant codal provision. Filler material with liquid polysulphide sealant compound shall be provided in expansion joint.

7. PACKAGE CONTRACTOR shall follow the layout provided in the package.

8. PACKAGE CONTRACTOR shall ensure lateral stability by providing box/ built-up sections for columns wherever it is not feasible to provide vertical bracing in either direction.

9. All designs, detailing & construction shall strictly conform to enclosed standards, specifications & drawings.

10. Sequence of construction is to be shown on the AFC drawings by indicating construction joints wherever required.

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11. Package contractor shall depute his concerned Civil-Structural design engineer to Owner/ PMC's review office as and when required for review of his documents. During such reviews involving computer aided analysis/ design/ drafting of structures, the package contractor shall make his own arrangement of Personal Computer (PC) in the form of Lap-top in the premises of Owner/ PMC's review office. This is required to expeditiously resolve all the comments including those involving the use of PC by Package contractor in his submission. The Package contractor shall ensure that these PC's are fully operational along with necessary software already loaded including the input/ output/ drawing files of the structures being reviewed. The Package contractor shall revise and re-submit the analysis/ design and drawings as required during review.

12. During the execution of the work, the contractor, at his own cost, shall keep structures, materials and equipment adequately braced by guys, struts or otherwise approved means which shall be supplied and installed by the Contractor as required till such time the installation work is satisfactorily completed. The provided guys, shoring, bracing, strutting, planking supports etc. shall not interfere with the work of other agencies and shall not damage or cause distortion to other works executed by him or other agencies.

13. Contractor has to take of all safety measures as per Refinery fire and safety standard.

14. PACKAGE CONTRACTOR shall depute his concerned Civil-Structural design engineer to Owner/ PMC's review office as and when required for review of his documents. During such reviews involving computer aided analysis/ design/ drafting of structures, the PACKAGE CONTRACTOR shall make his own arrangement of Personal Computer (PC) in the form of Lap-top in the premises of Owner/ PMC's representative's review office. This is required to expeditiously resolve all the comments including those involving the use of PC by PACKAGE CONTRACTOR in his submission. The PACKAGE CONTRACTOR shall ensure that these PC's are fully operational along with necessary software already loaded including the input/ output/ drawing files of the structures being reviewed. The PACKAGE CONTRACTOR shall revise and re-submit the analysis/ design and drawings as required during review.

15. Verification of foundation loading data for all equipment/ structures etc., which form part of the comprehensive packages supplied by the respective vendors, shall be entirely the responsibility of Package contractor. PACKAGE CONTRACTOR shall ensure that wind/ seismic loadings are strictly in line with the basic wind pressures/ seismic loads enclosed with this package.

16. PACKAGE CONTRACTOR shall furnish the BULK MTO for RCC structure & reinforcement within 45 days from the date of receipt of LOI/TOI. It shall also be updated at 50% & 90% stages of engineering progress and shall be submitted to Employer/Employer's representative for information in format attached elsewhere in the bid document.

17. The type of pile & pile capacities /Net Safe Bearing Capacity of Soil considered for the design of foundation shall be mentioned in drawings for all structures and equipment. All the data considered for design of foundation shall be approved by Owner / Owner's representative.

18. The contractor shall ensure proper co-ordination / co-operation with other agencies, while working in the Construction area, without affecting others work front areas.

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19. During execution of work, all existing facilities (Temporary /Permanent) shall be protected from any damage. In case of any damage / dismantling (if required) is required to be carried out for carrying out contractor's work. The same shall be restored to original condition to the satisfaction of Owner/ Engineer In-charge without additional time and cost implication.

20. Fabrication of structure steel shall be done in contractor's fabrication shop outside plant boundary.

21. Contractor shall make his own arrangements for casting of Pre-cast elements, outside the plant boundary, on its own cost.

22. Contractor shall consider requirement of borrowed earth from outside the plant boundary for backfilling and similarly disposal of unserviceable surplus earth and debris outside the plant boundary. Contractor shall obtain relevant statutory approval from all statutory authorities, local authorities (like municipal etc.) and including payment of charges/royalty/ octroi for the same. Contractor shall keep client indemnified of any liability and/or complaint from local authorities/municipal bodies etc. However serviceable surplus earth & rock shall be disposed within plant boundary limit at designated location as per directions of Engineer-in-charge.

23. Modularization of structure, equipment & piping, including electrical & instrumentation support shall be preferred to the extent possible. Successful bidder to present modularization philosophy during the kick-off meeting

24. Use of precast concrete shall be preferred in structures & buildings to the extent possible. Successful bidder to present the precast concrete philosophy during the kick-off meeting.

25. Contractor shall consider recycling of construction & demolition wastes to the extent possible (except in RCC structures) and to present the recycling philosophy during the kick-off meeting. The construction & demolition waste can be recycled subject to confirmation of material test report as per relevant BIS code for the intended purpose.

26. Crystalline Waterproofing Admixture shall be as per CPWD DSR Item No. 22.22 and CPWD Specification Item No. 22.14.

27. Usage self-compacting concrete is encouraged wherever required.

28. Use of products having less embodied carbon/ low carbon footprint (e.g. GreenPro certified), subject to meeting other statutory requirements mentioned elsewhere in the tender documents.

29. All works shall be done to the entire satisfaction of the Owner/Engineer-in-Charge. Any work not carried out in accordance with the instructions shall be dismantled and made good without any extra cost and time implication to the owner.

4.0 VENDOR DATA REQUIREMENT

Vendor to submit & get the documents approved as per VDR requirement provided in the bid document (C050-1U68-81-41-VDR-8010).

5.0 EXCLUSIONS-NIL

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6.0 LIST OF ATTACHMENTS

6.1 STANDARD SPECIFICATIONS

S. No	Doc No	Rev. No.	Document Title
1.	6-68-0001	6	Standard specification civil and structural works general scope.
2.	6-68-0002	7	Standard specification civil and structural works materials.
3.	6-68-0003	6	Standard specification civil and structural works earthwork.
4.	6-68-0004	8	Standard specification civil and structural works plain and reinforced cement concrete
5.	6-68-0005	6	Standard specification civil and structural works reinforced cement concrete for liquid retaining structures
6.	6-68-0006	8	Standard specification civil and structural works structural steel works
7.	6-68-0007	8	Standard specification civil and structural works structural steel works (tubular / hollow sections)
8.	6-68-0008	8	Standard specification : civil and structural works - miscellaneous steel works
9.	6-68-0009	5	Standard specification civil and structural works brick masonry
10.	6-68-0013	6	Standard specification civil and structural works miscellaneous items.
11.	6-68-0016	2	Standard specification civil and structural works concrete block masonry
12.	6-68-0017	1	Standard specification : civil & structural works - bipolar concrete penetrating corrosion inhibiting admixture
13.	6-68-0021	1	Standard specification civil - structural lump-sum turn-key works (LSTK works) general requirements
14.	6-68-0022	2	Standard specification civil - structural lump-sum turn-key works (LSTK works) material & construction
15.	6-68-0023	0	Standard specification civil - structural lump-sum turn-key works (L.S.T.K. works) vendor data requirements (Including Annexures)
16.	6-68-0035	1	Standard specification civil and structural works water-proofing of underground concrete structures
17.	6-78-0001	2	Specification for quality management system requirements from bidders
18.	6-78-0002	2	Specification for documentation requirements from contractors
19.	6-78-0003	2	Specification for documentation requirements from suppliers

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6.2 STRUCTURAL STANDARDS

S. No	Doc No	Rev. No.	Document Title
1.	7-67-0008	8	Pedestal for stair / ladder.
2.	7-67-0011	6	Flooring details for buildings.
3.	7-68-0051	7	Standard lifting hooks in precast slabs and chequered plates
4.	7-68-0052	8	Details for M.S. rungs for conc. structures
5.	7-68-0056	8	Metal insert plates
6.	7-68-0060	1	Handrail tube and ball type
7.	7-68-0067	2	Structural details of misc. arch features
8.	7-68-0201	7	Standard lugs
9.	7-68-0202	8	Typical grating support
10.	7-68-0203	8	Typical chequered plate support
11.	7-68-0213	7	Base plate for channels
12.	7-68-0355	4	Instrumentation cable duct / tray supporting arrangement
13.	7-68-0417	9	M.S. Anchor Bolt Assembly
14.	7-68-0501	8	Handrails
15.	7-68-0506	8	Steel stairs
16.	7-68-0507	9	Details of steel ladder
17.	7-68-0509	8	Steel ladder joint details
18.	7-68-0627	2	Precast cable trench and joint detail
19.	7-68-0683	5	Monorail fixing details with steel members
20.	7-68-0684	5	Monorail fixing details with R.C.C. beam
21.	7-68-0695	3	Electrical cable tray supporting structure
22.	7-68-0697	6	Electro-forged grating type-I and type-II

6.3 OTHER JOB SPECIFICATIONS / ATTACHMENTS

S No	Document No	Title
1	C050-1U68-81-47-GTD-8010	Geotechnical Data for Cooling Tower package PP (Polypropylene) Project
2	C050-1U68-81-41-VDR-8010	Vendor Data Requirement for Cooling Tower Package
3	C050-000-06-42-PLS-01	Job specification for surface preparation & protective coating
4	TP-1ZZZA-CV-BOD-0002_D1	Site specific seismic spectra
5	C050-999-81-41-EDB-1001	Engineering Design Basis (Structural)

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6.4 APPROVED VENDOR LIST

S No	Document No	Title of Document
1	C050-1U68-81-41-LL-8010	List of Approved Products for use in Structural works for Cooling Tower Package

7.0 ADDENDUM

S. No.	Document No.	Clause No.	Modifications
1.	7-68-0056	All Relevant	Wherever “Fe 500” is mentioned, the same shall be read as “Fe 500D TMT”.
2.	Other relevant Spec., if any.		

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SCOPE OF WORK & SUPPLY
FOR
EPC TENDER FOR COOLING TOWER PACKAGE

TENDER NO. C050-1U68-81-45-PB-T-8010

JOB NO. : C050

PROJECT : EPCM SERVICES FOR POLYPROPYLENE (PP) PROJECT, NUMALIGARH REFINERY

CLIENT : M/S NUMALIGARH REFINERIES LIMITED

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	13.08.25	ISSUED FOR TENDER	KT	SS	GJK

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1.0 GENERAL

1.1 This document describes the broad scope of work and supply of EPC CONTRACTOR for Architectural works.

1.2 This document shall be read in conjunction with the remainder (such as specifications, scope of works, design basis, drawings, applicable codes and standards etc) of the Bid document.

1.3 Requirements and provisions of design, drawings, specifications etc. contained in Bid documents are conceptual in nature, defining minimum requirements and are in no way exhaustive.

The above shall not relieve the EPC CONTRACTOR from ensuring correctness of his deliverables and other activities and any changes required for this purpose (after award of work) are deemed to be included in the EPC CONTRACTOR's scope of work, supply, execution and contract value/ price.

1.4 EPC CONTRACTOR shall develop the design and detail engineering and shall complete all activities in his scope of work and supply meeting all the provisions, requirements and criteria of the Bid document.

1.5 During the tendering/ bidding stage, EPC CONTRACTOR shall review and verify the contents of the Bid document and shall ensure his clear understanding of requirements, provisions and criteria of the same.

1.6 For this purpose, EPC CONTRACTOR shall point out any errors, omissions, contradictions, or discrepancies etc. with suggestive rectification for review & necessary action/ decision before award of the job.

1.7 After award of work, it shall mean that EPC CONTRACTOR has fully understood and accepted the provisions of the Bid Document and has undertaken to fully comply with them.

1.8 There shall be no time and cost implication to the OWNER or COMPANY and PMC for design, detail engineering, construction, execution, installation and other activities performed by the EPC CONTRACTOR required for completing the job due to any upward revisions and/ or additions of quantities, specifications, sizes etc. given in the specifications and drawings etc. required to be made during execution of the works meeting all the provisions, requirements and criteria of Bid Document.

2.0 DEFINITIONS

2.1 For definition of Architectural terminologies reference shall be made to National Building Code (NBC) and applicable referenced codes and standards.

3.0 SCOPE OF WORK & SUPPLY

3.1 Scope of work & supply of the EPC CONTRACTOR shall be pertaining to all the required buildings/ sheds/ structures such as:

- CWTP Building.
- Chemical Storage Shed
- Cooling Water Pump House Shed
- Other miscellaneous Shed

3.2 Buildings listed in clause 3.1 above are not exhaustive. Requirement of buildings shall also include**:**

3.2.1 Any other building/ buildings indicated in Plot plan/ area drawing/ equipment layout, scope of work & specification etc. of other disciplines.

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3.2.2 Any other building/ buildings required to meet the Operational, Maintenance, HSE (Health, safety & Environmental), Licensor's and statutory Requirements.

4.0 DETAIL SCOPE OF SUPPLY & WORK

The Scope of supply & work of the EPC CONTRACTOR shall broadly consist of following activities pertaining to buildings/ sheds/ structures included in this tender

4.1 Data collection.
4.2 Design & detail engineering.
4.3 Procurement and supply of all materials, labor, equipment, tools and tackles etc.
4.4 Fabrication, Transportation to site, Assembly, Erection, Installation. Construction, Execution and supervision.
4.5 Obtaining approvals from Statutory and Approving Authorities,
4.6 Preparation of As-built drawings, documents
4.7 Co-ordination
4.8 Any other incidental and other activities not explicitly mentioned but required to meet the requirements of the project.

4.1 Data collection

4.1.1 EPC CONTRACTOR shall visit the site & facilities and collect data required for carrying out his scope of work.

4.2 Design & Detail Engineering

4.2.1 Design & Detail Engineering shall meet the requirements of Design Basis, Job Specification, Drawings, Standards, Specifications, Reference codes etc contained in the Bid Document.

4.2.2 Design & Detail Engineering shall include conceptual design, finalization of design, Review by COMPANY or OWNER and PMC, preparation & submission of deliverables, Re-submission after incorporation of changes, revisions & review comments, obtaining approval for execution, resolution of conflicts and necessary co-ordination with all related parties.

4.2.3 EPC CONTRACTOR shall submit deliverables for Review, approval, information etc. to COMPANY or OWNER, PMC in accordance with provisions of bid document and contract or agreed methodology.

a. Deliverables shall be revised and resubmitted incorporating comments from COMPANY or OWNER, PMC or any other design, engineering requirements until they are reviewed, approved or accepted for construction, execution and installation.

b. Review, approval, acceptance of deliverables by PMC, COMPANY or OWNER shall not relieve the EPC CONTRACTOR from ensuring correctness of his deliverables.

c. EPC CONTRACTOR shall develop the FEED (Front end engineering design) to Approved for Construction (AFC) status, taking due account of the detailed requirements of the Job Specification, design basis, specifications and standards for architectural works for the scope of work covered under this Package.

d. EPC CONTRACTOR shall not proceed with construction till those documents which are specifically listed at "Review" category are reviewed by OWNER/PMC.

e. EPC CONTRACTOR shall submit Architectural schemes for Buildings supported by 3-D model (as per software requirement mentioned elsewhere in the bid document) and rendered perspective (interior as well as exterior) indicating all architectural features. The scheme once approved by Owner/ PMC (after incorporation of comments if any)

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shall be incorporated in the final design drawing to be issued for construction of the building.

f. Design & Detail engineering of buildings shall be performed by a qualified Architect or Architectural agency having Architects possessing experience of similar professional experience.

g. Any incorrectness, non-compliance with Design Basis, Job Specification, Drawings, Standards, Specifications, Reference codes etc noticed at any stage shall be corrected by EPC CONTRACTOR irrespective of review, approval, acceptance of deliverables by PMC, COMPANY or OWNER without any time and cost implication to them.

4.2.4 EPC CONTRACTOR shall prepare and submit all drawings, specifications and other deliverables required for execution of the job as indicated elsewhere in Bid document and Contract.

a. Deliverables shall be prepared using approved software in agreed format and shall be complete in all respect indicating document or drawing number, revision number, purpose of issue, signature of Performer, Checker and approver.

b. Drawings shall be prepared in 1:100 scale. For details the scale shall be 1:25. Key plans may be in larger but in legible scale.

c. Deliverables shall be submitted in requisite number of copies and approved media (Hard and soft copies) as indicated elsewhere in the Bid document, Contract.

d. EPC CONTRACTOR shall submit list of all Sub- vendors/ authorized applicators to be engaged for Execution of various specialized items (like Aluminum Doors and Windows, UPVC Window/ Ventilators, Waterproofing and Insulation, False ceiling, False Flooring, Partitioning and Paneling etc.) for approval.

e. EPC CONTRACTOR shall depute his concerned Architect/ design engineer to Employer/ Employer's Representative's review office as and when required for review of his documents. Schedule for communication with Architect or Architectural Agency shall be as follows:

i) During Kick off meeting for approval of Architect/ Architectural agency.
ii) Approval of Conceptual drawings of important buildings such as Control Room etc.
iii) After incorporation of comments received on first submission of drawings with CRS and 3d rendered views of buildings as applicable.
iv) Further meeting if required for resolving pending issues/ closure within stipulated time frame.

During such Reviews involving computer aided design/drafting, the EPC CONTRACTOR shall make his own arrangement of Personal Computer (PC) in the form of Lap-top in the premises of Employer/ Employer's representative's review office. This is required to expeditiously resolve all the VENDOR Comments including those involving the use of PC by EPC CONTRACTOR in his submission. The EPC CONTRACTOR shall ensure that these PC's are fully operational along with necessary software already loaded including the input/output/drawing files being reviewed. The EPC CONTRACTOR shall revise and re-submit the design and drawings as required during review.

f. EPC CONTRACTOR shall prepare and submit filled checklist along with the first submission drawings complying to all applicable points in the drawings as specified in the checklist attached elsewhere in bid documents.

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4.2.5 Following Parameters of Design & Drawings shall not be reviewed.

a. Adequacy of provisions (in terms of spaces, services & utilities) and space/ area/ room sizes for Plant Buildings or Plant Areas in other Buildings. The PACKAGE CONTRACTOR shall ensure correctness of such provisions vis-à-vis Owner/PMC reviewed/ approved G.A. drawings & submit Architectural drawings only after approval/ review of such provisions by concerned department of PMC.

b. Correctness of Drawings in terms of dimensions, matching of Plan, Elevation, Section, etc. These parameters may be reviewed at random only.

c. Location, Co-ordinates, Orientation & Road/Ground/Pavement levels. The PACKAGE CONTRACTOR shall ensure correctness of these vis-à-vis EIL reviewed/approved G.A. drawings.

4.3 Procurement and supply

4.3.1 EPC CONTRACTOR shall Procure & Supply of all materials, Labor, Equipment, Tools & Tackles, safety gear & measures etc.for all applicable height and locations within the plant boundary as required for successful completion of job and as directed by site in charge.

4.3.2 Supply shall also include necessary accessories, nuts, bolts, washers, erection tools and tackles, adhesive tapes, insulation tapes, etc. necessary for successful installation of structures.

4.3.3 Supply of materials shall include anticipated wastages as per standard practice required for completion of the work as per the specification, Drawing.

4.3.4 All bought out items such as fitting and fixtures, doors, windows, rolling shutters hardware, etc shall be of approved quality. Supplier shall allow for inspection and approval of such samples before procurement.

4.4 Fabrication, Transportation to site, Assembly, Erection, Installation. Construction, Execution and supervision.

4.4.1 EPC CONTRACTOR shall construct, execute, and install the work in accordance with approved design and drawings, specifications, directions of Engineer-In-Charge etc. meeting the requirements of Bid Document.

4.4.2 Construction, execution, Installation shall include:

a. Procurement, Supply of all materials, Labor, Equipment, Tools & Tackles, safety gear & measures etc.
b. Dismantling of existing works if required.
c. Protection of existing works/ facilities as required.
d. Rectification of damaged works etc.
e. Disposal of debris, storage of retained items etc.
f. Handing over the buildings and other works in complete, neat, clean and operable condition.
g. Supervision
h. Any other incidental works or activities not explicitly mentioned but required for completeness of construction, execution and installation.

4.5 Obtaining approvals from Statutory and Approving Authorities

4.5.1 EPC CONTRACTOR shall design and execute the works in accordance with requirements of Statutory Authorities and obtain approvals from them.

4.5.2 Approvals from following Authorities are envisaged.

a. Local Panchayat, Municipal, Development Authorities as applicable.

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b. Factory Inspector, Department of Industrial safety & Health.
c. Department of Fire & Emergency Services.
d. Regional, City or Town Planning Authority if applicable.
e. Airport Authority if applicable.
f. Any other Authority having jurisdiction.

4.5.3 EPC CONTRACTOR shall prepare drawings & documents necessary for obtaining approvals from statutory authorities.

4.5.4 EPC CONTRACTOR shall make necessary changes, modifications etc. in design and execution if required for obtaining approvals from statutory authorities.

4.5.5 EPC CONTRACTOR shall perform all liaising & co-ordination activities with required parties, Authorities etc. as required for obtaining approvals from Statutory Authorities.

4.6 Preparation of As-built drawings, documents

4.6.1 EPC CONTRACTOR shall prepare and submit As-built drawings in approved software and in requisite number of copies and approved media (Hard and soft copies) as indicated elsewhere in the Bid document, Contract.

4.7 Co-ordination

4.7.1 EPC CONTRACTOR shall do all co-ordination activities required for completion of the job with COMPANY or OWNER, PMC, SUB CONTRACTORs, MANUFATURERS, SUPPLIERS, VENDORS & other agencies.

4.7.2 Co-ordination by EPC CONTRACTOR shall also include presentation to COMPANY or OWNER, PMC as required for finalization of building design and other issues.

5.0 CONSTRUCTION, INSTALLATION & COMMISIONING.

5.1 EPC Contractor shall construct, install & Commission the work in accordance with approved design, drawings, specifications, and directions of OWNER, PMC etc. meeting the requirements of bid document and hand over the buildings in complete, neat, clean and operable condition.

5.2 All aspects of Construction, Execution, Installation such as material, workmanship, finishes etc. shall be in accordance with specifications contained in this specification & and directions of Engineer-In-Charge.

5.3 Deputation of requisite number of erection supervisors for erection supervision and guiding the assembly and installation works till successful installation of structures/ buildings/ sheds.

5.4 In case, required specification of any material, workmanship, finishes etc., is not covered in specification, relevant national or International codes, standards and recommendations of approved manufacturers shall be followed (with prior approval from the OWNER, PMC) without any time and cost implication to the OWNER, PMC.

6.0 PERFORMANCE GUARANTEE/ WARRANTY

6.1 All structural and civil works including supply and execution shall be warranted for a period mentioned in commercial agreement from the date of Installation & Commissioning. The Valid Warranty certificate must be submitted.

6.2 During this period, all defects arising out of defective material and faulty workmanship will be rectified by repairing or replacing part or whole material as necessary, free of charge.

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6.3 Any consequential damage/defect or loss of items due to poor workmanship/ poor material quality/ negligence etc. attributed to the bidder to be rectified/ replaced by the bidder free of cost.

7.0 LIST OF ATTACHMENTS

7.1 STANDARDS

S. No.	Standard No.	Rev.	Title
1	7-75-0002	6	Skirting detail (with brick wall).
2	7-75-0003	6	Skirting detail (with R.C.C. column).
3	7-75-0004	6	Dado detail (with brick wall & RCC col.)
4	7-75-0014	6	Glazed Aluminium Door
5	7-75-0015	6	Glazed Aluminium Window
6	7-75-0036	7	Pipe hand rail with square up right type.
7	7-75-0041	6	False ceiling details with aluminium grid.
8	7-75-0042	6	Aluminium panel false ceiling (84C system).
9	7-75-0043	6	Aluminium panel false ceiling (tray type).
10	7-75-0049		False Flooring
11	7-75-0054	6	Steel gate (for entrances upto 6.0m width)
12	7-75-0060	6	Orissa pan W.C. (fixing detail)
13	7-75-0062	6	European type WC (fixing detail)
14	7-75-0063	6	Urinal fixing detail
15	7-75-0064	6	Wash basin fixing detail
16	7-75-0065	6	Plinth protection (with building drain)
17	7-75-0068	6	Roof Drainage and Waterproofing
18	7-75-0066	6	Wooden panel door (toilet door)
19	7-75-0070	6	Steel Door (Pressed Steel) Single Shutter
20	7-75-0071	6	Steel Door (Pressed Steel) Double Shutter
21	7-75-0074	1	Steel Large door (pressed steel) double shutter
22	7-75-0091	2	Metal sheet (flashing detail)
23	7-75-0093	2	Stainless steel tubular handrail

4.2 SPECIFICATIONS

S. No.	Specification No.	Rev.	Title
1	6-75-0001	7	Specification for Architectural Works - General.
2	6-75-0002	7	Specification for floor finishing
3	6-75-0004	8	Specification for Steel/ Aluminum doors, windows & ventilators
4	6-75-0005	7	Specification for plastering & pointing.
5	6-75-0006	7	Specification for roof treatment.
6	6-75-0007	7	Specification for whitewashing, Colour washing, distempering, Painting & polishing.
7	6-75-0008	7	Specification for roofing.
8	6-75-0009	7	Standard specification for sanitary fittings and fixtures
9	6-75-0010	7	Specification for False Ceiling, False Flooring Under deck Insulation &

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			Partitioning
10	6-75-0011	2	Specification for fire check / fire resistant doors, windows & partitions

4.3 VENDOR LIST

S. No.	Title of Document	Document No	Rev.
1	List of Approved Manufacturers of Civil-Structural and Architectural Products	C050-1U68-81-46-LL-8010	A

4.4 ENGINEERING DESIGN BASIS

S. No.	Title of Document	Document No	Rev.
1	Engineering Design Basis	C050-000-81-46-EDB-1001	0

4.5 OTHER ATTACHMENTS

S. No.	Title of Document	Document No	Rev.
1	Vendor Data Requirements (Architecture)	C050-1U68-81-46-VDR-8010	A
2.	Check list	C050-1U68-81-46-TCL-8010	A

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HSE SCOPE OF WORK & SUPPLY FOR COOLING TOWER PACKAGE

(Tender No.: C050-1U68-81-45-PB-T-8010)

PROJECT : POLYPROPYLENE (PP) UNIT PROJECT

OWNER : M/s NUMALIGARH REFINERY LTD.

LOCATION: NUMALIGARH, ASSAM

JOB NO. : C050

Rev. No	Date	Purpose	Prepared by	Reviewed by	Approved by
A	04.09.25	Issued for Tender	IA	JKU	DK

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LIST OF ABBREVIATIONS:

DGMS	Directorate General Of Mines Safety
EIL	Engineers India Limited
EW&SS	Eyewash & Safety Shower
H_2	Hydrogen
HAC	Hazardous Area Classification
HAZOP	Hazard and Operability Study
HC	Hydrocarbon
HSE	Health, Safety and Environment
IEC	International Electrotechnical Commission
IS	Indian Standard
MMTPA	Million Metric Tonnes Per Annum
NREP	Numaligarh Refinery Expansion Project
NRL	Numaligarh Refinery Limited
OIL	Oil India Limited
OISD	Oil Industry Safety Directorate
PFCCU	Petrochemical Fluidized Catalytic Cracking Unit
PNGRB	Petroleum and Natural Gas Regulatory Board
PP	Polypropylene
QRA	Quantitative Risk Assessment
SIF	Safety Instrumented Function
SIL	Safety Integrity Level

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1 INTRODUCTION

Numaligarh Refinery Limited (NRL/Owner/Client), a subsidiary of M/s Oil India Limited (OIL) is operating a 3 MMTPA refinery located at Golaghat District in Assam, India, with associated crude receipt and handling facilities, cross country pipelines, marketing terminal etc. NRL is augmenting the processing capacity of the facilities from present 3.0 MMTPA to 9.0 MMTPA under Numaligarh Refinery Expansion Project (NREP). This project is integrated with a new crude oil pipeline from Paradip (Odisha) to Numaligarh (Assam) and a product pipeline from Numaligarh to Siliguri where NRL has its own Marketing Terminal for distribution of product. Under NREP project, a high severity PFCCU unit with a capacity of 1.955 MMTPA is being implemented. The LPG that will be generated in the high severity mode of PFCCU will contain a significant potential of propylene which is a good feedstock for production of high valued polymer i.e. Polypropylene. In view of expected growth in demand for petrochemicals products in India and to remain competitive in the market with products self-sufficiency, NRL plans to set up a Polypropylene (PP) Unit along with its associated facilities under Polypropylene (PP) project, beside the NREP refinery.

As part of the execution of Polypropylene unit project, Cooling Tower Package is to be installed. In order to ensure process safety aspect in the detail engineering stage, Cooling Tower Package Contractor shall carry out various HSE activities mentioned in the subsequent sections as a minimum requirement. Any other safety study mentioned elsewhere in the Tender shall also be executed by the Cooling Tower Package Contractor.

2 SCOPE OF WORK: HSE STUDIES

The scope of work for Cooling Tower Package includes the following safety studies as a minimum;

a. Participation in HAZOP Study Workshop

b. Participation in SIL Classification Study Workshop

Brief details for HAZOP & SIL Classification Study workshop and responsibility of the Package Contractor are defined in subsequent sections;

2.1 HAZOP STUDY

Hazard and Operability (HAZOP) Study, is one of the most conventionally used methods for identifying Hazard and Operability problems of the Process systems. HAZOP Study shall be arranged by EIL in Gurugram / Delhi Office and Contractor nominated personnel representing various disciplines (Process, Instr., Mechanical, Projects etc.) as required shall participate in the HAZOP Study of the Package. The recommendations arising out of the HAZOP Study shall be implemented by Contractor without any time and cost implication to Owner. Revised

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and updated documents / drawings after HAZOP Study shall be submitted by the Contractor for review / approval of EIL / Owner.

Deliverable(s):

a. P&IDs issued for HAZOP (to carryout node mark-up)

b. HAZOP Study Closeout Report

Note: HAZOP Study Report shall be prepared by EIL after completion of the workshop and subsequently HAZOP Study Closeout Report shall be prepared by the Contractor based on the recommendations provided in the report, if any during the study.

2.2 SIL CLASSIFICATION STUDY

SIL Classification Study shall be carried out for all SIFs as identified during the detail engineering stage under the package scope. SIL Classification Study shall be arranged by EIL in Gurugram / Delhi Office and Contractor nominated personnel representing various disciplines (Process, Instr., Mechanical, Projects etc.) as required shall participate in the workshop. The recommendations arising out of the SIL Classification Study shall be implemented by the Contractor without any time and cost implication to Owner. Revised and updated documents / drawings after the study shall be submitted by the Contractor for review / approval of EIL / Owner.

Deliverable(s):

a. SIF List (to be provided at least two weeks prior to SIL Classification Study workshop)

b. SIL Classification Study Closeout Report

Note: SIL Classifictaion Study Report shall be prepared by EIL after completion of the workshop and subsequently SIL Classification Study Closeout Report shall be prepared by the Contractor based on the recommendations provided, if any during the study.

3 SCOPE OF WORK: HSE ENGG. ACTIVITIES

Various HSE engg. activities under scope of work for Cooling Tower Package Contractor includes the following activities as a minimum;

a. Implement recommendations of QRA Study, if any

b. Prepare source list and develop Hazardous Area Classification Layout for the package, as applicable

c. Provide Eyewash and Safety Shower and depict the same at suitable locations in the package area

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d. Provide flammable gas detectors (HC and / or H2 detection) (as applicable) at the cooling tower

e. Provision of Portable fire extinguishers and first aid (as per OISD / PNGRB requirements)

Detail requirements for various HSE Engineering activities are provided in the subsequent sections;

3.1 RECOMMENDATIONS OF QUANTITATIVE RISK ASSESSMENT STUDY

QRA Study shall be carried out for the entire PPU project by EIL during detail engineering stage. The recommendations pertaining to Cooling Tower Package (if any), arising out of the QRA Study shall be implemented by the Package Contractor without any time and cost implication to Owner. Any such applicable recommendation shall be shared with Contractor during the progress of the engineering activities after completion of QRA study. Contractor shall submit closeout sheet for such recommendations (if any) for review / approval of EIL / Owner.

Deliverable(s):

a. QRA Study Closeout Report (if applicable)

3.2 EYE WASH AND SAFETY SHOWER (EW&SS)

Eye wash and Safety shower shall be provided near the Hazardous chemical storage and handling area and any additional requirement as per relevant OISD / IS / PNGRB code and standard. EW&SS requirement shall also be further reviewed during Layout review and 3D model review (as applicable) in presence of EIL / Owner Operation team. Water quality requirement (e.g., Temperature etc.) for EW&SS shall be as per applicable code, standard and local statutory requirement.

Any additional requirement of EW&SS as raised during 3D model review or any other review during detailed engineering stage shall be implemented by Contractor without any time and cost implication to Owner.

Deliverable(s):

a. Equipment Layout showing Eyewash & Safety Shower locations

b. Eyewash & Safety Shower datasheet

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3.3 HAZARDOUS AREA CLASSIFICATION

Areas within the battery limits of the package shall be classified for the degree and the extent of hazard from flammable materials. Classification of hazardous areas shall be done in accordance with various national and international stds. e.g. Petroleum Rules, DGMS regulations (where applicable), IS-5572 (for flammable gases & vapors), IS/IEC 60079 Part 10 Sec 2 (for explosive dust atmosphere), respective OISD standards and Process Licensors recommendations, if any.

Deliverable(s):

a. HAC Source List

b. HAC Layout

3.4 GAS DETECTOR AND FIREFIGHTING EQUIPMENT

Contractor shall provide HC and H_2 gas detector (as applicable) at the cooling tower top and portable firefighting equipment at various locations in the package area in line with respective OISD Std. / PNGRB regulations requirements. Location of detector shall be shown in the layout of the package and to be further reviewed during 3D Model review in presence of EIL / Owner team.

Deliverable(s):

a. Gas detector Layout

b. Gas detector datasheet

Note-1: Spare for firefighting facilities shall be provided by the Package Contractor as per respective OISD Std. / PNGRB regulations requirements.

Note-2: HSE Studies and documents / drawings mentioned above are minimum. Any additional study, document and drawings required for successful completion of the entire scope of work shall be prepared by Package Contractor without any time and cost implication to Owner.

Note-3: Submission of hard / soft copy and native files of all HSE related documents / drawings shall be in accordance to the tender requirements.

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Annexure-A
SCOPE OF SUPPLY / WORKS

COOLING TOWER PACKAGE

(SMED - STATIC EQUIPMENT)

TENDER No. C050-1U68-81-45-PB-T-8010

PROJECT	**:**	**EPCM SERVICES FOR SETTING UP POLYPROPYLENE UNIT AT NRL**
OWNER	**:**	**NUMALIGARH REFINERY LIMITED (NRL)**
EPCM	**:**	**ENGINEERS INDIA LIMITED**
EIL JOB No.	**:**	**C050**

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
0	22.08.2025	ISSUED WITH TENDER	CK	PKP	TK

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1.0 SCOPE OF WORK

Contractor scope of work shall include but not limited to the following Static equipment coming in the Cooling Tower package (Tender no. C050-1U68-81-45-PB-T-8010) for NRL Expansion Project (360 KTA PP Unit) of **NUMALIGARH REFINERY LIMITED (NRL)**.

S no.	Description	Process Specifications
1	Pressure Sand Filter (Vertical Dual Media Filter) (Item No. 1U68-ZGN-4271 A/B)	AS PER TENDER DOCS
2	H2SO4 Storage Tank for CT (1U68-TK-8632)	AS PER TENDER DOCS
3	H2SO4 Dosing Drum for CT (1U68-VV-8631)	AS PER TENDER DOCS
4	H2SO4 Tank Silica Gel Breather for CT (1U68-ZM-5771)	AS PER TENDER DOCS
5	H2SO4 Dosing Drum Silica Gel Breather for CT (1U68-ZM-5772)	AS PER TENDER DOCS
6	Any other static equipment envisaged in the Process Package/P&ID	AS PER TENDER DOCS

The scope of Static Equipment under this tender shall include complete design, detail engineering and supply of all the equipment including all mountings, accessories, & bought out items for vessels, tanks and Agitators (as applicable) etc., job specifications, EIL standard specifications etc. as enclosed elsewhere in the bid package.

Scope of work shall include but shall not be limited to the following:

Mechanical design including detailed engineering and preparation of fabrication drawings, procurement, supply of equipment as per the Package, material testing and inspection, shop/site fabrication, assembly, stage wise and final inspection by third party inspection agency, shop testing, hydro test, PWHT/Stress relieving, Cathodic protection (as applicable), packing (seaworthy when imported or marine Transported through Barge) & forwarding, transportation to site, storage, preservation, construction, erection, field testing, chemical cleaning, calibration, surface preparation, shop & field painting, any additional cleaning required by licensor, insulation, fire proofing, fitting of internal and external attachments, pre-commissioning, commissioning and Performance Guarantee.

a) Contractor shall procure all the equipment from the list of approved vendors as attached with the bid package elsewhere.

b) Submission of all mechanical design calculations, engineering drawings, fabrication drawings for review by OWNER/CONSULTANT shall be in accordance with the vendor data requirement (Doc. No. C050-IU68-80-42-VDR-8010).

c) Obtaining approvals from OWNER/CONSULTANT on Drawings and Documentation.

d) Obtaining statutory approvals for equipment as per the provision of the Tender.

e) Supply of "as built" documentation and QC dossiers.

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2.0 CONFLICT

In case of conflict between the above referenced documents, the same shall be reported in writing to OWNER/CONSULTANT for clarification and resolution before proceeding with the job. However, it shall be resolved considering the most stringent in the following order:

i. P&ID, Process Datasheet

ii. Job Specifications

iii. Requirements specified in this document

iv. Engineering Design Basis

v. Standard specifications/ Standards

vi. Applicable Codes

The scope of work as defined herein, shall be read in conjunction with Engineering Design Basis, & Standard Specifications.

3.0 SCOPE OF SUPPLY

a) Procurement and supply of all raw materials (Metallic & nonmetallic) and consumables required for fabrication of all process equipment & tanks covered in the package.

b) Complete internals including supports, Companion Flanges/ Reducing flanges/Cover flanges etc. including gasket, bolting and spares etc. as applicable.

c) Supply of Insulating material, primer & finish paints, fire proofing materials wherever required.

d) Supply of materials / equipment required for blast cleaning / chemical cleaning.

e) Spares

i. All mandatory spares as per Document no. C050-IU68-80-42-SL-8010- Annexure-A.

ii. All the Commissioning spares as required shall be supplied by contractor. Contractor shall procure the same from the equipment vendors and make it available well before commissioning of Plant/Equipment. In case, any additional spares are consumed during commissioning the same to be provided by the contractor. Any leftover spares shall be handed over to owner.

iii. Contractor shall furnish a list of spares recommended by the equipment vendor for two-year Normal operation and maintenance along with firm unit prices and shall be quoted separately as per the provisions of the Tender.

f) Statutory Approvals

The Contractor shall obtain all necessary approvals from statutory authorities but not limited to the following such as IBR, PESO, Factory Inspector, Local Municipal or Development Authorities, Town & Country Planning Organization, concerned electrical inspectorate (e.g. CEA etc.) etc.

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g) Supply of all material required for completion of storage tanks including all accessories.

h) Supply of slot dipping device for pressurized tanks where gauge hatch has been specified, when the tank is gas blanketed.

i) Preparation and supply of check lists for all types of equipment to ensure their correct installation, alignment, assembly, levelling, grouting and completion.

j) Supply of all other materials whether specifically mentioned or not but required for completion of the job in all respect as per bid package.

k) All external/internal attachment including nozzle, piping clip, ladder/platform clip, insulation clip, fire protection attachment, internals/ internal supports as deemed necessary for successful completion of project.

4.0 LIST OF ATTACHMENTS

CONTRACTOR shall carry out all works strictly in accordance with the drawings/ documents/ specifications indicated below.

Sl. No.	Title	Document No.
1.	Scope of Supply and Work– Static Equipment	C050-IU68-80-42-SOW-8002-Annexure-A
2.	Job Specification - Static & Machinery Equipment	C050-IU68-80-42-SP-8002-Annexure-A
3.	Technical Confirmation List (Static Equipment)	C050-00-IU68-80-42-TCL-8002-Annexure-A
4.	Spare List	C050-IU68-80-42-SL-8002-Annexure-A
5.	Vendor Data Requirement- Static & Machinery Equipment	C050-IU68-80-42-VDR-8002
6.	Vendor List – Static Equipment	
7.	Engineering Design Basis (SME)	C050-999-80-42-EDB-1001
8.	General Spec. for Pressure Vessels	6-12-0001
9.	Supp. Spec. for CS Vessels	6-12-0002
10.	Std. Spec. for BQCS Plate	6-12-0011
11.	Std. Spec. for Structural Quality Plates	6-12-0014
12.	Std. Spec. of Pressure Vessels for Package Items	6-12-0030
13.	Std. Spec. for Storage Tanks	6-13-0053
14.	Std. Spec for Mechanical Agitators	6-26-0001
15.	Specification for Surface Preparation & Protective Coating System-New Construction	C050-000-6-42-PLS-01
16.	Vessel Tolerances	7-12-0001
17.	Support For Horizontal Vessel	7-12-0002
18.	Skirt Base Details	7-12-0004

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Sl. No.	Title	Document No.
19.	Skirt Opening Details	7-12-0005
20.	Angle Leg Support	7-12-0006
21.	Pipe Leg Support	7-12-0007
22.	Bracket support for Vertical vessel	7-12-0008
23.	Manhole with Hinge cover	7-12-0009
24.	Manhole With Davit	7-12-0010
25.	Ladder Rungs for Manhole/Demister	7-12-0011
26.	Retaining Plate	7-12-0012
27.	Nozzle Reinforcement and Projection	7-12-0013
28.	Pad Nozzles for Vessels	7-12-0014
29.	Standard Bolt Hole Orientation	7-12-0015
30.	Internal Flanges	7-12-0018
31.	Vortex Breakers	7-12-0019
32.	Inlet Deflector Baffle	7-12-0020
33.	Pipe Davit	7-12-0023
34.	Lifting Lug Top Head Type	7-12-0024
35.	Fire Proofing Mand Insulation Supports	7-12-0025
36.	Earthing Lug	7-12-0026
37.	Name Plate	7-12-0027
38.	Manufacturer Name Plate	7-12-0028
39.	Bracket For Name Plate	7-12-0029
40.	Name Plate for Small Equipment	7-12-0030
41.	Supports For Internal Feed Pipe	7-12-0032
42.	Allowable Nozzle Loads	7-12-0038
43.	Earth connections	7-13-0001
44.	Anchor chair	7-13-0002
45.	Level indicator supports (for cone roof / floating roof tanks)	7-13-0006
46.	Gauge hatch with cover (non-pressure tanks)	7-13-0007
47.	Caged ladder for fixed roof tank	7-13-0010
48.	Name plates (for tanks)	7-13-0012
49.	Spiral stairway and hand railing for cone roof / floating roof tanks	7-13-0013
50.	Structural arrangement of cone roof tank	7-68-0661
51.	Roof structure for cone roof tanks joint details (dia. < 40m)	7-68-0680
52.	Roof structure for cone roof tanks central drum (detail B).	7-68-0681
53.	Cone roof structure schematic joint details & central drum.	7-68-0682

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Sl. No.	Title	Document No.
54.	Steel ladder joint details.	7-68-0509
55.	Foundation for acid tanks.	7-67-0004
56.	ITP for pressure vessels / columns carbon steel	6-81-0011
57.	Inspection and test plan for agitator / mixers	6-81-0162

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Annexure-B
SCOPE OF SUPPLY / WORKS
(SMED - PACKAGED EQUIPMENT)

COOLING TOWER PACKAGE

TENDER No. C050-1U68-81-45-PB-T-8010

PROJECT	**:**	**EPCM SERVICES FOR SETTING UP POLYPROPYLENE UNIT AT NRL**
OWNER	**:**	**NUMALIGARH REFINERY LIMITED (NRL)**
EPCM	**:**	**ENGINEERS INDIA LIMITED**
EIL JOB No.	**:**	**C050**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
0	26.08.2025	ISSUED WITH TENDER	AS	VMG	PD

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1.0 GENERAL

1.1 The intent of this document is to outline **Contractor's Scope** for all packaged equipment / items including all associated works viz. electrical, instrumentation, structural, painting etc. as required for **Cooling Tower Package** for NRL Expansion Project (360 KTA PP Unit) of **NUMALIGARH REFINERY LIMITED (NRL)** hereinafter referred to as Client.

1.2 This document shall be read in conjunction with Job Specification, Document No. C050-1U68-80-42-SP-8010 (Annexure-B).

1.3 It is not the intent of purchaser to specify every piece of equipment/item but nevertheless any item not specifically mentioned but required as per good engineering practice and for the safe and trouble-free operation of the system shall be deemed to have been specified and in the scope of Contractor, without any implication in price or schedule.

1.4 All the items / facilities shall comply with applicable national and international codes & standards as well as any statutory regulation in existence particularly for that item/ package.

1.5 All equipment shall be sourced from Owner / PMC approved vendor list attached with tender document.

2.0 SCOPE OF WORK

2.1 Contractor's scope of work shall include design, engineering, procurement, manufacture, painting, inspection, packing, supply, transportation, site storage, installation, insulation, testing, commissioning and performance guarantee test run of all packaged equipment associated with Cooling Tower Package as described in this document, job specification, attachments and documents/drawings referred therein forming a part of the tender document.

2.2 Contractor shall supply commissioning spares as required during commissioning of all equipment. Contractor shall procure spares from the original equipment manufacturers (as per their recommendation) and shall make them available at site well before the start of commissioning activities. Prices for the same shall be included in the lump sum quoted price.

Any and all spares required during commissioning, over & above the quoted spares, shall also be supplied by Contractor without any time & price implication.

2.3 Quotation (itemized price list along with recommended quantity) for spares required for two years' normal operation and maintenance as recommended by the OEM (Original Equipment Manufacturer) shall be provided during detailed engineering. Owner shall order these spares separately.

2.4 Contractor shall supply Special tools and tackles as recommended by OEM for erection, operation and maintenance of the offered equipment. Prices for the same shall be included in the lump sum quoted price.

2.5 Contractor shall prepare procurement specification as per the requirements given in Job Specification & Datasheets and other standards/ standard Specifications referred therein for purchase of equipment. Contractor/Vendor shall work out equipment sizing wherever applicable for engineering as per Design Requirements, Specific Requirements, data sheet and specification.

2.6 Electrical and Instrumentation works for all equipment shall be as per respective specification attached elsewhere in the tender.

2.7 Access platforms, ladders for equipment, machinery, instruments and valves requiring approach for manual operation, monitoring and maintenance.

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2.8 First fill of all lubricants, hydraulic oils, refrigerants, consumables etc. and replenishment of any loss of these during commissioning, trial runs & PG testing for all equipment.

2.9 Contractor shall prepare technical specification, data sheet of all such equipment where Consultant technical specification is not available in the tender document.

2.10 Contractor shall submit drawings, documents, specification, inspection & test reports, performance test procedures etc. as defined in Doc. No. C050-1U68-80-42-VDR-8010 attached elsewhere in the tender document.

2.11 Painting (Primer & finish) shall be done as per painting specification attached elsewhere in the tender document.

2.12 "On site" training to Owner's personnel for operation & maintenance including supply of all training materials.

2.13 Third Party Inspection shall be as per commercial part of tender document.

2.14 Obtaining all statutory clearances, permits from local, statutory and other bodies, as applicable, as per commercial part of the tender document.

3.0 SCOPE OF SUPPLY

3.1 Contractor's scope of supply shall also include, but not limited to the following mechanical equipment / facilities, complete in all respects:

Sl. No.	Item	Qty.	Remarks
1.	Hand Operated Travelling (HOT) crane of adequate capacity for Cooling Water Pump House (CWPH)	Lot	Capacity, Span, Long Travel distance, Height of lift etc. shall be firmed up by the Contractor based on the final equipment (pump, suction strainers etc.) selection and final layout of CWPH. Minimum capacity of the HOT crane shall be maximum weight of the equipment to be lifted plus 10% margin.
2.	Hand operated geared trolley mounted Chain Pulley Block (suitable for hazardous area classification) / Electric Wire Rope Hoist along with their respective monorail for the following areas: a) For the maintenance of each cooling tower fan motor at top of cooling tower (Note-1); b) For handling chemicals in the chemical storage shed; c) Other areas wherever maintenance and handling is required by Chain Pulley Block/ Electric Wire Rope Hoist. Note-1: Alternatively, Contractor may provide their standard material handling arrangement	Lot	Contractor to work out the quantity, capacity and location of CPB/Electric Wire Rope Hoist based on material handling/ maintenance philosophy study.

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	(for handling fan motor, gearbox etc.) with proven track record of supplying one number similar system for FRP cooling tower considering dolly cart, track for cart movement, removable hoist column/end wall derrick with chain of required length etc.		
3.	Inverter controlled Split AC units (5-star rating) for local operator room(s) / air-conditioned area(s), if any.	Lot	Quantity of Split AC units shall be decided by Contractor based on PMC/ Owner's approved heat load calculation. One (1) no. standby Split AC unit shall also be considered for each local operator room/ air-conditioned area.

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SCOPE OF SUPPLY / WORKS
STATIC & MACHINERY EQUIPMENT
ROTATING EQUIPMENT

COOLING TOWER PACKAGE
TENDER No.: C050-1U68-81-45-PB-T-8010

PROJECT : **EPCM SERVICES FOR POLYPROPLENE PROJECT AT NUMALIGARH REFINERY**

UNIT : **RECIRCULATING COOLING WATER SYSTEM**

CLIENT : **M/s NUMALIGARH REFINERY LIMITED(NRL)**

EPCM : **M/s ENGINEERS INDIA LIMITED (EIL)**

JOB NO. : **C050**

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
A	13.08.2025	ISSUED WITH TENDER	RPT	ME	TK

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CONTRACTOR'S SCOPE OF SUPPLY/WORK FOR ROTARY ITEMS

Contractor shall refer the bid package and note the following: -

1.0 Contractor scope of supply / work shall include but not limited to the following rotating equipment coming in the Cooling Tower Package (Tender no. **C050-1U68-81-45-PB-T-8010**) for **Polyproplene Project At Numaligarh Refinery** of M/s NRL: -

S. NO.	DESCRIPTION	PROCESS SPECIFICATIONS
1	Pump Centrifugal Horizontal (Large capacity cooling-water service): Cooling Water Recirculation Pumps, tag# 1U68-PA-4301 A/B/C	As per Tender Docs
2	Centrifugal Pumps (General Purpose Process) for H2SO4 Unloading/ Transfer Pump For CT, tag# 1U68-PA-8601 A/B; Back wash water pump; tag# 1U68-PA-4302 A/B	As per Tender Docs
3	Controlled Volume Pumps (for H2SO4 dosing pump for CT), tag# 1U68-PA-8602 A/B	As per Tender Docs
4	Chemical Dosing Skids (1U68-ZM-9382, CT Formulation Dosing Package; 1U68-ZM-9383, Polymeric Dispersant Dosing Package; 1U68-ZM-9384, Biocide Dosing Package) and other applicable dosing skids.	As per Tender Docs
5	Any other rotating equipment forming part of auxiliary system of above rotating equipment packages.	As per Tender Docs
6	Any other rotating equipment envisaged in the Process Package	As per Tender Docs

All rotating equipment shall meet the requirements specified in the process data sheets, job specifications, EIL standard specifications etc. as enclosed elsewhere in the bid package.

Contractor shall procure the complete rotating equipment package from the respective driven equipment vendors. The package as defined herein means as a minimum of the driven equipment, its driver, couplings, coupling guards, common base plate, foundation bolts, local instruments, local gauge board (as required), local control panel (as required) and other associated auxiliaries / accessories, as specified in the bid package and as required to make the package ready for safe & smooth operation.

2.0 Contractor shall procure all the equipment from the list of approved vendors as attached with the bid package elsewhere.

3.0 Contractor shall carry out the following activities for procurement of Rotating Equipment:

3.1 Contractor shall prepare the enquiry specifications/ documents for each Rotating Equipment to be purchased including spare parts for erection & commissioning, mandatory spares as applicable, spare parts for two-year normal operation and special tools and tackles.

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3.2 Contractor shall fill all the required data/information in the partially filled in Equipment data sheets formats forming part of the bid package for preparation of enquiry specifications/ documents.

3.3 Contractor shall prepare the detailed Purchase Requisition / specification for each Rotating Equipment Package. Purchase Requisition / specification shall contain the following:

- Filled in Equipment data sheets along with Performance Curves
- Process data sheet
- Equipment specific deviation list, if any
- Filled in Experience Record Proforma & General reference List
- Equipment Manufacturer's Latest Catalogue, General Arrangement Drawing, Cross Sectional Drawing & Schematic drawing / P&ID for the proposed model shall also be
  submitted along with the above documents.

4.0 Contractor shall carry out the detailed review and approval of data sheets, engineering & fabrication drawings and other technical data furnished by the respective Equipment Vendors to ensure a safe, smooth and reliable operation at site.

5.0 Contractor shall submit to the Owner/PMC, all engineering drawings/ documents/ data as specified in "Documents/drawings for Owner/PMC review".

6.0 Contractor shall ensure that, all inspection and tests are conducted for all equipment at Vendor's shops/site as specified in bid package. Contractor shall also submit the schedule of witnessed tests of all rotating equipment well in advance.

7.0 For all rotating equipment in the subject Cooling Tower Package, Contractor shall ensure that all mandatory spares, as per list attached in the bid package and/or as listed on the equipment data sheets / specifications are ordered on equipment vendor and the same shall be supplied to the Owner along with the equipment.

8.0 Contractor shall furnish a list of spares recommended by the equipment vendor for two-year normal operation along with firm unit prices and ensure that the Spare parts for Two-year normal operation, if ordered by the Owner, are procured from equipment vendor and supplied to the Owner.

9.0 Contractor shall include all the Commissioning spares as required in the equipment vendor's scope. Contractor shall procure the same from the equipment vendors and make it available well before commissioning of Plant/Equipment. In case, any additional spares are consumed during commissioning the same to be provided by the contractor at no additional cost to the Owner

10.0 Special tools and tackles required for all rotating equipment are to be included in vendor's scope of supply. Such tools/tackles shall be supplied by the vendor and shall form part of supply by Contractor to Owner.

11.0 Contractor's scope shall include complete supply, transportation of equipment package from vendor's shop to site, Receipt of material at site, Handling at site and arrangement for storage at site shall be as per the requirements indicated in the Bid Document.

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12.0 Equipment, which is transported by sea, shall have sea-worthy packing. The Contractor shall strictly follow the recommended preservation procedures during the period of storage for all equipment.

13.0 Contractor shall carry out the inter-connections at all interface points such as main process and all utility connections.

14.0 Contractor shall note that consumables, lubricants etc. required during erection, commissioning and performance guarantee run of Rotating Equipment and for six months of consumption shall be in Contractor's scope. A consolidated list for all rotating equipment shall be provided indicating type of lubricant, grease, oil etc. giving specifications, quantities and brand name. Chemicals for Dosing packages are not to be considered as consumables and hence not to be included in the list.

15.0 Contractor shall carry out the installation and erection of all the items of package at the specified location on the properly designed & cast foundation as per bid document.

16.0 Contractor shall supply & install maintenance facilities (as deemed necessary) sized for handling the heaviest single piece of equipment for maintenance. Contractor shall provide sufficient space for maintenance, dismantling and platforms for maintenance.

17.0 Contractor shall carry out the pre-commissioning and commissioning activity at site for all Rotating Equipment.

18.0 Contractor shall ensure the presence of equipment manufacturer (Vendor) at site for checking of supervision of equipment erection and supervision of commissioning of all Rotating Equipment.

19.0 Brief scope of supply for packages:
Process P&IDs shall be referred for any extra Process & Control Requirement. It shall be CONTRACTOR's responsibility to supply complete and safe operating package.

Chemical Dosing Skids

Bidder's scope of supply for each package shall include but not limited to the following:

- Chemical storage vessels / tanks of required capacity as per process data sheets.
- Double/Sandwich Diaphragm type Positive displacement pump (API 675 compliant controlled volume) of required capacity as per process data sheets, each complete with its diaphragm rupture detection system (i.e. pressure indicator & pressure switch) for generating alarm in case of diaphragm rupture, external safety relief valve conforming to API standard, suction pulsation dampener, discharge pulsation dampener, flexible metallic coupling and electric motor driver, mounted on a common base plate.
- Calibration cylinder (wherever specified) as per the system requirement.
- Y-Type/T- Type Suction strainers as required or indicated in the P& IDs.
- Necessary interconnecting piping, valves, fittings as required or indicated in the P&IDs.
- Necessary instrumentation & controls as per P&IDs, Line List and Instrumentation Job Specification.
- Plant air operated diaphragm type drum unloading pumps-AODD pump (wherever specified), each complete with air dryer requiring no electric power, air filter regulator with pressure gauge, bleed type master air valve, air discharge muffler, air side external relief valve (manufacturer's standard), liquid discharge side check valve, drain valve and adapter for mounting the pump on the chemical drum.

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- Skid mounted junction boxes & interconnecting cabling for instruments as indicated in the Instrumentation Job Specification enclosed elsewhere in the tender.
- Skid mounted Local control station (LCS) for the electric motor drivers of metering pumps, as described in electrical specification enclosed elsewhere in the tender.
- Interconnecting cabling and other electrical items as detailed in electrical job specification enclosed elsewhere in the tender.
- Common base plate (suitable for four-point lift) for each chemical dosing package with lifting lugs & leveling jackscrews.
- All foundation/anchor bolts, SS Shims, nuts and washers required for each skid.
- Access ladders and platforms, as required for safe and easy access to tank/ vessel, valves, man-ways and instrument connections.
- Drum racks i.e. space/platform (as specified) for keeping chemical drums/barrels.
- Mandatory spares for metering pumps & their drivers.
- Quotation for recommended spare parts for two years normal operation for metering pumps & their drivers.
- Commissioning spares, as recommended by the bidder for chemical dosing package.
- Special tools & tackles, as recommended by the bidder for chemical dosing package.
- Documents, drawings and other deliverables as per “Vendor Data Requirement” sheet enclosed with the tender.
- Any other item(s) not covered in this specification, Process Data Sheets and P&IDs but required for safe & smooth operation of the chemical dosing package.

19.1 Other rotating equipment:

Vendor’s scope for other rotating equipment included in the package shall be as defined in the tender document.

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20.0 LIST OF ATTACHMENTS

CONTRACTOR shall carry out all works strictly in accordance with the drawings/ documents/ specifications indicated below.

SL. NO.	TITLE	DOCUMENT NO.
1.	Technical Confirmation List (S&ME) – Rotating Equipment	Annexure-C: C050-1U68-80-42-TCL-8010
2.	Scope of Work/Supply (S&ME) – Rotating Equipment	Annexure-C: C050-1U68-80-42-SOW-8010
3.	Engineering Design Basis (S&ME)	C050-999-80-42-EDB-1001
4.	Job Specification (S&ME) – Rotating Equipment	Annexure-C: C050-1U68-80-42-SP-8010
5.	List of Data Sheets & ERP Formats (S&ME) – Rotating Equipment	C050-1U68-80-42-OD-8010
6.	Mandatory Spares List (S&ME) – Rotating Equipment	Annexure-C: C050-1U68-80-42-SL-8010
7.	Vendor Data Requirements (S&ME)	C050-1U68-80-42-VDR-8010
8.	List of Standard Specifications (S&ME) – Rotating Equipment	Annexure-C: C050-1U68-80-42-LSP-8010
9.	Vendor List (S&ME) – Rotating Equipment	Annexure-C: C050-1U68-80-42-VL-8010

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GEOTECHNICAL DATA
FOR
COOLING TOWER PACKAGE

PP PROJECT, NRL

(TENDER NO.: C050-1U68-81-45-PB-T-8010)

PROJECT	**:**	**POLYPROPYLENE (PP) UNIT PROJECT**
OWNER	**:**	**M/s NUMALIGARH REFINERY LTD.**
LOCATION	**:**	**NUMALIGARH, ASSAM**
JOB NO.	**:**	**C050**

1.0 INTRODUCTION

Rev. No	Date	Purpose	Prepared by	Reviewed by	Approved by
0	01.09.2025	Issued for Tender	ROUT	SHOBHA	VKP

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M/s NRL proposes to construct Cooling Towers, CWTP & its associated facilities for their proposed Poly Propylene unit, associated offsite and utility systems.

Location specific soil data is not available. Available borehole logs and laboratory test results for the nearby areas (soil investigations carried out during May 2019 in nearby areas approximately 230-250 meters away from the proposed location) are enclosed for reference only**. Bidder shall carry out confirmatory soil investigations to check and confirm the soil conditions and/or to develop additional soil data required for foundation design purposes and submit the report to PMC/Owner for review.** The information provided herein is for general guidance of the bidder for the tender purpose only. Notwithstanding the information given herein, no extra claim on time and/or cost shall be entertained by owner in case of change in any data due to subsoil variations.

2.0 SCOPE OF WORK

2.1 The Bidder shall carry out confirmatory Geotechnical investigation consisting of minimum 5 nos. boreholes of 25m and any other requisite test, including laboratory tests (including CBR test and chemical analysis of soil and ground water samples) as per relevant IS codes to generate soil parameters/data as required for design of foundation system for the proposed cooling tower package and all other associated facilities covered under the tender. Bidder shall submit Geotechnical investigation specification and scheme to Owner/PMC for their review. The soil investigation report shall be submitted to PMC/Owner for review.

2.2 A ***Foundation Design Basis/Comprehensive Geotechnical Recommendation Document*** shall be prepared by the bidder based on the available information and findings of confirmatory soil investigation **duly considering subsoil conditions & constructability aspects**, clearly stating type of foundations for all structures/facilities covered under proposed package giving all back-up calculations and the same shall be submitted to PMC/Owner for their review and approval before execution.

2.3 It is incumbent upon the bidder to seek all technical clarifications concerning the job prior to the bid preparation. No such clarifications shall be entertained after the award of job. Notwithstanding this, the decision of Engineer-in-Charge, in case of any disputes shall be final. However, it must be clearly understood by the contractor that any extra claim and/or time extension shall not be granted under any circumstances.

3.0 GROUND TOPOGRAPHY

Natural ground levels (NGL) in the proposed area are varying from approximately RL 94.01m to RL 101.62m and proposed finished ground level (FGL) for the area is RL 99.6m. For details regarding finished ground level, existing ground level and depth of cut/fill, reference may be made to civil-structural documents/drawings attached elsewhere.

4.0 FOUNDATION RECOMMENDATIONS

Contractor shall adopt pile foundations for major foundations. Foundation design Basis/Comprehensive Geotechnical Recommendation Document shall include details of piles such as type of pile, length below cut-off level, safe load carrying capacities in all the three modes (i.e. axial compression, lateral and uplift) and pile reinforcement etc. with all back up calculations. Pile capacities shall be established at site by conducting initial pile

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load tests on test piles before commencement of piling works and as per IS 2911 Part-IV. Routine pile load tests shall be conducted on job piles as per IS 2911 part-IV.

5.0 DEEP EXCAVATIONS

In case of deep excavations, and during the execution of foundations, special measures like side supports/proper slope and appropriate dewatering system (i.e. well point, deep tube well etc.) may have to be resorted to. It shall be contractor's responsibility to mobilize necessary equipment to carryout deep excavations wherever required, without any extra cost and time implication to the owner.

6.0 ROAD AND PAVEMENT

Design parameters required for design of road and pavement shall be established based on the available data and findings of confirmatory soil investigation.

7.0 AGGRESSIVENESS OF SOIL AND GROUND WATER TO FOUNDATION CONCRETE

Based on results of chemical analysis of subsoil and groundwater samples from confirmatory soil investigations, bidder shall adopt grade of concrete, minimum cement content, water-cement ratio, cover to reinforcement, type of cement and any remedial actions required for substructure concreting works due to aggressiveness of subsoil/groundwater, as per the requirement of relevant codes. However, the requirements specified in Engineering Design Basis document (enclosed elsewhere) shall be followed as minimum.

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ANNEXURE-I: BORE-LOGS & LAB TEST RESULT

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Project : Geotechnical Investigation Work for Refinery Project at Numaligarh. GEOST

Job No : 4304 | **Created by : Chandrani** | **Created on : 04/06/2019** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.45

Co-ordinates E=689.096 N=1116.864

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	14	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	14
Vane (V)		Disturbed (DS)	10
		Water Sample (WS)	0

Commencement Date : 28/05/19
Completion Date : 29/05/19
Bore Hole Diameter : 150 mm.
Level Of Ground : 99.378 M.
Water Struck At :
Standing Water Level : 0.90 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 7.5CM.	Ref. No	Depth (m)
0.00m.				
		1 1 1 1 6/2 2	SPT-1	0.50-0.95
			UDS-1	1.00-1.45
		2 2 3 2 12/3 4	SPT-2	1.45-1.90
Medium to stiff, brownish grey, silty clay. Obs. reddish & pink patches.	I		DS-1	2.60
			UDS-2	3.00-3.45
		2 2 2 3 14/4 5	SPT-3	3.45-3.90
			DS-2	4.50
5.00m.		2 2 3 4 16/4 5	SPT-4	5.00-5.45
			UDS-3	6.05-6.50
Very stiff, brownish grey to yellowish grey, silty clay.	II	2 3 3 4 18/5 6	SPT-5	6.50-6.95
			DS-3	7.60
8.00m.		3 4 5 8 32/9 10	SPT-6	8.05-8.50
			*UDS-4	9.00-9.45
		4 6 7 10 41/11 13	SPT-7	9.60-10.05
			DS-4	10.60
		5 6 8 11 44/11 14	SPT-8	11.05-11.50
			DS-5	12.05
		9 11 15 17 76/21 23	SPT-9	12.50-12.95
			DS-6	13.50
Dense to very dense, yellowish to light grey, silty sand. Obs. mica & clay binders.	III	10 12 16 19 76/20 21	SPT-10	14.00-14.45
			DS-7	15.00
		11 13 14 16 67/18 19	SPT-11	15.50-15.95
			DS-8	16.50
		12 16 18 22 91/24 27	SPT-12	17.00-17.45
			DS-9	18.00
		14 18 23 27 >100/31 35	SPT-13	18.50-18.95
			DS-10	19.50
20.85m.		17 22 27 32 >100/39 45	SPT-14	20.40-20.85

N.B. – '*' means sample could not be recovered.

BH-45/Sheet-1

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Project : Geotechnical Investigation Work for Refinery Project at Numaligarh.

Job No : 4304	Created by : Chandrani	Created on : 17/06/2019	Sheet No:

BORE LOG DATA SHEET — BORE HOLE NO.49

Co-ordinates E=744.907 N=1121.847

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	14	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	14
Vane (V)		Disturbed (DS)	10
		Water Sample (WS)	0

Commencement Date : 31/05/19
Completion Date : 01/06/19
Bore Hole Diameter : 150 mm.
Level Of Ground : 99.566 M.
Water Struck At :
Standing Water Level : 1.10 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 7.5CM.)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Medium, yellowish brown, silty clay. Obs. red spots & steel grey patches.	I	1 2 1 2 5/1 1	SPT-1	0.50-0.95
			UDS-1	1.00-1.45
		2 2 2 2 8/2 2	SPT-2	1.45-1.90
			DS-1	2.50
2.70m.				
Stiff, yellowish grey, silty clay. Obs. black spots.	I		UDS-2	3.00-3.45
		2 2 3 3 12/3 3	SPT-3	3.45-3.90
			DS-2	4.50
		2 2 2 2 10/3 3	SPT-4	5.00-5.45
6.45m.				
Very stiff, yellowish grey to greyish brown, clayey silt with fine sand mixture.	II		UDS-3	6.00-6.45
		3 3 4 4 18/5 5	SPT-5	6.45-6.90
			DS-3	7.50
		3 4 4 4 19/5 6	SPT-6	8.00-8.45
			*UDS-4	9.00-9.45
		4 5 6 6 26/8 6	SPT-7	9.60-10.05
			DS-4	10.50
11.00m.				
Very dense, steel grey, silty fine sand. Obs. clay binder & mica.	III	6 8 10 12 50/13 15	SPT-8	11.00-11.45
			DS-5	12.00
		7 10 13 16 67/18 20	SPT-9	12.50-12.95
			DS-6	13.50
14.00m.				
Hard, deep grey, clayey silt with sand mixture.	II	8 12 16 19 81/21 25	SPT-10	14.00-14.45
			DS-7	15.00
15.95m.				
Very dense, steel grey, silty fine sand. Obs. clay binder & mica.	III	10 14 19 27 >100/31 33	SPT-11	15.50-15.95
			DS-8	16.50
		12 17 21 25 >100/32 41	SPT-12	17.00-17.45
			DS-9	18.00
		16 22 34 41 >100/52 (50 cm Penth.)	SPT-13	18.50-18.85
			DS-10	19.50
20.47m.		21 34 48 55 >100/ (45 cm Penth.)	SPT-14	20.20-20.47

N.B. – '*' means sample could not be recovered.

BH-49/Sheet-1

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Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			Grain Size			
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Gravl	Sand	Silt	Clay
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	%	%	%	%
BH45	UDS01	1.00	Reddish brown clayey sit with steel grey patches.	1.93	1.48	2.73	31 S		UNCONFD		0.88	0	71	36	27		3	66	31
							31 T		0.0	0.898									
									0.0	0.876									
									0.0	0.866									
									REMOULD		1.50	0							
									0.0	0.518									
									0.0	0.505									
									0.0	0.477									
BH45	UDS02	3.00	Brownish grey silty clay with steel grey patches.	1.87	1.43	2.66	31 S		TRSH-UU		0.35	6	55	25	14		5	58	37
							31 T		3.0	0.704									
									2.0	0.626									
									1.0	0.486									
BH45	UDS03	6.05	Brownish grey clayey silt with red patches.	1.89	1.45	2.63	31 S	0.764	TRSH-UU		1.02	0	61	29	23		3	68	29
							30 T		3.0	1.082									
							29 C		2.0	1.022									
									1.0	0.960									
BH45	SPT06	8.05	Light grey clayey silty sand.														50	50 (Silt+Clay)	
BH45	SPT12	17.00	Light grey silty sand.														93	7 (Silt+Clay)	
BH49	UDS01	1.00	Brownish grey clayey silt with rusty spots and sand mixture	1.94	1.54	2.65	27 S		UNCONFD		0.57	0	56	23	17		7	64	29
							26 T		0.0	0.588									
									0.0	0.574									
									0.0	0.548									
									REMOULD		0.44	0							
									0.0	0.458									
									0.0	0.447									
									0.0	0.415									
BH49	UDS02	3.00	Brownish grey silty clay with steel grey patches.	2.02	1.63	2.71	24 S	0.670	UNCONFD		0.50	0	53	24	16		5	73	22
							24 T		0.0	0.416									
							24 C		0.0	0.447									
									0.0	0.631									
									REMOULD		0.40	0							
									0.0	0.418									
									0.0	0.408									
									0.0	0.374									
BH49	UDS03	6.00	Brownish grey clayey silt.	1.96	1.53	2.74	34 S		TRSH-UU		0.47	10	48	27	23		3	75	22
							28 T		3.0	1.191									
									2.0	0.980									
									1.0	0.770									
BH49	SPT08	11.00	Brownish grey silty fine sand with traces of mica														94	6 (Silt+Clay)	
BH49	SPT10	14.00	Light grey clayey silt with sand mixture.														21	79 (Silt+Clay)	
BH49	SPT11	15.50	Deep grey clayey silt with fine sand mixture.										50	21	17				
BH49	SPT13	18.50	Light grey silty sand with traces of clay binders & mica														64	36 (Silt+Clay)	

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NRL EXPANSION PROJECT

PROCESS DESIGN BASIS OVERALL

Rev.	Date	Reason for Issue	Prepared	Checked	Approved	Prepared	Review	Review
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D3	22/03/2021	APPROVED FOR DESIGN	RK	SCB	AR			
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ATTACHMENTS

Attachment 1 – Basic Engineering Design Data (14 Pages)

REFERENCES

Engineering Tag Number Specification, Document number NR-0ZZZZ-GE-SPE-0002

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1. INTRODUCTION

NUMALIGARH REFINERY LIMITED (NRL) 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 AND ACRONYMS

Wherever the following terms used in this document shall have the meaning as defined below:

NRL or OWNER or CLIENT	shall mean Numaligarh Refinery Ltd.
M-PMC or PMC	shall mean TECHNIP India Ltd (TPIL).
LICENSOR	shall mean agency responsible for the supply of basic know-how and process package for the 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:

AC	Alternating Current
ANSI	American National Standards Institute
APH	Air Preheater
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ATU	Amine Treatment Unit
BDEP	Basic Design and Engineering Package
BEDD	Basic Engineering Design Data
BFW	Boiler Feed Water
BL	Battery Limit
CBD	Closed Blow Down
CCRU	Continuous Catalytic Regeneration Reformer Unit
CDU	Crude Distillation Unit
CPCB	Central Pollution Control Board
CPU	Condensate Polishing Unit
CR-LPGTU	Cracked LPG Treatment Unit
CS / SS	Carbon Steel / Stainless Steel
CSO	Car Seal Open
CSC	Car Seal Closed
DCS	Distributed Control System
DFR	Detailed Feasibility Report
DHT	Diesel Hydrotreater Unit
DM	Demineralized
EPC	Engineering, Procurement, and Construction
EPCM	Engineering, Procurement, Construction, Management
ESD	Emergency Shutdown System
ETP	Effluent Treatment Plant
FD	Forced Draft
FEED	Front End Engineering Design
FG	Fuel Gas
FLO	Flushing Oil

GDS	Gasoline Desulfurization Unit
HAS	High Alloy Steel
HFLO	Heavy Flushing Oil
HGU	Hydrogen Generation Unit
HMB	Heat Material Balance
HP	High Pressure
IBR	Indian Boiler Regulation
ID	Induced Draft
ISA	International Society of Automation
ISBL	Inside Battery Limit
ISOM	Isomerization Unit
KL	Kiloliters
KOD	Knock Out Drum
KCS	Killed Carbon Steel
LAS	Low Alloy Steel
LP	Low Pressure
LPG	Liquified Petroleum Gas
LSTK	Lump Sum Turn Key
MDMT	Minimum Design Metal Temperature
MFB	Minimum Flow Bypass
MGD	Millions of Gallons per Day
MINAS	The Minimal National Standards
MMTPA	Million Metric Tons Per Annum
MOC	Material of Construction
MOEF & CC	Ministry of Environment & Forests and Climate Change
MOV	Motor Operated Valve
MP	Medium Pressure
M-PMC	Managing Project Management Consultant
MSP	Motor Spirit Plant
MT	Metric Tonnes
NACE	National Association of Corrosion Engineers
NHT	Naphtha Hydrotreating Unit
NREP	Numaligarh Refinery Expansion Project
NRL	Numaligarh Refinery Ltd
NSU	Naphtha Splitter Unit
OISD	Oil Industry Safety Directorate
OSBL	Outside Battery Limit
OWS	Oily Water Sewer
PESO	Petroleum & Explosives Safety Organization
P&ID	Piping & Instrumentation Diagram
PDS	Process Datasheet
PFCC	Petro Fluid Catalytic Cracking Unit
PLC	Programmable Logic Controller
PMC	Project Management Consultant
PMO	Project Management Office
PMS	Piping Material Specification
PP	Polypropylene Unit
PRU	Propylene Recovery Unit
PSA	Pressure Swing Adsorption

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PSV	Pressure Relief Valve
PWHT	Post Weld Heat Treatment
RP	Recommended Practice
RPTU	Resid Processing & Treating Unit
SPM	Suspended Particulate Matter
SRB	Sulphur Recovery Block
SR-LPGTU	Straight Run LPG Treating Unit
TBD	To be defined
TEMA	Tubular Exchanger Manufacturers Association
TMTPA	Thousand Metric Tonnes per Annum
TPD	Tons per Day
TPH	Tons per Hour
TPIL	Technip India Ltd
TSO	Tight Shut Off
VDU	Vacuum Distillation Unit
VFD	Variable Frequency Drive

3. PURPOSE

The purpose of this document is to provide the General Requirements, Basic Process Design Requirements and Criteria, which have to be followed to perform the Process Engineering Design of 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.

For licensed units, the rules of the process LICENSOR shall be used if they are more stringent than the rules provided in this document. In case some of the guidelines of the Process design basis are conflicting with other document, the order of priority is:

- National & Local Rules, Regulations, Codes & Standards and Statutory Requirements.
- Licensor Design Basis / Standards & Specification (Note 1)
- Project Standards & Specifications
- International Codes and Standards

Note 1:

In case of conflict between Licensor's specification / Client (NRL) or M-PMC's specification and Code requirements, the most stringent requirements of these shall govern with approval of Client (NRL) / M-PMC and the decision of Client (NRL) / M-PMC in resolution of the conflict shall be final.

The process design basis overall is meant mainly for grassroot / new units.

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4. APPLICABLE CODES & STANDARDS & REGULATIONS

The Project shall comply with the requirements of Indian authorities as applicable including but not limited to the following

a. Factories Act
b. Indian Petroleum Rules
c. Tariff Advisory Committee Guidelines
d. Liquid effluent discharge, as per Minimal National Standards for liquid effluents and air Emissions conforming to pollution control board standards
e. Civil Aviation Rules
f. Indian Boiler Regulation Act
g. India Electricity Rules
h. Requirement of Chief Controller of Explosives (PESO)
i. Requirements of other authorities concerned with the Project or out of any license, permission, sanction, approval or no objection relative thereto
j. CEA (Central Electrical Authority)
k. Legal Metrology
l. CPWD standard shall be considered for civil material related testing
m. International Standards: ANSI, ASME, ASTM, API, SA, NACE, NFPA, ISO, DIN, EN etc.
n. All statutory provisions of India / State Govt.
o. Indian Oil Industry Safety Directorate (OISD) codes and standards
p. Compliance to recommendations of Statutory committee report – M B Lal Committee Report

The Indian Oil Industry Safety Directorate (OISD) codes and standards, in particular related to equipment spacing, are mandatory and take precedence in the event of conflict with other project standards.

Bureau of Indian Standards (IS) are the governing Standards for both Civil and Electrical disciplines.

5. GENERAL INFORMATION

Language : English

5.1 Project Title

Project Name	Numaligarh Refinery Expansion Project (NREP)
Owner	Numaligarh Refinery Limited
Location	Numaligarh Dist. Golaghat, Assam

5.2 Plant Location

Refer Engineering Design Basis for complete details of plant location. This section presents brief details

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Site Location:

State / Country	ASSAM / INDIA
Nearest Railway Station	GOLAGHAT
Nearest Town / City	NUMALIGARH
Nearest Airport	JORHAT
Nearest National Highway	NH-39
Nearest Port	KOLKATA

Source of Water:

Fresh water : Dhansiri River

6. PROCESS UNITS UTILITY & OFFSITE FACILITIES

Process Unit, Utility and Offsite Facilities covered under this project,

Process / Utility Unit Description	Unit Number	Capacity	Remarks
New Units			
Crude Distillation Unit (CDU), Vacuum Distillation Unit (VDU) with Amine Treating Unit (ATU)	CDU/VDU - 1P21 ATU – 1P34	6.0 MMTPA	
Naphtha Hydrotreater (NHT)	1P22	1.16 MMTPA	(Part of MSP)
Continuous Catalytic Reforming Unit	1P23	0.789 MMTPA	(Part of MSP)
ISOM	1P24	0.465 MMTPA	(Part of MSP)
Resid Processing & Treating Unit (RPTU)	RPTU - 1P30 VGO HDT – 1P31	2.0 MMTPA 2.27 MMTPA	
Diesel Hydrotreater (DHT)	1P28	3.55 MMTPA	
Petro Fluidized Catalytic Cracking (PFCC) / LPGTU-2	1P25 1P26	1.95 MMTPA / 793.55 KTPA	
Gasoline Desulfurization (GDS)	1P27	0.66 MMTPA	
H2 Generation Unit (HGU)	1P29	95 KTPA	
Sulphur Recovery Block (SWS/ARU/SRU/TGTU)	SWS-1P32, ARU-1P33, SRU 1 -1P35, SRU 2 - 1P36, TGTU-1P37	2 x 240 TPD	
LPGTU-1 (CDU-VDU / RPTU)	1P38	138.97 KTPA	

Offsite & Utilities (*)			
Raw Water Storage and Distribution	1U51	60000 m3 & 3400 m3/hr	
Drinking water system	1U52	130 m3/hr	
Cooling Water System	1U53	CT-1: 7 cells (6W+1S) CT-2: 7 cells (6W+1S) (4000 m3/hr per cell)	
DM/Process Water System	1U59	4 x 250 m3 /hr (3W + 1S Trains)	
Condensate Polishing Unit DM Water Tank	1U59	2 x 120 m3/hr (1W +1S Train) 2 x 7287 m3 **	
Steam Generation System	1U60	3 x 125 TPH (1W+1S) boilers, 1W HRSG	
Instrument Air/Plant Air System	1U54	4 x 90000 Nm3/h (3W+1S)	
Nitrogen generation plant	1U55	5000 Nm3/h	
Fuel gas system	1U58	TBD *	
Flare System (HC & Acid Gas)	1U61	TBD *	
Raw Water Intake Facility	1U66	3400 m3/hr	
Raw Water Desilting System	1U67	3700 m3/hr	
Crude Oil Storage Tank	1S71	3 x 35800 m3**	
RPTU Feed Tank	1S72	2 x 29783 m3**	(New)
HCGO Tank	1S72	1 x 3319 m3**	
DCU Feed Tank	1S72	2 x 6583 m3**	(New)
NHT feed Tank	1S72	2 x 9800 m3**	
SR VGO Tank	1S72	3 x 20700 m3**	
GDS Feed Tank	1S72	1 x 9800 m3**	
PFCC Feed Tank	1S72	2 x 17595 m3**	
DHT Feed Tank	1S72	2 x 19650 m3**	(New)
Propylene Mounded Bullets	TBD	4 x 3350 m3	(Future)
Isomerate / Reformate Tanks	1S72	4 x 5000 m3** 1 x 11500 m3** 1 x 15100 m3**	(Existing)
MS Tanks	1S73	3 x 29210 m3** 4 x 7900 m3**	(Existing) (Existing)

HSD Tanks	1S73	3 x 23100 m3** 1 x 20700 m3** 3 x 27700 m3**	(Existing)
Light Slop	1S72	2 x 5161 m3	(New)
Heavy Slop	1S72	2 x 5000 m3	(New)
Chemical storage / handling/ pump house	1S74	TBD	
Product blending facility	1S75	2 nos. for HSD / Gasoline	
LPG Storage and Disposal facility	1S76	6 x 4045 m3	(2 nos. future)
Sulfur storage & disposal facility	1S78	TBD	
New ETP	1S79	400 m3/h	

*- Capacity to be confirmed later.
**- Capacity indicated is Stored Capacity.

7. MECHANICAL DESIGN CONDITIONS

7.1 DESIGN TEMPERATURE

7.1.1 Equipment / Piping Operating at Temperature above 0 °C

As a general rule the design temperature shall be defined as follows:

T_D = T_{MCO} + 15 °C as minimum requirement

Design temperature shall not be lower than 65 °C
Shall be round up to the nearest 5°C above unless flange rating affected

Where:

T_D = Design temperature (°C)

T_{MCO} = Maximum continuous operating temperature (°C) is a maximum continuous operating temperature reached during an operating cycle (e.g. end of run condition). Its selection must take into account some specific operating conditions: turndown conditions, different feed and operating cases, etc.

For pressurized LPG storage facilities, the design temperature is equal to the corresponding boiling temperature at design pressure and assessed LPG composition.

Exceptional operating temperatures which correspond to alternate or transient operations, such as regeneration, dry out, or bypass of heat exchanger of a feed/effluent heat exchangers train have to be considered, the duration of the corresponding operations exceeding a total of 100 hours per year. If there is no change in operating pressure, the process design temperature will be the maximum of the two values:

- Either the maximum temperature for alternate transient operation
- Or the maximum continuous operating temperature + 15 °C minimum.

If there is a significant change in operating pressure for these exceptional operating conditions (for example reaction loops with in-situ catalyst regeneration, decoking conditions), another set of design temperature and pressure has to be specified corresponding to these operating conditions. Refer to section 7.1.2 special case.

The accidental temperatures, which can occur in emergency situations such as loss of utilities, valve failure or during start-up, shut-down or any abnormal operation corresponding to a short duration and are not taken into account as long as the temperature increase does not exceed codes limits (investigation has to be followed with specialists). However, some exceptions can be made to this general rule on a case to case basis as described in section 7.1.2 special case.

Equipment containing parts, which can be damaged by abnormal high temperature, has to be designed for this temperature. It concerns column internals, desalter internal electrical isolating material, heat exchanger or air coolers tubes with polymer coating. For this type of equipment, steam out delivery conditions have to be reconsidered in order to remain below the maximum acceptable temperature. (if steam-out conditions are governing then it will be reviewed on case by case basis).

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Accidental temperatures, which can occur in fire case situation, will not be considered to define the Design Temperature as adequate mitigation measures (e.g. depressurizing system, firefighting) have to be considered.

For piping, accidental temperatures are not considered for piping class selection, but shall be indicated as flexibility temperature in the line list for pipe flexibility study.

7.1.2 Special Cases

Condensing service by air coolers (column overhead, air condenser in reaction loop etc.). Design temperature downstream the air cooler is equal to air condenser normal inlet temperature decreased by expected cooling due to natural draught through the air cooler.

For air cooler on final product cooling, a similar approach can be taken for the design temperature of downstream equipment. But the design temperature of off-site lines will not be increased beyond the application of the general rule.

If for process reasons, a specified maximum operating temperature must not be exceeded, this maximum possible operating temperature is used as design temperature (e.g. catalytic reforming reactors). However, the design conditions of such reaction loops are defined by the Licensor and have to be followed.

When maximum continuous temperature (T_{MCO}) is unknown with sufficient accuracy or can be sensibly affected by feed quality, the design temperature can be exceptionally considered with a margin of 30 °C.

Equipment whose thickness is designed for creep (e.g. steam cracker furnace tubes), the combination of the maximum pressure and the maximum temperature is in general not considered simultaneously.

For heat exchanger trains with by-pass of individual exchanger, the design temperature (hot side) of the downstream exchanger will be the normal operating temperature of the by-passed exchanger assuming that shells are by-passed piece by piece (simultaneous by-pass of several exchangers in series is not considered) unless hot fluid is bypassed automatically, same philosophy will be applied to a trim cooler downstream air fin.

7.1.3 Steam Out

The steam out conditions (using LP steam) are as follows:

- External Pressure : 0.5 kg/cm^2(a) Half vacuum at 170 °C
- Internal Pressure : 0.5 kg/cm^{2}g at 170 °C

Steam out conditions (using MP steam) are as follows:

- External Pressure : 0.5 kg/cm2(a) Half vacuum at 225 °C
- Internal Pressure : 0.5 kg/cm^{2}g at 225 °C

Typically LP steam shall be used for steam out operations, option of utilizing MP Steam for steam out operation to be decided case to case based on specific requirement.

7.1.4 Emergency Depressurizing

The exceptional cold temperature generated by depressurizing of equipment or complete system will be indicated with the related residual pressure in order to select the material accordingly.

Only depressurizing actions, clearly identified in the operating manual for process or safety reasons are considered. Accidental depressurizing, due to single control valve / safety valve failure or operator error for example are not taken into account. Indeed, these potential cases can be faced by:

- Closing the block valves associated to the control valve
- Clear instruction / procedure within the operating manual to avoid such operator error

The equipment has to be reheated and slowly re-pressurized according to a written procedure. When immediate re-pressurization is required, a second set of design pressure/design temperature shall be specified.

7.1.5 Vacuum Conditions

A specific design temperature will be associated to specified vacuum design pressure.

7.1.6 Equipment operating at a temperature below 0 °C

As a general rule, the design temperature shall be defined as follows:

$$T_D = T_{MCO} - 10\ °C \quad (3)$$

Where:

T_D = Design Temperature (°C)
T_{MCO} = Minimum continuous operating temperature (°C) taking into account minimum operating pressure except depressurization.

Notes:

(1) If a piece of equipment normally operated below 0 °C can be submitted to temperature above ambient during particular operating phases (dry out, start-up, regeneration, …) or accidental causes (except fire), a hot design temperature will be indicated with associated design pressure. Such a data can have an impact on insulation type selection.

(2) For depressurization, refer to section 6.1.4

(3) If such temperature cannot be reached due to intrinsic process limits, the lowest possible temperature will be selected.

(4) Equipment in stand-by at ambient low temperature that can be pressurized for process reasons shall be specified with a second set of design conditions.

7.1.7 Minimum Design Metal Temperature (MDMT)

Refer to site data for MDMT (Low ambient temperature) as per Attachment-1 Basic Engineering Design Data (BEDD).

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7.1.8 Discontinuous Processes

For discontinuous / cyclic processes (for example molecular sieves, regeneration, decoking), different sets of design temperature / pressure shall be specified to ensure that all operating cases are covered. The magnitude and frequency of the temperature / pressure swing shall also be provided. Mixing between sets of extreme conditions of pressure and temperature shall not be considered.

For cyclic operation, cycle duration has to be specified.

7.2 DESIGN PRESSURE

7.2.1 General Rule

The operating pressure (OP) is the pressure applied to the inside of a pressure vessel during its normal, steady operation. The maximum operating pressure (MOP) is a maximum continuous operating pressure reached during an operating cycle (e.g. End-of-Run conditions).

Based on MOP, Design pressure (DP) for columns, vessels, heat exchangers, reactors, and lines shall be established as follows:

Maximum Operating Pressure	Design Pressure
Atmospheric Pressure (Pressure vessels)	0.5 kg/cm^2(g)
Vacuum	Full Vacuum (FV) and 3.5 kg/cm^2(g) minimum (1)
Between 0 and 10 kg/cm^2(g)	Max. operating pressure + 1 kg/cm^2 as minimum requirement (3.5 kg/cm^2(g) min.) (2)
Between 10 kg/cm^2 (g) and 35 kg/cm^2(g)	Max. operating pressure + 10 % or 2 kg/cm^2(g) minimum whichever is higher
Between 35 kg/cm^2 (g) and 70 kg/cm^2 (g)	Max. operating pressure + 10 %
Above 70 kg/cm^2 (g)	Max operating pressure + 5% min.

For LPG (or similar service) storage systems under pressure, the MOP is equal to the vapor pressure at the maximum operating temperature of the assessed LPG composition.

Notes:

(1) Full vacuum design conditions will be applied to equipment that fulfil one of the following:
- Normally operates under vacuum.
- Is subject to vacuum during transient operation.
- When the equipment utilizing steam during normal operation, e.g. steam stripping.
- Can undergo vacuum through the loss of heat input (to be studied case by case). Vacuum prevention systems are also acceptable.

Design pressure for equipment shall consider vacuum condition which can occur due to equipment elevation: an example is given by exchangers in cooling water service normally (provided with vacuum breaker).

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(2) For equipment in equilibrium with flare, the design pressure is the flare design pressure. For equipment provided with safety valve discharging to a flare system, the design pressure cannot be lower than the flare network design pressure.

For equipment provided with safety valve discharging to atmosphere the design pressure is 2.5 Kg/cm^2(g).

(3) Short time conditions for line design, as per ANSI B31.3 and 31.4, can be applied, when:
- for pressure surges due to water hammer.
- for decoking operations.

(4) Alternate operations, such as regeneration, dry-out, start-up, shut-down etc. shall be considered in determining the design pressure.

7.2.2 Mechanical Design Pressure for Storage Tanks

Design pressure of storage tanks shall be in accordance with API-620, API-650 and API-2000 (latest edition), as appropriate. Blanketed storage tanks shall have a blanketing design pressure of 150 mmWC, unless a higher pressure is deemed necessary from process considerations.

The design pressure of blanketed storage tanks shall be determined to allow adequate overpressure for out-breathing and emergency relief devices. The blanketed tanks shall also be designed for 50 mmWC vacuum.

7.2.3 Design Pressure Profile for Columns & Systems

The design pressure at the bottom of a fractionation column will be determined as follows:

$$P_{DB} = P_{DT} + \Delta P_1$$

Where:

P_{DB} = Design pressure at the bottom (vapor phase)
P_{DT} = Design pressure at the top calculated as per paragraph
$\Delta P1$ = Column pressure drop and liquid head (HHL) at column bottom

The liquid flowing density and the maximum liquid height will be indicated on the Process Data Sheet. Liquid head has to be considered in defining the design pressure of natural circulation reboilers.

7.2.4 Design Pressure at Discharge of Pump

In principle design pressure for lines and equipment located on the pump discharge shall be equal to pump process design pressure down to the last block valve located before a section protected by a safety valve.

The design pressure at the discharge of the pump will be set as follows, before pump selection:

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$$DP_{discharge} = DP_{suction} + \frac{K \times \Delta H_{design} \times density_{max}}{A}$$

$DP_{discharge}$	=	Design pressure at pump discharge
$DP_{suction}$	=	Design pressure at pump suction
ΔH_{design}	=	Differential head at design flow (m)
$density_{max}$	=	Maximum density of pumped fluid (kg/m^3) at the pumping conditions (start-up conditions to be considered if sizing but not pre commissioning phase when pumps can be tested with water)
K	=	1.2 for motor driven pump
	=	1.4 for turbine driven pump
A	=	10 000 for pressure unit of measurement in Kg/cm^2

No provision has to be taken for maximum impeller diameter.

In case of two pumps in series, the maximum differential head will be the sum of the maximum differential head of each pump if there is no pressure relief valve between the pumps.

The pump Design Pressure at discharge shall also be applied up to and including the suction block valves for pumps in parallel (for example: spared pumps).

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).

7.2.5 Positive Displacement Pump

For positive displacement pumps (rotary or reciprocating type), the discharge design pressure shall be the same as the set pressure (SP) of the external safety valve installed on the discharge piping of each pumps.

The set pressure is determined as follows (based on maximum operating pressure at the discharge)

P operating (kg/cm^2 g)	P Setting (kg/cm^2 g)
≤ 10	$P_{op.}$ + 2.5
10 – 20	1.25 x $P_{op.}$
20 – 50	$P_{op.}$ + 5.0
> 50	1.10 x $P_{op.}$

7.2.6 Design Pressure for Complex Systems

For any piece of equipment in the loop, the design pressure will be equal to the design pressure of the equipment where the safety valve is located plus ΔP, where ΔP is the pressure drop under safety valve discharge conditions, between this item and equipment protected by the safety valve.

For Process systems similar to that of a reactor-recycle gas loop and protected by single safety valve, design pressure shall be estimated based on Compressor settle out conditions as per API STD 521, Appendix B. Minimum design pressure of the separator (PSV set pressure) shall be equal to 1.05 times the settle out pressure.

7.2.7 Tube Rupture for Heat Exchangers

This concerns TEMA and multi tubes heat exchanger and not applicable to double pipe exchangers.

The recommended practice consists in oversetting, if necessary, the design pressure of low pressure side of heat exchangers in order to have a hydraulic test pressure of the low pressure side equal to the design pressure of the high pressure side.

The design pressure of the low pressure side shall be therefore defined as:

$$DP_{low\ pressure\ side} = \frac{10}{13} \times DP_{high\ pressure\ side}$$

This rule, while avoiding the installation of safety valve on exchanger low pressure side for tube the rupture, does not eliminate the possibility of tube rupture itself; the relevant consequences on entire low pressure system should be therefore evaluated case by case. The installation of a relief valve on the downstream piping might still be required especially if vaporization occurs during tube rupture

This rule shall not be applied for column reboilers with the heating medium on the high pressure side considering that an open path exists back to the column.

7.2.8 Steam Containing Equipment

As a general rule, full vacuum conditions should be added to design conditions of a steam containing equipment under normal operation, since vacuum can happen during cooling of such equipment, if it is not connected to atmosphere or equipped with special protection device.

Steam out operation is excluded.

7.3 MATERIALS & CORROSION ALLOWANCE

Metallurgy shall be specified by respective unit designer / Licensor based on process considerations.

7.3.1 Corrosion Allowance

Corrosion allowance shall be provided to meet the minimum design life as specified below based on the corrosion rates for the governing case at the maximum operating temperatures (Note1),

- 30 years for heavy wall pressure vessels (2) (3) (4) and reactors (3) (4)
  - 30 years for non-removable internals
  - 15 years for removable internals
- 20 years for non-heavy pressure wall vessels (3) (4), tanks, pumps, compressors

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- 20 years for non-removable internals
- 10 years for removable internals

- 10 years for piping
- 100, 000 hours for heater tubes (5)
- 10 years for S&T heat exchangers tube bundles

Corrosion allowance shall not be lower than the following minimum values (3, 4, 5):

	Carbon Steel / Low-Alloy Steel (6)	**Stainless Steel / High-Alloy Steel (7)**
Wet H_2S service	3.0 mm / 1.5 mm (process) 6.0 mm / 3.0 mm (sour water)	0 mm (if no clad) 3 mm clad thickness
Corrosive process service (excluding Wet H_2S service)	3.0 mm / 1.5 mm	0 mm (if no clad) 3 mm clad thickness
Non corrosive process service	3.0 mm / 1.5 mm (vessels)	0 mm
Water / Steam Condensate	3.0 mm / 1.5 mm (vessels)	0 mm
Steam	3.0 mm / 1.5 mm (vessels)	0 mm

Notes:

(1) Corrosion allowance typically applies to drums, columns, heat exchangers (shell and tubes type, hair pin type) and air coolers. For piping, also refer to project piping classes.
(2) Heavy wall pressure vessels (columns, drums, exchangers, air coolers): above or equal to 50 mm.
(3) No corrosion allowance shall be provided for removable vessel internals in high alloy or stainless steel. The necessary corrosion allowance shall however be specified for internals subject to severe conditions, such as reactor internals.
(4) For internals, each surface side, including welding exposed to the process fluid, shall have a minimum corrosion allowance as follows:
    - Welded or non-removable parts: 100 % of the specified value
    - Bolted or removable parts (including trays): 50 % of the specified value
(5) For fired heaters, corrosion allowance for process coils(radiation & convection) of carbon steel up to and including 9Cr-1Mo-V tubes shall be 3 mm minimum.
Corrosion allowance shall be minimum 1.5 mm for higher grades of tubes.
(6) Low alloy steel: up to and including 5Cr-½Mo.
(7) High alloy steel: above 5Cr-½Mo up to austenitic stainless steel.

7.3.2 Material Selection

As far as possible, base material shall be Carbon Steel. The following materials are suitable for low temperature service (to avoid embrittlement):

- Carbon Steel (CS) ≥ -29 °C
- Low Temperature Carbon Steel (LTCS) ≥ -45 °C
- Stainless Steel < -45 °C

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7.3.3 Special Services Selection

7.3.3.1 Hydrogen Service

Definition

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 (typical)

For minimum base material selection, refer to the Nelson curves, API STANDARD 941 (H_2 corrosion at high temperature). Material selection shall be based on maximum operating temperature (MOT).

For material selection and corrosion rate calculation, refer to Couper-Gorman curves, API RP 939-C, (Guidelines for Avoiding Sulfidation (Sulfidic) Corrosion Failures in Oil Refineries).

Information on Process Documents
Process data sheets shall include a note to clearly identify the hydrogen service. The hydrogen partial pressure of the vapor phase shall also be indicated on the datasheet (ppH_2 in kg/cm^2 abs).

7.3.3.2 Wet H2S Service

Refer to NRL Specification for Carbon Steel Components used in Sour Service in Petroleum Refinery, Document number NR-0ZZZZ-PI-SPE-0025 for applicability of wet H2S service.

Process data sheets shall include a note to identify the Wet H2S Service.

7.3.3.3 Amine Service

Definition

Metallic materials in presence of amine and H_2S in the aqueous phase (free water) may be subject to Sulphide Stress Cracking (SSC) and / or hydrogen induced cracking (HIC).

Amine service is defined as any service that contains 2% or more by weight MEA, DEA, or other amine.

- Amine service shall be specified for items exposed to lean or rich amine service.
- Wet H_2S service shall also be specified for items exposed to lean or rich amine service.

Information on Process Documents

Process data sheets shall include a note indicating amine service and wet H_2S service.
Minimum Material Requirements (typical)

- Base, weld and clad materials shall conform to API STANDARD 581 / NACE MR 0103.
- Carbon steel shall be fully killed and fine grained (KCS).
- Materials shall be stress relieved (post weld heat treatment, PWHT).
- Base, weld and clad materials shall be resistant to hydrogen induced cracking (HIC).

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7.3.3.4 Caustic Soda Service

Caustic service is defined as any service that contains 1% or more by weight NaOH or KOH. For caustic soda service, a post weld treatment (PWHT) for stress relief could be required to avoid cracking when using carbon steel.

The caustic service chart in NACE SP 0403 shall be used to determine the need for caustic soda service with PWHT. The selection of caustic service depends on caustic concentration and maximum operating temperature (MOT).

Information on Process Documents

Process data sheets shall include a note to identify the service, i.e. “Caustic Service”.

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8. PROCESS DESIGN CRITERIA FOR MAIN EQUIPMENT

8.1 EQUIPMENT DESIGN MARGIN

The overdesign margins on systems and equipment's are considered by respective licensors as per their own standard practice, however the following process design criteria shall be used as minimum requirement to generate the equipment process specification.

Equipment		Overdesign factor (1)
Pumps (2) (3)	**Centrifugal Pumps**	
	Reflux or pump around pumps	20%
	Reflux + Product pumps	20% on reflux + 10% on product
	Reboiler circulation pumps	20%
	Boiler feed water pumps	10%
	Feed pumps	10%
	Product pumps	10%
	Reciprocating Pumps	
	For all pumps	10%
Compressors		
	Recycle compressors in reaction loop (centrifugal)	According to Licensor
	Makeup compressors in reaction loop (volumetric)	According to Licensor
	Other compressors and blowers	10%
Process Turbines (Turboexpanders etc.)		According to Licensor
Fired Heaters	Design duty for process heater shall be:	Minimum design shall be: - 10 % of normal flow for hydraulic margin - And 10% of normal duty or - normal duty + 5 % of exchanger train duty upstream the heater whichever is greater. Or as per Licensor / Designer recommendation
	Reboiler fired heater	As per Licensor requirement or 20% on flow will be specified

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Equipment		Overdesign factor (1)
Heat Exchanger	Column reboiler (4)	the highest value between: - 20% on flow and duty - 20% on flow and 10% on duty of feed/bottom exchanger
	Column bottom cooler (4)	the highest value between: - 10% on flows and duty
	Feed preheater or reactor effluent cooler (if not located downstream reactor effluent air cooler) (4)	According to LICENSOR specification
	For feed preheat against products	No margin for thermal rating, 10% on flows for hydraulics on both sides
	For column pump arounds services	20% on duty and on flows of pump arounds (Hot) side. For cold side, margin on flows to be selected in line with service, e.g. 10% if feed or product.
	For product coolers	10% on flow and duty shall be specified
	For column overhead trim condensers	20% on flow and duty shall be specified.
Air Coolers	For column pump arounds	20% on flow and duty shall be specified
	For column overhead air condensers	20% on flow and duty shall be specified. (To be checked against overdesign considered for the reboiler which could lead to higher required margin on the overhead condenser).
	For product cooling	the highest value between: - 10% on flows and duty
	For reactor effluent air cooler	According to LICENSOR specification
Columns	Vapor and liquid load	10% of heat and material balance.
Cooling towers		10%
Package Boilers		Note 5

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Notes:

(1) In specific case where, above design margin is different from Licensor value, Licensor's design margin shall prevail.
(2) Continuous recirculation flow shall be added to the net process design flow when installed for minimum flow protection.
(3) Normal and design flow rates shall be identical in such instances as:
    - Intermittent services, sump pumps etc.

(4) To take into account the risk of lower performances of heat recovery systems (e.g. column feed / bottom, reactor feed / effluent) than expected ones, the minimum margins between normal and design shall be specified.
(5) Normal load not to exceed 85% of boiler capacity.

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8.2 VESSELS

8.2.1 Types of Vessels

Horizontal vessels shall be preferred for services with high liquid volumes, such as feed surge drum, column feed accumulators, recycle accumulators, liquid separators, etc. Vertical separators shall be preferred when liquid flow-rate is low and vapor phase prevails, or when an accurate level control is required for reduced liquid flow-rates.

8.2.2 Vessel Sizing

Vessels with proprietary internals may be considered, in such a case sizing will be in accordance with licensor / vendor guarantee, otherwise the following guidelines shall be used.

Vessel sizing will be performed as follows:

Vessel length will normally be between 2 – 4 times vessel diameter.

Vertical vessels shall be sized in order to keep vapor velocity sufficiently low and facilitate the separation of the two phases, based on the "critical velocity".

For vessels with internal diameter less than 610 mm, a note shall be added on the process datasheet specifying that a piping element is acceptable. Design adequacy shall be verified by vessel specialist based on applicable pressure vessel design code.

For vessel where entry is required through manhole, the minimum diameter of the vessel is 1200 mm. In some exceptional cases, a vessel diameter between 900 mm and 1200 mm can be specified.

The following level positions shall be used unless specified otherwise by LICENSOR

LSHH (1)(3)	High High Liquid Level (Safety)
HLL	High Liquid Level (Control)
HLA	High Level Alarm (Control)
NLL	Normal Liquid Level
LLA	Low Level Alarm (Control)
LLL	Low Liquid Level (Control)
LSLL (2)(3)	Low Low Liquid Level (Safety)

Notes:

(1) LSHH : Level Safety High High, cut-off (trip) by ESD at high high liquid level.
(2) LSLL : Level Safety Low Low, cut-off (trip) by ESD at low low liquid level.
(3) The trip connections will be independent from other instrument connections.

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The following minimum liquid heights shall be used for the level measurement / control:

- Top Tangent Line (TTL) – (LSHH) — 300 mm mini. or 20% of diameter whichever is larger
- Top Tangent Line (TTL) – HLL if no LSHH — 300 mm mini.
- LSHH-HLL — 200 mm mini. (emergency hold-up)
- HLL-LLL — 300 mm mini (normal hold-up)
- LLL-LSLL — 200 mm mini (emergency hold-up)

The installation of a high-high liquid level alarm shall be considered on the compressor suction separators. If the high-high level alarm is not provided with a shutdown device, an additional 1 minute minimum will be allowed between the high level limit (HLL) and the bottom of the feed inlet nozzle. The same hold-up time value will be provided for vessels with a low/low level alarm.

The recommended hold-up times shall be in accordance with the Table 1.0 attached below

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HOLD-UP VOLUMES FOR PROCESS DRUMS (Table 1.0)					
SERVICE	**REFER. SKETCH**	**VESSELS TYPE NORMALLY USED**	**HOLD UP VOLUME (whichever is larger)**		
			LEVEL NORMAL SPAN HL – LL	**LEVEL EMERGENCY SPAN (note 2)**	
				HHL – HL	**LL – LLL**
REFLUX DRUM					
- Liquid product to storage	1	Horizontal	5R or 2P	note 3	1 (P + R)
- Liquid product to fractionator or to Unit without surge drum	2	Horizontal	5R or 10P	note 3	1 (P + R)
- Vapour product	3	Horizontal	5R		1R
LIQUID SURGE DRUM					
- Feed to Unit	4	Horizontal or vertical	10P	2P	2P
- Feed to critical equipment (furnace, column)	5	Horizontal or vertical	5P	2P	2P
VAPOUR / LIQUID SEPARATOR					
- Compressor, suction	-	Vertical	2P (note 4)	2P	-
- Refrigeration compressor, interstage:	-	Vertical	3P (note 4)	2P	-
- Process compressor, interstage:					
- liquid to storage	6	Vertical	5P	2P	
- liquid to fractionator	7	Vertical	5P	2P	2P
- Fuel gas KO drum	-	Vertical	5P (note 5)	-	-
- Steam gas KO drum	-	Vertical	5P (note 5)	-	-
- Steam drum (boiler)	-	Horizontal	(note 6)	-	-
LIQUID / LIQUID SEPARATOR		Horizontal	Time required for separator (note 7)	-	-
COLUMNS BOTTOMS					
- Bottoms to Unit or heat recovery train	8	-	5P	2P	2P
- Bottoms to storage	8	-	2P	2P	2P
- Fired coil reboiler product draw off	9	-	5P	-	2P
- Bottoms to fractionator manual level control	10	-	15P	1P	1P
- Fired coil preheater	11	-	5P to 10P	1P	1P
- Fired coil preheater product draw off	12	-	5 to 10 (F + P)	1 (F + P)	1 (F + R)

HOLD-UP VOLUMES FOR PROCESS DRUMS (Table 1.0)					
SERVICE	**REFER. SKETCH**	**VESSELS TYPE NORMALLY USED**	**HOLD UP VOLUME (whichever is larger)**		
			LEVEL NORMAL SPAN HL – LL	**LEVEL EMERGENCY SPAN (note 2)**	
				HHL – HL	**LL – LLL**
- Kettle type reboiler	13	-			
• Bottoms to unit		-	10P	-	2P
• Bottoms to storage		-	5P	-	1P
- Min. hold-up in tar pot	14	-	5 - 10 seconds on P (note 9)	-	-
- Amine absorber	-	-	5P	2P	2P
- Amine stripper	-	-	5P (note 8)	2P	2P

Notes:

(1) P = Liquid product (m³/min.)
R = Reflux (m³/min.)
F = Feed (m³/min.)

(2) Above or below level control span, when HHL or LLL gives shutdown for flooding or emptying.

(3) At least 2R or 1P (whichever is larger) before the flooding.

(4) P is max. liquid flowrate or 10 % of vapor flowrate (on weight basis) whichever is larger.

(5) P is max. liquid flowrate or a liquid volume equivalent to 3 m of feed pipe (whichever is larger) and however not less than 600 mm from BTL to the highest liquid level.

(6) 2F or 1/3 of boiler volume.

(7) or, for each liquid phase, 2P (product to storage) and 15P (product to fractionator) whichever is larger.

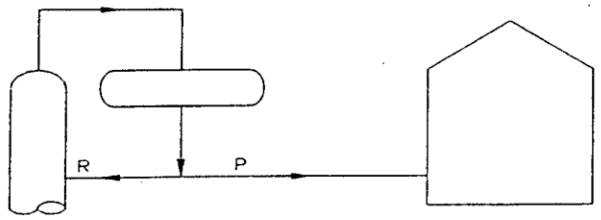
(8) If the amine unit includes a surge tank with a hold up volume 15P min., the level normal span can be reduced to 2P; otherwise the level normal span of the stripper bottom is to be designed for 2 – 4 days of amine make-up.

Hold-up volumes for huge plants to be set-up case by case.

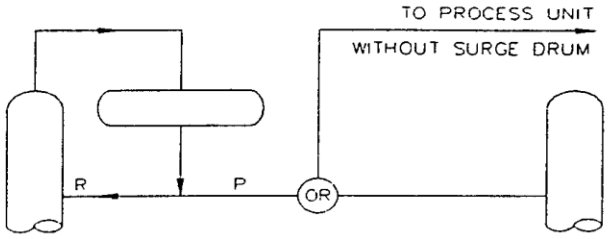
(9) Without quench facilities.

REFERENCE SKETCHES

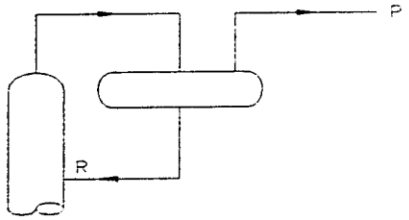
SKETCH N. 1
LIQUID PRODUCT TO STORAGE



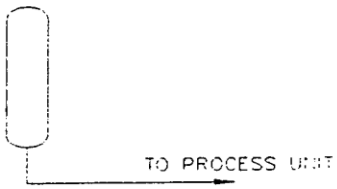
SKETCH N. 2
LIQUID PRODUCT TO FRACTIONATOR OR
TO UNIT WITHOUT SURGE DRUM



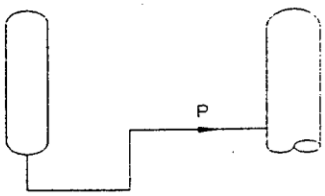
SKETCH N. 3
VAPOR PRODUCT



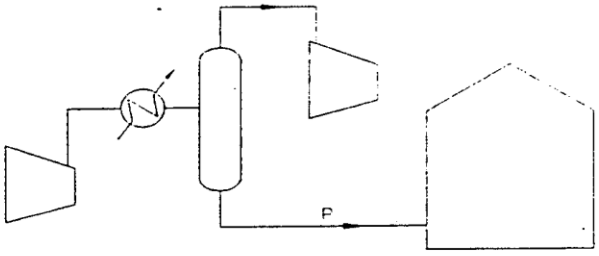
SKETCH N. 4
FEED TO UNIT



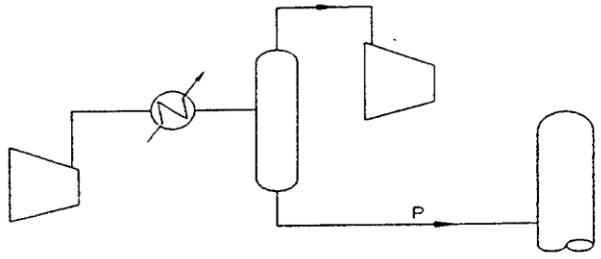
SKETCH N. 5
FEED TO CRITICAL EQUIPMENT
(FURNACE, COLUMN)



SKETCH N. 6
PROCESS COMPRESSOR INTERSTAGE
LIQUID TO STORAGE



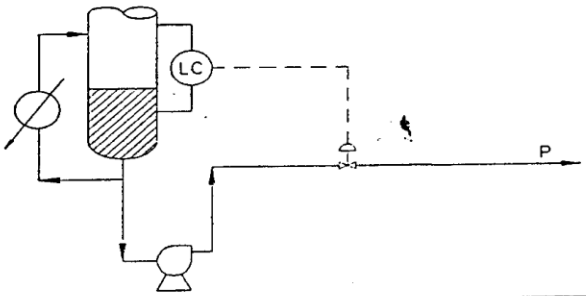
SKETCH N. 7
PROCESS COMPRESSOR INTERSTAGE :
LIQUID TO FRACTIONATOR



REFERENCE SKETCHES

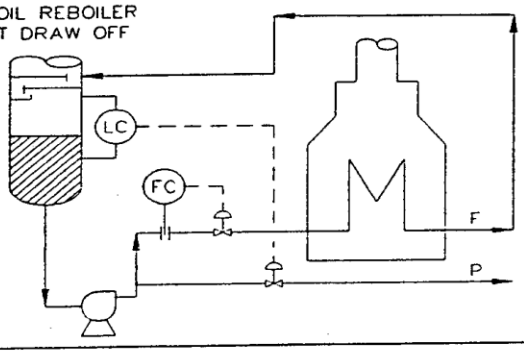
SKETCH N. 8 COLUMN BOTTOMS

TO UNIT OR TO STORAGE



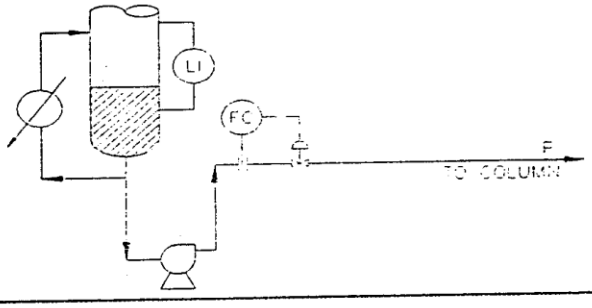
SKETCH N. 9 COLUMN BOTTOMS

FIRED COIL REBOILER
PRODUCT DRAW OFF



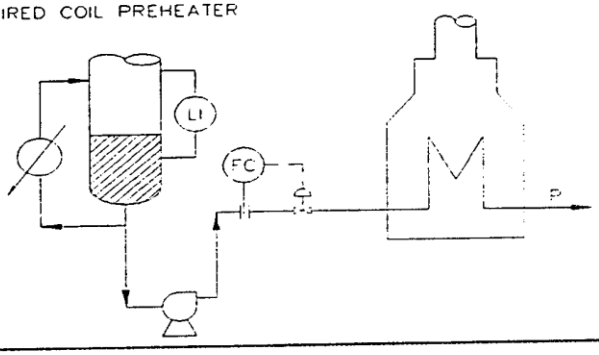
SKETCH N. 10 COLUMN BOTTOMS

TO FRACTIONATOR
MANUAL LEVEL CONTROL



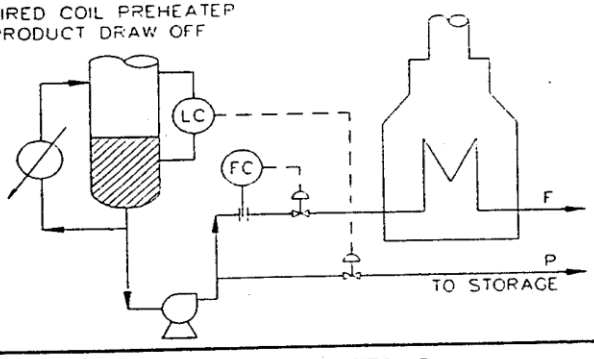
SKETCH N. 11 COLUMN BOTTOMS

FIRED COIL PREHEATER



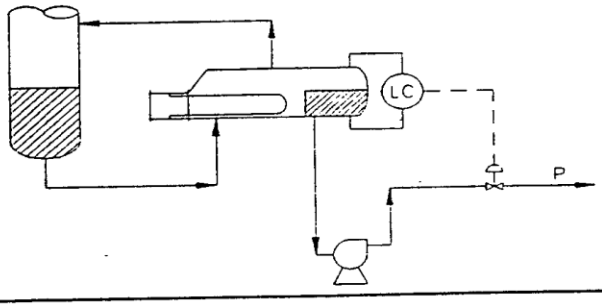
SKETCH N. 12 COLUMN BOTTOMS

FIRED COIL PREHEATER
PRODUCT DRAW OFF



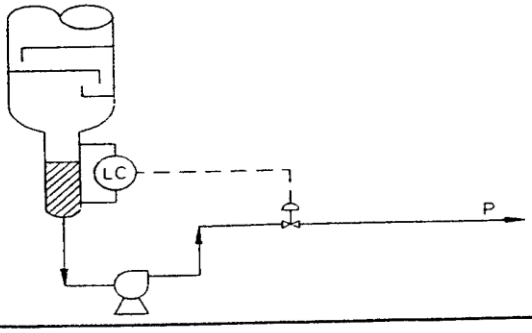
SKETCH N. 13 COLUMN BOTTOMS

KETTLE-TYPE REBOILER :
TO UNIT OR TO STORAGE



SKETCH N. 14 COLUMN BOTTOMS

MIN. HOLDUP IN TAR POT



8.2.3 Equipment Nozzles

Nozzle Connections

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 minimum recommended nozzle connection size shall be

- For flanged connections attached to unclad vessel shall be 2"
- For flanged connections attached to internal lined / clad shall be 3"

Refer to Engineering design basis for Instrumentation document number TP-1ZZZA-IC-BOD-0001 for instrument nozzle size and connection details.

8.2.4 Manholes Handholes & Flanged Heads

The minimum size of manholes shall be

- 24" NB for vessel diameter ≥ 1 200 mm
- 20" NB for vessel diameter between 1 000 mm to 1 199 mm
- 18" NB for vessel diameter between 900 mm to 999 mm (to be decided on case to case basis)

Flanged heads shall be specified for diameter smaller than 900 mm when access for vessel / column internals is required and where no access is required a hand hole will be provided with minimum of 8" NB unless a suitable nozzle for other service exists.

For horizontal vessels having a straight length between heads welds greater than 6 000 mm, one manhole shall be provided on each opposite side (on heads or shell). For shorter horizontal vessels, at least one manhole shall be provided plus a separate blanked-off ventilation nozzle on the opposite side of the manhole (or to the inspection hole) such as to provide effective ventilation during inspections, refer to Section 7.2.6 Ventilation Nozzle.

For vessels with diameter lower than 900 mm which cannot be physically entered, manholes shall be replaced by handholes (one or two) minimum of 8" size.

8.2.5 Drains Vents & Utility Connections

Drains, vents and utility connections for vessels shall be sized as follows:

Volume of the vessel (m^3)	Vent size	Drain size	Utility connection size
$15 < V \leq 75$	2"	2"	2"
$75 < V \leq 220$	3"	3"	2"
$220 < V \leq 420$	4"	4"	3"
$V > 420$	6"	4"	4"

Vessels with internal baffling require special consideration: one drain on each side of the baffle.

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Utility connections shall be hard-piped for nozzle sizes of 3" and above. All hard-piped utility connections to be provided with block and bleed arrangement with spectacle blind, swing elbow to be considered for specific case.

8.2.6 Ventilation Nozzle

If entry in a horizontal or vertical vessel (with length of 3 000 mm or above) equipped with only 1 manhole is required, a blanked-off ventilation nozzle shall be added directly to the vessel in addition to the vent. The vent with blanked-off valve which is typically used in steam-out operations can directly mounted on the ventilation nozzle.

For horizontal vessels, 3 000 mm or over in tangent length, provide blanked-off ventilation nozzle on the top of the vessel near the end and opposite to the manhole.

For vertical vessels, 3 000 mm or over in tangent length, provide blanked-off ventilation nozzle on the top head unless two (or more) manholes are specified with at least one at the top and one at the bottom of the vessel.

Ventilation nozzles shall be sized as follows:

Vessel Length (mm)	Ventilation Nozzle Size
TL to TL < 3 000	-
3 000 ≤ TL to TL ≥ 4 500	4”
4 500 ≤ TL to TL ≥ 7 500	6”
TL to TL > 7 500	8”

8.2.7 Vortex Breakers / Mist Eliminators

Liquid discharge nozzles shall be provided with vortex breakers in the following cases,

- Connection to pump suction
- Connection to reboiler inlet
- Liquid draw-off from trays
- Connection to control valve

For fouling services, the vortex breaker shall be installed at a minimum of 150 mm above the vessel bottom. For drums equipped with a boot in water / hydrocarbon separation service, the vortex breaker shall be installed at a minimum of 150 mm above vessel bottom.

Mist eliminator shall be installed whenever liquid droplets must be removed from vapor to the maximum extent.

8.3 COLUMNS & TRAYS

For general requirements applicable to all vessels refer also to Section 7.2 Vessels.

In general the following criteria is to be followed for number of pass trays, unless specified otherwise by Licensor

- Single pass, 2 pass and 4 pass trays can be utilized appropriately.
- Utilization of 3 pass trays are generally not preferred.

8.3.1 Types of Trays & Tray Sizing

Trays shall be numbered from bottom to top of the column.

In general, valve trays shall be used, sieve trays may be used in fouling service. Foaming factor shall be specified for columns in foaming service.

The column shall be sized based on the design vapor / liquid loads, foaming factor and the following maximum flooding factors calculated at design flows:

- 70 % for columns with diameter below 900 mm
- 77 % for vacuum columns
- 80 % for other columns

For columns of diameter ≤ 900 mm, trays shall be cartridge type trays.

8.3.2 Tray Spacing

Minimum tray spacing shall be followed unless specified otherwise by Licensor (only for conventional trays):

- 450 mm for column diameter ≤ 2 000 mm
- 600 mm for column diameter > 2 000 mm
- 1 000 mm for installation of a manhole (24")

8.3.3 Tray Loading Margin & Flexibility

Tray hydraulic calculations and confirmation of column diameter shall be done by the tray vendor. Required tray flexibility shall be 50 - 110 % of guaranteed cases, unless otherwise specified to reach operating conditions flexibility.

8.3.4 Tray Material

Tray material is specified, as a minimum, in SS410S without corrosion allowance, however for licensed units licensor specific recommendation shall be followed

8.3.5 Column Internals / Connections / Hold-ups & Height

Thermowells shall usually be located at feed trays, side stream trays and trays for reboiler control and shall be installed in the vapor phase 200 mm (8”) below upper tray.

Manholes shall be provided for the installation and access of column internals. The arrangement shall be determined by the pressure vessel specialist (e.g. orientation and elevation).

The minimum size of manholes shall be 24". Manhole sizes of 20" or 18" may be used on case by case basis for vessel with diameter less than 1 200 mm. For vessels with internal diameter less than 1 200 mm, flanged heads can also be specified (without installation of manhole) if access for the vessel internals is required.

For packed columns, each packed bed will have a manhole each above and below the bed. For packed beds with random packing, hand holes shall be provided just above the packing support plates, for removal of packing. These shall be two in number and opposite to each other for large diameter columns (diameter 1000 mm and above).

To facilitate access to the column internals, minimum number of manholes shall be positioned as follows:

- Top near the head
- Feed / return tray (for easy access to distributors)
- Below draw-off tray
- Flash zone
- Bottom near the head
- At any tray where removable internals are located.

In addition, depending on the service, the following table applies:

Service	Additional Manhole location
Clean	1 manhole every 15 trays
Fouling	1 manhole every 10 trays

Hold-up times for sizing column bottoms shall be in accordance with the Table 1.0 under section 7.2.2 vessel sizing.

8.4 AIR COOLERS & HEAT EXCHANGERS

8.4.1 Air Coolers.

- A maximum of air coolers should be installed Yes……
- Type of control, if any, to be considered:
  - Automatic variable pitch No……
  - Variable speed motors Yes……
  - Shutters No……
  - Air recirculation No……
- Tubes with or without fins acceptable in one or two tube rows in a tube bundle Yes……

8.4.2 Selection of Air Coolers

- Air cooled heat exchange is to be maximized except for specific intermittent services or small cooling duties where air-cooled exchanger is not justified.
- The lowest process stream outlet temperature for air cooled heat exchange is:
  - Air cooled exchanger not followed by water cooling : 50 °C
  - Air-cooled exchanger followed by water cooling : 60 °C
  - Dry bulb temperature for cooler sizing : 35 °C

  However, to avoid small trim cooler or air cooler, these guidelines can be relaxed.
- Forced draft fans are preferred for air cooled heat exchangers. However, for the low approach temperature less than 12°C, induced draft fan shall be used in consultation with owner and M-

PMC. If induced draft fan to be used, Licensor has to refer to owner / M-PMC on case to case basis.

- Fan blades in FRP / Aluminium are preferred.
- Air cooler air side fouling resistance = 0.0001 hr.m2.C/kcal.

- Preferred location / sizes for Air-cooled exchangers: Air coolers may be located on pipe-rack or platform structures.
- Air-cooled exchanger tube length to be used depends upon pipe-rack width / equipment layout.
  - Typically tube length should be pipe rack width + 0.5 m.
  - Preferred tube length is _____ m (to be confirmed later).
  - Air cooled exchanger bundle width : 3.2 m. (4.0 m max. for single Bundle)
  - Limits on fan motor power with (HTD) belt drive : 45 kW
  - Fan Motors over 45 kW shall use Gear drives.
- Requirements of winterizing or for highly congealing service air coolers, following option will be considered:
  - Steam coils.
- Avoid air coolers in highly congealing service.

Preferred Tube Dimensions

Tube Metallurgy	CS / LAS	HAS / SS
Tube diameter	25.4 mm OD	25.4 mm OD
Tube thickness	2.77 mm	2.11 mm
Fin height	15.875 mm / 12.5 mm	15.875 mm / 12.5 mm
Type of Fin	Al. `G' type *	Al. `G' type *
Max. No. of fins	433 per m	433 per m

* G – Grooved (embedded) fins

For design temperatures > 400°C, CS welded fins shall be used. Fin density for CS fins shall be 236 per m in this case.

8.4.3 Type of Headers

Plug header shall be provided if any of the following conditions exist: Otherwise cover header are to be provided.

- Hydrogen partial pressure ≥ 7.0 kg/cm² (a)
- Clean service with fouling < 0.0004 Hr. m2 °C/kcal
- High pressure over 30 kg/cm² (g)

If inter-pass temperature difference exceeds 110°C or if inlet temperature exceeds 180°C, split headers shall be used. In addition to this Licensor requirements shall prevail in selection of type of headers. Minimum slope of 10 mm / meter shall be provided for single pass condensing exchangers, towards the outlet header. Last pass of multi-pass condenser shall have a slope of 10 mm / meter, towards the outlet header.

8.4.4 Grouping of Air Coolers

Large air-cooled exchangers shall be divided into sections and fans sized and provided in each section. Air-coolers, which are smaller than section size, can usually be grouped into one section and provided with a common set of fans (for similar service), unless the designer has an over- ruling consideration. However, air coolers provided with control arrangement cannot be combined together.

Inlet and outlet piping for air coolers with multiple bundles / bays shall be designed to ensure uniform process fluid distribution and avoid channeling.

8.4.5 Fin Fan Control Scheme

When fluid outlet temperature requires to be controlled (whether automatic or regulated manually, say, for seasonal climatic variation) or when stipulated to conserve power, variable speed drives are to be considered.

Variable frequency drives (VFD) are the preferred means for speed control of air cooler fans where airside flow control is required minimum 50% of total fans shall be provided with VFD.

8.5 HEAT EXCHANGERS

8.5.1 Plate Heat Exchangers

Plate type heat exchanger can be installed in place of shell and tube heat exchanger as deemed fit for best heat recovery by the unit designer / Licensor. Use of these exchangers should not have effect on unit reliability. Adequate references should be available for similar service, fluid quality and trouble free operation.

8.5.2 Shell & Tube Exchangers

Fouling Factors

Fouling factors for process streams: Fouling factors for process streams are decided by Licensor / designer based on past experience and good design practices. However, specific requirements are addressed in unit design basis document.

Fouling factors for Utility streams: The following default fouling factors for utility streams are to be considered.

Cooling Water:	0.0004 hr-m2-^{o}C/kcal
Steam:	0.0001 hr-m2-^{o}C/kcal
DM Water:	0.0001 hr-m2-^{o}C/kcal
Tempered Water:	0.0002 hr-m2-^{o}C/kcal
Condensate:	0.0001 hr-m2-^{o}C/kcal
Air:	0.0001 hr-m2-^{o}C/kcal
For Others:	As per TEMA

Tube-Side Velocities

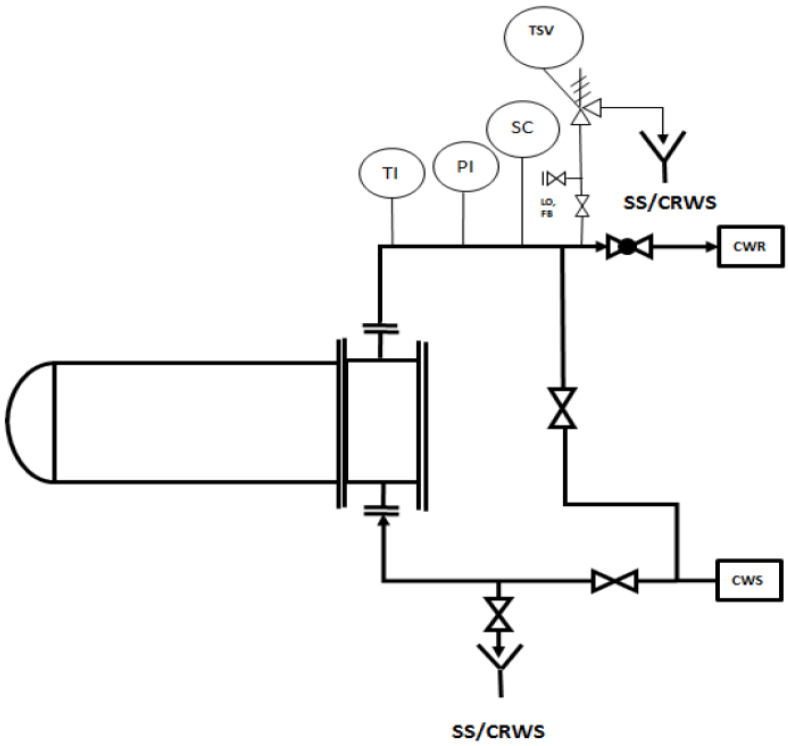
It is a good practice to recommend specific tube side velocities for better on-stream factors of heat exchangers in fouling services. Cooling water flow rates are normally not expected to be turned down during operation and can be designed for a velocity constraint applied only for normal flow.

Minimum tube side velocity for cooling water shall be 1.0 m/sec at normal flow. Process fluid velocities are to be specified by licensor / designer considering the nature of fluid, e.g. viscous, fouling, slurries etc. Cooling water heat exchangers to be designed with maximum allowable pressure drop of 0.7 kg/cm2.
For ease of cleaning, cooling water to be kept on the Tube side.

Minimum tube side velocities for specific services such as slurry oil, MCB exchangers shall be followed as per licensor requirement.

Typical Cooling Water Piping

All cooling water consumers connected to recirculation cooling water system are to be provided with back flush arrangement. The Typical scheme is provided below, the detailed requirement is provided in legend and typical PIDs.



Note:

(1) Back flush lines to be provided with same size as main cooling water line when main line size is ≤ 6 inch. One size lower to be provided for main line size up to 10 inch. Two size lower to be provided for main line size > 10 inch.
(2) For exchangers at an elevation, vacuum protector to be provided in cooling water lines.

8.5.3 Selection of Shell & Tube Heat Exchangers

Floating Head type exchanger is preferred construction in refinery service. The use of fixed tube-sheet heat exchangers shall be minimized to the extent possible. These can be used in limited services such as vertical thermosyphon reboilers where steam is on shell side. Steam-out conditions shall be specified for fixed tube-sheet heat exchangers, considering either shell-side or tube-side being steamed out at one time. Expansion bellows are not preferred on fixed tube sheet heat exchangers.

Double pipe or multi-tube heat exchanger should not be used except in the event of infeasible shell-and-tube heat exchanger design.

The exchangers can be stacked considering the size of exchangers, equipment layout and approach for operation and maintenance.

Maximum number of shells in a stack

- For shells with diameter <500 mm : 3 (if individual shell isolation and bypass facility not provided).
- For shells with diameter >500 mm : 2 (if individual shell isolation and bypass facility not provided).
- Exchangers not to be stacked, when individual shell isolation and bypasses are provided.

General Criteria for Selection of TEMA Type

Shell side fouling resistance (hr-m^2-^{o}C/kcal)	Tube side fouling resistance (hr-m^2-^{o}C/kcal)	TEMA type (preferred)
>0.0002	>0.0002	Floating head
≤0.0002	>0.0002	Fixed tube sheet
>0.0002	≤0.0002	U tube bundle
≤0.0002	≤0.0002	Fixed tube sheet / U tube bundle

Or as specified by licensor

All shell and tube heat exchangers in a refinery application shall follow TEMA-R unless required otherwise. However, for coolers (oil coolers) in the packaged equipment's will follow TEMA-C. Process surface condensers (e.g., vacuum producing package of CDU/VDU unit) in the package scope will be TEMA-R.

Preferred exchanger type for refinery services shall be horizontal, single pass shell, floating head tube bundle (TEMA type 'S') arranged with two or more tube passes per shell. Specific type recommended by Licensor to be complied with.
Tube pitch shall be square or rotated square for fouling services and triangular pitch for clean services.

The fouling factors ≥ 0.0004 hr-m2- ^{0}C/kcal is defined as dirty service.

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General Criteria for Specifying U-tube Construction is:

- Services where steam is condensed or generated on tube side; tube pitch shall be triangular if shell side fluid is clean and square / rotated square if shell side fluid is fouling.
- TEMA type B stationary head: hydrogen services or when steam or other clean fluid is on tube side, not requiring cleaning.
- TEMA type A stationary head when tube side fluid is cooling water or similar process fluids, requiring cleaning.
- For U tube bundles, consideration shall be given for hydro testing of tubes for IBR/normal testing after preventive maintenance. If necessary, dummy shell shall be designed for testing for maintenance purpose.
- Other constraints: TEMA type B or C stationary heads shall not be used when design pressure is higher than 140 kg/cm2 g. Tube sheet shall not be full diameter extended type when TEMA type B stationary head is used.

Cathodic Protection Requirement for Cooling Water Exchanger

- Requirement of cathodic protection for cooling water side of exchangers in case of dissimilar metallurgy only. Sacrificial anode, if required, shall be sized and positioned in such a way that flow restriction is not there.

Preferred sizes for shell & tube Exchangers with Removable Bundles

- Preferred Tube lengths : 2.438 m, 3.048 m, 3.658 m, 4.877 m, 6.096 m, 7.315 m and 9.144 m.
  Max. tube length - 6.096 m, for exceptional cases tube length up to 9.144 m shall be used.
  Maximum tube length shall be 9.144 m for fixed tube sheet exchangers.
- Max. tube bundle diameter : 1.5 m for 6.096 m tube length, For exceptional cases tube bundles diameter may exceed by 100 mm.
- Max. tube bundle weight : Approximately 25 tons and for high pressure exchanger, bundle weight can go higher.

Preferred tube dimensions

Type	CS & Low alloy	High Alloy & SS
Tube diameter	25.4 mm /19.05 mm	25.4 mm /19.05 mm
Tube thickness	2.77 mm / 2.11 mm (min.)	2.11 mm / 1.65 mm (avg.)
Tube thickness (IBR Service)	2.77 mm / 2.11 mm (min.)	2.11 mm / 2.11 mm (min.)

Any change in the above preferred dimensions, specific approval is needed.

For Licensed units, deviations on tube size and thickness are acceptable as Licensor requirement is to be followed. However, for IBR service, the tube thickness specified in the table shall be met as a minimum requirement.

For dirty service, tube OD >= 25.4mm shall be used.

Note: Higher tube OD to be used in case of pressure constraints.

- Low fin tubes are not allowed.

- Longitudinal fin tubes are not allowed.
- Use of tube inserts is allowed for viscous services with approval from Owner / M-PMC.

8.5.4 Additional Instructions

For shell-and-tube heat exchangers, the low pressure (LP) side of exchanger including upstream and downstream system equipment shall be preferably specified with a design pressure at least equal to 10/13 of high pressure (HP) side design pressure, in order to avoid having to install a pressure relief device on the LP side.

The 10/13 criteria shall necessarily be adhered to when:

- LP fluid is on the tube side.
- Relief discharge cannot be connected to flare header owing to nature of fluid.
- Relief discharge is two-phase and cannot be connected conveniently to a low-pressure destination with free-draining piping.
- Liquid relief cannot be connected to a closed blowdown system.

When the 10/13 criteria call for an increase by less than a factor of 13/10 of the mechanical design pressure of the LP side as would be calculated from normal estimation procedures. However, based on process considerations and designers own practice, heat exchanger can be designed without upgrading design pressure by providing tube rupture pressure relief valve after getting consent on case to case basis from Owner / M-PMC.

For feed / effluent exchanger, the tube sheet and tubes in high pressure service need not be designed for full design pressure of the shell and / or channel provided these components can never experience these conditions. The same should be designed for maximum differential pressure expected. Designer must consider start-up, shutdown and emergency depressurizing while deciding maximum differential pressure.

In cases, where shell side pressure is very low compared to tube side, for subsequent testing of tube bundle, additional facility like spare shell for testing shall be considered.

- Mechanical / Chemical cleaning connections shall be provided as applicable
- Impingement protection (plate/rods) to be provided on tube bundle for inlet side of shell as per TEMA criteria.
- Unless otherwise specified by the licensor standards, for shell ID up to DN400 (CS shell), nominal pipe shall be considered.

8.6 PUMP

8.6.1 Pump Sizing Criteria

Pump design flowrates shall include a minimum of 10 % margin on max. operating flowrate unless in the following cases:

- intermittent service
- recirculation

for which the design flowrate will be equal to operating flowrate.

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Note: When a permanent recirculation flow for mini flow protection is installed, extra flow must be added to the net process flow.

Pump differential head indicated in the specification shall be calculated at design flow-rate.

8.6.2 Pump Sparing

Process pump in continuous service will, in general, be provided with installed spare. Intermittent pump services such as chemical unloading, batch make-up, etc., shall not be provided with installed spare, however one complete spare pump shall be supplied as warehouse spare. These shall be decided on a case-to-case basis.

For pumps in similar service (such as HC drain pumps), a common warehouse pump shall be considered.
Where more than one operating pump is found necessary for a service, or when defined by owner, pump capacity and spare shall be as follows:

Number of operating pumps	Rated capacity per pump	Installed spare pumps
1	100% of total rated flow	1
2	50% of total rated flow	1
3	33% of total rated flow	1
4	25% of total rated flow	2

As an operational requirement, Boiler Feed Water (BFW) service shall be provided with minimum of two operating pumps with different power source shall be considered.

8.6.3 Seals

Selection of Mechanical seals shall be as per API 682 guidelines and OISD STD125 latest edition.

8.6.4 General Recommendations

Positive displacement pumps shall normally be provided with a relief valve.

Reciprocating pumps shall have pulsation dampeners on the suction and discharge side whenever liquid pulsation is detrimental to process operation.

Auto-start for pumps shall be considered on a case by case basis based on criticality or as per Licensor's recommendation.

End of curve operation will be specified on pump data sheet for the following cases:

- pumps in auto start service (remote control, sequence activation, etc.).
- pumps without control valve at discharge.
- pumps in parallel operation.
- Tank farm pumps & Utility pumps (case to case as required).

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8.6.5 Automatic Stop by LSLL

An automatic stop (trip on LSLL) shall be provided in the Emergency shutdown System (ESD) in case of low low liquid level for the following cases:

- Presence of light hydrocarbons of liquid butane or a more volatile liquid under normal operating conditions (e.g. LPG)
- Liquids above their auto-ignition temperature (AIT)

The ESD interlock prevents the pump from running dry which could cause mechanical damage to the pump and to the mechanical seals followed by the release of a dangerous fluid to the atmosphere.

8.6.6 Minimum Flow Protection & Control

A minimum flow recirculation with flow control shall be implemented for centrifugal pump for the following cases (but not limited to):

- Multistage pumps with differential pressure higher than or equal to 35 kg/cm2g.
- Pumps with discharge control valve operated by suction side vessel level with (LIC / FIC Cascade).
- Low capacity pumps (< 10m3/hr) on case to case basis.
- Large pumps with driver power higher than 160 kW.
- For process reasons (turndown), flow rate lower than or equal to 30% of maximum flowrate.
- For pump with capacity less than 100 m3/hr or driver power less than 18 kW, the MFB usually will be a spillback line with constant bypass flow through a restriction orifice and a globe valve. A separate min. flow control for each pump (operating as well as standby) shall be evaluated for high pressure, multistage pumps.
- For pumps with capacity more than 100m3/hr or driver power more than 18 kW, except recirculating service pumps, shall be provided with an automatic min. flow control with a protective minimum flow control provided to save the pumping energy.
- For low capacity pumps if min. flow control will be through a restriction orifice, minimum flow shall be added to maximum pump flow for operating case to specify the rated flow.

8.7 COMPRESSORS

8.7.1 Centrifugal Compressors

Unless there are specific Licensor requirements, the design capacity of compressors shall include a 10 % minimum margin over the operating flow rate for each centrifugal compressor except recycle compressors in reaction loops.
Compressors shall be designed (in terms of capacity, head, etc.) considering all possible operating cases (e.g. start-of-run, end-of-run etc.) The driver rated power shall cover all possible operating cases (e.g. SOR, EOR, Star-up etc.)

8.7.2 Reciprocating Compressors

Flow-rate control on process compressors shall have the following points of reference: 0 %, 25%, 50 %, 75% & 100 %, or else in accordance with process requirements and number of cylinders per stage. Step less control shall be considered on case by case basis.

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8.7.3 Sparing Philosophy

- **Centrifugal Compressor:** Normally no spare compressor shall be considered. Spare rotor shall be considered.
- **Screw Compressor:** Normally no spare compressor shall be considered. Spare rotor shall be considered. For screw compressors in refrigeration service, 100% spare shall be considered.
- **Reciprocating Compressor:** 100% stand-by to be provided for continuous operating reciprocating compressor. For Specific intermittent service, no spare compressor is required.

8.8 DRIVERS

8.8.1 Steam Turbine Drives

Steam turbine drives shall be specified in extremely critical services where even short-term failure of a drive can result in a shutdown from where an operational recovery is difficult, time-consuming or has a large economic penalty, such as irreversible catalyst poisoning.

Steam turbine drives shall also be specified for the following drives that, among other considerations, shall ensure that a power failure does not automatically lead to a steam failure:

Options	Yes/No
Cogeneration / Steam generation plant BFW pumps	Yes
Compressor lube oil & seal oil pumps case to case basis	Yes
Emergency Evacuation pumps	Yes
All utility drives which are required to operate during power failure.	Yes
Any specific drive which can help in mitigation of large flare load during Power failure scenario.	Yes

8.8.2 Preferred Type of Steam Turbine Drive

Back pressure turbine is preferred type when there is a large use of MP or LP steam, a back-pressure steam turbine to drive a pump / compressor shall be evaluated in the unit to minimize let down through pressure reducing station (PRDS) from HP steam level to MP / LP steam level.

Steam condensing pressure at turbine exhaust shall be considered as 0.12 kg/cm² (a) for the purpose of basic engineering specifications. Only water cooling shall be considered for exhaust condensation. Cleanliness factor of 0.6 shall be considered for surface condensers.

In case back pressure turbine is considered, HP to MP turbines are preferred.

8.8.3 Critical Service Rotating Equipment

Motor drives are preferred for pumps and Reciprocating compressors. In the event of general power failure, emergency power supply may sometimes be required to aid in safe shutdowns or to minimize impact of normal power supply failure. Analysis of such emergency power supplies usually lead to a

requirement of continuously running a diesel generator or to ensure backup motive steam drives in power plants.

It is recommended that requirement of emergency power be minimized through strategies such as steam turbine drives for standby pumps, steam turbine drive for some cooling water pumps, etc. Emergency power drive requirement can be also specified / identified to reduce overall flare load during General Power failure depending on feasibility.

Unit designer / licensor shall specify the requirement of emergency power, if any, within ISBL based on their experience.

In general,

- If emergency oil pump is provided for compressors, the same to be provided with emergency power backup in case of AC motor drive.
- Emergency power back up shall be provided for CBD pumps (case to case basis) and Flare KOD pumps.
- Nominal requirements of emergency power such as for local panels, frame heating of compressors, etc., can be checked and implemented wherever required

Critical lighting only will have DC supply. The emergency lighting will have AC supply and fed from emergency power source (DG).

8.8.4 Reacceleration Feature

Designer/ Licensor may specify reacceleration feature in some critical pump motor drives to ensure faster start-up or to minimize plant down time in case of process disturbances due to momentary voltage dips.

Requirements	Yes/NO
No reacceleration feature is desired	No
Reacceleration to be specified for identified motors to cover brief interruptions up to 5 seconds in normal power supply. Such pumps to be identified based on designer / licensors own experience.	Yes
a) Re-acceleration feature is acceptable for critical pump motors of 415 V rating (LT) and auxiliary drives of HT motors such as lube oil pumps etc. b) For HT motors, reacceleration feature shall be provided wherever required for process consideration as per licensor / designer	Yes

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8.9 HEAT RECOVERY

Heat integration is to be done in the Process units as far as possible. Designer / Licensor of a particular unit shall indicate the following at the outset of design activities,

- Energy shall be preferentially recovered into process streams. Steam generation MP steam (preferred), LP Steam shall be considered thereafter to recover excess available energy. Steam generation levels shall be chosen to preferably match the corresponding steam level demand within unit. Run down stream temperature to Cooling water exchanger or air cooler to be minimized.
- For reboilers, heat input using Process stream shall be preferred option over steam. To be decided by unit designer / licensor.
- Option of the heat integration within the same BLOCK to be explored during the Basic design stage, taking in to consideration operational flexibility / reliability of such integration.
- Low-level energy recoverable for external consumption, say, for Boiler Feed Water/DM water preheats which can be used in other Units. This requirement shall be chosen to match the total complex requirement.
- Option of Liquid ring vacuum pump in place of last stage of ejector shall be explored (for energy / operating cost).
- Maximize heat recovery / Steam generation from heater convection section.
- Deployment of PHE for increasing low level heat recovery.
- Application of PRTs wherever possible
- Application of VFDs in Pumps, Air coolers, Steep less control in compressors.

8.10 HEATERS

Unless there are specific Technology Licensor requirements, fired heaters should be designed with the following criteria:

- Operating Range : 30% - 100%

Unless otherwise specified by the Technology Licensor, the following criteria shall be used for fired heaters overdesign, whichever is greater :

Design duty for process heater shall be:

- 110 % of normal duty (or)
- Normal duty + 5 % of exchanger train duty upstream the heater
- For Licensed Units design, licensor specifications shall be governing.

8.10.1 Type of Fuel for Firing

Heaters shall be of Gas fired with Fuel Gas / RLNG.

8.10.2 Heater Efficiency

Achievable heater efficiency depends on service, process temperatures, furnace heat duty and quality of fuel. Highest target efficiencies shall be pursued by a unit designer, as found economically justified. Air preheating is preferred to steam generation for heat recovery for better furnaces efficiency.

Fuel efficiency calculation shall be based on the Low Heating Value (LHV) of the fuel. Efficiency calculation shall include a minimum radiation loss of 1.5% in case there is no air preheat system and minimum 2.5% in case there is an air preheat system.

Desired minimum heater efficiency based on low heating value of fuel: and ____Note-1____% excess air for gas firing : 92% (min)
In case of minimum guaranteed efficiency value, individual heater Process datasheet shall be followed.

Note-1:

- For Natural Draft
  - Fuel Oil 25%
  - Fuel Gas 20%

- For Force Draft
  - Fuel Oil 20%
  - Fuel Gas 15%

However, hydraulic design of flue gas duct and stack to be suitable for 40% excess air, For Licensed units / design, licensor specifications shall be governing.

8.10.3 System for Waste Heat Recovery from Flue Gas

- Steam generation ☐

Pressure level requirement : HP / MP / LP Steam

- Air preheat ☒

Rotary regenerative ☐

Stationary tubular ☒

Circulating fluid ☐

Other ☐

Absolute Heat Duty (MM kcal/h)	Air Preheater Design
<7	None
≥7<15	On board
≥15<20	On board / Out board
≥20	Out board

APH type: Provide a flue gas air preheater of the recuperative (stationery) type. Cast iron type air preheater shall be supplied. Option of using Welded Plate type heater (preferably) to be consider.

- The fuel gas temperature leaving the flue gas/combustion air preheater shall be 40 °C (75 ˚F) above the maximum calculated acid dew point temperature.
- The minimum metal temperature shall be at least 14°C above acid dew point of flue gas.
- For Licensed Units design, licensor specifications shall be governing.

Steam generation from flue gases to be minimized by capturing the heat into combustion air to the maximum extent possible. Subsequently LP steam or MP steam generation to be considered.

APH wash effluents are collected in underground pit, neutralized by caustic and plant air supplied to the pit to ensure mixing of caustic and effluent. Neutralized effluent is pumped out by steam ejector to OWS.

8.10.4 Burner Minimum Turndown based on Design case

- 5:1 for gas firing
- In case of limitation of turndown, few burners may be kept off

8.10.5 Indicate any other process requirements relating to fired heaters

Maximum allowable average heat flux in the radiant section shall be follows:

Configuration	Center-Center Nominal spacing	Maximum Allowable Average Heat Flux, W/m2 (Btu/h-ft2)
Single Feed	2 c-c	31 550 (10 000)
	3 c-c	37 850 (12 000)
Double Feed	All	45 750 (14 500)

As per Licensor PDS and specification. Pollution monitoring nozzle required as per state / central pollution control board.

8.10.6 Control of FD/ID Fans

Recommended combustion air configuration for forced-draft (FD) heaters is considering each FD fan sized for 100% capacity but with both running normally at 50% capacity. Failure of one FD fan shall cause the other fan to switch over to 100% load. Total fan failure shall result in heater shutdown and no stipulations shall be made for automatic switchover to natural draft operation.

Cold air bypass to be provided and heater specifications shall allow operation at 100% normal duty with APH bypassed.

Spare induced-draft (ID) fans shall not be provided. Failure of ID fans shall cause APH bypass to open to divert flue gas to the stack. Detail heater design shall have provision for coil purging (as applicable), snuffing steam and water washing of FD/ID fan impellers and out-board air preheaters.

8.10.7 Capacity Control

- **FD Fans** **Tick mark**
  - Variable Frequency Drive ☒
  - Variable Frequency drive and inlet box damper ☐
  - Hydraulic Coupling / Variable Speed Drive ☐
  - Inlet Box Damper ☐

- **ID Fans**
  - Variable Frequency Drive ☒
  - Variable Frequency drive and inlet box damper ☐
  - Hydraulic Coupling/Variable Speed Drive ☐

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Note: Scheme of fan control (e.g. Variable frequency drive etc.) to be decided specifically for each unit with the unit/ facility designer.

8.10.8 Burners

- Burners shall be Low NOx type.
- Continuous self-inspirating, fuel gas fired pilot shall be specified for each burner. Provision of portable igniters (one electric operated and one battery operated per cell) shall be kept.
- Metallurgy of pilot gas line from the FG header should be stainless steel.
- Minimum height of burner plenum from grade shall be 2100 mm
- Burners should be designed for entire range of the fuel specified in the datasheet.
- Flame scanner for pilot and main burner. Ionization rod to be provided for pilot burner and UV scanner for main burner.
- Noise Level: 85 dB(A) at 1m from source.
- Convection section tube type shall be finned tubes for gas firing.
- Burners are to be designed for max _____ mole% H_2 in the fuel gas resulting due to various scenarios (e.g. PSA failure). Design shall be based on various fuel gas composition as specified (Refer Basic Engineering Design Data, attachment-1 of this document for max. H_2 content in the fuel gas).
- Burner Management System (BMS) to be considered for all the heaters.
- Emission

  a) MOEF notification G.S.R. 186(E) dated 18th Mar-08 Permissible emissions are

Parameter	Maximum emission Limit (mg/Nm3)
NOx - Oil firing	350
NOx - Gas firing	250
CO - Oil firing	150
CO – Gas firing	100
Particulate matter - Oil firing	50
Particulate matter - Gas firing	5

  b) For pollution monitoring, sampling nozzles shall be provided on the stack as per central Pollution Control Board guidelines:

    - 4 number of nozzles for stack diameter ≥ 2m (6" NB size with 1" inside lining)
    - 2 number of nozzles for stack diameter < 2m (6" NB size with 1" inside lining)

- Burner Excess Air Levels: Burner shall be specified for operation at following excess air levels (in addition to excess air levels to be used for heater design), for fuel gas firing:

    - Natural Draft : 10%
    - Forced Draft : 5%

8.10.9 Convection Section

- Gas firing: Finned Tubes
- Convection bank for BFW preheating, steam generation, and steam superheating shall be designed for dry run conditions wherever the BFW feed pump doesn't have an emergency drive backup.

8.10.10 Standard Fired Heater Requirements

- Low-Low fuel gas pressure shuts down fuel gas supply but keeps pilots running.
- Low-low heater pass flow shuts down fuel gas but keeps pilots running.
- Emergency shutdown shuts down fuel gas as well as pilots.
- Low-Low fuel gas supply pressure shuts down fuel gas supply and return
- Low-low differential pressure between atomizing steam and fuel oil shuts down fuel oil supply and return
- Emergency coil steam introduction, manual or automated, depending on criticality
- Heater shuts down for the following:
  - Low-low fuel gas pressure shuts down fuel gas supply but keeps pilots running
  - Loss of Combustion Air
  - High-high Arch Pressure
  - High-high Outlet Temperature
- Draft gauge connections at: Burners, Below convection, Above stack damper, Below stack damper, at ID Fan suction
- Flue gas sampling connections at: Below convection section, Below stack damper
- On-line analysis with location as per connections mounted at the same plane: O2 analyser (TDLS type), NOx analyser, SOx analyser, CO analyser, SPM analyser.
- Minimum instrument should be provided as per latest OISD norms.
- Flue gas side Temperature measurement connections below convection section, below stack damper, at hearth level.
- Adequate number of flanged connections shall be provided for steaming out, water freeing, steam air decoking (where applicable) and chemical cleaning.
- Minimum metallurgy in hydrocarbon coils in heaters shall be as per process datasheet.
- Painting of stack shall be suitable for 8-10 yrs. of maintenance free operation.
- Skin thermocouples shall be considered for measuring temperature of furnace tubes (for each pass) as per OISD.
- Pad type skin thermocouples shall be considered for measuring temperature of furnace tubes. Two additional Type "B" thermocouples shall be installed close to the skin thermocouples for checking purpose. These Type "B" thermocouples shall be connected to an accessible terminal box for connection to a portable instrument.
- Damper should be operable pneumatically and manually from grade.
- Fuel gas lines shall always be traced (preferably electrical) from KOD up to individual furnace burners.

- In-line duplex strainers on fuel gas and pilot gas are recommended in burner piping for each unit. These shall be located not more than 20 meters upstream of the burner manifold and shall be 1 on-line + 1 spare strainer with mesh size of 200 for Fuel Gas and mesh size of 100 for Fuel oil. All mesh sizes are Tyler standard.
- Pilot gas line shall be provided with self-actuated PCV.
- Pilot gas line MOC: Stabilized Stainless steel (minimum).
- Main Fuel gas line MOC: CS (Carbon Steel) / Licensor specification as applicable.
- In case owner has any other preference, indicate here: –
  - Smart stack dampers (with dual sealing mechanism to avoid leakage) to be used as applicable.
  - Peep hole with glass to be provided in convection section as well (in addition to the radiant section)
  - Provision for addition of minimum 2 future tube rows (in the convection) to be provided
- Heater refractory requirements:

Type of Firing	Section	Refractory Type
Only Gas Fired	Radiant walls	Ceramic fibre
Oil or Only Gas Fired	Floor	Bricks
Oil or Only Gas Fired	Convection section	Castable

8.10.11 Coke Thickness for Hydraulic Calculations

Coke laydown shall take place in fired heaters handling hydrocarbons containing coke precursors. Heater tube diameter selection and hydraulics shall take cognizance of this in respective unit Licensor's Design Basis.

Return bends are preferred choice. Bends for the radiant section shall be inside firebox for radiant section and inside header box for convection section. Requirement of plug headers shall be specific to furnace service

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8.11 LINE SIZING CRITERIA

Line sizing is performed for rated capacity. Unless there are specific Technology Licensor requirements, the line sizing shall be carried out as per criteria provided in the following sections.

8.11.1 Line Sizing Criteria for Liquids

SERVICE	LINE SIZE	MAXIMUM VELOCITY m/s	PRESSURE DROP (Kg/cm^2)/km	
			Normal	Max.
Pump suction, bubble point (1)	≤2”	0.6	0.6	0.9
	3” – 10”	0.9		
	12” – 18”	1.2		
	≥ 20”	1.5		
Pump suction, subcooled	≤2”	0.9	2.3	3.5
	3” – 6”	1.2		
	8” – 18”	1.5		
	≥ 20”	1.8		
Pump discharge, P ≤ 50 Kg/cm^2(g)		1.5 to 3 (8)	3.5	4.5
P > 50 Kg/cm^2(g)			7.0	9.0
Gravity flow		0.6 (3)	0.25	0.45
Side-stream draw-off (2)	≤ 2”	0.6	0.6	0.9
	≥ 3”	0.9		
Cooling water (7): i. sub-header		2.5	2.5	3.5
ii. main header			0.6 – 1.5	(4)
iii. Between pumping station and unit		1.5 to 3	1.5	(4)
Kerosene jet fuel		(5) 3.0 (max)		
Hot oil		1.0 (min)		
Lean Amine (velocity lamination max.)		2.0 for (CS) / 5.0 for SS		
Rich Amine (velocity lamination max.)		1.0 for (CS) / 5.0 for SS		
Caustic (velocity lamination max.)		1.5 for (CS)		

Notes:

(1) Applicable to liquid containing dissolved gas.
(2) Provide a vertical run of 3 meters minimum from nozzle, at nozzle size, before reducing the size of the line.
(3) Normal velocity.
(4) To be analyzed case by case.
(5) 50 to 100 m upstream tank inlet or loading facilities, the velocity shall be reduced to 1 m/s limit risks associated with static electricity.
(6) Pressure Drops for liquid to thermosiphon reboiler are 0.2 – 0.4 (Kg/cm^2)/km to be checked by heat exchanger section.
(7) Minimum velocity is 1 ~ 1.2 m/sec.
(8) For off sites large lines velocity criteria can be increased

8.11.2 Line Sizing Criteria for Gas & Vapors

	ρV^2 (max) Pa	Pressure Drop (Kg/cm^2)/km	Maximum Velocity m/s
1. VACUUM SERVICE		4 % Abs. Press. Max.	90
2. COMPR. SUCT.		0.2 – 0.7	
3. COMPR. DISCH. GAS		0.4 – 1.0	
4. STEAM (sub-headers)	15 000		(1)
a) 1 Kg/cm^2(g)		0.4 – 1.0	
b) 10 – 40 Kg/cm2(g)		1.0 – 2.0	
c) > 40 Kg/cm2(g)		(3)	
5. STEAM (long lines)	15 000		(1)
a) 1 Kg/cm^2(g)		0.1 – 0.2	
b) , c) > 10 Kg/cm2(g)		0.2 – 1.0	
6. KETTLE REBOILER OR NATURAL CIRCULATION RETURN LINE		0.2 – 0.4 (2)	
7. OVHD VAPOUR FROM STRIPPER		0.2 – 0.45 (2)	
8. COLUMN OVHD (P ≥ atm.)	15 000	0.3 – 0.6	
9. COLUMN OVHD (vacuum)		TOTAL = 5 mm Hg max	90
10. GAS LINES			(2)
P ≤ 20 Kg/cm2(g)	6 000		
20 < P ≤ Kg/cm2(g)	7 500		
50 < P ≤ 80 Kg/cm2(g)	10 000		
P > 80 Kg/cm2(g)	15 000		

Notes:

(1) The following table applies to set the velocity:

Pipe size	Saturated Steam	Superheated Steam
< 2”	10 m/s	15 m/s
3” – 8“	30 m/s	40 m/s
> 10”	40 m/s	60 m/s

(2) For large diameter lines of over 300 mm, it should be verified that the following velocities are not exceeded

Pressure (Kg/cm2(g))	Max. Velocity (m/s)
0.1 or lower	60.0
Up to 1.0	40.0
Up to 2.5	30.0
Up to 10.0	15.0
Up to 20.0	10.0
Up to 40.0	7.0

(3) To be analyzed case by case

8.11.3 Erosional Services

		Pressure Drop (Kg/cm^2)/km	Velocity m/s
1.	Mixed Phase Condensates	0.2 – 0.3	10 – 20
2.	Reboiler Return Line (Natural Circulation)	0.2 – 0.4	
3.	Partial Condenser Outlet	0.3 – 0.6	
4.	Mixed Phases at Compressor Delivery	0.4 – 1.0	

Vertical and horizontal pipes should not be affected by slug flow.

In a first step, the following criteria can be used

v_m = 10 to 23 m/s

$\rho_m v_m^2$ = 5 000 to 10 000 Pa (15 000 Pa Max)

where:

ρ_m = density of mixed phase

v_m = velocity of mixed phase (equal to 10 to 23 m/s)

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8.11.4 High Velocity Services

In offshore facilities piping handling gaseous and mixed phase (gas / vapor + liquid) streams, velocity shall be lower than the erosional velocity defined in API RP-14E/3, that is:

$$V_e = \frac{C}{\sqrt{S}}$$

Where:

V_e = ft/s
S = lbs/ft³
C = refer to the following table

"C" VALUES	
FOR CONTINUOUS SERVICE	
150	For high alloy/corrosion resistant material.
100	For uniform corrosion with rates lower than 0.3 mm/a, or when a corrosion inhibitor is used.
80	For uniform corrosion with rates higher than 0.3 mm/a.
FOR DISCONTINUOUS SERVICE	
200	For all cases.

Velocity shall be in any case lower than 50 m/s in continuous services except vacuum services, while for discontinuous services (as safety valve discharges to flare) velocity shall be lower than:

- MACH for individual users 0.75
- MACH for flare header 0.50

In case of solid particle entrainment, limitations for discontinuous services shall be used.

8.11.5 Liquid & Gas with Solids

		Velocity (m/s)
1.	Liquid + solids	1 ≤ v ≤ 3 (1)
2.	Gas + solids (pneumatic conveying)	20 ≤ v ≤ 30 (1)

Notes:

1. For licensed plants, refer to Licensor requirements.

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9. PIPING DESIGN

9.1 Inter Equipment Spacing

It is mandatory to adhere to stipulations of OISD standard 118 (latest edition) for minimum inter-equipment spacing and distance between process unit and process units & offsites.

For mounded vessels (mounded bullets), the minimum spacing of vessels and other safety regulations shall be as per OISD standard 150 (latest edition).

9.2 Piping

Engineering Design Basis shall define the detailed design requirements for overall piping, insulation, and painting and corrosion protection standards.

9.3 Heat Tracing Philosophy

Heat tracing philosophy for units (ISBL) and Offsite (OSBL) are listed below,

Heat Tracing Philosophy	**Yes/NO**
Within the unit battery limit, steam tracing shall be provided, (option of maximizing electrical tracing shall be considered).	Yes
In offsites, heat tracing shall be provided by:	
Steam tracing	No
Electrical tracing for temperatures up to 150 °C	Yes
Electrical tracing for temperatures up to 250 °C	Yes

LP steam shall be used for services with viscosity up to vacuum gas oil viscosity (pour point up to 70°C) and MP steam shall be used for heavy stocks.

LP steam tracing shall be used for service temperature up to 130°C.

Type of tracing shall be indicated in PIDs and Process Line List.

9.4 Guideline for Use of Gear Aided & Motor Operated Valves

- Gear aided operation shall be as per PMS.
- Gear aided valves shall be provided (of size 14” and above) for all the frequently operated valves, which can be opened or closed during normal unit operation such as isolation valves for pumps, compressors, filters etc., which are provided with standby or bypass.
- If Licensor requires motor-operated valves (MOV), the same shall be specified in P&ID (Process package)
- If Licensor requires gear aided valve (not specified in PMS), the same shall be specified in P&ID (Process package)

9.5 Special Item Identification

- All special purpose valves shall be tagged in P&IDs or identified in appropriate piping class. The Unit Design Basis shall contain appropriate specifications towards the same.

- All special piping items will be tagged and specifications will be furnished by Licensor / unit designer in the Process Package.
- Wherever two check valves (NRVs) are required to be installed in series to prevent reverse flow, the two check valves shall be of dissimilar type and from different manufacturers. This shall be duly noted on P&IDs.

9.6 Underground & Aboveground Lines

- All piping within a process unit shall be above ground except for oily water sewer, various closed blowdown systems and contaminated rain water sewer (CRWS).
- Cooling Water supply and return headers shall be on pipe rack for sizes up to 30". For sizes above 30" even though above ground routing is preferred, underground routing is also acceptable if there are plot constraints.
- All condensing vapor lines shall be specified with no pockets, free draining requirement.
- For flare line, isolation valve at unit B.L. should be lock open & it should be only in Horizontal line with stem pointing in downward (preferable) / horizontal position to avoid free fall of Gate & Blockage of line.
- For cooling water / raw water services, butterfly valves can be used including 12” and above. Gate valves to be used for lower sizes.
- All Wash Water/ Caustic / Neutralizing Amine / Filming Amine injection points in Column Overheads, Reactor Effluent lines and HHPS vapor lines shall have injection quills and spray nozzles.

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10. INSTRUMENTATION

10.1 General Requirements

Following are the general requirements considered in basic engineering design:

- All symbols in P&ID shall be as per NRL Symbols and Legends.
- OISD 111 (Latest) and 152 (Latest) shall be complied with.
- Sensor / transmitter for shutdowns shall be separate from that of control / indication.
- Solenoid valve operation shall be considered for interlock shutdown system and on-off sequence valves like PSA / Dryers etc.
- Status indication shall be in DCS / auxiliary panel as applicable.
- Emergency Interlock bypass switches shall be hardwired only (Exceptions to be discussed with Owner / M-PMC)
- Hardwired recorders shall not be used.
- Shutdown signals shall be repeated in DCS from PLC.
- Instruments shall have individual tapings from process lines and equipment's.
- Critical rotating equipment's shall be provided with hard wired remote stop push button.
- Block and bypass valves to be provided for turbine meters, vortex PD meters, mass flow meters, magnetic flow meters and rotameters.
- 2 out of 3 voting required for all safety trip / ESD interlocks. In case of requirement for enhancement of any interlock not linked with safety shutdown, 2oo2 shall be considered on case to case basis.
- Rotating equipment with auto-start facility shall have auto-manual switch in Local Control Panel and at local control station (Field).
- No Process Switch (pressure, level, temp, and flow) shall be used.
- Instrument impulse lines to be insulated / traced, wherever required, to avoid condensation / congealing.
- Critical rotating equipment, pumps to have vibration monitoring system with control room Indication
- For PSA units, dedicated air filter to be provided for Instrument air header at inlet of the PSA skid.
- For Critical open loops, Closed loops, complex loops, final control elements etc., conventional non-field bus method (direct 4-20mA from / to field) shall be considered, and for non-critical open loops designated only for monitoring purpose wireless instrumentation system shall be considered, subject to approval from OWNER, for details refer to instrumentation design basis.
- For specific cases, online density meter to be considered for HC main feed to unit.
- Using of self-actuated pressure control valves shall be avoided except for tank blanketing and auxiliary system.

10.2 Flushing Requirement

It is recommended to use continuous flushing oil purge for flow, level and pressure transmitters in heavy residue, congealing services (except for bitumen product which can become off-grade) and services with fines for temperature above 200 °C in the vacuum service and for temperatures above 300 °C in the atmospheric service.

For instruments in vapor phase of congealing services e.g. in vacuum column instruments in vapor phase in the above temperature range, nitrogen purge / any other by Licensor / Designer shall be used.

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10.3 Level Instruments

For Level Instrument type, nozzle size and connection details refer to Engineering design basis for Instrumentation, document number TP-1ZZZA-IC-BOD-0001.

10.4 Flow Instruments

For Flow Instrument type, nozzle size and connection details refer to Engineering design basis for Instrumentation, document number TP-1ZZZA-IC-BOD-0001.

10.5 Startup / Shutdown Operation from Control Room

Following emergency operations to be enabled from the control room:

- Individual unit emergency shutdown (control room Aux console and field)
- Fired heater emergency shutdown (control room Aux console and field)
- Critical rotating equipment shutdown (control room Aux console and field)
- All other rotating equipment shutdown (control room DCS and field)
- SOVs will have control room manual reset except heater related SOVs which will have field manual reset. However, licensor recommendation if any shall be incorporated.
- Shutdown valves to fail-safe position
- Damper (control room DCS and field)
- Gate operation (field only)

10.6 Control Philosophy for Vendor Package Items

All vendor package monitoring, control and logics shall be implemented in control room with minimum instrumentation in local control panel for startup and shutdown.

Governor Control Systems and Anti Surge Control Systems, which will be mounted on hardwired consoles in control rooms. (For details, refer to Instrumentation Design Basis).

10.7 Standard Instrumentation

10.7.1 Packed Towers

- Local differential pressure indication for each bed (DPT only).
- Local differential pressure indication for total section (DPT only).
- Control Room differential pressure indication for each bed.
- Control Room differential pressure indication for total section.

10.7.2 Heat Exchangers & Air coolers

- Local & DCS Temperature Instrument (TI) at process inlet and outlet of each service.
- Local & DCS Pressure Instrument (PI) at process inlet and outlet of each service.
- DCS Temperature Instrument (TI) at the outlet of each Air Cooler element.
- DCS Temperature Instrument (TI) at cooling water outlet of each exchanger.

11. GENERAL SAFETY ASPECTS

11.1 Emergency Isolation valves

Emergency Isolation valves (EIV) shall be provided for equipment and piping to isolate possible release of hazardous material. The provision of EIV's is linked to the risk associated to hazardous inventories, equipment and operation.

- EIV's shall be designed considering (subject to change based on licensor's requirement).
- Pneumatically operated by ESD system (through solenoid valve)
- Either in open or closed position in normal operation (Control valve shall not be used as EIV)
- Quick closing / opening
- Cannot be provided with a bypass
- Manual trip activated by the operator (in field at safe distance or from central control room)
- Local manual rest on the solenoid to avoid uncontrolled opening of the valve when the conditions are not safe
- Fail safe design in case of air/power supply failure.
- Valve position indication via open / close limit switches connected to DCS or position transmitter connected to ESD.
- Fire resistant valve
- Instrument air bottle to prevent spurious closing to be designed for 3 strokes to be considered on case by case basis.
- EIV on dangerous service shall be ball type valve to minimize leakage.
- Dual solenoid with independent signals from the ESD shall be provided for all shutdown valves in 2oo2 configuration in order to increase the reliability to prevent spurious trip.

11.2 Automatic Isolation valves Between Process Vessel & Pumps

Inventory isolation valves (solenoid operated shutdown valves (SDV)) will be provided as follows. All these valves and associated accessories to be fire safe type. Inventory isolation valves (Solenoid operated shutdown valves) will be provided for the following:

a) Pumped Circuits

- C4 and lighters pump suction irrespective of inventory
- C5 and heavier pump suction (50m3 and more inventory)
- Pumped liquid > auto-ignition irrespective of inventory
- Pumped liquid temp >250 deg C

b) Non-Pumped Circuits

- C4 and lighters irrespective of inventory (case to case basis)
- C5 and heavier irrespective of inventory (50 m3 and higher inventory on case to case basis)
- Fuel supply line to Heater
- For debutanizer / stabilizer bottoms being routed to OSBL directly or through other equipment, column bottom low level shutdown valve to be provided.
- HP to LP service to avoid high gas break through (These should be typically actuated by low low level in upstream Vessel).
- Rich Amine going to OSBL.
- Sour water going to OSBL

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c) For the SOVs as described above, following to be considered:

- Start permissive to be provided for the pump with remote operated valve in open condition.
- Remote operated valve to be provided with limit switches indicating full open and full close condition in DCS. Pump to trip when remote operated valve is not in fully open condition.
- Remote operated valves to be provided with field mounted open and close switches. These switches to be installed at least 15 m away and at easily accessible location.
- Close switch to be also provided in DCS hardware console.

d) Process alarms shall be judiciously prioritize (emergency/high/low etc.) on the basis of criticality.

11.3 Constraint Due to Streams Containing H2S

When a process unit contains streams with H_2S content (Sour water) higher than or equal to 10 ppm wt., the following precautions shall be taken into account to avoid release of H_2S to atmosphere:

- Sample connections shall be with a closed loop.
- Closed sampling system shall be provided for sour water streams at outlet of HP Separators
- Draining of pressurized liquids which could release H2S after expansion shall be sent to a dedicated system as below
  - For hydrocarbons, Closed blowdown drum
  - Acid waters to sour water treatment system.
- Adequate H2S detection system in the process unit shall be provided.

11.4 Other Safety Aspects

Push buttons for stopping critical motors, shall be provided at a safe location, away from the fire-zone of the respective motors and also in control room. This is in addition to usual start stop push buttons provided for such motors. Critical motors to be identified based on Licensor requirement. Air cooler stop push button to be located at grade level in addition to start / stop button near the fan at platform.

Suction / discharge valves and suction filter should be close to the pump in order to avoid hydrocarbon wastage during filter cleaning and pump maintenance.

Flare line isolation valve at unit battery limits should be installed only in Horizontal line with stem pointing in downward (preferably) / horizontal position to avoid free fall of gate & blockage of flare line. Flare header leaving unit shall be provided with such isolation valves to facilitate maintenance of flare piping and pressure relief valves within the unit.

Emergency trips specified for HT and Critical motors shall be wired directly to switch gear in addition to control room.

Insulation shall be provided for personnel protection where operating temperature exceeds 60°C.

Furnace box / coil purge valve to be 15 m away from the furnace.

MB Lal Committee recommendation to be followed for Tank farm Area:

- In tank farm area, TSVs should be provided at operating manifolds outside the dykes.
- In tank farm area, hammer blinds for tanks isolation should not be considered.
- MOVs are to be provided on all outlet lines of Class A & Class B petroleum storage tanks, crude, finished and intermediate tanks. The first body valve on the tank is to be remote operated (MOV / ESD / Shutoff valve).
- MOV push buttons are to be located outside the dyke. It should be pull and push type.

- Provision of closing all tanks MOVs and ESDs are to be given from the control room. ESD's and MOV's are to be fire proofed
- Remote shutoff of MOVs from Control Room
- Tank Manual Dyke valves to be provided with position indicator (open / close) in Control Room.
- Tank handling A class product shall be designed with double shoe shield / Rim seal fire protection.
- Closed sampling system to be provide for Fluid class A, class B, Crude, Sulphur, H2, Toxic and Hazardous services
- HC Detectors to be considered as per MB Lal committee recommendation and OISD.
- Dual Level gauging system (one is Radar) with additional over fill protection shall be provided.
- Column handling hydrocarbon above auto ignition at its bottom will have isolation facility by way of remote operated valves at column bottom.

Double isolation valves: Double manual isolation valves shall be provided for equipment and instrumentation in following services which can be taken out of operation for inspection / maintenance with the unit still in operation. Typical examples such as spared pumps, control valve manifolds with bypass, spared relief valves and pressure indicators.

Double isolation shall be provided for Instruments in the following cases:

- For all service with rating >= 600#.

Double valving shall be provided for Equipment's / Pipe lines in the following cases:

- Hydrogen services with rating ≥ 600#.
- Rating ≥ 900# (even if not hazardous).
- Operating vents & 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. (Note 1)
- Utility lines permanently connected to process lines or equipment in all cases.

Note 1: Double isolation valves requirement shall be followed as per Licensor recommendations. In case of absence of any such requirement/recommendations from Licensor then below guidelines shall be followed

Sour service:

Gas containing >24% H2S by Volume
(or)
Liquid containing > 4.0 psia H2S partial Pressure at operating temperature.

Toxic service:

Licensor recommendation to be followed.

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12. SAFETY VALVES

12.1 Types of Safety Valve

Safety valves shall be balanced for discharge into closed system (flare header) and conventional for discharge to atmosphere. Pilot operated relief valves can be considered on a case by case basis in clean service (non-fouling & freeing) if process operating pressure is close to the relief valve set pressure.
Lines filled with liquid which may be blocked-in between two isolation devices shall be protected by safety valves for liquid expansion.

12.2 Safety Valve Sizing

Safety valves shall be sized according to API, ASME standards, OISD STD 106 and IBR requirements. For each safety valve, the applicable causes for relief and the resulting relief requirements shall be determined.

The following general emergencies shall be considered separately, unless one emergency will precipitate the other:

- Total cooling water failure
- Total electricity failure - Partial electricity failure, that is failure of one cable or transformer
- Steam failure, total or partial
- Instrument Air supply failure
- External fire, for each probable fire area

12.3 Setting of Single & Multiple Safety Valves

Refer to API RP-520, OISD STD 106 and IBR requirements

Pressure relief valve configuration is as follows:

- PSV for operational failures shall have installed spare with isolation facilities.
- PSV need not be equipped with a by-pass when depressurizing of the vessel to the flare is possible through accessible valves and suitable piping.
- PSV in hydrocarbon service will normally release to Flare.
- PSV exclusively for non-operational failures (external fire or heat exchanger tube rupture or thermal expansion) shall not have installed spare.
- If fire case is the governing case where process also requires safety valve, full capacity spare valve shall be provided.
- In general, PSV shall have upstream and downstream isolation valves.
- PSV in IBR steam service shall have no isolation.
- There shall be TWO full flow safety valves for steam generation equipment.
- PSV connected to open system shall have only upstream isolation (other than IBR)
- PSV on spare equipment shall not have spare.
- Dual safety valves on all pressurized storage vessels as per PESO requirement.
- PSV sizing and selection shall be as per guidelines provided in API 520 (parts 1 & 2), API 521, API 526, API 2000, ASME section-1 and IBR design requirements.

12.4 Basis of PSV Overpressure

Overpressure (as percentage of set pressure) for sizing relief valves shall be,

PSV Overpressure table:

S. No.	Contingency	
1	Steam generating / consuming equipment	3% or 5% as per code requirement
2	Fire case	21%
3	Thermal relief (Piping / Equipment)	25% / 10%
4	Operational failures	10%

13. CONTROL VALVES

13.1 Pressure Drop

Unless established by process requirements, control valve pressure drop values shall be calculated as the sum of the following two items, at normal flow rate:

- 20 % of circuit pressure drop, excluding the valve.
- 10 % of the static pressure of the system which the circuit discharges into, for pressures up to 15 Kg/cm2(g) (220 psi g); 1.5 Kg/cm2(g) (22 psi g) for pressures from 15 Kg/cm2(g) (220 psi g) to 30 Kg/cm2(g) (440 psi g); 5 % for pressures over 30 Kg/cm2(g) (440 psi g) (unless the pressure of the system which the circuit discharges into is directly connected with the suction circuit, e.g. reflux pumps). However, the following minimum values shall be specified at design flow rates: for

Control valves on liquid lines

- If upstream and downstream pressure are interdependent: 10 % of circuit pressure drop, or 0.7 Kg/cm2 (10 psi), whichever is greater.
- In all other cases: 5 % of pressure in discharge vessel, or 0.7 Kg/cm2 (10 psi).

Control valves on gas lines

- ΔP min = 0.2 Kg/cm2 (3 psi)

Control valves on reflux and recycle lines where static pressure variations influence the whole circuit shall be sized according to the same minimum values.

The DP for the closed valve shall be preliminary assumed as being equal to upstream design pressure, except for recycle lines such as reflux and recycle Hydrogen.

13.2 Flow-rate

As a general rule, control valves shall be specified for the following operating conditions:

- Maximum flow rate: 110 % of max. operating flow rate or according to connected equipment.
- Minimum flow rate: 40 % of minimum operating flow rate, in order to guarantee correct functioning at the extremes of the operating range.

Control valves shall also be checked in order that allowable noise levels are not exceeded.

13.3 Control Valve Materials

Control valve materials shall be selected according to line materials, taking into account valve operating conditions (flash).

13.4 Seat Leak Requirement

All the control valves discharging to atmosphere, flare, fuel gas or similar system must be specified as tight shut-off (TSO) type (ANSI Class V for liquids, VI for gases).

Control valves in services other than the above shall be specified with a seat leak standard.

On-Off valve connected to flare shall be TSO (leakage class V or better).

13.5 Control Valve Manifold

- As a default, control valves shall be provided with a manifold of upstream / downstream block and bypass valves. Type of bypass valve shall be same as main line control valve. Control valves not having block and bypass provision shall be provided with hand wheel for manual operation.
- The control valve inlet & outlet block valve size shall be same as corresponding line size. The bypass valve and line size shall be same as control valve size.
- Control valve sizes shall be as per Licensor / M-PMC engineering specification. Control valve selection to ensure that control valve shall be capable of operation between all specified flowrates from turndown to rated flow.
- Shut down valves shall not be provided with block and bypass valves.
- Anti-surge valve will not have bypass valves. Only ‘LO’ type isolation valve shall be provided.
- All the control valves shall have isolation valves, drain and bypass valve. Type of Bypass Valve shall be considered same as main line control valve.

13.6 Control Valve Bypass

Bypass shall be provided with the following exceptions:

- Control valve greater than 12” unless specified case by case.
- Normally no flow (NNF) control valve. (E.g. Start-up lines)
- No manual control is possible due to operational / safety reasons.
- Compressor anti surge valves (hand wheel not allowed).

For the above exceptions, isolation block valves, hand wheel (only if manual control is acceptable), drain valve shall be provided for the control valve manifold.

Size of bypass valve to be selected carefully if it has an impact on downstream relief valve (to be specified on datasheet for control valve and impacted relief valve).

13.7 Fail Safe Position

The choice shall be made so as to leave the plant in the safest possible condition following the loss of instrument air and / or electrical power supply:

Control valves which are usually designed to open on failure include (but not limited to):

- Reflux control valves
- Control valves in cooling duty
- Pump minimum flow control valve

Control valves which are usually designed to close on air failure include (but not limited to):

- Control valves on fluids supplying heat to the process
- Control valves on lines entering or leaving the unit
- Level control valves
- Pressure control valves

13.8 Control Valve Vent and Drain

All control valves shall be provided with ¾" drain valves both at upstream and downstream of control valve. For control valves in congealing hydrocarbon service, 1" bleeder shall be provided upstream and downstream of all control valves. This can be decided on case to case basis.

Drain valves shall be blind flanged for all hydrocarbon, hazardous and IBR steam service. Drain valves shall be capped for all non-hydrocarbon & non-IBR service. Control valves bleed / vent connected to flare shall be provided with double block valves.

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14. RELIEF & FLARE SYSTEM

14.1 Relief System Design

Pressure relief systems shall be provided to ensure that equipment within the plant cannot be subjected to pressures beyond its design capacity. Flare headers and blowdown facilities shall be designed for all possible contingencies, discounting any process control or interlocks, which are designed to minimize any releases. The effect of auto-refrigeration during pressure relief shall be considered in the design.

All relief valves in flammable or toxic service shall discharge to the refinery closed flare system; discharge to atmosphere is not permitted other than under exceptional and controlled conditions.

Pressure relief valves shall be designed to accommodate 100% spare capacity to cater for mandatory testing requirements. Relief valves shall be interlocked to facilitate ease of removal and provide continuous on-line protection. Installation valves located between vessels and relief valves or located in relief headers shall be provided with CSO to ensure that they cannot be left in the closed position when the vessel or equipment they are protecting is live.

All relief valves discharging to a closed system and their discharge piping shall continuously slope towards the flare header.

14.2 Flare System

The flare system shall provide a safe collection and disposal route for all hydrocarbon relief and depressurizing flows from the refinery facilities during normal or upset conditions. The relief flows which are typically flammable, toxic and or corrosive, are converted to less objectionable compounds by combustion at elevated flares.

The Flare of NREP shall be connected to dedicated new flare. No interconnecting to the existing refinery flare is envisaged.

There will be dedicated flare systems provided for the following types of flare,

- Hydrocarbon Flare
- Acid Flare

Acid Gas Flare System shall be considered to manage the disposes of the releases containing acid gas from units which include Sulphur Recovery Unit (SRU), Amine Regeneration Unit (ARU) and Sour Water Stripper Unit (SWS).

14.3 Flare System Design

- Vapor releases of all molecular weights to be connected to flare system.
- For adherence to OISD 106, it is recommended that individual unit shall be provided with a flare KOD, whenever significant liquid relief is anticipated from the pressure relieving devices, apart from the main knockout drums at the flare stack. The flare KOD shall be sized to separate out liquid droplets down to a size of 400 microns and liquid relief continue for 15 min as minimum.
- OSBL main flare KOD shall be sized to separate out liquid droplets down to 600 microns.

- API 521 standard shall be adopted for estimating the governing flare loads.
- Flare knock-out drum provided at individual units to be horizontal.
- Purge gas (nitrogen) connection shall be provided in all dead ends of flare header in addition to the normal fuel gas connection for purging. Both Nitrogen and fuel gas connections shall be provided with rotameter for monitoring the flow.
- Flare header shall be sloped towards flare knock-out drum, slope value to be fixed as 1:500.
- 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 only in Horizontal line with stem pointing in downward (preferably) / horizontal position to avoid free fall of gate & blockage of flare line.
- Continuous flow measurement systems to be provided in common stack (OSBL).
- Ultrasonic flow measurement will be provided for flare releases from each unit (ISBL).
- Main flare header commissioning / De-commissioning provision is to be kept.
- Flare water seal drum drain to be diverted to OWS.
- The flare header shall be designed for Mach number of 0.5.

Flare KOD to be equipped with automatic condensate pump out facility designed to handle lightest liquid hydrocarbon likely to be released.

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15. STEAM & CONDENSATE SYSTEM

15.1 Introduction

This document describes the philosophy of the condensate collection and blowdown handling for all process units of the refinery. The system is provided to collect and return steam condensate for use as boiler feed water makeup while blowdown as cooling water makeup to minimize both water and energy consumption.

The designer / Licensor shall adopt this default philosophy towards sizing of equipment generating or consuming Steam:

- Steam turbine drives and ejectors shall be rated based on minimum steam conditions available at unit battery limits. (ISBL pressure and temperature drop to be considered).
- All other steam consuming equipment including heat exchangers shall be thermally rated based on normal steam conditions.
- All steam generating equipment shall be rated based on delivering steam at maximum conditions to the header.
- Normal steam conditions shall be used for operating utility estimates, heat and material balances and battery limit connections.

Condensate recovery will be maximized from process consumers. Segregated / separate system shall be considered for clean condensate and suspect condensate.

15.2 Condensate Control for Steam Consumers

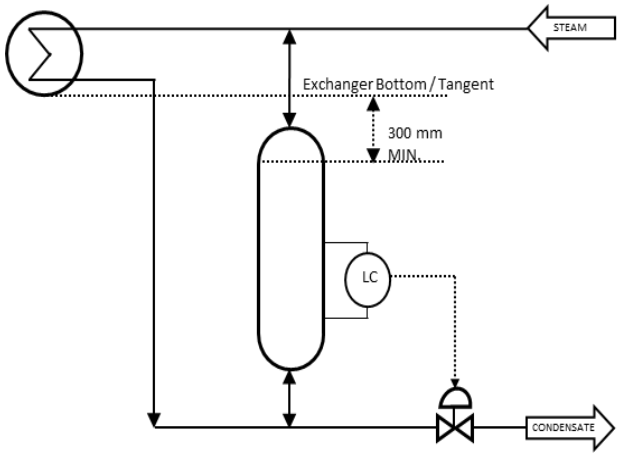
For steam flows up to 1000 kg/hr to a steam-heated exchanger, steam traps shall be considered for condensate removal. For larger consumers, condensate shall be collected in a pot provided with a level control valve for condensate withdrawal. The condensate pot top elevation shall be 300 mm lower than the exchanger bottom tangent line unless warranted otherwise from a process control scheme consideration.

The residence time for condensate in condensate pot shall be 90 seconds minimum.

The Steam condensate handling system is provided to collect and return steam condensate for use as boiler feed water make-up to minimize both water and energy consumption.

Steam condensate is returned in three forms as Suspect Condensate, Pure condensate (NOC), Cold condensate and Tracers/Trap condensate.

Typical Condensate Pot control scheme:



15.3 Suspect Condensate

Suspect condensate is condensate from exchangers and other equipment's where any leakage that might occur would be from the process into the steam / condensate (steam pressure lower than process pressure).

The equipment leak case is remote and unexpected. The steam condensate outlet shall be provided with hydrocarbon analyzer with DCS alarm (high) for leak detection. Suspect condensate is continuously monitored by online analyzer and normally routed to pure condensate collection system.

In case of hydrocarbon analyzer high alarm, Operator shall route condensate to suspect condensate collection system (refer Figure 1). The suspect condensate collected is pumped to condensate polishing (CP) unit for treatments.

15.4 Pure Condensate

Pure condensate is condensate from exchangers and other equipment where any leakage that might occur would be from the steam / condensate system into the process (steam pressure higher than process pressure).

Pure condensate is directly reused for steam generation.

HC analyzer and online conductivity analyzer with DCS alarms shall be provided in pure condensate return header from each unit within ISBL.

15.5 Cold Condensate

Cold condensate is condensate from turbines, which is clean condensate with respect to hydrocarbons, but can be contaminated with salts from cooling water and oxygen from ingressed air.

Surface condenser condensate will be routed normally for steam generation and to CPU (if Suspect with high conductivity) and shall be provided with online conductivity analyzer with DCS alarm (high).

15.6 Tracers / Trap Condensate

Tracers / Trap condensate is condensate from line steam tracing, process steam trap, line steam trap and storage tank / vessel heating coil. Tracers / Trap condensate shall be considered for condensate polishing if feasible. The non-recoverable steam condensates such as line steam trap and steam tracer trap shall be connected CRWS.

15.7 Steam Generator Blow Down Drains

Flash MP and HP blowdown for recovery of LP steam (if adequate steam generation is feasible) and further cool blowdown to 55 °C in cooling water exchanger and route to integrated Effluent Treatment plant for recycle.

15.8 Condensate Collection & Transfer System

The steam condensate recovery shall be maximized from process consumers. High / Medium pressure steam condensate shall be utilized for generating LP steam as much as possible.

HP and MP condensate form the steam consumers are flashed in a vessel. LP steam generated is routed to LP steam header and LP condensate liquid is further flashed to atmospheric pressure at

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condensate drum. The vapors are condensed in a vent condenser to 90 °C and returned to condensate drum. The total condensate from condensate drum is pumped to OSBL condensate header / utilized inside the process unit.

Pure and Suspect condensate routing shall be separate system (refer figure 1).

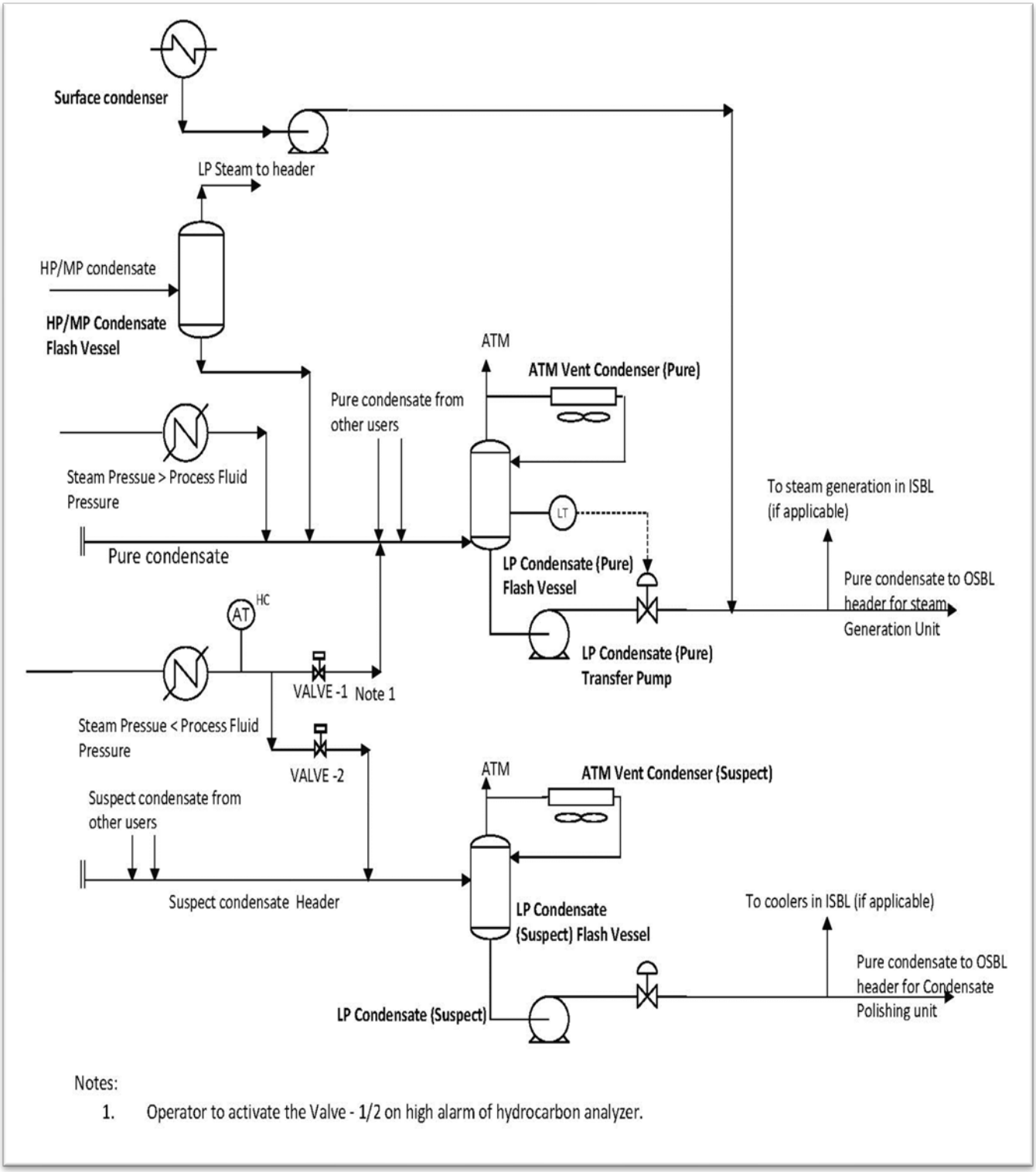

Figure -1 Typical Steam Condensate Collection System

16. IBR REQUIREMENTS

Scope of IBR

Steam generators / steam users shall meet the latest IBR regulations. Major IBR requirements are summarized below:

a) Vessels: Any closed vessel exceeding 25 liters in capacity which is used exclusively for generating steam under pressure and include any mounting or other fittings attached to such vessels, which is wholly or partly under pressure when steam is shut-off.

b) Piping: Any pipe through which steam passes and if:
- Steam system mechanical design pressure exceeds 3.5 kg/cm2(g)

or
- Pipe size exceeds 254 mm internal diameter and having design pressure 1.0 kg/cm2g and above.

c) The following are not in IBR scope
- Steam Tracing
- Heating tubes in tanks
- Steam Jackets
- Heating coils

d) All steam users (heat exchangers, vessels, condensate pots etc.) where condensate is flashed to atmospheric pressure i.e. downstream is not connected to IBR system are not under IBR and IBR specification break is done at last isolation valve or equipment flange upstream of equipment.

e) All steam users where downstream piping is connected to IBR i.e. condensate is flashed to generate IBR steam are covered under IBR.

f) De-aerator, BFW pumps are not under IBR and IBR starts from BFW pump discharge.

g) Safety valves / Relief valves on IBR system will not have isolation valve.

` **Material Certificate:** (This section is only for information on IBR requirement).

- All items which are part of steam piping i.e. pipes, valves, fittings, traps, safety valves must have material certificates, countersigned by the local boiler inspectors.
- For imported items – Certificates issued by an authority empowered by Central Boilers Board (As per IBR) or under the law in force in a foreign country in respect of boilers manufactured in that country may be accepted.
- All drawings coming under preview of IBR shall be certified by Local Boiler Inspector.
- All datasheets of equipment which come under IBR scope shall have the annotation: "IBR is applicable".

17. DRAIN SYSTEM PHILOSOPHY

This document covers the design and operating philosophy for safe handling and disposal of liquid blowdown from various process equipment in the NREP. The closed blowdown and sewer system shall be designed as per OSID Standard 109, latest edition.

In this document," blowdown" shall refer to a liquid stream containing water, oil, chemicals or a combination of two or more of these which are required to be drained from various process equipment under different operating situations like start up, shutdown, normal operation or emergencies.

Continuous draining from process vessel to open funnel shall not be provided due to safety concern.

17.1 Hydrocarbon Drain

All drains from equipment / instruments handling hydrocarbon shall be connected to Closed blow down network(CBD), which shall be buried and lead to a closed blowdown drum, floating on flare pressure. The CBD discharge shall be pumped to slops tank in offsite area and shall not be put into sewers. Vapors from CBD vent shall be directed to flare system.

CBD drum shall be located in RCC pit and sand packed by Vibro compression with lean concrete on top 100 mm thick. The pit shall have a minimum clearance of 500 mm all around the vessel.

Adequate provision shall be provided prevent ingress of liquid into pit and remove any hydrocarbon / liquid accumulation in the pit. The CBD header and drum hall have suitable external protective coating to prevent it from corrosion. Cathodic protection is not required for the buried drum.

17.2 Sizing of Closed Blowdown Drum and Pump

- Dedicated Closed Blowdown drum shall be provided for individual units.
- Closed Blowdown drum shall be sized of minimum of 10 m3 to cater residual drains or to be sized for single largest equipment inventory.
- CBD pump shall be sized adequately to pump out the liquid in maximum of two hours. However, CBD pump of minimum capacity of 10 m3/h for units shall be provided.
- The liquids from the CBD drum is pumped out by pump vertical submersible pumps (1 working+1 ware house spare) which shall be automatic starting and stopping facility on high and low liquid levels in the drum.
- In case of units where unit flare KOD contents are routed to CBD, at least two pumps with independent power supply shall be provided.
- CBD system is designed for 200°C assuming only cooled liquid drains. Intermittent high temperature drainage can be tolerated by system.
- At the dead end of the CBD header steam and/ or inert gas connections shall be provided for proper purging and cleaning of the header. Drum shall be designed for steam out / vacuum condition.
- Underground drain line slope requirements shall be as per civil design basis and shall be designed to prevent any vapor reaching / flashing in the drum.
- Heavy hydrocarbons which tends to solidify under ambient conditions is classified as congealing (Black / Heavy) fluids and lighter hydrocarbons such as Naphtha, Kerosene and Diesel are classified as Non-Congealing (white / Light) fluids.
- Normally CBD drum shall be provided with cooling coils. If congealing hydrocarbon drains combined with non-congealing drains, combined cooling and heating coil to be provided in CBD drum.

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- Separate CBD drums with pumps to be provided for collecting and transferring congealing and non-congealing hydrocarbon drains.
- LPG is drained directly to the flare system.
- Small quantities (check point) and base plate drain of pumps are connected to OWS.
- External corrosion allowance of 1.5 mm shall be considered for buried drain drums.

17.3 Amine Systems

- Amine drains from equipment handling amine solution shall be routed to a dedicated underground Amine blowdown drum (ABD) floating on acid flare and shall not be routed to any other hydrocarbon CBD system.
- Amine blow-down drum shall have oil separation & disposal facility (if required) / LP Steam sparer to remove dissolved H2S, if required.
- Amine blowdown drum shall be provided with submerged pump. Liquid from this drum shall be sent to ARU for reprocessing.
- For design requirement of ABD shall be similar to hydrocarbon CBD.
- Baseplate drains of pumps are connected to OWS.

17.4 Process Sour Waters

- Process sour waters from the units shall normally be routed to sour water stripper.
- Sour water within sour water stripper unit which will have large inventory of sour water will be provided with sour water blowdown drum (floating with acid gas flare system) for any drains.
- Provision for oil disengagement in the drum maybe provided if required and intermittently drained to CBD network.
- The residual low holdup drains (very infrequently) operation during maintenance only will be drained in OWS after dilution.
- Residual drains from instruments may be drained to oily water sewer with adequate safety precautions
- Small quantities and baseplate drain of pumps are connected to OWS. All baseplate drains of pumps are connected to the OWS sewer system.

17.5 Caustic Drain

All bulk caustic inventory drains shall leave process unit under own pressure or be pumped out after degassing. For residual caustic drains such as un pumpable vessel bottoms, level gauge drains, etc.

Drain Philosophy	Yes/No
Provide underground caustic CBD system with buried vessel and pump out	Yes*
Collect residual drains by temporary facility like drums and jars in case of small quantity	No
Collect residual drains by temporary facility and route to neutralization pit. From neutralization pit, it will be sent to OWS.	No
In process unit area, un pumpable caustic shall be recovered in an underground caustic collection vessel and then it will be sent to ETP	No
Drain residual caustic to OWS and flush with clean water	No

* - Common caustic drain system shall be considered on case to case basis.

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17.6 Chemical Drain

Chemicals used in process / utility units shall not be drained to a sewer system and shall be collected in curbed / diked area and disposed safely. Disposal method shall be decided case by case.

Chemicals / RO reject water from DM water unit shall be routed to neutralization PIT and pumped to ETP / CRWS.

17.7 Steam Generator Blow Down Drains

Blowdown from a boiler / waste heat steam generator is done usually at high temperature and high pressure to maintain the water quality for steam generation.

MP or HP blowdowns from steam generators are flashed to low pressure for LP steam recovery and further cool blow down to 55°C in cooling water exchanger and route to CRWS.

17.8 Circulating Fresh Cooling Water Drain

- Drains from cooling water users shall be routed to CRWS.
- Fresh Cooling tower continuous blow down will be connected to ETP directly.
- Water from cooling water back flush shall be routed to CRWS.
- Discharge of TSV shall be routed to CRWS.

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18. FLUSHING OIL SYSTEM & SLOP HANDLING

The slop and flushing oil system of NREP can be distinguished as:

18.1 Flushing Oil Systems

18.1.1 Normal Flushing Oil (FLO)

This is usually gas oil or procured diesel, charged to a header at a moderate pressure, for flushing out equipment, piping and instruments handling congealing liquids. FLO is stored in offsites, either separately or combined with product storage.

Centralized flushing oil system is envisaged

Flushing Oil System Design

- When FLO used as external flush for pump API seal plans, or for purging instruments in congealing service, the FLO needs to be boosted, the pressure becoming known only during detailed engineering.
- The flushing oil requirements are to be assessed, suitable scheme to be considered as applicable during design. During normal operation FLO header shall be pressurized through product run down lines of process units with strainer. Wherever continuous flushing such as pump / instant flushing is required, unit wise system shall be provided with individual vessel and pumps.
- Normally FLO booster system design will be considered (in individual unit) with surge vessel and pump where FLO received from offsite is stored in an adequately sized surge vessel and pumped to required higher pressure with in unit.
- Normal FLO pump and booster FLO pumps drives shall be motor driven.

18.1.2 Heavy Flushing Oil (HFLO)

This is usually straight-run vacuum gas oil cut required only in refinery units having hot, heavy fluid services. HFLO is not stored in offsites because only one cut of vacuum gas oil is selected whereas offsite storage is a mixture of multiple cuts. A centralized system is usually located in the originating or largest consuming unit (to be finalized), charging to a header at a pressure to be determined during detail engineering and at a temperature of around 80 - 110 °C. This HFLO can be used as external flush for those pump API seal plans where FLO cannot be used because of vapor blowout possibilities inside the seals.

During normal operation, HFLO shall be sourced internally within process unit. During startup / shutdown, hookup connection from appropriate external source shall be decided during detail engineering.

18.2 Slop Handling

18.2.1 Wet Slops

Slops originating from CPI, OSBL drain vessels that can contain large quantities of water. Wet slops are routed to the Light slop tank blanketed with nitrogen.

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18.2.2 Light Slops

Flushing oil return from ISBL units handling light hydrocarbons (Diesel and lighter) is routed to the light slops header. The slops from these units, including the slops from the light HC drain vessels are routed to Light slops tank. The water phase is drained under gravity to the OWS, while the oily phase is pumped under flow control to the CDU unit (or to the suction of Crude charge pump) The dry slops tank are also used during startup of the CDU / VDU to store (on spec / off spec) products from this unit.

18.2.3 Heavy Slop

Heavy Flushing oil return from ISBL units handling Heavy / congealing hydrocarbons (heavier than Diesel) is routed to the Heavy slops header. The slops from these units, including the slops from the Heavy HC drain vessels are reprocessed within these units. Any quantity which is not reprocessed within the respective units are routed to Heavy slops tank. The heavy slops tanks are equipped with an LP steam coil for heating the contents of the tank to prevent the segregation of light and heavy hydrocarbons and keep the hydrocarbon in flowing conditions.

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19. ENVIRONMENTAL CONTROL

19.1 CPCB Emission Standards For Furnace & Boilers

a. Emission norms for Furnace, boilers and heaters (As per Air (Prevention and Control of Pollution) Act, 1981 and its subsequent amendments)

Parameter	Firing Mode	Limiting concentration (mg/Nm3)
Sulphur Dioxide (SO2)	Gas	50
Oxides of Nitrogen (NOx)	Gas	250
Particulate Matter (PM)	Gas	5
Carbon Monoxide (CO)	Gas	100

1) All the furnaces / boilers with heat input of 10 million kilo calories/hour or more shall have continuous systems for monitoring of SO_2 and NOx. Manual monitoring for all the emission parameters in such furnaces or boilers shall be carried out once in two months.

2) All the emission parameters in furnaces / boilers having input less than 10 million kilo calories / hour will be monitored in three months.

3) In case of continuous monitoring, one hourly average concentration values shall be complied with 98% of the time in a month. Any concentration value obtained through manual monitoring, if exceeds the limiting concentration value shall be considered as non-compliance.

b. Emission norms for FCC Regenerators (As per Air (Prevention and Control of Pollution) Act, 1981 and its subsequent amendments):

Parameter	Limiting Concentration (mg/Nm3) for New refinery units
Sulphur Dioxide (SO2)	500 (for hydro-processed feed) 850 (for other feed)
Oxides of Nitrogen (NOx)	350
Particulate Matter (PM)	50
Carbon Monoxide (CO)	300
Nickel and Vanadium (Ni+V)	2
Opacity, %	30

Notes:

1) In case part feed is hydro-processed, the emission values shall be calculated proportional to the feed rates of untreated and treated feeds.

2) FCC regenerators shall have continuous system for monitoring of SO_2 an NOx. One hourly average concentration values shall be complied with 98% of the time in a month, in case of continuous monitoring. Manual monitoring for all the emission parameters shall be carried out once in two months.

3) Any concentration value obtained through manual monitoring, if exceeds the limiting concentration value, shall be considered as non-compliance.

4) Data on Sulphur (wt%), Nickel (PPM) and Vanadium (PPPM) content in the feed to FCC shall

be reported regularly.

5) Limit of Carbon Monoxide emissions shall be complied within except during annual shutdown of CO boiler for statutory maintenance.

c. Emission norms for Sulphur Recovery Units (As per Air (Prevention and Control of Pollution) Act, 1981 and its subsequent amendments):

Parameter	Capacity (tonnes/day)	Limiting values for New SRU
Sulphur recovery, %	Above 20	99.5
H2S, mg/Nm3		10
Sulphur recovery, %	5-20	98
Sulphur recovery, %	1-5	96
Oxides of Nitrogen (NOx), mg/Nm3	All capacity	96
Carbon Monoxide, mg/Nm3	All capacity	100

Notes :

1) Sulphur recovery units having capacity above 20 tonnes per day shall have continuous systems for monitoring of SO2. Manual monitoring for all the emission parameters shall be carried out once in a month.

2) Data on Sulphur Dioxide emissions (mg/Nm3) shall be reported regularly.

3) Sulphur recovery efficiency shall be calculated on monthly basis, using quantity of Sulphur in the feed to SRU and quantity of Sulphur recovered.

19.2 Aromatics Handling

Special precautions will be applied towards handling process streams containing aromatics. Threshold values for applying special precautions are:

- Benzene content greater than 1% weight.
- Aromatics greater than 25% weight.

The design and equipment provisions toward special precautions shall be:

- Sampling points as defined in standard legend P &ID
- Dual mechanical seals for pumps
- Connecting the following to the unit closed blowdown system as possible:

Requirements	
Vessel drains	Yes
Pump drains	Yes
Level gage, level instrument & Standpipe drains	Yes
Control valve drains	Yes
Drains of equipment (isolated for maintenance)	Yes
Special Gas detectors (e.g Benzene detectors) installed at strategic locations	Yes

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19.3 General Considerations

- Low NOx burners shall be used in all furnaces.
- Emission from the stacks shall be as per the norms as stipulated by CPCB and other mandatory regulations.
- Emission from the project will be such that the National Ambient Air Quality standards are met outside battery limits.
- The hazardous waste generated shall comply with Hazardous Waste (Management & handling) Rules, 2016.
- Liquid effluent generated shall conform to MINAS standards.
- All unit designers have to necessarily furnish complete effluent characteristics as defined in the section 18.5
- **Noise level:**
  - 85 dB(A) at 1 meter from source
  - 75 dB(A) daytime and 70 dB(A) night time at the fence.
- **Relief /Depressurization:**
  - For PSV relief / depressurization allowable noise to be 115 dB(A)
  - For Control valve releasing to atmosphere, noise limit shall be 85 dB(A)
- Online Continuous Emission Monitoring System (OCEMS) shall be provided with Remote calibration facility. This is required for data verification / validation by SPCB's / PCC's.

19.4 Stacks

- Stacks shall be individually mounted on each heater unless there are considerations such as grade mounted APH or combined APH for group of heaters.
- Minimum fired heater stack height for various heater shall be higher of indicated heights in respective unit documents or as calculated in the formula below :
  - Height (H) of stack from Grade : 60 m or
  - Stack height using formula H=14(Q)0.3 (where H is stack height, meters and Q is total SO2 emission, kg/hr) shall also be calculated and if it is higher than that indicated above, same shall be adopted.
- Top of stack shall be at least
  - 5 m higher than highest working platform within radius of 30 m
  - 3 m higher than highest working platform for radius of 30-50 m
- The maximum height of stack is not to exceed ___m (Not Applicable)
- For pollution monitoring, 6" NB size (with 1" inside lining) sampling nozzle shall be provided on the stack as per Central Pollution Control Board guidelines:
  - 4 nozzles for stack diameter >2.0m
  - 2 nozzles for stack diameter <= 2.0 m
  - 1 number isokinetic nozzle at 500 mm above and 90 °C to SPM analyser at stack.
- All sampling point should be accessible and adequate platform to be provided for the same.

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19.5 Effluent Data

19.5.1 Gaseous Effluent Data

To be filled by Licensor / Detailed engineering Contractor

Description	Unit of Measurement
Source/Originating Point	
Type of Emission (Fugitive/Stack)	
Flow rate	m^3/hr
Type of Flow (Cont./Intermit)	
Frequency and Duration If Intermittent	
Height of Stack/Source	m
Diameter of Stack (TIP)	m
Temperature of Gases	°C
Pressure	kg/cm^2a
Mol. Weight of Gases	
Density of Gases	Kg/m^3
Viscosity of gases	cP
Exit Velocity of Gases	m/sec
Composition of Gases (WT%)	
Hydrocarbons (HC)	
CO (Carbon monoxide)	
CO2 (Carbon Dioxide)	
SO2 (Sulphur Dioxide)	
N2S (Nitrogen sulphide)	
SO3 (Sulphur oxide)	
NOx (Oxides of Nitrogen)	
N2 (Nitrogen)	
O2 (Oxygen)	
H2O (Water vapours)	
Any other component (Chemical Composition)	
Suspended particulates matter (SPM)	
Density & Bulk Density	Kg/m^3
Dust Load	g/m^3
Nature of Dust	
Amorphous	
Crystalline	
Needle shaped	
Fibrous	
Metallic	
Particle Size Distribution (wt%)	
Up to 5 microns	
5-20 microns	
20-40 microns	
40-80 microns	
Above 80 microns	

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19.5.2 Aqueous Effluent Data

To be filled by Licensor / Detailed engineering Contractor

Description	Unit of Measurement
Source / Originating Point	
Flow Rate (Average/Peak)	m^3/hr
Frequency of flow	Continuous / Intermittent
Duration if Intermittent	Hours / day
Temperature	°C
Color/ Odor	
Pressure	Kg/cm^2g
Sp. Gravity	
Viscosity	cP
Vapor Pressure	Kg/cm^2a
pH	
BOD, 20 °C	mg/lit
COD	mg/lit
Suspended Solids	mg/lit
Sp. Gravity of solids	
Particle size	Microns
Total Dissolved solid	mg/lit
Volatile matter	mg/lit
Total Oil content	mg/lit
Viscosity of oil	cP
Phosphates	mg/lit
Sulfates	mg/lit
Chlorides	mg/lit
Fluorides	mg/lit
Nitrates	mg/lit
Total Nitrogen	mg/lit
Free/Fixed Ammonia	mg/lit
Cyanides	mg/lit
Sodiumates	mg/lit
Calcium	mg/lit
Magnesium	mg/lit
Phenolic Compounds	mg/lit
Heavy Metals	mg/lit
Chromium	mg/lit
Nickel	mg/lit
Lead	mg/lit
Zinc	mg/lit
Mercury	mg/lit
Any other	mg/lit
Emulsified oil	
Chemical Composition	% wt.

12.1.1 Solid Effluent Data

To be filled by Licensor / Detailed engineering Contractor

Description	Unit of Measurement
Source/Originating Point	
Quantity of Solid Waste	
Quantity of Solid Waste	Kg/day
Continuous/Periodical	
Frequency & Duration, if periodical	
Temperature	
Density	
Physical Condition (Slurry / Sludge/Powder/ Lumps)	
Viscosity, If slurry/sludge	
Nature of Waste (Hazardous/Toxic/Explosive/ Corrosive/Abrasive/Radioactive)	
Calorific Value	Kcal/kg
Chemical Composition	Wt%
Volatile Matter	Wt%
Moisture Content	Wt%
Recycling of Waste Required	Yes/No
Recovery of Valuable component	Yes/No
Schemes of Reuse/Recycle	
Sale value of Waste	Rs./Ton
Availability of Land for Disposal	Yes/No
Leachate Characteristics (If Slurry)	

ATTACHMENT-1

BASIC ENGINEERING DESIGN DATA

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1. LOCATION

Country	India
State	Assam
District	Golaghat
Town/City	Numaligarh
Plant site co-ordinates	Longitude 93º 43' 30" E & Latitude 26º 37' 30" N
Site altitude	90.4m above MSL

2. SITE DATA

2.1 Climatic Conditions

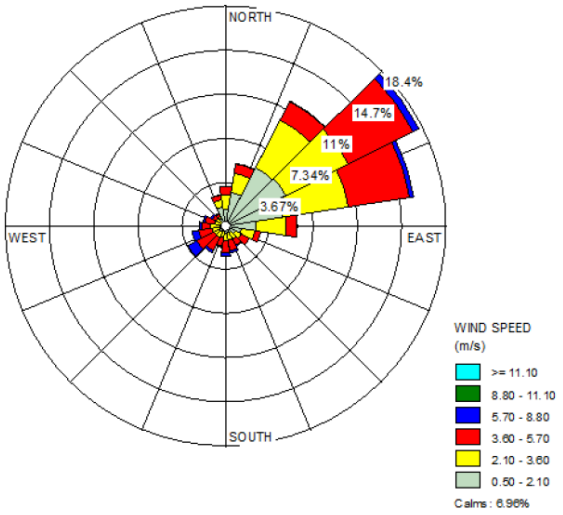
Ambient temperature: Normal Minimum Maximum Design	 35 °C 5 °C 38 °C 65 / 5 °C	
Design Minimum Temperature (MDMT):	5 °C	(Note 1)
Winterizing temperature:	5 °C	(Note 2)
Relative humidity:	85% at 35 °C	
Design dry bulb temperature: (for other design activities including HVAC)	35 °C	
Design wet bulb temperature: (for other design activities including HVAC)	27 °C	
Design Air temperature for air cooled exchangers where followed by water cooling	35 °C	
Design Air temperature for air cooled exchangers where not followed by water cooling	35 °C	
Design Air temperature for GT's / Boiler	35 °C	
Coincident relative humidity , % and temperature °C for Air Blower / Air Compressor/ GT / Boiler	85% at 35 °C	
Barometric pressure: Normal:	994.7 mbar(a)	
The design temperature for a surface exposed to direct sunshine	65°C	
Rainfall data for 1-hour period	90 mm (max)	
Rainfall data for 24-hour period	160 mm (max)	

	(rainy season is from April to September)	
Maximum Recorded flood level.	To be defined later	
Earthquake Design factor	(Code IS-1893 Zone-V/ Site spectra whichever is governing) As per IS 1893, Seismic factor Z = 0.36	

Note 1: Used as MDMT (Minimum Design Metal Temperature), unless otherwise specified.
Note 2: Used for tracing requirement.

2.2 Wind

- Direction of prevailing wind predominantly: As per wind rose, refer Civil Engineering Design Basis
- Velocity to be used for insulation: 36 km/hr (10 m/s) or as per IS-875 whichever is higher.
- Velocity to be used for Flare radiation calculation: 36 km/hr (10 m/s).
- Wind Velocity, max: 140 km/hr
- Wind Direction: NE to SW



Primary wind rose diagram

2.3 Environment Condition

- Corrosive Industrial Environment : Yes
- Extreme Moisture (Tropical Climate) : Yes
- Marine Exposure (salt spray) : No
- Exposure to pollutants originating from surrounding industrial plant : No
- Thunderstorm Frequency : Yes (High)
- Basic wind speed, Vb : 50 m/sec as per IS875 Part 3 : 2015
- Terrain category for K2 : Category 2, As per Code IS875 Part 3 : 2015
- K3 factor, Ka,Kc,Kd : As per Code IS875 Part 3 : 2015

3. SYSTEMS (UNITS) OF MEASUREMENT

This following table indicates the units of measurement to be used for the Numaligarh Refinery Expansion Project.

Parameter	Preferred unit	Alternate unit
Ampere hours	ampere-hours	
Angle	deg	
Apparent power	VA	
Area	m^2	
Composition -Gas/Vapor	Mol % or Vol%	ppmv
Composition -Liquid	Wt%	ppmw
Current Density	A/m^2	
Date	DD-MM-YYYY	
Electrical Conductivity	µS/cm	
Electrical Current	A	
Electrical Conductance	S	
Electrical potential	V	
Electrical resistance	ohm	
Enthalpy	Kcal/kg	
Entropy	kcal/kg-°C	
Flow Rate (gas)	Nm^3/hr	
Flow Rate (liquid)	m^3/hr, Sm^3/hr	Kg/hr (or) l/hr
Flow Rate (mass)	Kg/hr	T/hr
Flow Rate (steam)	Kg/hr	T/hr
Force	N	
Fouling resistance	m^2 °C hr/Kcal	
Furnace draft	mmWC	
Heat	Kcal	
Heat rate	MMKcal/hr	Gcal/hr
Heat transfer coefficient	Kcal/hr-m^2-°C	
Inertia	Kg/m2	
Length	mm	M
Liquid density	Kg/m^3	
Liquid relative density	Sp. Gr. T°C/15°C	
Mass	Kg	
Mass per length	kg/m	
Pipe diameter	in	
Plant Capacity	T/hr	m^3/hr, TM/MMTPA
Power	kW	MW
Pressure (absolute)	Kg/cm^2 (a)	
Pressure (gauge)	Kg/cm^2 (g)	
Pressure (vacuum)	mmHg	mmWC
Reactive power	VAR	

Resistance per length	Ohm/m	
Sound Pressure Level	dBA	
Specific heat	Kcal/kg °C	
Standard liquid	Sm^3/hr @ 15°C& 1.033 kg/cm^2 (a)	
Standard vapor	Nm^3/hr @ 0°C & 1.033 kg/cm^2 (a)	
Stress	N/m^2	
Storage tank pressure	mmWC (g)	kg/cm^2 (g)
Surface Tension	N/m	dynes/cm
Temperature	°C	
Thermal conductivity	Kcal/hr-m-°C	
Thermal Expansion	$°C^{-1}$	
Thickness	mm	
Time	hr	Sec, min
Torque	N-m	
Vacuum	mmWC	mmHg
Vapor Flowing density	Kg/m^3	
Velocity, linear	m/s	km/hr
Velocity, angular	rpm	
Vessel nozzle sizes	in	
Viscosity, Dynamic	cP	
Viscosity, kinematic	cSt	
Volume (gases/liquid)	m^3	

4. UTILITY CONDITIONS & SPECIFICATIONS

4.1 Utility Conditions

Unless and otherwise specified, utility conditions are at unit battery limits [All B/L pressure are as measured at grade]

S.No.	Parameter	Minimum	Normal	Maximum	Mech Design
1	**HIGH PRESSURE (HP) STEAM**				
	Pressure, kg/cm^2(g)	39	40	42	47 / FV
	Temperature, °C	415	454	460	480
2	**MEDIUM PRESSURE (MP) STEAM**				
	Pressure, kg/cm^2(g)	13.5	14.5	15.0	16.5 / FV
	Temperature, °C	215	220	225	240
3	**LOW PRESSURE (LP) STEAM**				
	Pressure, kg/cm^2(g)	3.5	4.0	4.5	6.5 / FV
	Temperature, °C	150	165	170	200
4	**CONDENSATE RETURN (PURE & SUSPECT / SURFACE)**				
	Pressure, kg/cm^2(g)	-	6.0	-	12 / FV
	Temperature, °C	-	90	-	150
5	**SERVICE WATER**				
	Pressure, kg/cm^2(g)	4.0	4.5	5.0	12
	Temperature, °C	Amb.	Amb.	Amb.	65
6	**DRINKING WATER**				
	Pressure, kg/cm^2(g)	4.0	4.5	5.0	8
	Temperature, °C	Amb.	Amb.	Amb.	65
7	**COOLING WATER (Note A)**				
	Supply Pressure, kg/cm^2(g)	4.5	5.0	5.5	10.5
	Return Pressure, kg/cm^2(g)	2.5	3.0	3.5	10.5
	Supply Temperature, °C	-	33	35	65
	Return Temperature, °C	-	45	45	65

8	**DM WATER**				
	Pressure, kg/cm^2(g)	5.0	5.5	6.0	12
	Temperature, °C	Amb.	Amb.	Amb.	65
9	**BOILER FEED WATER (HP / MP)**				
	Pressure, kg/cm^2(g)	-	60/ 30	65 / 31.5	85 / 44
	Temperature, °C	-	105 / 105	110 / 110	150 / 130
10	**FIRE WATER**				
	Pressure, kg/cm^2(g)	7.0	10.5	-	15
	Temperature, °C	Amb.	Amb.	Amb.	65
11	**PLANT AIR**				
	Pressure, kg/cm^2(g)	4.5	5.5	6.5	10.5
	Temperature, °C	Amb	Amb	45	65
12	**INSTRUMENT AIR**				
	Pressure, kg/cm^2(g)	4.0	4.5	5.5	10.5
	Temperature, °C	Amb	Amb	45	65
13	**NITROGEN**				
	Pressure, kg/cm^2(g)	4.0	4.5	5.0	9
	Temperature, °C	-	Amb.	-	65
14	**HYDROGEN (EXPORT FROM HGU)**				
	Pressure, kg/cm^2(g)	18.5	19.0	20.5	22.5
	Temperature, °C	-	45	-	150
15	**IGGL NATURAL GAS (Note B)**				
	Pressure, kg/cm^2(g)	35	45	55	92
	Temperature, °C	0	Amb.	Amb.	65
16	**REFINERY FUEL GAS (Note B)**				
	Pressure, kg/cm^2(g)	3.0	3.5	4.5	7
	Temperature, °C	Amb.	Amb.	Amb.	65
17	**SOUR WATER @ SWS B.L**				
	Pressure, kg/cm^2(g)	5.0	5.5	9.0	16.2
	Temperature, °C	-	51 - 55	-	85

18	**STRIPPED SOUR WATER**				
	Pressure, kg/cm^2(g)	-	6.0	-	15
	Temperature, °C	-	40 - 65	-	100
19	**DILUTED CAUSTIC (15wt%)**				
	Pressure, kg/cm^2(g)	-	4.0	-	8
	Temperature, °C	-	40	-	65
20	**SPENT CAUSTIC**				
	Pressure, kg/cm^2(g)	-	6.0	-	13
	Temperature, °C	-	38	-	65
21	**RICH AMINE @ ARU B.L**				
	Pressure, kg/cm^2(g)	-	4.5	-	16
	Temperature, °C	-	50	-	120
22	**LEAN AMINE**				
	Pressure, kg/cm^2(g)	-	10.5	-	16
	Temperature, °C	-	45	-	120
23	**FLUSHING OIL**				
	Pressure, kg/cm^2(g)	3.0	-	-	10
	Temperature, °C	40	-	-	65
24	**CLEAN CONDENSATE SUPPLY**				
	Pressure, kg/cm^2(g)	-	5.0	-	12
	Temperature, °C	-	90	-	150

Note

A. CW Supply and Return temperature shall be used consistently. For design purpose the cooling water supply / return temperature shall be considered as 35 / 45 ˚C respectively.

B. **IGGL Natural gas is used for producing Hydrogen in HGU.** Refinery Fuel gas is consumed in all the furnaces within the process units, steam and power generation systems. Additional requirement is met by IGGL Natural gas.

4.2 Utility Specification

4.2.1 Service Water Specification

Quality	Units	Normal
pH		7.24
Total hardness as $CaCO_3$	mg/l	146.38
Calcium as Ca	mg/l	21.5
Magnesium as Mg	mg/l	22.54
TDS	mg/l	223
Total Alkalinity	mg/l	123
Total Suspended solids	mg/l	5
Chloride as Cl	mg/l	28.6
Sulphate as SO4	mg/l	12.8
Turbidity in NTU		
Conductivity	µS/cm	346
Iron as Fe	mg/l	0.13
Silica	mg/l	13-18

4.2.2 DM Water Specification

Quality	Units	Design
pH		8.5-9.5
Total hardness as $CaCO_3$	mg/l	Nil
Total Silica as SiO_2	mg/l	< 0.02 (max)
Total iron as Fe	mg/l	0.01 (max)
Total Copper, as Cu		-
Oil Content		Nil
Conductivity at 25 °C	µS/cm	< 0.2 (max)

4.2.3 Boiler Feed Water Specification

Quality	Units	Design
pH		8.5-9.5
Total hardness as $CaCO_3$	mg/l	Nil
Total Silica as SiO_2	mg/l	< 0.02 (max)
Total iron as Fe	mg/l	0.01 (max)
Total Copper, as Cu		-
Oil Content		Nil
Conductivity at 25 °C	µS/cm	< 0.2 (max)
Oxygen	mg/l	< 0.005 (max)

4.2.4 Cooling Water Specification

Quality	Units	Normal
pH		7-8
Total hardness as $CaCO_3$	mg/l	732
Calcium as Ca	mg/l	108
Magnesium as Mg	mg/l	113
TDS	mg/l	1115
Total Suspended solids	mg/l	50
Chloride as Cl	mg/l	143
Sulphate as SO4	mg/l	45
Turbidity in NTU		
Conductivity	µS/cm	1730
Iron as Fe	mg/l	0.50
Silica	mg/l	65-90

4.2.5 Nitrogen Specification

Quality	Design
Nitrogen Purity	99.99 vol% minimum
O_2 Content	5 ppmv maximum
CO_2 Content	1 ppmv maximum
CO Content	Nil
Quality	Dry & Oil free
Dew point	-100 °C
Oil Content	Nil

4.2.6 Plant Air Specification

Quality	Design
Dew Point (Ambient)	Saturated
Oil Content	Nil
Quality	Dust free

4.2.7 Instrument Air Specification

Quality	Design
Dew Point (Ambient)	-40 °C @ atmospheric pressure
Oil Content	Nil
Quality	Dust free

Note:

Instrument Air Buffer volume: Instrument air receiver holdup time shall be sized adequately for minimum 30 mins of supply after power failure to facilitate safe shut-down of the unit.

4.2.8 Refinery Fuel Gas Specification

Composition	Case -1 (mole %)	Case -2 (mole %)
H_2O	1.23	1.38
O_2	0.37	0.55
N_2	6.93	5.46
CO	NIL	NIL
CO_2	0.92	0.55
Hydrogen	23.37	27.84
Methane	32.42	34.71
Ethane	14.20	16.44
Ethylene	14.75	6.57
Propane	2.48	3.20
Propene	0.75	0.28
i-Butane	0.19	0.25
n-Butane	0.83	1.05
1-Butene	0.25	0.11
i-Pentane	0.00	0.00
n-Pentane	1.30	1.61
Total	**100**	**100**
H_2S ppm	**100 (max)**	**100 (max)**
LHV (Kcal/Kg)	10308	10636
Average MW	19.85	18.62

4.2.9 IGGL Natural Gas (R-LNG) Specification

Components	mole%
Water	Note-1
Nitrogen	0.028
Methane	93.670
Ethane	6.099
Propane	0.164
i-Propane	
n-Butane	0.019
i-Butane	0.021
H_2S, ppm, wt	5 (max)
Total Sulphur, ppm, wt	10 (max)
Specification	
LHV (Kcal/kg)	11860
Gas MW (kg/kmol)	16.96 (Note-1)

Notes:

1. Moisture content in natural gas is Nil. However, for design, pipeline spec of 80 kg moisture/ MMSCM of Natural gas to be considered.

From other source:

R-LNG from Dahej / Dhamra is proposed to be transported through JHBDPL/BGPL for gas injection point to the North-East gas Grid at Guwahati

Refer below table for Gas composition

Gas Components	mole%
C1	98.34
C2	1.5
C3	0.02
i-C4	0
n-C4	0
i-C5	0
n-C5	0
C6+	0
N2	0.12
CO2	0.02
Total	**100**

4.2.10 Hydrogen Specification

The source of hydrogen for the Refinery is provided by the Hydrogen Generation Unit (HGU).

Components	Volume
Hydrogen	99.50 %
Nitrogen	500 ppmv (max.)
Chlorine + Chlorides	1 ppmv (max.)
CO + CO_2	20 ppmv (max.)
CO	10 ppmv (max.)
Water	20 ppmv (max.)
Methane	Balance

4.2.11 Amine Specification

S.No	Parameter	Design
1	Amine Strength	35wt% MDEA
2	Lean amine Loading	0.015 mole of acid gas/ mole of MDEA (max)
3	Rich amine Loading	0.4 mole of acid gas / mole of MDEA (max)

4.2.12 Stripped Sour Water Specification

S.No	Parameter	Design
1	Free H2S	<50 ppmw (max)
2	Free NH3	<50 ppmw (max)

4.2 Economic Aspect

S.No	Utility	Unit	Price (Rs.)
1	Power	Kwh	6.5
2	VHP Steam	MT	3327
3	HP Steam Import	MT	3161
4	MP Steam Import	MT	3003
5	HP Steam Export	MT	2845
6	MP Steam Export	MT	2402
7	LP Steam Import	MT	2823
8	LP Steam Export	MT	0.0
9	Treated Fuel Gas	MT	31942
10	BFW	M3	485
11	Circulating / Cooling water	M3	1.1
12	DM water	M3	86
13	Raw water	M3	3.23
14	Nitrogen	Nm3	12.41
15	Plant Air	Nm3	1.0

4.3 Flare Back Pressure

A new HC flare and acid gas flare system is expected for this expansion project. Maximum flare backpressure shall be considered for sizing of pressure relief devices as follows:

S. No.	Flare system	Superimposed backpressure (kg/cm^2g)	Built-up backpressure at unit battery limits (kg/cm^2g)	Built-up backpressure at PSV outlet (kg/cm^2g)
1	HC Flare (LP Flare)	0.1	1.4	1.7
2	Acid Gas Flare	0.1	0.5	0.7

Notes :

1) Built-up back pressure at PSV outlet shall be estimated based on location of PSV within the unit.

2) Design conditions of new flare networks.

HC Flare:

Design Pressure 3.5 kg/cm2(g)

Design Temperature 320 °C (Hold) (Fire cases are not considered)

Acid Gas Flare:

Design Pressure 3.5 $kg/cm^2(g)$

Design Temperature 200 °C (Hold)

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ENGINEERING DESIGN BASIS

(GENERAL CIVIL)

JOB NO.	C050
PROJECT NAME	EPCM SERVICES FOR 360 KTPA PPU AT NRL
CLIENT NAME	NUMALIGARH REFINERY LIMITED

EIL SIGNATURE:

CLIENT SIGNATURE: 3/9/25

Rev. No.	Date	Purpose	Prepared by	Reviewed by	Approved by
1	29.08.2025	Revised & Re-Issued for Client's Approval	SJ/VMF	GYAS	SKN
0	13.08.2025	Comments Incorporated & Issued for Client's Approval	SJ/VMF	GYAS	SKN
A	24.03.2025	Issued For Client's Comment/ Approval	SJ/VMF	GYAS	SKN

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ABBREVIATIONS

Abbreviation	Description
3LPE	3 Layer Polyethylene
A/G	Aboveground
CBR	California Bearing Ratio
CRWS	Contaminated Rain Water Sewer
CS Pipe	Carbon Steel Pipe
DGCA	Director General of Civil Aviation
ERC/ IRC	Electrical/ Instrumentation Road Crossing
ETP	Effluent Treatment Plant
FGL	Finished Ground Level
GI	Galvanized Iron
HDPE	High Density Polyethylene
HFL	High Flood Level
HPP	Highest Pavement Point
IMD	Indian Meteorological Department
IRC	Indian Road Congress
MoRTH	Ministry of Road Transport & Highway
msa	Million Standard Axle
MSL	Mean Sea Level
OISD	Oil Industry Safety Directorate
OWS	Oily Water Sewer
PCC	Plain Cement Concrete
PESO	Petroleum Explosives & Safety Organization
PMS	Piping Material Specification
PVC	Polyvinyl Chloride
PWB	Pipe-way Bridge
QRA	Quantitative Risk Analysis
RCC	Reinforced Cement Concrete
RRA	Rapid Risk Analysis
RWTP	Raw Water Treatment Plant
SCRC	Street Cable Road Crossing
SRR	Satellite Rack Room
U/G	Underground
uPVC	Unplasticized Polyvinyl Chloride
WMM	Wet Mix Macadam
WBM	Water Bound Macadum

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1.0 SCOPE

This document covers Engineering Design Basis for General Civil works such as Overall Plot Plan, compound wall, fencing, site grading, roads, pavements, storm water drainage, water supply, waste collection & disposal system, cooling tower, underground piping works etc.

Order of Precedence:

I. Statutory Provisions
II. P&IDs
III. Engineering Design Basis
IV. IS Codes/ IRC Codes

1.1 STATUTORY NORMS, CODES, STANDARDS & PUBLICATIONS

STATUTORY PROVISIONS

- Environmental Guidelines for setting of Industry published by Ministry of Environment, Forest and Climate Change (MoEFCC)
- Petroleum Rules (for Hydrocarbon Storage under Chief Controller of Explosives of PESO)
- The Static and Mobile Pressure Vessels (unfired) rules (SMPV)- (For Pressure Storage of gases under Chief Controller of Explosives)
- Director General of Civil Aviation Rules

1.2 CODES & STANDARDS

S.NO.	DESCRIPTION	STANDARDS/ CODES
1	CIVIL WORKS	
1.1	Code of practice for plain and reinforced concrete	IS: 456
1.2	Precast Concrete Pipes (With and Without Reinforcement) - Specification	IS: 458
1.3	Code of practice for general construction in steel	IS: 800
1.4	Code of practice for design loads (Other than earthquake for buildings & structures	IS: 875
1.5	Code of basic requirements for water supply, drainage & sanitation	IS: 1172
1.6	Specification for Hard-drawn Steel Wire Fabric for Concrete Reinforcement	IS: 1566
1.7	Code of practice for building drainage	IS: 1742
1.8	High Strength Deformed Steel Bars and Wires for Concrete Reinforcement - Specification	IS: 1786
1.9	Code of practice for structural use of unreinforced masonry.	IS: 1905
1.10	Code of practice for water supply in buildings	IS: 2065
1.11	Code of practice for brick work	IS: 2212
1.12	Code of practice for installation of septic tanks	IS: 2470
1.13	Code of practice for concrete structures for storage of liquid	IS: 3370
1.14	Code of practice for ancillary structures in sewerage system	IS: 4111
1.15	Chemical Resistant Mortar-Silicate type	IS: 4441

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1.16	Chemical Resistant Mortar-Sulphur type	IS: 4442
1.17	Chemical Resistant Mortar-Resin type	IS: 4443
1.18	Testing of Mortar	IS: 4456
1.19	Chemical Resistant Mortar (Parts | to III)	IS: 4832
1.20	Specification for high density polyethylene pipes for potable water supplies	IS: 4984
1.21	Unplasticized PVC Pipes for Potable Water Supplies - Specification	IS: 4985
1.22	Guidelines for design of surface drains	IS: 8835
1.23	Specification for precast concrete septic tanks	IS: 9872
1.24	Specification for UPVC pipes for soil and waste discharge systems inside buildings including ventilation and rainwater system	IS: 13592
1.25	Unplasticized Non-Pressure Polyvinyl Chloride (PVC - U) Pipes for use in Underground Drainage and Sewerage Systems - Specification	IS: 15328
1.26	Codes for roads	IRC Codes & MORTH specifications
2.0	OISD STANDARDS & GUIDELINES	
	Layouts for Oil and Gas Installations	OISD -118
	Design and Safety Requirements for Liquefied Petroleum Gas Mounded Storage Facility	OISD - 150
	Safety of Control Room for Hydrocarbon Industry	OISD - 163
	Liquefied Petroleum Gas (LPG) Installations	OISD - 144
	Cross Country LPG Pipelines	OISD - 214
	Fire Prevention and Protection System for Electrical Installations	OISD – 173
	Process Design and Operating Philosophies on Blow Down & sewer system	OISD – 109
	Storage and handling of Petroleum Products at depots and terminals including standalone crude oil storage facilities	OISD - 224
	Design, Layout, Operation & Maintenance of Refrigerated LPG Storage	OISD - 236
	Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Petroleum Refineries and Gas Processing Plants) Regulations, 2023	PNGRB T4S, 2023
	Process Licensors requirement, if any	

Note: Where Indian codes are not available, any other suitable international code shall be referred. All codes & standards shall be latest revision with all amendments issued thereto.

1.3 REFERENCED PUBLICATIONS:

I. The Environmental Act, 1948
II. The Environmental Protection Act, 1986
III. Home Ministry Circular (for perimeter wall)
IV. Process Licensors requirement, if any
V. CTI Blue book Fulkerson's method

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VI. CTI code ATC-105 Acceptance Test Code for cooling tower

2.0 RAINFALL DATA

S. No.	Philosophy
1	Design Rainfall Intensity – As per IMD (HOLD)

3.0 OVERALL PLOT PLAN

a) The Overall Plot Plan shall be developed based on good engineering practices and meeting the requirements of various statutory bodies and local authorities.

b) The Overall Plot Plan shall meet the applicable requirements of OISD standards/ guidelines.

c) The requirements of DGCA shall be applicable for the plants in the vicinity of the airports

d) The Overall Plot Plan shall be offered to the Owner for approval after completing the in-house approvals. After receipt of the Owner's approval, the Overall Plot Plan shall be issued for further engineering and statutory approvals.

4.0 SITE GRADING

I. All the tree roots and vegetation shall be grubbed up and removed from site.

II. The grading of the area shall be done by cutting and filling with the following:

Cutting area	Thoroughly rolled and compacted
Filling area	Compacted in layers not exceeding 30 cm in loose thickness to achieve min. 90% of max. laboratory dry density as per IS:2720 Part-VII

III. HFL : HOLD

IV. Plant FGL : xx m (Shall be finalized after survey)

V. Unit HPP : 0.4 m above FGL

VI. Green Belt Area : As per Environment Clearence (EC) requirement.

VII. Slope in Graded Areas:

a)	General Site Grading	1 in 500 to 1 in 1500
b)	During micro grading, after completion of major construction (for road corridors)	1 in 200 to 1 in 500
c)	Tank farms	1 in 100 to 1 in 500

Micro grading shall be carried out over graded areas to bring the FGL to required levels in line with slope provisions and finishes.

5.0 ROADS

Cross section of road shall be designed as per IRC 37.

Road width and classification

S. No.	Location	Road Way	Carriage Way	Classification
1.	Roads for product movement around Polymer Warehouse	16.0 m / 12.5 m	14.0/ 10.5 m	Bituminous/Concrete
2.	Roads around units & utilities	16.0/ 12.5 m / 9 m / 7.5 m / 6 m	14.0/ 10.5 m / 7 m / 5.5 m / 4 m	Bituminous
3.	Roads for high lift crane	As per requirement		

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S. No.	Location	Road Way	Carriage Way	Classification
4.	Unit Approach Road	Width as per equipment layout		Asphalt
5.	Roads around Tank Farm, utilities	7.5 m	5.5 m	Asphalt
6.	Footpath	1 m	-	PCC

Camber	1 in 40
Ruling Gradient	1:30
Radius of curve	Minimum 15 m
Design CBR	As per Geotechnical recommendation
Design Standard	As per IRC - 37 (Using 2 msa & Design CBR) for Crust design & MoRTH specifications for Construction material/ Construction
Road finish	Bituminous concrete as per MoRTH specifications consisting of granular subbase (GSB), WMM base course and wearing course of DBM and bituminous concrete (BC).
Road Embankment	Shall be provided with Brick Pitching/ PCC lining

Finished road top level above FGL -

S.No.	Description	Project Philosophy
1.	When pipe way bridges for Pipe sleepers/ tracks are provided	Raised locally as per Pipe way bridges crossing requirement
2.	Road around Process units	Road level around hazardous area should be decided such that no roads are classified.
3.	Other areas	0.4m.- 0.6m. above FGL

6.0 RCC PAVEMENT

Pavement slope 1 in 100

Type

a.	Vehicular movement area	
i)	Unit	Type-I (200 mm thick RCC) (As per EIL standard no. 7-65-0404)
b.	Non-vehicular movement areas	
i)	Unit	Type-II (150 mm thick RCC) (As per EIL standard no. 7-65-0404)
ii)	Offsite Pump Station	Type-III (100 mm thick RCC) (As per EIL standard no. 7-65-0404)
c.	Truck Parking Area	Type-I (200 mm thick RCC) (As per EIL standard no. 7-65-0404)

- Grade of Concrete shall be as per Structural design basis (Minimum M30)
- For product movement Concrete Road, Flexural strength of concrete shall be 4.5 MPa (minimum)

Notes:

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a) Subgrade below RCC pavement shall be provided as per Geotechnical Recommendation.
b) For Crane movement area, pavement shall be designed as per loading envisaged and soil data.
c) The surface of concrete paving exposed to corrosive chemicals shall be protected with the suitable anti-corrosive/ chemical resistant material/ coating which shall be selected and applied fully in accordance with the job specification.

7.0 SITE FINISH

S. No.	Area	Finish
1.	Process Units, Utilities	RCC paved
2.	Product Movement Road	Bituminous/Concrete finish
3.	Road	Bituminous finish
4.	Approach Roads	RCC Pavement (Type I)
5.	Footpath	Interlocking Paver Block
6.	Tank farm	100mm thick PCC M20 with HDPE film lining
7.	Between unit & roads	Compacted earth
8.	Truck Parking, loading/ Unloading area	RCC paved
9.	Pipe ways	PCC M20 (Width of PCC shall be extended 600mm on either side of Piperack).
10.	Open storage Yard (Permanent)	WBM/ RCC pavement/ Compacted earth
11.	Road shoulder	Paver Blocks

8.0 STORM WATER DRAINAGE

Storm water drainage system shall be designed to protect the project area from flooding and allow efficient operation of systems during the design storm events. The drainage system shall be provided to collect storm water run-off from project area and convey it through the storm water network to discharge into a receiving body without causing adverse site impacts. The conveying system of storm water shall include drains, ditches, channels, guard pond, pumps etc. to provide an efficient mechanism of conveying design flow from various catchments to the discharge point without causing surface flooding and surcharging.

The general considerations in design of storm water drain shall be:

- Storm frequency / return period
- Time of concentration
- Minimum/maximum flow velocities
- Minimum slope/grades

Design Return Period

Return period is the average length of time in years for an event (e.g. flood or storm) of given magnitude to be equalled or exceeded.

For storm water drainage design, considering importance of development and the degree of protection which gives the maximum benefit cost ratio, return period of **1 in 50 years** shall be adopted.

Design Methodology

Rational Method

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Estimation of storm water runoff is dependent on the intensity and duration of rainfall, characteristics of catchment area and the time required for such flow to reach the drain. For estimating the peak runoff rates rational method shall be used.

Q = 0.00278 CIA
Where:
Q = flow, m^3/s
C = weighted runoff coefficient
I = rainfall intensity in mm/hr corresponding to time of concentration
A = drainage area in hectares

Time of concentration

The rainfall intensity (I) in the rational formula is the average rainfall intensity over a given duration **equal to the time of concentration** for the drainage area

The time of concentration (tc) is defined as flow travel time taken from the hydraulically most remote point in the contributory catchment to the point under consideration**.** The time of concentration for drain sizing is the time required for water to travel from the most hydraulically distant point in the total contributing catchment to the design point. Typically, this time consists of two components:

I. Time for the surface flow to reach the first inlet, i.e., t_0
II. Time to flow through the storm drainage system to the point of consideration i.e. t_f

$tc = t_0 + t_f$

Run off Coefficients:

a)	Paved area	
	- Concrete	1.0
	- Bituminous	0.9
b)	Compacted area such as Offsite area	0.7
c)	Unusable open area/ Green Belt area	0.4

Hydraulic Design

The velocity and Flow in open drains or pipes shall be calculated using Mannings formula or continuity /momentum equation.

Storm water Drains

a)	Type	Rectangular type in and around units. Other areas, ditches shall be rectangular and/or trapezoidal type
b)	Construction	
	• Rectangular Ditches around & inside Units	RCC (cast-in-situ/ pre-cast)
	• Rectangular Ditches in Offsites	RCC (cast-in-situ/ pre-cast)
	• Trapezoidal Ditches	PCC lined
c)	Storm water drains on periphery of the unit shall be provided with removable type galvanized grating designed for allowing heavy vehicular movement.	
d)	The storm water drains shall be designed for full flow ensuring velocity of minimum 0.6 m/s and maximum 2.4 m/s.	

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8.1 CULVERTS AND ROAD CROSSINGS

S.No.	Description	Philosophy
1.	Pipe Culverts (under Roads)	RCC pipes (Class NP3 as per IS:458).
2.	Storm Water Box culverts	Pre cast/ Cast-in-situ RCC Construction
3.	Cable Road crossings	RCC box culvert/ PVC pipe Class-1 (IS 4985) embedded in PCC/ corrugated HDPE pipe

8.2 OIL CATCHER IN STORM WATER

Oil catcher with baffle wall type arrangement shall be provided on storm water ditch before it enters storm water pond/guard pond.

8.3 STORM WATER DISPOSAL

Storm Water drainage from PP Project area shall be connected to existing drain passing through Rajabari Plot.

9.0 RAIN WATER HARVESTING

Rain Water harvesting for re-charging of ground water shall be provided for clean rain water collected from roof of non-plant buildings.

10.0 WATER SYSTEM

Raw Water

	Raw water for the complex shall be sourced from existing NRL refinery.	
a)	Storage	
	Type of storage	From existing NRL refinery
	Capacity	As per Process requirement
b)	Treatment	As per Process requirement

Drinking Water System (Plant Service)

S.NO.	Description	Philosophy
1.	Rate of water supply	45 liters/ head/ day
2.	Network	Combination of Above ground (A/G) & Underground (U/G) pipes and fittings. Drinking water piping shall preferably be laid aboveground, wherever feasible. A/G pipes shall be insulated against solar radiation.
3.	System	• Existing drinking water network of NRL refinery shall be extended to cover areas of PPU project. Booster pumps will be provided incase pressure in existing network is not adequate.

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S.NO.	Description	Philosophy
		• Individual buildings shall have roof top overhead tanks of HDPE (Minimum capacity 500 liters) with PUF insulation.
4.	Disinfection Method	As defined in Environment document
5.	Material of Construction	• U/G pipes –CPVC as per IS:15778 • A/G pipes - Galvanized Carbon Steel as per PMS with insulation • CPVC pipes for buildings as per IS: 15778
6.	Storage	UG storage sump shall have storage capacity of 24 hours

Cooling water System

Cooling water system (comprising of Cooling Tower, Cooling Water Treatment, Cooling Water Sump and Pumping arrangement) shall be as per Process Design Basis.

11.0 UNDERGROUND PIPING

All underground CS pipes shall be provided with corrosion resistance protection as per job specification

S.No.	Service	Type of Corrosion protection
1.	CRWS, Fire Water, Cooling water, OWS, Vent pipes, Storm Sewer and any other under-ground piping with CS pipes & having design temperature less than 65°C	3LPE pre-coated pipes as per PMS & job specification
2.	CBD, ABD, Process sewers/ blowdowns and any other CS pipes having design temperature more than 65°C	Corrosion protection painting as per job specification

In case of any other special requirement for underground painting by Licensor, same shall be considered.

For underground fire water pipes in RCC paved areas, removable type RCC precast slab/ paver blocks (suitable for Hydra crane movement) shall be provided for ease of maintenance & inspection.

12.0 SEWERS

General

S.No.	Philosophy
1.	Storm water drains shall be designed and provided on both sides of the road. Storm water drains shall not be combined with oily water sewer. However, within the paved area of the unit where rain water is likely to get contaminated with oil, the same shall be discharged to CRWS.
2.	OWS/ CRWS from within process unit and tank farm area shall be collected in sumps and subsequently pumped to existing EFFLUENT TREATMENT PLANT (ETP).
3.	CRWS/ Storm water drainage in Process Unit Area: It is expected that floor wash of identified equipment area of process units shall have accidental oil contamination. The floor wash of contaminated area shall be

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S.No.	Philosophy
	collected in a CRWS pit/sump through a network of catch basin and pipes and shall be sent to ETP by pumping. Baffle wall shall be provided in the CRWS sump for both incoming pipe & outgoing discharge to storm water drain. After 10 minutes, the incoming flow of CRWS sump shall be routed to storm water open drain through overflow drain from pit Baffle wall arrangement shall be provided before overflow drain connection to prevent oil contamination of open drain. Rotary Lobe pumps with floating suction shall be provided in CRWS Sump to ensure earliest removal of Floating oil. • Each unit shall be provided with dedicated CRWS sump. • RCC drain with galvanized grating all around the unit pavement to collect non-contaminated water as per requirement. This drain shall be connected to main offsites drain through double valve pit arrangement. In case of accidental contamination, in generally non-contaminated areas, the flow can be diverted to CRWS via double valve pit. • Maximum catchment area for each catch basin shall not be more than 500 sqm • CRWS Pit shall be covered – RCC construction
4.	OWS in Process Unit Area – The OWS/ process waste sewer from unit area shall be collected in OWS sump located inside each unit area and shall be pumped to existing ETP The sump shall be covered and of RCC construction.
5.	Tank farm drainage shall be provided in such a way that the storm water discharge shall be either sent to storm water open ditch or to the oily water sewer by providing triple valves pit outside the dyke wall depending on its contamination.
6.	Corrosion resistant protection given to underground CS pipe shall extend up to min. 500 mm. above/ beyond grade.
7.	Transformer oil shall be drained to RCC pit as per electrical Design Basis/ OISD-173 requirement. The oil shall be pumped out of RCC pit time to time using portable pump.
8.	The underground process blowdown in the unit area which require heat tracing as per process requirement, shall be laid in RCC trenches with suitable supporting. The stress analysis of the header shall be carried out & accordingly loops other recommendations shall be suitably implemented.
9.	Minimum underground pipe size for CRWS shall be 8 inch and for SS/ OWS shall be 4 inch.

Disposal Method of Sewer

S.No.	Type of Sewer	Disposal
1.	OWS	Pumping by OWS pumps from OWS sump to existing ETP/ existing OWS sump/Manhole in refinery area #
2.	CRWS (First 10 minutes flow)	Pumping by CRWS pumps from CRWS sump to existing ETP/ existing CRWS sump/Manhole in refinery area #
3.	Acidic and Alkali	As per Process P&ID
4.	Chemical Sewer/ CBD/ ABD/ Other Process Blowdown	As per Process P&ID

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5.	Sanitary Sewer	Pumping by Sanitary sewer pumps from sanitary sumps to existing STP/ ETP/ existing Sanitary sump/Manhole in refinery area #

Location of existing sumps/manhole shall be finalized during detailed engineering

Design & Other Criteria

S.No.	Philosophy
1.	The contaminated rain water and Oily Water Sewer shall be kept separate.
2.	Design of Oily Water Sewer shall be based on the quantities of process waste specified by process department/ Licensor.
3.	Design of contaminated rain water Sewer shall be for the greater of following combinations: - Contaminated rain water, (running 2/3rd full) or - Fire water, (running full) The quantities of contaminated rain water shall be worked out based on the contaminated process area in the unit block.
4.	No open drain funnel or Trench shall be provided within 15m from heater.
5.	Sanitary sewer shall be designed for 3 times the average flow, flowing half full, in case of lateral sewer, and flowing 2/3 full in case of Main Sewers. A minimum velocity of 0.75 m/s at design peak flow shall be ensured.
6.	For CRWS, minimum velocity shall be 0.6 m/s and maximum velocity shall be limited to 2.4 m/s.
7.	For OWS, minimum velocity (running full) shall be 0.6 m/s. The maximum velocity shall be limited to 2.4 m/s.
8.	Suitable Clean outs shall be provided at the ends and at the change of direction of branch headers (where manhole is not provided) for cleaning of sewers (OWS/ CBD/ other blowdowns) as and where required.

Cover for Sewer Line

S.No.	Philosophy
1.	Minimum cover over sewer line in offsite shall be 600 mm.
2.	Under road, sewer shall be protected by concrete encasement if minimum cushion is less than 1200 mm.
3.	Minimum Clear Cover for sewers inside Unit are as follows: - For pipe size upto 4 Inch- 250 mm For pipe size 6 Inch & above- 450 mm. Crane/ Truck Movement areas- 750 mm.

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Material of Construction for Manholes

S.No.	Description	Philosophy
1.	OWS/ CRWS Sewer	RCC leak resistant
2.	Sanitary Sewer	RCC
3.	Acid/ Alkali sewer	RCC leak resistant with internal acid/ alkali resistant lining
4.	Manhole Cover	RCC manhole - CI manhole frame with lugs and cover conforming to IS-1726. Heavy duty covers for vehicular movement areas & Medium Duty for non-vehicular movement areas

Seal in OWS/ CRWS Manholes & Sumps/ Pits

S.No.	Philosophy
1.	For trapping of gas or prevention of spread of fire through sewer from one area to another, a liquid seal of minimum 150 mm shall be provided in manhole.
2.	Sealed Manholes shall be provided at the following locations: - Process Units o All manholes in the unit areas including interface manhole at the battery limit so that the unit area is cut off from any fire in offsite area or vice versa. - Offsites o At change of direction of the line o At entry of branch line to manhole or mainline.
3.	Sealed manhole with bent pipes (seal type), shall be used for CS pipes up to 16-inch diameter. For CS pipes greater than 16-inch diameter, double compartment type sealed manholes shall be used.
4.	All sealed manholes shall have airtight covers and vents.
5.	Vents in unit area should be installed on the sealed manholes to maintain atmospheric pressure in the sewer and to release vapors to safe locations. Vents should be located along pipe rack columns or building columns and shall be taken 3 m above the building parapet or last layer of pipes on the pipe rack/ structure within 15 m radius of the vent. The minimum size of the vent pipe shall be 4 inch. Vent pipes of adjacent manholes/ double compartment manholes shall not be combined. The outlet of vent pipe shall be provided with bird mesh.
6.	Vents in offsite shall be installed on the sealed manholes to maintain atmospheric pressure in the sewer and to release vapors to safe locations. Vents should be located along pipe rack columns or building columns and should be taken 3 m above the building parapet or last layer of pipes on the pipe rack/ structure within 15 m radius of vent. The minimum size of the vent pipe shall be 4 inch. Vent pipes of adjacent manholes/ double compartments manholes shall not be combined. The outlet of vent pipe shall be provided with bird mesh. In case there is no building/ tech-structure/ pipe-rack within 15 m radius, the vent shall be located 3 m above the manhole.
7.	Vents with flame arrestor shall be provided on top of CRWS/ OWS sumps/ pits. Vents of OWS/CRWS sump pits shall be connected to VOC control system to minimize VOC emissions.

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Material of Construction for Sewers

S.No.	Description	Philosophy
1	CRWS	
1.1	Within process units and hydrocarbon tankage areas	CS pipes as per PMS
1.2	Offsite gravity sewer	
1.3	Offsite pressure main	
2	OWS	
2.1	Within process units and hydrocarbon tankage areas	CS Pipes as per PMS
2.2	Offsite gravity sewer	
2.3	Offsite pressure main	
3	Chemical Sewer or Process Sewers	As per Process P&ID and PMS
4	Sanitary Sewer	
4.1	Toilet block upto Inspection chamber	uPVC pipes as per IS:13592 (Type-B) & fitting conforming to IS:14735
4.2	Gravity main & lateral	uPVC pipes as per IS:15328 & fitting conforming to IS:14735
4.3	Pressure main	Galvanized Iron pipe as per PMS

13.0 STORAGE TANK FOUNDATION & DYKE WALLS

S.No.	Description	Philosophy
1.	Sand Pad tank foundation	As per Geotechnical recommendation, for fixed roof floating roof tanks
2.	Storage Tank Dyke Walls & Fire Walls	RCC

14.0 FENCING/ COMPOUND WALL

Compound wall is existing

15.0 PROCESS CONTROL ROOM SAFETY

Control room shall be sized and designed meeting requirements of OISD-163 (Process Control Room Safety). Blast Resistant construction requirement of the Main Control Room & SRR shall be met as per RRA/ QRA and OISD 116.

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ENGINEERING DESIGN BASIS
PIPING

JOB NO: **C050**

PROJECT: **EPCM Services for setting up Polypropylene Unit at NRL**

CLIENT: **NRL - REFINERY**

EIL SIGNATURE:

CLIENT SIGNATURE:

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

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1.0 SCOPE

The Design Basis briefly covers the basic requirements for the design of Piping systems for Refineries, Petrochemicals, Onshore Piping & Gas Processing facilities covered by ASME B31.3. These shall be adhered to by Engineering / EPCC Contractor(s) or his subcontractor(s) during the course of engineering, procurement & construction

2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

2.1 ABBREVIATIONS

Code	Description
EDB	Engineering Design Basis
EPCC	Engineering, Procurement, Construction & Commissioning
ISBL	Inside Battery Limit
LSTK	Lumpsum Turnkey
OISD	Oil Industry Safety Directorate
OSBL	Outside Battery Limit
HAZ	Heat Affected Zone
BHN	Brinell Hardness Number
PNGRB	Petroleum and Natural Gas Regulatory Board

2.2 CODES & STANDARDS / PUBLICATIONS

The following codes & standards in their latest edition including latest addenda as on the date of first issue of this design basis shall be followed.

S.No.	Description	Standards / Codes	Edition	Remarks
1	International Codes/Standards		Latest	
1.1	Process Piping	ASME B31.3	Latest	
1.2	Pipe Flanges and Flanged Fittings	ASME B16.5	Latest	
1.3	Large Diameter Steel Flanges	ASME B16.47	Latest	
1.4	Welding and Brazing Qual.	ASME BPV Sec. IX	Latest	
1.5	Non Destructive Examination	ASME BPV Sec.V	Latest	
1.6	Welding rods, electrodes & filler materials	ASME BPV Sec.II Pt.C	Latest	
1.7	Indian Boiler Regulations	IBR	Latest	
1.8	PNGRB Regulations	-	Latest	
1.9	Expansion Joints Manufacturers'' Association	EJMA Standards	Latest	
1.10	Layouts for Oil and Gas Installations	OISD-118	Latest	

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S.No.	Description	Standards / Codes	Edition	Remarks
1.11	Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments Resistant Metallic Materials for Oilfield Equipment	NACE MR 0103	Latest	
1.12	Materials for use in H2S containing Environments in Oil & Gas Production	NACE MR0175/ISO15156	Latest	
1.13	Sizing, Selection & Installation of Pressure Relieving Devices in Refineries	API RP 520	Latest	
1.14	Centrifugal Pumps for Petroleum, Heavy Duty Chemical and Gas Industry Service	API Std. 610	Latest	
1.15	Steam Turbines for Mechanical Drive Service	ANSI/NEMA SM 23	Latest	
1.16	Centrifugal Compressors for Petroleum, Chemical and Gas Industry Service	API STD. 617	Latest	
1.17	Air Cooled Heat Exchanger	API Std. 661	Latest	
1.18	Fired Heater	API STD. 560	Latest	
1.19	Evaluation of Pipeline and Pressure Vessel Steel for Resistance to Hydrogen Induced Cracking	NACE MR-0284	Latest	
1.20	Laboratory Testing of Metals for Resistance to Sulfide Stress Cracking in H2S Environments	NACE TM-0177	Latest	
2	EIL Standards		Latest	
2.1	Standard Spec. For Steam Tracing	6-44-0007	Latest	
2.2	Standard Spec. For Steam Jacketing	6-44-0078	Latest	
2.3	Standard specification for application of torque and hydraulic bolt tension for flange joints	6-76-0002	Latest	
2.4	Welding Specification for fabrication of Piping	6-77-0001	Latest	
2.5	Material requirements for carbon steel components used in sour service for petroleum refinery environments	6-79-0013	Latest	

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S.No.	Description	Standards / Codes	Edition	Remarks
2.6	Job specification for surface preparation and protective coating (SMMS)	C050-000-06-42-PLS-01	Latest	
2.7	Standard Spec for Hot Insulation	6-79-0026	Latest	
2.8	Standard Spec for Cold Insulation	6-79-0027	Latest	
2.9	Standard specification for positive material identification (PMI) at construction sites	6-82-0002	Latest	
2.10	Clearances	7-44-0501	Latest	
2.11	Accessibility for valves and Instruments	7-44-0502	Latest	
2.12	Table of Basic Span	7-44-0506	Latest	
2.13	Maximum Spacing of Guides for Vertical and Horizontal Pipes	7-44-0507	Latest	

3.0 GENERAL / DESIGN CONSIDERATIONS

3.1 EQUIPMENT LAYOUT

3.1.1 BASIS OF EQUIPMENT LAYOUT

Equipment Layout shall be developed based on the following data.

S.No.	Project Philosophy
1	P&IDs
2	Overall Plot Plan
3	Wind direction
4	Equipment Data Sheets
5	Indicative Equipment Layout from Process Licensor/EIL Process
6	Process Package
7	OISD Std. 118 / PNGRB Regulations

3.1.2 DEVELOPMENT OF EQUIPMENT LAYOUT

The following aspects shall be considered during development of equipment layout.

S.No.	Project Philosophy
1	Process Requirement i.e. proper interconnection between equipment as per P&IDs to achieve the intended process parameters.
2	Economy of Piping material Minimize the quantity of costly piping.
3	Erection & Construction requirement-Erection scheme and schedule of all equipment must be considered during equipment layout to have smooth erection mainly in case of tall columns, heavy equipment like thick walled reactors, space for laying tall column, approach road for cranes / derrick for lifting the column or reactors and requirement of special foundation / pile etc.
4	Safety Requirements - As a minimum, 'OISD Std. 118 / PNGRB Regulations' shall be followed. Safety shower location shall be marked in equipment layout.

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S.No.	Project Philosophy
5	Operation and Maintenance Requirement like Overhead and side clearances for exchangers and pumps, Provision of exchangers tube bundle pulling area, Horizontal & overhead clearances for easy movement of working personnel, Crane approaches for air coolers/fired heaters/exchangers. Provision of catalyst loading/unloading facilities, Provision of monorail/mobile crane for maintenance of pumps, Provision of hydro extractor/monorail for maintenance of exchangers and Provision of EOT/HOT crane for compressors, Provision of Analyzer shelter.
6	Similar equipment grouping - All columns, exchangers, pumps etc. should be grouped together for convenience of maintenance and safety wherever feasible.
7	The technological structures should be inter-connected for easy movement of operational personnel.
8	U/G piping corridors for main headers and U/G trenches (as applicable) should be marked in equipment layout.
9	All areas requiring crane access for erection or specific maintenance purpose e.g. catalyst loading etc., hard stand for construction, tube bundle pulling area and drop-out/laydown areas shall be marked on the equipment layout.

3.1.3 PIPE RACK

S.No.	Type	Description
1	Pipe Rack Configurations	Preferably Straight. However, L/T/U/H/Z can be used based on area available
2	Preferred Pipe rack width depending on project requirements	Single Bay : 6M/7M/8M/9M/10M/11M/12M Single Bay (where hydra access is not envisaged): 3M/4M/5M Double bay : 14M/16M/18M/20M/22M/24M
3	Maximum Tiers	Generally 4 or as per requirement
4	Portal Spacing	8M(standard). All other spacing as per job requirements. Intermediate structural member shall be provided in pipe rack for supporting pipes as per requirement
5	Clearance beneath Pipe Rack - Units	4.75M Vertical X 3M Horizontal; First Tier at 6M Min. (For Main and Branch Pipe rack) However, for Branch pipe rack where hydra movement is not envisaged, first tier elevation may be 5M.
6	Road Clearance	7M : Main Road 5M : Secondary Road / Fire Tender access
7	Pipe Rack Clearance - Offsites	2.2M (Refer clause 3.1.3 S. No. 6)
8	Space for Future Expansion - Units	As per Clause 5.0 S.No. 3.
9	Space for Future Expansion - Offsites	As per Clause 5.0 S.No. 3.
10	Water lines on Pipe Rack	As per Clause 5.0 S.No. 4.
11	Minimum Sleeper Height	As per Clause 5.0 S.No. 5.
12	Interconnecting platforms	Interconnecting platforms shall be provided between pipe rack & technological structures.

3.1.4 TOWERS AND VERTICAL VESSELS

S.No.	Type	Description

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S.No.	Type	Description
1	Location	Towers and vertical vessels in a row with a common centerline with OD minimum 4M away from Pipe Rack. Chemical Dosing vessels near dosing point to the extent possible, especially for ammonia and corrosion inhibitors and grouped together with escape routes
2	Minimum Clearance	Minimum 3M. Minimum 100mm horizontal gap between platforms of adjacent tower. Minimum 900mm clear aisle between plinths. Clearance shall allow full opening of Manhole.
3	Interconnecting platforms	To be provided at suitable levels where possible allowing for differential expansion.
4	Davit provision for heavy items (relief valves, blinds, etc)	On side of vessel away from pipe rack with clear drop out area at grade Clear access shall be provided at grade on the access side for lowering external & internal fittings, PSVs, Control valves etc from elevated equipment(columns, towers etc) by providing pipe davits.

3.1.5 REBOILER

S.No.	Type	Description
1	Location	Reboilers shall be located next to the tower they serve except fired heater type. Clearance for rodding to be provided for vertical reboilers. Vertical thermo siphon types to be supported by tower (except large vertical types which may require independent structure) and located away from pipe rack. Pressure drop calculations to be done before finalizing.
2	Elevation	As per P&ID.

3.1.6 HORIZONTAL VESSELS

S.No.	Type	Description
1	Location	Perpendicular to Pipe Rack and Min. 4M away from it.
2	Minimum Clearance	Minimum 2M Minimum 900mm clear aisle.

3.1.7 PUMPS

S.No.	Type	Description
1	Location	As per Clause 5.0 S.No. 7. Wherever possible, centerline of discharge shall be kept on common straight line.
2	Minimum Clearance	Minimum 900mm clear aisle between pumps Gap between each pump foundation and foundation of technical structure should be sufficient after piping, for access.
3	Maintenance	
3.1		As per Clause 5.0 S.No. 8.

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S.No.	Type	Description
3.2		Sufficient space to be available for maintenance below pipe rack. Clear access of 4.0M vertically and 3M horizontally shall be provided centrally under main pipe ways for small mobile equipment to service pumps/motors, wherever these are installed under pipe ways with prior specific approval. Pumps outside rack shall be approachable by mobile equipments etc. from under the pipe rack.

3.1.8 EXCHANGERS

S.No.	Type	Description
1	Location	Floating head 4M from pipe rack
2	Minimum Clearance	Minimum 2M. Minimum 900mm clear aisle. Heat Exchanger train should be suitably spaced such that shell/ tube inlet/ outlet piping do not foul with floating Head Covers.
3	Maintenance	
3.1	Maintenance of shell and tube type exchangers	Shell and tube type exchangers may have a removable shell cover with flanged head. Tube pulling or rod cleaning area must be allowed at the channel end.
3.2	Maintenance with Hydroextractor	Tube bundle pulling area shall be minimum the tube bundle length + 4M from the channel head for hydroextractor frame (1.5M on platform and rest clear in front of tech. structure subject to a minimum of 10M for crane movement)
3.3	Maintenance with monorail and chain pulley block	Tube bundle pulling area shall be minimum the tube bundle length + 1.5M from the channel head on the platform and 4M clear in front of Tech structure for vehicular movement.
3.4	Maintenance of vertical exchangers	In case of vertical exchanger suitable platform shall be provided below the top flange of channel or bonnet. For vertical exchanger, davit shall be provided for cover removal (as part of exchanger),if required, for maintenance.
3.5	Maintenance of high pressure exchangers	For high pressure exchangers, shell pulling on rails shall be provided, as required.
3.6	Means of tube bundle removal	As per Clause 5.0 S.No. 9.

3.1.9 AIR COOLERS

S.No.	Type	Description
1	Location	As per Clause 5.0 S.No. 6.
2	Flooring	For air coolers located on technological structure/rack, blind floor shall be provided if any part of pumps /equipment handling hydrocarbons are placed below them. In other cases, flooring with grating shall be provided.

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S.No.	Type	Description
3	Supporting Structure	The width of the structure from where Air cooler assembly is supported shall be about 2.0m more than the Air cooler tube bundle length so that proper supporting of inlet/outlet piping manifolds can be done from the main members of pipe rack/technological structure to transfer piping load to main structural members
4	Maintenance	Davit shall be provided for lowering the motor, gear boxes etc. along with mobile trolley with retractable jacking arrangement of suitable load carrying capacity. Crane access shall be provided.

3.1.10 FIRED HEATERS

S.No.	Type	Description
1	Location	
1.1		Fired heaters are located upwind or sidewind of process units to blow any combustible leaks away from the open flame. They are located minimum 90M away from hydrocarbon tanks and 30M away from control room. Distances for equipments handling hydrocarbon from the fired heaters shall be as per OISD norms / PNGRB Regulations. Vessels / reactors directly connected to fired heaters are exception.
1.2		Fired heaters shall be arranged with centerline of the stacks on a common line in case of circular fired heaters and wherever a common stack is furnished to cater more than one fired heater the stacks shall be located at the end or side, which is away from the unit. In case of individual box fired heater, the edge of the fired heater on the rack side shall be matched. F.D. fans shall be located at one corner of fired heater area away from equipments handling hydrocarbons.
1.3		It shall be ensured that there are no working platforms within an elevation of 6M below the tip of stack and within a 25M radius of stack. However, the stack height is governed by the clearances from statutory authorities like Director General of Civil Aviation and Pollution Control Board.
1.4		Air Pre Heaters should be located in such a way that the modules can be removed by crane.
2	Maintenance	
2.1		Vertical tube fired heaters must have access to permit a crane to remove and replace tubing.
2.2		Horizontal tube fired heaters must have horizontal free space equal to tube length plus crane parking space for tube pulling / maintenance / cleaning.
2.3		In case of bottom floor fired heaters, there shall be adequate headroom clearance underneath the fired heater for removal of burners.
2.4		In case of wall fired heaters min. 2M wide platform with escape route at each end is necessary.
3	Drainage	

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S.No.	Type	Description
3.1		Pits and trenches are not permitted under fired heater or any fired equipment. All the OWS/CRWS/SS drain points within 15M of Fired heater area shall be taken through closed pipe sewers.

3.1.11 COMPRESSORS AND THEIR PRIME MOVERS

S.No.	Type	Description
1	Location	
1.1		Compressors shall be located to keep suction lines as short as possible.
1.2		The gas compressors shall be located downwind side of fired heater so that leaks are not blown towards fired heater.
1.3		In general compressors are to be located under shed if required as per Clause 5.0 Point 18.1. When compressors are located under shed, sides to be kept fully open for the low shed or partially closed from top for high shed to avoid accumulation of heavier gases in the shed, however, in case of hydrogen compressors located under the sheds provision for top venting from compressor sheds shall be provided.
1.4		In case of a turbine driven compressor, if exhaust steam is condensed, turbine and compressor need to be located at an elevated level and condenser to be located below turbine.
1.5		A major consideration in centrifugal compressor location is the lube and seal oil console. It must be accessible from a road, must be lower than the compressor to allow gravity drain of oil to the consoles oil tank.
1.6		Intercoolers & Knockout pots may be kept within/outside the Compressor house shed, but, shall be kept near compressor house.
1.7		Compressor manufacturer may be consulted for recommended layout. Licensor's requirement, if any, shall also be taken into consideration.
2	Maintenance	
2.1		For compressors E.O.T/H.O.T as per clause 5.0 S.No. 18.2 to handle heaviest removable piece shall be provided for each compressor house.
2.2		Maintenance bay for compressors shall be provided. Maintenance bay shall be accessible from road to facilitate unloading & loading on to truck etc.
2.3		For removal of bundles of exchangers located within building monorail arrangement shall be provided.
2.4		Compressor manufacturer may be consulted additional requirement for maintenance. Licensor's requirement, if any, shall also be taken into consideration.

3.1.12 ACCESSIBILITY

S.No.	Type	Description
1	Crane access	

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S.No.	Type	Description
1.1		Equipment, Structures shall be arrange to permit crane access to service air coolers, compressors in the open area & exchangers
1.2		A clear space for tube bundle removal shall be provided.
2	Pumps Maintenance	As per Clause 3.1.7
3	Access to lowering piping components	Clear access shall be provided at grade on the access side for lowering external & internal fittings, PSVs, Control valves etc. from elevated equipment (Column, Tower etc.) by providing pipe Davits.

3.1.13 LAYOUT AND ACCESS REQUIREMENTS FOR PLATFORM

S.No.	Type	Description
1	Platform requirement	
1.1		Air coolers shall have platforms with interconnected walk ways provided to service valves, fan motors and instruments.
1.2		Fired heaters located adjacent to one another shall have inter connecting platforms at various elevations.
1.3		Inter connecting platforms between adjacent towers shall be provided wherever feasible, taking into consideration expansion of towers.
1.4		Platforms shall be provided for columns/vertical vessels as per Clause 5.0 S.No. 35.
1.5		All round Platform shall be provided for maintenance of Filters, wherever feasible.
2	Access to Platforms - ladders and stairs	
2.1		Two means of access (i.e. two ladders or one ladder and one stair case) shall be provided for any elevated platform, which serves three or more vessels and for battery limit valves operating platform.
2.2		Platforms, ladders & stairways shall be consistent with access & safety requirements.
2.3		Stairway for tanks to be provided on upstream of predominant wind direction.
2.4		Dual access (i.e. one staircase and one ladder) shall be provided at large elevated structure if any part of platform has more than 22.65M (75 ft) of travel. Maximum distance to escape ladder/staircase shall not be more than 22.65M from any point on the platform. Additional ladders to ensure this shall be provided as required.
2.5		Air coolers platforms shall have Dual access (i.e. one staircase and one ladder).
2.6		Platforms shall be provided with stair access in the case of platforms provided for normal monitoring (once a day or more) or where samples are taken, where vessels or equipment items have operator attention such as compressors, heaters, boilers etc and main pipe rack at battery limits.

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S.No.	Type	Description
2.7		Ladder access shall be provided in the case of platforms for items that require occasional operating access including valves, spectacle blind and motor operated valves, heater stack sampling points and Man-ways above grade on equipment.
3	Ladder Design	
3.1		Wherever practicable, ladder shall be so arranged that users face equipment or platform rather than facing open space. Ladder shall preferably have side entry to platform.
3.2		Landings shall be staggered. No ladder shall be more than 6M in one flight.

3.1.14 CLEARANCES

S.No.	Project Philosophy
1	Clearance requirements shall be as per 7-44-0501

3.1.15 ELEVATOR

S.No.	Project Philosophy
1	Requirements shall as per Clause 5.0 Point 17

3.2 UNIT PIPING

3.2.1 BASIS OF UNIT PIPING

S.No.	Project Philosophy
1	Piping & Instrument Diagrams
2	Equipment layout
3	Equipment Data sheet & Setting plan
4	Line list
5	Instrument Data sheet
6	Structural 3D model & building drawings
7	Topography of the plant
8	Piping material specification
9	Overall Plot Plan
10	Proper access to all operating points including valves and for all orifice -tapping points, instruments in particular (refer 7-44-0502).
11	Proper access to interrelated operating points for specific purpose and for maintenance

3.2.2 PIPE WAYS/RACK PIPING

S.No.	Project Philosophy
1	Racks shall be designed to give the piping shortest possible run and to provide clear head rooms over main walkways, secondary walkways and platforms.
2	Predominantly process lines are to be kept at lower tier and utility & hot process lines on upper tier. Generally, hot lines and cold lines shall be kept apart in different groups on a tier.

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S.No.	Project Philosophy
3	Generally the top tier is to be kept for Electrical cable trays (if not provided in underground trench) and Instrument cable ducts/trays. Cable tray laying to take care of necessary clearances for the fire proofing of structure.
4	Generally the bigger size lines shall be kept nearer to the rack column.
5	Minimum spacing between adjacent lines shall be decided based on O.D. of bigger size flange (minimum rating 300# to be considered), O.D. of the smaller pipe, individual insulation thickness and additional 25 mm clearance. Even if flange is not appearing the min. spacing shall be based on above basis only.
6	Actual line spacing, especially at 'L' bend and loop locations, shall take care of thermal expansion / thermal contraction / non-expansion of adjacent line. Non-expansion / thermal contraction may stop the free expansion of the adjacent line at 'L' bend location.
7	Anchors on the racks are to be provided on the anchor bay if the concept of anchor bay is adopted. Otherwise anchors shall be distributed over two to three consecutive bays.
8	Anchors shall be provided within unit on all hot lines leaving the unit.
9	Process lines crossing units (within units or from unit to main pipeway) are normally provided with a block valve, spectacle blind and drain valve. Block valves are to be grouped and locations of block valves in vertical run of pipe are preferred. If the block valves have to be located in an overhead pipe-way, staircase access to a platform above the lines shall be provided.
10	Branches from main headers shall be preferably from top.

3.2.3 COLUMN / VESSEL PIPING & CONTROL VALVES

S.No.	Project Philosophy
1	Piping from column shall drop or rise immediately upon leaving the nozzle and run parallel and close as practicable to vessel. Reboiler outlet piping shall be as short as possible with minimum bends.
2	Piping shall be grouped as far as possible for the ease of supports and shall run on the rack side of the column.
3	Manholes shall be kept on the road side and shall be approachable from the platform.
4	Piping shall be supported from cleats welded on the Vessel. Small bore lines may also be supported from operating platform where taking support from cleat is not feasible.
5	Proper guides at recommended intervals shall be provided for long vertical lines.
6	Access platforms/ladders shall to be provided along the column for valves and instruments as per Clause 5.0 S.No.35. Minimum clear width of platform shall be 750mm.
7	For ease of operation and maintenance, column and vessels which are grouped together, should preferably have their platforms at the same elevation and should be interconnected by walkways where feasible. However each column / vessel shall have an independent access also.
8	Column / vessel platforms should be designed in such a way so that all the nozzles should be approachable from platforms.
9	Piping at columns/vessel nozzles shall be arranged so that blanks can be easily installed for hydrotesting.
10	Unless specifically indicated in P&IDs control valves shall preferably be kept at grade or on technological platforms.
11	Piping intended for vacuum services shall be routed as short as possible with minimum bends and flanged joints.

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S.No.	Project Philosophy
12	Piping support cleats for safety valves shall be independent and meant for safety valves only. These cleats shall be designed considering impact loading during popping off.
13	Utility Connection nozzles shall be from side/top.

3.2.4 EXCHANGER PIPING

S.No.	Project Philosophy
1	Exchanger piping shall not run in the way of built in or mobile handling facilities.
2	Wrench clearance shall be provided at exchanger flanges.
3	Piping shall be arranged so that they do not hinder removal of shell end and channel cover and withdrawal of tube bundle.

3.2.5 FIRED HEATER PIPING

S.No.	Project Philosophy
1	Arrange piping to permit burner removal by providing break-up flanges in the piping
2	Burner valves shall be located close to the peepholes/sight doors for operation so that adjustment can be made while observing the flame from working level as per Clause 5.0 S.No. 46.
3	Piping to burners shall be arranged so that there are no pockets & shall distribute equal and sufficient quantity of oil/gas to all burners.
4	Block valves for emergency, snuffing steam valve shall be located at the recommended distance from the heater, preferably on the upwind side of the heater.
5	Piping from various passes of heater outlet nozzles should preferably be symmetrical. Transfer line from heater to column shall be as short as possible, without pockets, free draining and with minimum bends.
6	No piping shall be routed in the tube withdrawal area. If unavoidable, break up flanges shall be provided in the piping for removal.
7	Only flexible metallic SS (SS316/SS304) hoses shall be used for burner piping, if required.

3.2.6 PUMP PIPING

S.No.	Project Philosophy
1	Pump drives shall have clear access.
2	Pump suction piping shall be as short as possible and shall be arranged to avoid vapour pockets.
3	Reducers immediately connected to the pump suction shall be eccentric type with flat side up to avoid the accumulation of gas pocket.
4	For pump suction, elbows shall not be directly connected to the suction flange. A straight piece minimum 5 times the nozzle size unless otherwise recommended by Pump Manufacturer shall be provided at the suction nozzle.
5	Pump discharge check valve if installed in vertical lines shall be fitted with a drain connection as close as possible downstream of the valve.
6	All small bore piping connected to pump (drain to OWS & CBD, seat and gland leak drain) shall have break up flanges for removal of pumps.
7	Piping shall be so arranged that the forces and moments imposed on the pump nozzle do not exceed the manufacturer recommended values / Double the allowable values of API 610.

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S.No.	Project Philosophy
8	Pump discharge piping should be routed away from the motor side. For Top suction and top discharge pumps, straight run at pump discharge nozzle shall be provided as per Pump manufacturer's recommendation.
9	Pump cooling water connection shall be taken from the top of circulating cooling water header.

3.2.7 COMPRESSOR PIPING

S.No.	Project Philosophy
1	Suction lines shall be as short as possible
2	Suction piping shall have adequate flanged joints for ease of erection and maintenance.
3	Where the line between knockout drum and the compressor cannot be routed without pocket, low point drain shall be provided to remove accumulation of liquid. The system should be approved by Process.
4	A minimum straight length of suction pipe shall be provided as per manufacturer's recommendation.
5	Lube oil cooler space shall be provided in a way so as to facilitate tube bundle removal.
6	All operating valves on main suction and discharge piping shall be lined on one side as far as possible.
7	Piping shall be designed so that forces and moments imposed on the compressor do not exceed the manufacturer's recommendation.
8	Low points in the discharge line from an air compressor shall be avoided because it is possible for lube oil to be trapped and subsequently ignited. If low points are unavoidable, they shall be provided with drains.
9	In case of reciprocating compressor, piping shall be suitably supported to avoid vibrations due to pulsating flow. Unless requirements of no pockets are specified by the licensor, all the piping shall run at 500mm above grade level so that proper supports can be provided to minimize vibrations. Digital Acoustic Pulsation & Mechanical Vibration study as per applicable requirements of API 618 shall be carried out for complete compressor piping including suction / discharge piping as per P&IDs and the study recommendations if any, shall be implemented.
10	Reciprocating compressor piping shall be provided independent supports (preferably RCC) from grade and shall not be supported from compressor shed / platform structure.
11	The small bore branches shall be checked for requirement of braced supports
12	Seal gas skid shall be placed below the compressor platform level so as to avoid entry of entrapped liquid in to dry gas seal unless otherwise recommended by Vendor.
13	All the inlet & outlet piping of the compressor and drive shall be routed from one side, to the extent possible so as to enable free space for maintenance.
14	For reciprocating compressor, normal operating valves, strainers, and check valve piping loops shall be in a separate tier to the extent possible to avoid congestion in the compressor platform.

3.2.8 RELIEF SYSTEM /BLOW DOWN SYSTEM PIPING

S.No.	Project Philosophy
1	Wherever the inlet line size is higher than the safety valve inlet size, reducer shall be installed adjacent to inlet of safety valve.

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S.No.	Project Philosophy
2	Relief valve discharging steam, air or other non flammable vapour or gas directly to atmosphere shall be equipped with weep-hole / drain to prevent accumulation of liquid at valve outlet.
3	Liquid-phase blowdown piping connected to a gravity flow closed system shall be self draining to the blowdown system.
4	Liquid-vapour phase relief valves shall discharge into the flare header at an angle 45 degrees in the direction of header flow, to minimize the effect of kinetic energy and to avoid accumulation of liquid.
5	Pockets in the flare header and blowdown system shall be prohibited.
6	Relief valve discharge piping shall be taken to safe location as per following: 3M above top platform of column or structure, within 8M radius for steam and 15M for hydrocarbon/ toxic discharge or as per P&ID, whichever is more stringent. 25M Horizontally away from fired heater for hydrocarbon. 50M Horizontally away from fired heater, if more than one hydrocarbon relief system of different set pressures is discharging into one common riser of vent stack.
7	Inlet and outlet piping of pressure relief valve shall be adequately supported to take care of the thrust induced by the relief valve during popping.
8	Reaction forces including both momentum & static pressure effects due to safety valve popping shall be ascertained in the connected piping according to API RP520 for systems discharging to atmosphere. The effect of these forces on the piping supports and the anchors of the piping system shall be calculated to ascertain that the allowable limits at these locations are not exceeded. The supporting structure also shall be adequately designed so that when subjected to these reaction forces the supporting elements connected to piping as well as the basic supporting structure i.e. platform members etc. are capable of withstanding them.

3.2.9 BOILER REGULATION REQUIREMENTS

S.No.	Project Philosophy
1	All statutory requirements as per Indian Boiler Regulations (IBR) shall be met for IBR piping.
2	All materials used on lines falling under IBR must be accompanied with IBR Inspection Certificate in original. Alternatively, photocopy of the original certificate duly countersigned and attested by local boiler inspector is acceptable. Leading inspection authority viz. Lloyds, EIL, CEIL etc are authorised inspection authorities for IBR outside India, whereas, for Indian supply only IBR is the inspection authority.
3	IBR documents for lines falling under IBR must be approved by IBR authority of State in which the system is being installed.
4	All welders used for fabrication of IBR system must possess IBR welding qualification certificate.
5	IBR system shall be designed to comply with IBR regulations as well as ASME B31.3. Design calculations for the same must be approved by IBR authority.
6	IBR approval is obtained with requisite fees payable to Indian Boiler Board of the State concerned.
7	The discretion of IBR authority of state is final and binding for the above cases.

3.2.10 STEAM HEADER AND SUPPLY LINES

S.No.	Project Philosophy
1	Steam header shall be located generally on the upper tier and at one end of the rack adjacent to columns.
2	Branch lines from horizontal steam header, except condensate collection points, shall be connected to the top of the pipe header.

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S.No.	Project Philosophy
3	Isolation valves (if provided) on the branch line shall preferably be provided on the horizontal run and outside the pipe rack.
4	All branch lines should be drainable.
5	Drip legs & compact steam trap assemblies with integral glandless piston valve and in-built strainer shall be provided at all low points and dead ends of steam header. Steam trap assemblies may be used for 900# and above. Drip legs at low points shall be closer to downstream riser.
6	All turbines on automatic control for startup shall be provided with a steam trap in the steam inlet line.
7	All traps shall be provided with strainers if integral strainers are not provided.
8	Expansion loops are to be provided to take care of the expansions within units.
9	Wherever condensate is to be drained, proper condensate draining facility shall be provided.
10	Steam trap connection in upstream of OSBL isolation valve shall be provided to avoid accumulation of condensate during unit is under shutdown.

3.2.11 STEAM TRACING

S.No.	Project Philosophy
1	Shall be as per 6-44-0007. Material of tracer shall be as per Clause 5.0 S.No. 28.
2	Steam Manifolds shall be located preferably at upper levels in pipe-rack, accessible from a platform whereas Condensate Manifolds shall be located on grade. Manifolds shall be installed in vertical position.

3.2.12 STEAM JACKETING

S.No.	Project Philosophy
1	Shall be as per 6-44-0078. For jacketed lines using high pressure steam, actual calculations for core jacket and feeder pipe shall be performed before finalization.

3.2.13 UTILITY STATIONS

S.No.	Project Philosophy
1	Requisite number of utility stations shall be provided throughout the unit to cater to the utility requirement. Number of utility stations shall be such that all equipments shall be approachable from at least one utility station. The approach of utility station shall be considered 15M all around the station location.
2	Utility stations shall have three connections [one for LP steam (SL), one for Plant Air (AP) and one for Service Water (WS)] each of 1"NB unless otherwise specified in P&ID. A single common hose shall be procured for Plant air and Service water connections. Air and water lines shall have quick type hose connection and steam line shall have flanged type hose connection and shall be directed downward. All connections shall have globe valve for isolation purpose. Inert gas hose, when required, shall have built in non return valve and quick connection coupling at piping end.
3	The Utility stations shall generally be located adjacent to pipe-rack column. The utility stations shall also be provided on elevated structures like technological structure, operating platforms of vertical equipments etc. Operating platforms having manholes must be accessible from utility station.

3.2.14 ADDITIONAL REQUIREMENTS

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S.No.	Type	Description
1	Safety Shower / Eye Wash	As per Clause 5.0 S.No. 16
2	Fire Fighting	Refer Engineering Design Basis of Fire Protection System (EWS)
3	Cryogenic Piping	For Liquid/Two phase Cryogenic service, stem of the valve shall be at least 45° above horizontal. For Vapour Cryogenic service, stem of the valve shall be at horizontal or above.

3.3 OFFSITE & YARD PIPING

S.No.	Type	Description
1	General philosophy	In general, offsites piping (except tankages area), electrical cable and instrumentation cable shall be laid as per Clause 5.0 Point 10, 13 and 14. The movement area along sleepers shall be approachable from the road at a distance of every 500 meters.
2	Road Crossings	Pipes at road crossing shall be as per Clause 5.0 Point 12. Culverts / overhead pipe bridges shall be adequately designed to take care of future requirements
3	Layout	
3.1		Clearances between lines shall be minimum 'C' as given below. C=(Do+Df)/2 + 25 mm + Insulation thickness(es) Where, Do - outside diameter of smaller pipe (mm) Df - outside diameter of flange(min 300#) of bigger pipe (mm) However this 'C' spacing between the offsite piping on the rack/sleeper can be suitably increased so that the lines should not touch each other after insulation/lateral expansion.
3.2		Adequate clearance shall be provided for every long & high temperature lines to avoid clashing at the bends. Actual line spacing, especially at 'L' bend and loop locations, shall take care of thermal expansion / thermal contraction / non-expansion of adjacent line. Non-expansion / thermal contraction may stop the free expansion of the adjacent line at 'L' bend location.
3.3		Expansion loops for all lines shall generally be kept at the same location.
3.4		Vents shall be provided on all high points & drains shall be provided at all low points. Drain valves at sleeper piping shall be kept outside the sleeperway if the same is not accessible and valves shall be put in horizontal only. At all such places where piping is extended to make drain valves accessible - 2 nos. of stiffeners, irrespective of pipe rating, shall be provided at 90° to each other from the main pipe to impart adequate stiffness to the branch connection. The stiffeners shall be made of 6mm thick flats of material equivalent to the pipe material.

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S.No.	Type	Description
3.5		Spacing of guides on each line on a pipe bay shall not exceed the value given in 7-44-0507.

3.4 TANK FARM PIPING

S.No.	Type	Description
1	Layout	
1.1		The number of pipelines in the tank dyke shall be kept minimum and shall be routed in the shortest practicable way to main pipe track outside the tank dyke, with adequate allowance for expansion. Within one tank dyke the piping connected to that tank shall only be routed.
1.2		Manifolds shall be located outside the tank dyke & by the side of the roads, easily accessible by the walkway.
1.3		Special consideration shall be given as regards to spacing of nozzles while installing special item like hammer blind, MOV etc.
1.4		Pipe crossing the dyke wall shall pass through a sleeve suitably sealed. Coating & wrapping for pipe sleeves & pipes crossing dyke walls, shall be as requirements of 6-79-0020
2	Settlement	If exceptionally high settlement is expected, it shall be taken care during stress analysis as per Clause 5.0 Point 27.

3.5 FLARE PIPING

S.No.	Type	Description
1	Layout	Flare header shall be sloped towards flare knock-out drum. Expansion loop shall be provided in horizontal plane as per requirement to accommodate thermal expansion. The desired slope shall be ensured throughout including flat loop. Flare header shall be supported on shoe of height ranging from 100mm to 400mm.
2	Stress Analysis and supporting	Proper thermal analysis temperature shall be established including the possibility of temperature gradient along the line before providing expansion loops. Efforts shall be made to minimize the number of loops. Flare line between knock out drum and water seal drum shall be designed for pressure fluctuations and adequately supported to avoid vibrations.

3.6 UNDERGROUND PIPING SYSTEM

S.No.	Type	Description
1	Design and Layout	As per Engineering Design Basis - Structural(UG-Civil)

3.7 FLEXIBILITY ANALYSIS AND SUPPORTING

3.7.1 PIPE SUPPORTING CRITERIA & GENERAL GUIDELINES

Piping system shall be properly supported taking into account the following:

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S.No.	Project Philosophy
1	Sustained Loads including weight of Piping (Bare pipe, service fluid, valves, flanges etc), Weight of Insulation (if any), - Weight of snow (if any), Weight of online equipments (if any), Weight of instruments (if any). Thermal loads due to operating/design/steam out/decoking or any other possible abnormal condition. Occasional Loads such as Wind/Seismic loads(as and when required). Pressure relief loads due to safety valve operation, Dynamic loads due to pulsating flow/two phase with slug flow, Pressure-Thrust loads in case of expansion joints, Differential settlement for tanks.
2	The design of piping systems shall take into account the different conditions expected during operation, start-up, shut-down, cold branch in case of standby pump, tracing, etc. Hydrocarbon lines shall be designed for steam-out conditions, if so specified in Process document. System where combination of different operating conditions are envisaged, such system shall be analysed for all possible combinations e.g. ejector system etc.

3.7.2 BASIC SPANS, GUIDES SPACING

S.No.	Project Philosophy
1	Pipe supporting shall preferably follow the basic span as given in 7-44-0506 except for flare line in offsite on trestles in which case the basic span shall be restricted to max. 18.0 metres. For sizes not covered in 7-44-0506, basic span shall be established based on project requirement. For piping on rack or sleeper, as a minimum, providing resting support on every grid of pipe rack/sleeper is mandatory.
2	Guides shall be provided on straight run of pipes at intervals as specified in 7-44-0507, unless specifically becomes non-viable due to flexibility problems.

3.7.3 SUPPORTING

S.No.	Project Philosophy
1	Guides, anchors, special supports like spring supports and sway braces shall be provided based upon detailed analysis of piping system to restrict the forces on nozzles of critical equipments like pumps, compressors, turbines, exchangers, Air coolers etc.
2	Permanent arrangement for supporting shall be provided for lines which do not need any supporting otherwise but require supporting during maintenance.
3	In the heaters where steam air decoking provision is there, the main lines and decoking lines should be supported in such a way that either of the lines should not be in the hanging position when not in operation.
4	Piping passing through the technology structure or passing near the concrete column etc. should have adequate space to avoid restriction of line movement during thermal expansion. The gap should take care the thermal expansion along with insulation thickness.
5	Pipe support design shall be such that deflection in piping systems due to sustained loads shall not exceed 15mm, between two adjacent supports. However, in case of Steam lines deflection shall not be more than 3 mm.

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S.No.	Project Philosophy
6	The use of expansion joints shall be considered only when space or pressure drop limitation does not permit pipe bends. Expansion joint of axial type shall generally be avoided.
7	All pipes supports shall be so designed that there is no undue tension on equipment flanges. Forces and moments due to weight, thermal loads and other imposed loads on the equipment nozzle must not exceed the allowed loads for the equipment. In case the same is exceeded, categorical written confirmation of acceptance of the higher loads shall be obtained from the equipment supplier.

3.7.4 CORROSION PAD REQUIREMENT

S.No.	Project Philosophy
1	As per Clause 5.0 S.No. 49.

3.7.5 TRUNNION SUPPORTS

S.No.	Project Philosophy
1	As far as possible long trunnion types of supports (more than 0.5 mtr.) are to be avoided. In case long trunnion support is unavoidable in straight length of pipe, trunnion height to be preferably restricted to 0.5m and balance height to be made up by providing extended structure.

3.7.6 SUPPORTING FOR SMALL BORE LINES

S.No.	Project Philosophy
1	Adequate care shall be taken for small bore (1.5" and below) branch from piping. As a rule, all small bore branches, e.g. vents, drain, pressure tappings, temperature tappings, sample connections etc. from lines in 600# & above classes, lines having two phase flow, lines having Pulsating flow such as discharge of reciprocating compressors & reciprocating pumps, shall be provided with 2 number stiffeners at 90° to each other from the main pipe to impart adequate stiffness to the branch connection. The stiffeners shall be made of 6mm thick flats of material equivalent to the pipe material. Further , irrespective of line rating, the stiffeners shall be provided for all orifice taps, all small bore tappings from PSV/TSV inlet / outlet lines and all small bore tappings from Control Valve manifolds.

3.7.7 SUPPORTING OF COLD INSULATED LINES

S.No.	Project Philosophy
1	High density PUF blocks shall be considered for cold piping supports. Wooden blocks may be used for load taking supports on vertical lines or as anchor supports.

3.7.8 ANALYSIS TEMPERATURE

S.No.	Project Philosophy

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S.No.	Project Philosophy
1	All lines shall be analysed at analysis temperature. In the absence of analysis temperature, lines shall be analysed at operating temperature if difference between operating & design temperatures is less than or equal to 30 deg.C, otherwise it shall be analysed at design temperature. However, analysis of flare line & calculation of thermal growth of tall equipments shall be done as per Process input. All hydrocarbon lines shall be analysed at Steam out temperature. Steam out temperature shall be taken as per the line list. In case of non-availability of line-list, it shall be taken as 30 deg.C less than the saturation temperature of type of steam.

3.7.9 LINES REQUIRING MANDATORY FORMAL ANALYSIS

S.No.	Project Philosophy
1	All process lines to and from fired heaters and steam generators
2	All process lines to and from centrifugal compressor and blower
3	All lines to and from turbines
4	All pump lines (6" & above and analysis temp > 120°C or less than -60°C) & air cooler lines.
5	Reboiler piping, Flare header/sub headers, Jacketed lines, Non metallic Piping
6	All other lines as below: 6" to 8" with analysis temp above 300°C or less than -100°C 10" to 14" with analysis temp above 150°C or less than -80°C 16"& above with analysis temp above 100°C or less than -80°C
7	Lines requiring Dynamic/Seismic/Wind analysis or composite stress analysis (Piping along with Structure and Equipment)
8	Lines requiring Flange leakage check, i.e. 26" & above except air & water lines (upto 600 rating) 4" & above for hydrogen lines (900 rating and above) 8" & above, other lines (900 rating and above) For dissimilar material flanged joints in lines requiring formal stress analysis
9	All other critical lines (connecting to sensitive equipments). Such as Platefin exchangers, Cold boxes (sizes 6" and above and analysis temp. > 120°C or less than -60°C)
10	For lines involving pulsating flow such as those connected to reciprocating pumps & compressors, in addition to thermal analysis, digital study for acoustic & mechanical vibration shall be done along with equipments, by approved vendor / Agency.
11	Dynamic analysis shall be performed as per Clause 5.0 S.No. 43. The fundamental frequency of the piping system shall be well above the imposed frequencies, if any, to avoid resonance. The minimum acceptable frequency for transfer lines shall be 7 Hz and for remaining lines with slug flow, it shall be 6 Hz.
12	Seismic Analysis shall be performed as per Engineering Technology Development Department Seismic analysis Design Basis.
13	Wind Analysis shall be performed as per Engineering Technology Development Department Wind analysis Design Basis.
14	The requirement of Composite Stress Analysis shall be decided in consultation with Engineering Technology Development Department on a case-to-case basis, for critical and important systems only, like FCC R-R Section, CCR Cyclemax Reactor System, etc. where the relative stiffness of structure and/or equipment may affect the response.

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3.7.10 ADDITIONAL REQUIREMENTS

S.No.	Type	Description
1	Software	As per Clause 5.0 S.No. 34.

3.8 MATERIALS

S.No.	Type	Description
1	Basic Material of Construction	Basic material selection of particular line depending on its service, temperature and corrosivity shall be as spelt out in process package. Detailed material specification shall follow the requirements stated herewith, except wherever specified as per Licensor's requirement.

3.8.1 PIPE

3.8.1.1 THICKNESS

S.No.	Project Philosophy
1	Calculation of pipe thickness and branch reinforcement shall be based on requirements of ASME B31.3 / IBR as applicable. Proper corrosion allowance and mill tolerance shall be considered while selecting nominal thickness.
2	For carbon steel and low alloy steel pipes minimum pipe thickness shall be as follows: 'S160' up to 0.75"NB(except steam tracing), 'XS' up to 0.75"NB(for steam tracing), 'XS' for 1" to 2"NB, 'STD' for above 2NB, 12 mm for above 48" NB.
3	For stainless pipes minimum pipe thickness shall be as follows: '80S' up to 0.75"NB, '40S' for 1"NB to 2"NB, '10S' for above 2"NB
4	The philosophy of minimum thickness / schedule is applicable for both seamless and welded pipes but is not applicable to category -D classes and firewater service specification where IS pipes are being used.
5	All pipes (seamless & welded) shall have uniform negative wall thickness tolerance of 12.5% for wall thickness calculations purpose.
6	For thicknesses exceeding minimum thickness/schedule criteria, schedule XS shall be selected for CS & AS classes (for 2" & above). Intermediate schedules between STD & XS shall be ignored. Similarly for SS classes (2" & above) S10, S20, S30 & 40S may be selected beyond minimum thickness/schedule criteria.
7	Maximum 10% of corrosion allowance may be reduced in special cases, to optimize the pipe schedules.
8	For Cat-D classes, for aboveground applications, 'D/t' ratio shall be taken as 120(max.). For other than Cat-D classes, 'D/t' ratio shall be restricted to 100 (except for Flare, Cooling water, Vacuum, O/H Vapour and Transfer lines. For these lines minimum thickness specified in clause 3.8.1.1(2) shall be followed). 'D' is outer dia. and 't' is nominal thickness for all other components except branches where 't' is minimum thickness as per purchase specification. In cases where 'D/t' ratio exceeds 100 for above exceptional services, components shall be treated as unlisted components and designed according to B31.3.

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S.No.	Project Philosophy
9	Pipe wall thickness shall be calculated at Class condition except as defined in Clause 3.8.1.2

3.8.1.2 BASIS FOR WALL THICKNESS CALCULATION

In general, the pressure-temperature combination to calculate wall thickness shall be as given. Deviation to this clause can be permitted with specific permission from HOD-Piping and Client.

Material For Groups

Group A1
(1) C.S. (A106 GR.B, API-5L GR.B, A672)
(2) LTCS (A333 GR.6, A671)

Group A2
(1) Low Alloys
(2) 1.25% Cr-0.5% Mo
(3) 2.25% Cr-1.0% Mo
(4) 5%Cr-0.5% Mo
(5) 9%Cr-1.0% Mo
(6) 9%Cr-1.0% Mo-V

GroupB
(1)SS(A312 TP304, 304L, 304H, 316, 316L, 316H, 321, 321H, 347, 347H)
(2)SS(A358 TP304, 304L, 304H, 316, 316L, 316H, 321, 321H, 347, 347H)

Group C
(1) Higher Alloys

S.No.	GROUP	CLASS	SIZE	DESIGN CONDITION
1	A1/A2	150	upto 24"	Class condition
2	A1/A2	150	above 24"	Line condition (Note-1,4)
3	A1/A2	300	upto 14"	Class condition
4	A1/A2	300	above 14"	Line condition (Note-1,4)
5	A1/A2	600	upto 8"	Class condition
6	A1/A2	600	above 8"	Line condition (Note-2,4)
7	A1/A2	900	upto 8"	Class condition
8	A1/A2	900	above 8"	Line condition (Note-2,4)
9	A1/A2	1500, 2500	upto 4"	Class condition
10	A1/A2	1500, 2500	above 4"	Line condition (Note-4)
11	B	150	up to 24"	Class condition
12	B	150	above 24"	Line condition (Note-3,4)
13	B	300	upto 14"	Class condition
14	B	300	above 14"	Line condition (Note-3,4)
15	B	600	upto 6"	Class condition
16	B	600	above 6"	Line condition (Note-3,4)
17	B	900, 1500	upto 4"	Class condition
18	B	900, 1500	above 4"	Line condition(Note-4)
19	B	2500	upto 2"	Class condition
20	B	2500	above 2"	Line condition(Note-4)
21	C	150	upto 6"	Class condition
22	C	150	above 6"	Line condition(Note-4)
23	C	300 to 2500	all sizes	Line condition(Note-4)

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NOTES:

1. Only If the thickness / schedule as per class condition exceeds 16.0mm for Group A1 and XS for Group A2, the thickness shall be calculated based on actual design service conditions subject to a minimum of 80% class rating upto 20mm thickness. Above 20 mm thickness, it should be based on actual/design service conditions subject to minimum 20mm.

2. Only If the thickness / schedule as per class condition exceeds 18.0mm for Group A1 and XS for Group A2, the thickness shall be calculated based on actual design service conditions subject to a minimum of 80% class rating upto 20mm thickness. Above 20 mm thickness, it should be based on actual/design service conditions subject to minimum 20mm.

3. Only If the thickness / schedule as per class condition exceeds 40S The thickness shall be calculated based on actual design service conditions subject to a minimum of 80% class rating upto 20mm thickness. Above 20 mm thickness, it should be based on actual/design service conditions subject to minimum 20mm.

4. "Line Condition" is defined as the maximum line condition for the entire job considering all lines for which thickness is to be calculated on line conditions.

5. For Cladded and Refractory lined Pipes, above notes 1 to 3 are not applicable.

3.8.1.3 PIPE SIZE

S.No.	Project Philosophy
1	Pipe sizes shall normally be 0.5", 0.75", 1.0", 1.5", 2.0", 3", 4", 6", 8", 10", 12", 14", 16", 18", 20", 24", 26", 30",32", 36", 40", 42", 44", 48", 52", 54", 56", 60", 64", 72", 76", 78", 80" For category-D water service above 24", Pipe sizes shall normally be 26", 30", 32", 34", 36", 38", 40", 42", 44", 46", 48", 50", 52", 54", 60", 66", 72", 78", 84", 90", 96", 102", 108", 114", 120", 126, 132", 144"

3.8.1.4 TYPE

S.No.	MATERIAL	SIZE	TYPE
1	CS, LTCS, AS	Upto 18"	Seamless
2	CS, LTCS, AS	20" and Above	E.F.S.W.
3	SS	Upto 8"	Seamless
4	SS	10" and Above	E.F.S.W.

3.8.2 FITTINGS

S.No.	Type	Description
1	Material	
2	Type	Type of Fittings shall be equivalent to pipe type.
3	Thickness / Rating	Thickness of fittings at ends to match pipe thickness for BW fittings SW fittings shall be 3000#, 6000#or 9000# depending on the pipe thicknesses S80, S160 and above S160 respectively.
4	Branch Connections	

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S.No.	Type	Description
4.1	Upto 600#	1.5" NB and below : Half Couplings/Tees/Sockolet 2" and above : Tees/Pipe to Pipe with reinforcement
4.2	900# and above	Equal tee/unequal tee shall be used for all sizes. In case of non availability of unequal tees, o-lets may be used. Usage of sweepo-let shall be avoided due to poor availability globally.
5	Mitres	Mitres shall not be used.
6	Unions	Union shall not to be used in lines other than Cat-D water lines.

3.8.3 FLANGES

S.No.	Type	Description
1	Type	
1.1	For 150 class rating	Upto 1.5" : SW RF (with Non-metallic Gasket), WN RF (with metallic/Spiral Wound gasket) 2" and above : WN RF for CS (other than Cat.D),AS&SS WN FF for Cat.D service & Fire Water service up to 24" and WN FF for Cat.D service 26" and above
1.2	For 300,600 class rating	Upto 1.5" : SW RF 2" and above : WN RF
1.3	For 900 class rating and above	All sizes : WN RTJ
2	Hydraulic Bolt Tensioning	Shall be performed to the extent and as defined in 6-76-0002

3.8.4 GASKETS

S.No.	RATING	MATERIAL/SERVICE	TEMPERATURE	TYPE	GASKET OR STRIP MATL+FILLER MATL/RTJ GASKET MATL
1	150	CS & SS(utilities & except steam)	up to 371 Deg.C	PLAIN	BS 7531 Gr.X/ EPDM/ Butyl Rubber/ CNAF/ PTFE
2	150	CS & LTCS (Process and steam)	up to 371 Deg.C	Spiral wnd	SS316L+Grafoil+ I ring
3	150	AS (all services)	up to 371 Deg.C	Spiral wnd	SS316L+Grafoil+ I ring
4	300 & 600	CS	up to 427 Deg.C	Spiral wnd	SS316L+Grafoil+ I ring
5	300 & 600	AS	All	Spiral wnd	SS316L+Grafoil+ I ring
6	150, 300, 600	SS (other than utilities)	All	Spiral wnd	SS316L+Grafoil+ I ring

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S.No.	RATING	MATERIAL/SERVICE	TEMPERATURE	TYPE	GASKET OR STRIP MATL+FILLER MATL/RTJ GASKET MATL
7	300(*), 600(*), 900, 1500 2500	CS	All	Octagonal RTJ	Soft Iron
8	300(*), 600(*), 900, 1500 2500	AS	All	Octagonal RTJ	5Cr-Alloy steel
9	300(*), 600(*), 900, 1500 2500	SS	All	Octagonal RTJ	SS

(*) Only if RTJ is specially mentioned in PMS.

3.8.5 VALVES

S.No.	Type	Description
1	SW Valves	Upto 1.5 inch for 150#, 300#, 600#, 800# : All except amine, caustic & corrosive service Note- Valve with Pup Piece for all PWHT pipe classes, ball valves & plug valves.
2	Flanged Valves	Above 1.5 inch for all ratings.
3	BW Valves	Upto 1.5 inch for 150#, 300#, 600#, 800# : In Amine, Caustic & Corrosive service Upto 1.5 inch, for 900# and above: All Note- Valve with Pup Piece for all PWHT pipe classes, ball valves & plug valves.

3.8.6 STRAINERS

S.No.	Type	Description
1	Y-Strainers	As per Clause 5.0 S.No. 42.1.
2	T-Strainers	As per Clause 5.0 S.No. 42.2.

3.8.7 TRAPS

S.No.	Type	Description
1	Main line drains up to 600# Rating / Steam Supply Manifold	Pre-fabricated Compact Steam Trapping assemblies with thermodynamic Steam traps
2	Main line drain for 900# and above	Thermodynamic/Bimetallic Steam traps with conventional fabricated Steam Trap Assembly.
3	Traps in Steam Tracing Lines	As per Clause 5.0 Point 28

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S.No.	Type	Description
4	Process Traps	As per Process Data Sheets

3.8.8 NDE REQUIREMENTS (IF NOT SPECIFIED IN PMS)

S.No.	Type	Description
1	General	Extent of NDE in all cases shall depend on severity of application. In case of any conflict in NDE specifications, more stringent NDE shall apply.
2	No radiography	Category 'D' service as per B31.3
3	5% Radiography of Butt welds and DP/MP testing of Fillet welds	150#, 300#, 600# Normal Hydrocarbon service, CS & SS & LTCS
4	10% Radiography of Butt welds and DP/MP testing of Fillet welds	150#, 300#, 600# in IBR, Firewater
5	20% Radiography of Butt welds and DP/MP testing of Fillet welds	150#, 300#, 600# up to 3% Cr AS - General Services. 150#, 300#, 600# NACE, Caustic - CS & SS. 150#, 300# Hydrogen & Oxygen- CS & SS.
6	100% Radiography of Butt welds and DP/MP testing of Fillet welds	All ratings for Cryo, 5%Cr and above AS, High temp. applications (>500 deg.C), severe cyclic Piping. 900# and above for all services . 600# and above for hydrogen & oxygen in CS & SS NACE, Oxygen, Hydrogen, Caustic for all ratings for up to 3% Cr AS.

Notes:

1. In place of Radiography, Ultrasonic Testing is also acceptable wherever allowed as per Welding specification and subject to prior approval of Owner.

In case of any conflict amongst the radiography requirements above or any other specifications, the more stringent requirement shall be followed.

3.9 THERMAL INSULATION OF PIPING, EQUIPMENT & VESSELS

S.No.	Type	Description
1	Hot Insulation	As per 6-79-0026
2	Cold Insulation	As per 6-79-0027

3.10 PAINTING

S.No.	Type	Description
1	Shop and Field Painting	As per Clause 5.0 S.No. 23.
2	Colour Coding requirements	As per Clause 5.0 S.No. 24.
3	Environment	As per Clause 5.0 S.No. 21.

3.11 WELDING

S.No.	Type	Description

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S.No.	Type	Description
1	Applicable Codes & Stds.	Process Piping - B31.3 (all requirements) Indian Boiler Regulations (all requirements) ASME BPV Sec. IX(Welding and Brazing Qual.) ASME BPV Sec.V (Non Destructive Examination) ASME BPV Sec.II Pt.C (Welding rods, electrodes & filler materials)
2	Welding Specification	As per 6-77-0001

3.12 MISCELLANEOUS

S.No.	Type	Description
1	Positive Material Identification	Positive material identification (PMI) test at construction site shall be done as per 'Standard Specification for positive material identification PMI at construction site, 6-82-0002'.

4.0 SPECIFIC DESIGN REQUIREMENTS

4.1 HYDROGEN SERVICE REQUIREMENTS

4.1.1 PIPES, FITTINGS AND FLANGES

S.No.	Project Philosophy
1	All carbon steel pipes, fittings and flanges having wall thickness 9.53 mm and above shall be normalised. All seamless pipes shall be normalised irrespective of the pipe size and thickness. Cold drawn pipes and fittings shall be normalised after the final cold draw pass for all thicknesses. In addition, fittings made from forgings shall have Carbon - 0.35% max. and Silicon - 0.35% max. The normalising heat treatment shall be a separate heating operation and not a part of the hot forming operation.
2	All alloy steel (Cr-Mo) pipes, forgings and fittings shall be normalised and tempered. The normalising and tempering shall be a separate heating operation and not a part of the hot forming operation. The maximum room temperature tensile strength shall be 100,000 psi.
3	For carbon steel pipes, fittings and flanges, hardness of weld and HAZ shall be 200 BHN (max.). For alloy steel, hardness of weld and HAZ shall be 225 BHN (max.).
4	For all Carbon steel and Alloy steel pipes, fittings and flanges with wall thickness over 20mm, Charpy-V Notch impact testing shall be carried out in accordance with paragraph UG-84 of ASME Section VIII, Div-1 for weld metal and base metal from the thickest item per heat of material and per heat treating batch. Impact test specimen shall be in complete heat treated condition and accordance with ASTM A370. Impact energies at 0°Celsius shall average greater than 27J (20 ft-lb) per set of three specimens, with a minimum of 19J (15 ft-lb). If welding is used in manufacture, impact testing of Heat Affected Zone(HAZ) & weld metal shall also be carried out.

4.1.2 VALVES

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4.1.2.1 GENERAL

S.No.	Project Philosophy
1	All valve castings shall be of radiographic quality. All cast valve flanges & bodies with flange rating of class 900 or greater shall be examined in accordance with paragraphs 7.2 through 7.5 of Appendix-7 of ASME SEC-VIII, DIV.1, regardless of casting quality factor. Only Normalized and Tempered material shall be used in the following specifications: Castings : A217 Gr.WC1, A217 Gr.WC4, A217 Gr.WC5, A217 Gr.WC6, A217 Gr.WC9, A217 Gr.C5, A217 Gr.C12 Forgings : A182 Gr.F11 Cl.2

4.1.2.2 HELIUM LEAK TEST

Body / bonnet / cover joints & stuffing box of all valves shall have low emission. One valve per metallurgy, per rating, per size shall be helium leak tested as per ASME Sec.V, Subsection A, Article 10 (Detector Probe Technique), Appendix IV at a minimum of 25% of the allowable (rated) cold working pressure. Selection of valves for helium leak test shall be at random. Test duration shall be as follows :

S.No.	PRESSURE CLASS	NOMINAL SIZE	TEST DURATION(in Minutes)
1	Upto 300	Upto 2"	3
2	Upto 300	3" to 6"	6
3	Upto 300	8" to 16"	9
4	Upto 300	18" to 24"	9
5	600	Upto 2"	6
6	600	3" to 6"	9
7	600	8" to 16"	9
8	600	18" to 24"	12
9	800 & 900	Upto 2"	9
10	800 & 900	3" to 6"	12
11	800 & 900	8" to 16"	12
12	800 & 900	18" to 24"	15
13	1500	Upto 2"	12
14	1500	3" to 6"	15
15	1500	8" to 16"	15
16	1500	18" to 24"	18
17	2500	Upto 2"	12
18	2500	3" to 6"	18
19	2500	8" to 16"	18
20	2500	18" to 24"	21

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

4.1.2.3 CS & AS VALVES

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S.No.	Project Philosophy
1	Bend test and Magnetic Particle inspection of the entire surface of body and bonnet casting shall be in accordance with ASTM A217. Supplementary requirement S3 & S4 evaluation of magnetic particle, inspection shall be in accordance with MSS-SP-53 except that no linear discontinuities shall be allowed. The Brinell hardness of heat treated casting shall not exceed 200 BHN for carbon steel & 225 for alloy steel. Repair of defective casting shall be outlined in writing to the purchaser before repair starts. Repair method to be approved prior to welding. Casting shall be preheated to a minimum of 400°F prior to welding and all Chromium-Molybdenum alloys shall be postweld heat treated after welding is complete. Stress relieving is essential for welds. Carbon steel shall be normalized and alloy steels shall be normalized & tempered. Dye Penetrant test of welds shall be in accordance with ASTM B165 Procedure B-2. Interpretation as per Appendix-8 of ASME-VIII Div.1. The tensile stress for AS shall be less than 100,000 psi. Charpy V-notch impact testing is to be done for valve material (average 20 ft-lb for set of 3 [minimum value 15 ft-lb] at 30 F). For radiography and acceptance criteria of Valve castings, refer Paragraph 2 of Clause 4.1.2.4(1)

4.1.2.4 SS VALVES

S.No.	Project Philosophy
1	Casting and test bar shall be heat treated together. Valve casting shall be in solution heat treated and pickled condition. Critical body and bonnet casing section typically defined by ASME B16.34 shall be radiographed and shall meet ASTM E446 (upto 2" thick) Category A,B & CA Level 2, Category CB, OC & CD Level 3, Category D,B & F Level 0. For wall thickness 2" to 4.5" comparable plates of ASTM E186 shall be used. ASTM E94 and ASTM E142 shall be used for recommended practice & controlling quality of radiography as guide. The entire surface of all castings shall be dye-penetrant inspected after pickling. Repair welds shall be 100% radiographed and evaluated in accordance with paragraph 344.5 of ASME B31.3 with a minimum casting quality factor of 0.95. Dye Penetration test shall be as per ASTM E165 Procedure B-2, Interpretation as per Appendix-8 of ASME-VIII Div.1.

4.2 TECHNICAL REQUIREMENTS FOR PIPING MATERIAL

This is applicable over and above the requirements specified in Clause 3.8.

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4.2.1 GENERAL

S.No.	Type	Description
1	Ends : Unless otherwise specified, the ends shall be to the given standard	SW/SCRD : ASME B16.11 BW : ASME B16.25 FLANGED : ASME B16.5 and ASME B16.47 SERIES "B" THREADING : ASME/ANSI B1.20.1 (NPT, Taper threads) up to 1.5" and IS-554 for 2" to 6"
2	Face Finish shall be to MSS-SP-6/ASME B46.1 / ASME B16.5 / B16.47.The interpretation shall be as given	Stock Finish : 250-1000 µ in AARH Serrated Finish /Smooth Finish/125 AARH : 125-250 µ in AARH Extra Smooth Finish/63 AARH : 32-63 µ in AARH
3	Austenitic Stainless Steel requirements	
3.1		All items/parts shall be supplied in solution annealed condition
3.2		For all Austenitic Stainless steels, Intergranular Corrosion (IGC) Test shall be conducted as per following : ASTM A262 Practice 'B' with acceptance criteria of 60 mils/year (max.) for casting. OR ASTM A262 Practice 'E' with acceptance criteria of 'No cracks as observed from 20Xmagnification' & microscopic structure to be observed from 250 X magnification" for other than casting. For IGC test, two sets shall be drawn from each solution annealing lot; one set corresponding to highest carbon content and other set corresponding to the highest rating/thickness.
3.3		For all items of stabilised SS grades (SS321, SS347), stabilizing heat treatment shall also be done.It shall be carried out subsequent to normal solution annealing. Soaking temperature and holding time shall be 900°C and 4hrs respectively
4	Threaded joints	Upto 204 deg.C, threaded joints shall be made with 1" width PTFE joining tape. Above 204 deg.C, threaded joints shall be seal welded with a full strength fillet weld. All threaded joints, irrespective of pressure and temperature, for critical services including toxic fluid, hydrogen etc shall be seal welded with a full strength fillet weld.
5	Piping used in fire fighting system	Piping used in fire fighting shall be marked as such.

4.2.2 PIPES

Unless specifically exempted, welded pipes shall be acceptable only with longitudinal weld made employing automatic welding, however, ERW Pipes are not acceptable.

S.No.	Project Philosophy
1	Spiral Weld pipes shall be acceptable only for Category D and Fire Water services.

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S.No.	Project Philosophy
2	Unless mentioned otherwise in the material code, double seam 180 deg. apart is allowed for sizes 36" and larger only.
3	Galvanised Pipes shall be only Hot Dip galv. to ASTM A53.

4.2.3 FITTINGS

S.No.	Project Philosophy
1	All fittings shall be seamless in construction unless otherwise specified.
2	For reducing BW fittings having different wall thickness at each end, the greater one shall be employed and the ends shall be matched to suit respective thickness.
3	All welded fittings shall have maximum negative tolerance equivalent to pipe selected.
4	All welded fittings shall be double welded. Inside weld projection shall not exceed 1.6mm, and the welds shall be ground smooth at least 25mm from the ends.
5	For fittings made out of welded pipe, the pipe itself shall be of double welded type, manufactured with the addition of filler material and made employing automatic welding only.
6	All welded fittings shall be normalized for CS, normalized & tempered for AS; and 100% radiographed by X-ray for all welds made by fitting manufacturer as well as for welds on the parent material.
7	Bevel ends of all BW fittings shall undergo 100% MP/DP test.
8	Those used in fire fighting facilities shall be marked.

4.2.4 FLANGES

S.No.	Project Philosophy
1	Bore of weld neck flange shall correspond to the inside diameter of pipe for specified schedule/thickness. Ends shall be beveled to suit the specified schedule / thickness.
2	For RTJ flanges, only octagonal section ring joint flanges shall be used.
3	Minimum Hardness of groove of RTJ flanges of given materials, blinds and spacers shall be as given : Carbon Steel : 140BHN 1% Cr to 5%, 9% Cr : 150BHN Type 304, 316, 321, 347 : 160BHN Type 304L, 316L : 140BHN
4	For RTJ flanges, blinds & spacers, the hardness of the groove shall be specified on the test report.

4.2.5 VALVES

4.2.5.1 GENERAL

S.No.	Type	Description
1		Valves of Class 900 & above shall be pressure-seal type. Threaded and seal welded or welded bonnet may be employed upto sizes 1.5".
2		All flanged valves (except forged) shall have flanges integral with the valve body. Weld-on flanges shall be made by full penetration joints and 100% radiographed.
3		Forgings are acceptable in place of Castings but not vice-versa.

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S.No.	Type	Description
4		Cast Iron valve use shall be as per Clause 5.0 S. No. 41
5		Valve under LTCS (Low temperature Carbon Steel temperature below -29°C to -48°C) and cryogenic service (below -45°C) shall meet the requirements of BS 6364/ BS EN ISO 28921-1 and shall be procured from pre-qualified vendor. Pre-qualification test as per BS 6364/ BS EN ISO 28921-2 is mandatory regardless of intended service.
6		For Vacuum service, One valve per metallurgy, per rating, per size shall be helium vacuum tested as per ASME Sec.V, Subsection A, Article 10 (Hood method) Appendix IX.
7		Face-to-Face/End-to-End dimension shall be as per ANSI B16.10. In case the same is not covered under B16.10, the dimension shall be as per BS 2080/Manufacturer's Std.
8	By pass arrangement	
8.1	A globe type valve shall be provided as bypass for the given sizes of gate valves. Size of bypass valve shall be 0.5" for main valve up to 4", 0.75" for main valve of 6" and 8" size and 1" for main valves 10" and above.	Class Rating Size of valve requiring bypass 150 26" and above 300 16" and above 600 6" and above 900 4" and above 1500 4" and above 2500 3" and above
8.2		Bypass piping, fittings and valves shall be of compatible material and design. By-pass attachment to the main valve body shall not be screwed. All fillet welds for by-pass installation shall be 100% examined by DP/MP test and Butt-weld joints shall be 100% examined by radiography. NDT of bypass valve shall be in line with main valve.
9	Radiography of castings	All casting shall be of radiographic quality. This requirement to be ensured by sample radiography before proceeding with the actual production. Radiography procedure, areas of casting to be radiographed, and the acceptance criteria shall be as per ASME B16.34. Percentage of radiography shall be as given below.
9.1	Hydrogen/Hydrogen bearing hydrocarbons, oxygen, NACE service, stress relieved classes, amine, caustic, corrosive	Class 150 : 100% all sizes Class 300 : 100% all sizes
9.2	LT/Cryo services	Class 150 : 20% up to 24" and 100% for 26" & above Class 300 : 20% up to 16" and 100% for 18" and above
9.3	Stabilized grades of SS	100% radiography irrespective of size or rating

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S.No.	Type	Description
9.4	All services other than those mentioned at Clause 4.2.5.1 S.Nos. 9.1, 9.2, 9.3 above, Category D services, Fire water	Class 150 CS : 5% up to 24" and 100% for 26" and above Class 150 AS & SS : 20% up to 24" and 100% for 26" & above Class 300 CS : 10% up to 16" and 100% for 18" and above Class 300 AS & SS : 20% up to 16" and 100% for 18" & above
9.5	All services	Class 600 & above : 100% radiography for all sizes
9.6	Category 'D' , Fire water	NIL
10	Ball/Plug /Butterfly valve requirements	
10.1		Each valve shall be supplied with a lever / wrench except for gear operated / motor operated valves
10.2		Soft-seated ball, plug & butterfly valves shall be supplied with antistatic devices.
10.3		The ball of ball valve shall not protrude outside the end flanges of valve.
10.4	Ball valves shall be of floating ball / trunnion mounted type as given:	150# : Up to 8"-Floating ball;10" & above-Trunnion mounted 300# : Up to 4"- Floating ball; 6" & above-Trunnion mounted 600# and above : Up to 1.5"- Floating ball; 2" & above- Trunnion mounted
10.5		Use of soft seated ball/plug/butterfly valves shall be suitably selected based on temperatures handled.
10.6		Butterfly valves shall be suitable for throttling application.
10.7		For all services other than Category-D butterfly valve shall be triple offset, high performance type.
10.8		Quarter-turn valves shall have "open" position indicators with limit stops.
10.9		Fire safe valves shall be used for all Hydrocarbon services.

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S.No.	Type	Description
11	Fugitive Emission Requirements	Except for Valves in Cat-D and Water service, all valves with stem packing shall comply with the fugitive emission requirements detailed below as a pre-qualification. Gate valves as per API-600 and all Gate/Globe valves as per API-602 shall comply with fugitive emission requirements of API 624. Gate valves of Class rating 900 & above, Gate valves of size 26" & above and Globe valves of size 2" & above or valves where API-624 is not applicable due to non-graphite stem packing material, shall comply with Fugitive emission requirement of ISO-15848-1. Quarter turn valves shall comply with Fugitive emission requirement of API 641.Quarter turn valves where API-641 is not applicable due to non-graphite stem packing material, shall comply with Fugitive emission requirement of ISO-15848-1.

4.2.5.2 VALVE OPERATION REQUIREMENT

Manual mode of operation shall also be provided for all MOVs. Requirement of Gear operator for manual mode of operation shall be defined below.

Gear operation shall be provided as given. For sizes lower than these ranges, hand wheel / lever / wrench shall be provided. For pressure balance plug valves manufacturer's recommendation shall be acceptable. Hand wheel diameter shall not exceed 750mm and lever length shall not exceed 500mm on either side. Effort to operate shall not exceed 35 Kg at hand wheel periphery. However, failing to meet the above requirements, vendor shall offer gear operation.

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

Group Valve Type

A Gate Valve, Globe Valve & Diaphragm Valve
B Ball Valve / Plug Valve (Other than pressure balance plug valves)
C Butterfly Valve

S.No.	VALVE GROUP	CLASS	SIZE REQUIRING GEAR-OPERATOR
1	A	150 Class	10" and larger
2	A	300 Class	10" and larger
3	A	600 Class	6" and larger
4	A	900 Class	6" and larger
5	A	1500 Class	3" and larger
6	A	2500 Class	3" and larger

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S.No.	VALVE GROUP	CLASS	SIZE REQUIRING GEAR-OPERATOR
7	B	150 Class	6" and larger
8	B	300 Class	6" and larger
9	B	600 Class	4" and larger
10	B	900 Class	3" and larger
11	B	1500 Class	3" and larger
12	C	150, 300 Class	6" and larger

4.2.6 STRAINERS

S.No.	Project Philosophy
1	Allowable pressure drop when specified shall be certified by vendor along with the offer. If asked specifically, vendor shall furnish pressure drop calculations.
2	All 2" & higher sized Y type strainers shall be provided with 0.75" threaded tap and solid threaded plug as drain connection on the blind flange. For less than 2", this shall be 0.5" size.
3	Bottom flange of Y-type strainer shall not have tapped hole. Full length standard size studs shall be used for joining blind flange.
4	For fabricated strainers, all BW joints shall be fully radiographed and fillet welds shall be 100% DP/MP.
5	All the strainers shall be hydrostatically tested at the lower of twice the design pressure and 1.5 times the class rating as per ASME B16.5 at ambient temperature.

4.2.7 TRAPS

S.No.	Project Philosophy
1	Vendor shall furnish the performance curve indicating the capacity in mass/hour at various differential pressures across the trap.
2	Parts subject to wear and tear shall be suitably hardened.
3	Traps shall function in horizontal as well as in vertical installation.
4	Traps shall have integral strainers.
5	All traps shall be hydrostatically tested to twice the design pressure. Air traps shall be tested at 1.5 times the design pressure.

4.2.8 HOSES

S.No.	Project Philosophy
1	Manufacturer shall guarantee suitability of hoses for the service and working conditions specified in the requisition, even if the material is not specified in the Material Requisition for any particular service.
2	All hoses shall be clearly marked with service and working pressure at both ends.
3	Hoses shall be resistant to ageing, abrasion and suitable for outdoor installations.
4	Complete Hose assembly shall be tested at two times the design pressure.
5	Rubber Steam hoses shall be subject to steam resistance test.

4.2.9 EXPANSION JOINTS

S.No.	Project Philosophy
1	The applicable codes are ASME B31.3 and EJMA (Expansion Joint Manufacturer's Association).
2	Bellows shall be formed from solution annealed sheet conforming to the latest ASTM Spec.

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S.No.	Project Philosophy
3	Any longitudinal weld shall be 100% radiographed. The finished longitudinal weld must be of the same thickness and same surface finish as the parent material. Circumferential welds are not permitted.
4	Bellows are to be hydraulically or expansion (punched) formed. Rolled formed bellows are not acceptable. Noticeable punch or die marks resulting from expansion operation are not acceptable.
5	No repairs of any kind are allowed on the bellows after forming. Deep scratches and dents are not acceptable.
6	The out of roundness shall be limited to ± 3mm. This is the max. deviation between the max. & min. diameter.
7	The actual circumference of the welding end shall be maintained to ± 3mm of the theoretical circumference.
8	Apart from the usual requirements, the vendor shall also furnish Design calculations to justify stiffness and fatigue life, Axial, lateral stiffness, angular stiffness, effective pressure thrust area, Installation/maintenance manual and Moments & forces due to stiffness & pressure thrust due to expansion joint.

4.2.10 SUPPORTS AND SPRING ASSEMBLIES

S.No.	Project Philosophy
1	The Material, Design, Manufacture and Fabrication shall be generally as per MSS-SP-58/ MSS-SP-89 and/or BS 3974.
2	Testing of springs shall be as per BS1726

4.2.11 GASKETS

S.No.	Project Philosophy
1	Asbestos shall not be used for gaskets and fillers.
2	Full face gaskets shall have bolt holes punched out
3	Non-metallic ring gaskets as per ASME B16.21 shall match flanges to ASME B16.5 upto 24", and ASME B16.47 for sizes > 24" unless otherwise specified.
4	Spiral wound gaskets as per ASME B16.20 shall match flanges to ASME B16.5 upto 24", and ASME B16.47 series "B" for sizes > 24" unless otherwise specified.
5	All spiral-wound gaskets shall have inner ring & outer ring irrespective of size and pressure rating.
6	In case of RTJ gaskets, only octagonal section ring gaskets shall be used & shall have proper marking stamped. Material certificate shall be available for the gasket. Hardness of RTJ gaskets shall be 20 BHN(min) less than the corresponding flange groove hardness.

4.2.12 STUDS, BOLTS, NUTS

S.No.	Project Philosophy
1	All bolting shall be as per ASME B18.2.1 for Studs, M/C Bolts and Jack screws, and ASME B18.2.2 for nuts.
2	Threads shall be unified (UNC for ≤ 1" dia and 8UN for > 1" dia) as per ANSI B1.1 with class 2A fit for Studs, M/C Bolts and class 2B fit for nuts.
3	Stud bolts shall be threaded full length with two heavy hex nuts. Length tolerance shall be in accordance with the requirement of ASME B16.5
4	The nuts shall be double chamfered, semi-finished, heavy hexagonal type and shall be made by the hot forged process.
5	All the stud/ bolt should have metallurgical certificates in case of alloy/ SS metallurgy with identified colour marking at the stud ends/ bolt side face.

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S.No.	Project Philosophy
6	Heads of jack screws and M/C bolts shall be heavy hexagonal type. Jack screw end shall be rounded.
7	Wherever bolt tensioning is specified stud bolt length shall be longer by minimum one diameter to suit bolt tensioner. Excess threads shall be protected by a threaded nut.

4.2.13 SPECIAL SERVICE REQUIREMENTS

S.No.	Type	Description
1	IBR	IBR stands for Indian Boiler Regulation. For steam services, it is statutory obligation to meet IBR requirements. For items under IBR material composition restrictions, test reports, painting, etc. shall be as per IBR's stipulations.
2	NACE & Sour Service	For items under this category EIL Standard Specification 'Material requirements for Carbon steel components used in sour service in Petroleum Refinery Environments, 6-79-0013' shall be followed, unless otherwise specified by Licensor.
3	CRYO & Fire-Safe	For items to be used under LTCS (low temperature Carbon Steel -29°C to -48°C) and cryogenic conditions, temp below -45°C and those required to be fire-safe, special designs and tests would be applicable. Pre-qualification criteria needs to be complied before execution of job.
4	Impact Tests	Welded Pipes and Fittings used below ASME Temp. -29 °C shall be impact tested as per requirement of ASME B31.3.

4.2.14 INSPECTION AND TESTING

S.No.	Project Philosophy
1	All items and their parts shall be subjected to all mandatory as well as supplementary (wherever specified) tests and checks called for in the respective codes/standards/data sheets.
2	The examining personnel shall have the requisite qualification and experience.
3	Client and its authorized representative reserve the right to vet and suggest changes in vendor's procedures.
4	Vendor's works and facilities shall be accessible to the Client/Representative at all reasonable times.
5	Test reports for all mandatory as well as supplementary tests wherever specified shall be furnished.
6	Positive material identification test at vendor's works shall be done as per 'Standard specification for positive material identification PMI at vendor's works, 6-81-0001'.

4.2.15 MARKING

S.No.	Project Philosophy
1	All items shall be marked (stamped/etched) in accordance with the applicable code/standard/specification. In addition, the item code, if available, shall also be marked.

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S.No.	Project Philosophy
2	For ease of identification, the colour of painted strip (wherever required) shall be as per the applicable standard.
3	Paint or ink for marking shall not contain any harmful metal or metal salts which can cause corrosive attack either ordinarily or in service. Special items/smaller items shall have attached corrosion resistant tag providing salient features.

4.2.16 DISPATCH

S.No.	Project Philosophy
1	All items shall be dry, clean and free from moisture, dirt and loose foreign material of all kinds.
2	All items shall be protected from rust, corrosion, and mechanical damage during transportation, shipment and storage.
3	Rust preventive on machined surfaces to be welded shall not be harmful to welding and shall be easily removable with a petroleum solvent.
4	Ends shall be suitably protected, and the protectors shall be securely and tightly attached.
5	Each variety and size of item shall be supplied in separate packaging marked with the purchase order no., item code (if available), and the salient specifications.
6	Carbon steel, LTCS and low alloy steel valves shall be painted with one coat of inorganic zinc silicate primer.

5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS

S.No.	Description	Selected Option
1	Equipment spacing (ISBL)	Generally OISD norms / PNGRB Regulations / Licensor requirements
2	Minimum pipe rack width (Main Pipe Rack)	As per equipment layout
3	Spare capacity on Rack / Sleeper	10% of clear rack/ Sleeper width for Offsites and Nil for Units
4	Cooling water lines	On rack upto 36" Underground above 36"
4.1	FW lines (in Units)	As per Engineering Design Basis for Fire Protection system (EWS)
5	Minimum height of sleeper	300mm (with pavement/ gravel below pipe-way) or 500mm without pavement
6	Air cooler location	On Pipe rack / Tech structure top
7	Location of pumps:	
7.1	In Units	Pump discharge 1m outside rack with motor towards rack
7.2	In Offsites	Open area (no shed)
8	Requirements of monorail on pumps:	
8.1	Under pipe rack / shed	In Motor rating 75KW and above for all pumps
8.2	Open area	None
9	Means for Exchanger bundle removal:	
9.1	In Open area at grade and on Tech Structures top floor open to sky	None

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S.No.	Description	Selected Option
9.2	On Tech Structures except top floor open to sky	Hydroextractor
10	Offsites Piping (On sleepers / Pipe Rack)	Generally Pipe Rack, however, sleepers may be considered in localized areas
11	Battery limit valves' operation:	
11.1	OSBL Piping on sleepers	Operable from ground / platform at grade level
11.2	OSBL Piping on Piperack : Valves at grade level / Valves at piperack level	Valves at grade level, Operable from ground/platform at grade level
11.2.1	Valves at grade level	Operable from ground / platform at grade level
11.2.2	Valves at Piperack level	Operable from platform
12	Pipe way road crossing	Culvert / Overhead pipe bridges, as applicable
13	Electrical cable routing underground / above ground	As per Electrical Design Basis
14	Instrument cable routing underground / above ground	As per Instrumentation Design Basis
15	Any requirement of statutory approval.	IBR regulations for projects in India
16	Safety shower / eye wash	As per P & ID, Equipment Layout
17	Requirement of elevators	As per Specific requirement of Client/Licensor
18	Compressor house for ISBL & OSBL:	
18.1	Location	As per SME(Equipment Division) Engineering design basis
18.2	Maintenance requirement	As per SME(Equipment Division) Engineering design basis
19	Instrument Air Drier Shed	None
20	Insulation material: Hot Cold Safety Electrical heat tracing	Material selection and thickness as per agreed Process Design Basis
21	Type of environment for selection of painting system	Environment as per C050-000-06-42-PLS-01.
22	Method of surface preparation: Mechanical tools Power tool cleaning Blast cleaning	Blast cleaning (Grit blasting) No sand blasting is permitted
23	Corrosion protection below insulation:	
23.1	CS Pipe (upto 125 DEG C operating temperature)	As per EIL Painting spec C050-000-06-42-PLS-01
23.2	SS Pipe: Cold Insulated Hot insulated	As per EIL Painting spec C050-000-06-42-PLS-01
24	Specific colour coding requirements	As per EIL Painting Spec C050-000-06-42-PLS-01
25	Usage of IS grade material	Limited to Cat-D services as per ASME B31.3 & Fire water service
26	Usage of asbestos sheet gasket	Not permitted

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S.No.	Description	Selected Option
27	Provision for high settlement in tank farm: Usage of dresser coupling in tank farms Flexibility of piping	Flexibility of piping
28	Steam tracing	Tracer material shall be 0.5" Seamless CS Pipe unless otherwise specified in the Process Design Basis. Supply Lead lines from Steam supply manifold to traced lines and return lead lines from traced lines to Condensate return manifold shall be Pre-insulated SS304 tubing. Bought out Standard modules of Steam distribution & Condensate Recovery with 'integral glandless piston valves' for Steam Station and 'integral glandless piston valves and trap valve station' for Condensate recovery. Condensate Return station shall have Balanced pressure thermostatic steam traps.
29	Bulk Material Supplier	EIL approved vendor list
30	Engineering Drawing mode	Electronic - ISBL/OSBL
31	Specific software package for engineering drawings:	S3D
32	Material Control System	EIL in-house software package
33	Item Coding system	EIL practice
34	Stress analysis package	CAESAR-II
35	Access to nozzles of columns	Platform for 'manholes, nozzles with valves, spectacle blinds and instruments' (However, ladder access may be provided for Instrument connections)
36	Staircase / Ladders for tall columns	Ladder
37	Provision of breakup flanges for removal of tube bundles of heat exchangers	Nil / To be established during 3D model review.
38	Height of pipe support pedestals	150 mm
39	Mandatory Bulk Material Escalation	EIL Std.
40	Cathodic Protection of Tankage and U/G Piping	As per Client requirement.
41	Cast iron valves	None, except in drinking water service for sizes 2" and above and in Butterfly valves in cooling water service where Ductile Iron Castings are acceptable in place of Carbon steel castings
42	Strainers:	
42.1	Y Type	Upto 1.5" irrespective of service 2" & above in steam service
42.2	T type	2" & above in services other than steam
43	Dynamic stress analysis	Required for: Two phase flow lines with slug/plug flow Transfer lines
44	Piping isolation valve for instruments/ Stand Pipes	As per P&ID/ Process Design Basis

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S.No.	Description	Selected Option
45	Disposal of nonrecoverable condensate in units & offsites: Through U/G header to storm water sewer Soak Pit	As per Process Design Basis
46	Sequence of burner piping near peep-doors	Valves to be operable while viewing from peepholes
47	Sea Water Piping	CS with Corrosion Allowance 3.0mm upto 2" size and Cement Lined CS for 3" & above
48	Spiral Weld pipes	IS pipes for Category D services & Fire Water service.
49	Corrosion Pad/Protection Shield:	
49.1	Corrosion Pad on bare pipe (except galvanized) directly resting on Pipe rack/ sleeper/ structure	For 14" NB and above for CS Piping; For 2" NB and above for AS/SS Piping
49.2	Protection Shield for Shoe type support on insulated/bare Piping	For 10" NB & above for CS Piping For 2" NB and above for AS/SS Piping
49.3	Protection Shield with Trunnion/Lug/Dummy etc. type support on insulated/bare Piping	For support at all locations : For 2" NB and above for AS/SS Piping with dissimilar welding between pipe and support. For support excluding at elbow : 2" NB and above for SS Piping (Class 150 and Class 300); 10" NB and above for SS Piping (Class 600 and above); 10" NB and above for CS/AS Piping (for all ratings)
50	Special requirements for Hydrogen service	As per Clause 4.1
51	Ultrasonic examination in place of radiography is acceptable	As per Clause 3.8.8, Note 1
52	Percentage of Conventional Radiography/ Digital Radiography /Close Proximity Radiography / Ultrasonic examination	As per client requirement
53	Access for operation/ removal of Spacer/ blind in horizontal vessels (One side/ Both sides)	Both sides

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ENGINEERING DESIGN BASIS
INSTRUMENTATION

JOB NO: **C050**

PROJECT: **EPCM Services for setting up Polypropylene Unit at NRL**

CLIENT: **NRL - REFINERY**

EIL SIGNATURE:

CLIENT SIGNATURE:

0	22/Jul/2025	Issued For Implementation	RAHUL KAPOOR	NARENDRA KAKKAR	MAINAK NANDI
Rev. No.	**Date**	**Purpose**	**Prepared by**	**Reviewed by**	**Approved by**

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

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1.0 SCOPE

This Specification covers the design criteria for the purpose of carrying out Engineering for Procurement of various instruments and control systems required for the project including spare philosophy

2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

2.1 ABBREVIATIONS

Code	Description
AWG	American Wire Gauge
BEDB	Basic Engineering Design Basis
BIS	Bureau of Indian Standards
CCTV	Closed Circuit Television
DCS	Distributed Control System
DGMS	Director General of Mines Safety
DPDT	Double Pole Double Throw
FRP	Fibre Reinforced Polymer
GRP	Glass Reinforced Polymer
HART	Hi-way Addressable Remote Transducers
HC	Hydrocarbon
HVAC	Heating Ventilation and Air Conditioning
IBR	Indian Boiler Regulations
IP	Ingress Protection
IR	Infrared
IS	Intrinsically Safe
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MCC	Motor Control Center
NACE	National Association of Corrosion Engineers
NB	Nominal Bore
NEC	National Electric code
NEMA	National Electrical Manufacturer's Association
NPT	National Pipe Threads
OSHA	Occupational Safety and Health Authority
PESO	Petroleum and Explosives Safety Organisation
PLC	Programmable Logic Controller
PWAMC	Post Warranty Annual Maintenance Contract
RTD	Resistance Temperature Detector
SAMA	Scientific Apparatus Maker's Association
SPD	Surge Protection Device
SPDT	Single Pole Double Throw
TFMS	Tank Farm Management System
TFT	Thin Film Transistor

2.2 CODES & STANDARDS / PUBLICATIONS

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

S.No.	Description	Standards / Codes
1	AGA-American Gas Association	

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S.No.	Description	Standards / Codes
1.1	Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids- Part 1: General Equations and Uncertainty Guidelines	AGA Report No-3 Part-1
1.3	AGA Report No-9, Measurement of Gas by Multipath Ultrasonic Meters	AGA Report No-9
2	ASME- American Society of Mechanical Engineers	
2.1	Pipe Threads General Purpose (Inch)	B 1.20.1
2.2	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/ Inch Standard	B 16.5
2.3	Metallic Gaskets for pipe Flanges- Ring Joint, Spiral- wound and Jacketed	B 16.20
2.4	Valves-Flanged, Threaded and Welding End	ASME B 16.34
2.5	ASME Boiler and Pressure Vessel Code (BPVC), Section VIII, Division 1: Rules for Construction of Pressure Vessels	ASME BPVC-VIII-1
2.6	Boiler and Pressure Vessel Code (BPVC), Section I: Rules for Construction of Power Boilers	ASME BPVC-I
2.7	Thermowells Performance Test Codes	PTC 19.3 TW
2.8	Orifice Flanges	ASME B.16.36
2.9	Measurement of Fluid Flow in Pipes using Orifice, Nozzle and Venturi	MFC-3M
2.10	Measurement of Fluid Flow in Pipes using Small Bore Precision Orifice Meters	MFC-14M
3	ANSI/FCI-American National Standards Institute/Fluid Control Institute	
3.1	Control Valve Seat Leakage Classification	FCI 70-2
4	API-American Petroleum Institute	
4.1	Part-I Sizing and Selection	API STD 520
	Part-II Installation	API RP 520
4.2	Guide for Pressure Relieving and Depressurising Systems.	API RP 521
4.3	Flanged Steel Pressure Relief Valves	API RP 526
4.4	Seat Tightness of Pressure Relief Valves	API RP 527
4.5	Manual of Petroleum Measurement Standards	API MPMS
	Vocabulary	API MPMS 1-Vocabulary
	Proving Systems	API MPMS 4 Chapter-4
	Metering	API MPMS 5 Chapter-5
4.6	Process Measurement Instrumentation- Part I - Process Control and Instrumentation	API RP 551
4.7	Transmission Systems	API RP 552
4.8	Venting Atmosphere and Low Pressure Storage Tanks	API STD 2000
4.9	Valve Inspection & Tests	API STD 598
4.10	Machinery Protection Systems	API STD 670
5	BS/EN -British Standards/ European Standard	
5.1	Multi-Element Metallic Cables Used in Analogue and Digital Communication and Control- Part 7: Sectional Specification for Instrumentation and Control Cables	50288-7
5.2	Valves for cryogenic service	6364
5.3	Metallic materials- Types of inspection documents	10204
5.4	Cryogenic vessels - Safety devices for protection against excessive pressure - Part 1: Safety valves for cryogenic service	EN 13648-1

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S.No.	Description	Standards / Codes
6	ANSI/ISA -American National Standards Institute/ International Society of Automation	
6.1	Wireless systems for industrial automation: Process control and related applications	100.11a
7	IEC-International Electrotechnical Commission	
7.1	Electrical Apparatus for Explosive Gas atmosphere	IS/IEC 60079-0
7.2	Electrical Insulation - Thermal Evaluation and Designation	IEC 60085
7.3	Tests on Electric and Optical Fiber Cables under Fire Conditions - Part 1-1: Test for Vertical Flame Propagation for a Single Insulated Wire or Cable-Apparatus	IEC 60332
7.4	Degree of protection provided by enclosures.	IS/IEC 60529
7.5	Industrial Process Control Valves - Part 2-1: Flow Capacity - Sizing Equations for Fluid Flow Under Installed Conditions	IEC 60534-2-1
7.6	Industrial Process Control Valves- Part 2: Flow Capacity - Section Three - Test Procedures	IEC 60534-2-3
7.7	Industrial Process Control Valves - Part 2-4: Flow Capacity - Inherent Flow Characteristics and Rangeability	IEC 60534-2-4
7.8	Industrial Process Control Valves - Part 2-5: Flow Capacity - Sizing Equations for Fluid Flow Through Multistage Control Valve with Interstage Recovery	IEC 60534-2-5
7.9	Thermocouple Tolerances	IEC 60584-2
7.10	Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors	IEC 60751
7.11	Electromagnetic Compatibility (EMC) - Part 4: Testing and Measurement Techniques Set (Contains 30 sections)	IEC 61000-4 SET
7.12	Industrial Communication Networks - Fieldbus Specifications - Part 1: Overview and g Guidance for the IEC 61158 and IEC 61784 series	IEC/TR 61158-1
7.13	Industrial Communication Networks - Fieldbus Specifications - Part 2: Physical Layer Specification and Service Definition	IEC 61158-2
7.14	Functional Safety – Safety Instrumented Systems for the Process Industry Sector	IEC 61511
7.15	Functional Safety of Electrical / Electronic / Programmable Electronic Safety-related Systems.	IEC 61508
7.16	Industrial networks-Wireless Instrumentation network and communication profiles-Wireless HART	IEC 62591 Wireless HART
7.17	Test for Electric and Optical Fiber cables under Fire Conditions- Circuit Integrity	IEC 60331
7.18	Network and system security for industrial-process measurement and control	IEC 62443
8	IS-Indian Standard	
8.1	Specification of Thermal Evaluation and Classification of Electrical Insulation	IS-1271
8.2	PVC insulated (heavy duty) electric cables working Part I -voltage up to and including 1100V	IS-1554
8.3	Specification for pressure and vacuum gauges	IS-3624

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S.No.	Description	Standards / Codes
8.4	PVC insulation and sheath of electric cables.	IS-5831
8.5	Specifications for Thermocouples	IS-7358
8.6	Thermocouple compensating cables.	IS-8784
8.7	Flame Arresters-Performance Requirements, Test Methods and Limits for Use	IS-16485
9	ISA-International Society of Automation.	
9.1	Binary logic diagrams for process operations	ISA 5.2
9.2	ISA 7.0.01 Quality Standard for Instrument Air	ISA 7.0.01
9.3	Standards related to control valves	S-75.xx
9.4	Instrumentation Loop Diagrams	ISA 5.4
9.5	Instrumentation Symbols & Identification	ISA 5.1
9.6	Annunciator Sequence & Specifications	
9.7	Environmental conditions for Process measurement & control systems - Temperature & Humidity	ISA 71.01
10	ISO - International Organisation for Standarization	
10.1	Measurement of Fluid Flow by Means of Pressure Differential Devices - Part 1: Orifice Plates, Nozzles and Venturi Tubes Inserted in Circular Cross-Section Conduits Running Full	ISO 5167-1
10.2	Measurement of Fluid Flow in Circular Cross-Section Conduits Running Full Using Pressure Differential Devices - Part 2: Orifice Plates	ISO 5167-2
10.3	Measurement of Fluid Flow in Circular Cross-Section Conduits Running Full Using Pressure Differential Devices - Part 3: Nozzles and Venturi Nozzles	ISO 5167-3
10.4	Measurement of Fluid Flow in Circular Cross-Section Conduits Running Full Using Pressure Differential Devices - Part 4: Venturitube	ISO 5167-4
10.5	Industrial Valves - Measurement, test and qualification procedures for fugitive emissions	ISO 15848-1
10.6	Industrial valves Isolating valves for low-temperature applications Part 2: Type testing	ISO 28921-2
11	Enclosures for Industrial control and systems.	NEMA ICS-6
12	NFPA-National Fire Protection Association	
12.1	Purged and pressurized enclosures for electrical equipment.	NFPA-496

3.0 GENERAL / DESIGN CONSIDERATIONS

S.No.	Description
1	All instruments and equipments shall be suitable for use in specified site climatic conditions and industrial environment where corrosive gases and/or chemicals may be present. As a minimum, all instruments and enclosures in field shall be dust proof and weatherproof to IP-65 as per IEC-60529 or equivalent NEMA enclosure rating or better and secure against the ingress of fumes, dampness, insects and vermin. All external surfaces shall be suitably treated to provide protection against corrosive plant atmosphere.

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S.No.	Description
2	In case of contradiction between licensor specification and this Design basis, licensor specification shall prevail unless waiver to that specific requirement has been identified in the job specification. In case, job specification categorically identifies requirement, which is in contradiction to this, job specification will prevail.
3	The design of electronic instruments shall be in compliance with the electromagnetic compatibility requirements as per IEC 61000-4 "Electromagnetic compatibility for Industrial Process measurement and Control equipment".
4	All electrical/electronic instruments used in hazardous area shall have statutory certification from the country of origin. Additionally these instruments shall be certified by PESO as applicable, whenever installed in India. Also indigenous flameproof equipment shall comply with BIS requirement.
5	Process switches, shall be realised through field transmitters. If for some packages, process switches (pressure, level etc.) are unavoidable due to Licensor/ OEM requirement, same shall be provided with sealed micro switch contacts rated for the specified application. Contacts shall be 1 no. DPDT preferably. Otherwise 2 nos. SPDT can be considered. All switch contacts except those used in intrinsically safe circuits shall be silver plated. Contacts used in intrinsically safe circuits shall be suitable for the applications. Switches shall be hermetically sealed type. Switches shall be connected through Barriers / interposing relays, as applicable.
6	Redundancy Philosophy for DCS: a) Controller: Redundant (1:1 redundancy). b) I/O cards: All DCS I/O cards shall be redundant (including DCS loops used in SOV / Interlocks, all DCS DO signals), except for the open loops for which single I/O card will be considered. c) Power supply subsystem: Redundant (1:1 redundancy). Redundancy shall be provided to ensure availability of the system at single point failure. d) Communication subsystem: Redundant (1:1 redundancy). e) History: Redundant (1:1 redundancy). f) System server (for server based DCS)RAID-1/ RAID-10: Redundant (1:1 redundancy). g) Modbus / serial interface: Redundant (1:1 redundancy) h) OPC server: OPC server shall have RAID-1 / RAID-10 configuration. Redundant OPC server(shall not be combined with DCS system server) shall be considered with independent DMZ and double firewall. One shall be for Plant LAN and other as gateway for APC. Also, independent Server (Hardware) shall be considered for redundancy.
	Redundancy Philosophy for DCS: i) UPS Power supply feeders for DCS & ESD-PLC shall be redundant and separate. j) Redundant historian and Engineering station shall be RAID-1 / RAID-10 configuration. k) IAMS / AIMS / DON servers - RAID-1 / RAID-10 machines in Non-redundant configuration. l) Operation Technology (OT) policy of owner regarding Cyber Security shall be followed by DCS/PLC vendor including compliance to all the requirements mentioned in OT policy as per IEC 62443 standard
7	Threaded end connections shall be to NPT as per ASME B 1.20.1. Flanged end connections shall be as per ASME B 16.5. Orifice flanges shall be as per ASME B 16.36
8	Instruments of gas service are to be installed only above or at least parallel to the tapping with a slope in the impulse piping towards the tapping to achieve self draining condition.

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S.No.	Description
9	All online process analysers and gas detectors & Fire detectors and Spill detectors wherever required shall be supplied complete with proper calibration apparatus/ calibration gas cylinders etc. Auto calibration facility need to be provided for the analysers and gas chromatographs. Wherever auto calibration features are not available for any analysers from the approved manufacturers, manual calibration shall be considered. Valid PESO certificate must be provided along with carrier gas (H2 and N2) cylinders. PESO certificates for both basic gas and mixture gas must be provided for calibration gas cylinder and the certificates should be in the name of M/s NRL.
10	For instrumentation electrical interface, input and output contacts shall be in separate multicables.
11	All instruments in sour service shall meet NACE requirement wherever required as per licensor specification/ piping material specification.
12	Canopy shall be Prefabricated type and of FRP material. Canopy for transmitters shall cover Top and all 3 sides (Back & two sides)with a window of transparent material at the centre to view local indication without lifting canopy. Canopy for JB & Push button shall cover top side only. SS canopy instead of FRP, if offered by package vendor, shall also be acceptable. No separate canopy shall be required for instruments located under shed like compressor shed etc.
13	Wherever dual power supplies are used, anyone power supply failure shall generate an alarm in DCS graphics.
14	All Instruments/Valves in Cryogenic services shall be selected suitable for the same along with testing requirement as per PMS wherever applicable.
15	The instrument item like control valve, pressure relief valve, orifice flanges, level instrument, thermowell etc., coming on pipe and vessel under IBR services shall be certified by IBR or IBR authorised representative, even for SS metallurgy.
16	Virtualization of servers shall be incorporated only for sub-systems AIMS, OPC,UHN and DON in DCS system (As applicable).
18	Pushin type screw less terminal blocks (TB) shall be provided.
17	Smart transmitters when specified shall be used in analog mode with an accuracy of ± 0.065% of span and with maximum rangeability of 100:1 unless specified otherwise. Universal type Hand held communicator suitable for smart transmitters shall be supplied. Minimum 08 Nos. Universal type Hand Held Communicators shall be considered for the PPU unit.
19	For each SIS loop, SIL study assessment and SIL incorporation as per the assessment shall be incorporated.

3.1 CONTROL PHILOSOPHY

3.1.1 TYPE OF PLANT

S.No.	Description	EIL Choice	Remarks
1	Grassroot	YES	Petrochemical
2	Expansion	NO	
3	Utilities & Offsites	YES	

3.1.2 MODE OF PLANT OPERATION

S.No.	Description	EIL Choice	Remarks
1	Centralised		

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S.No.	Description	EIL Choice	Remarks
1.1	For PP Unit, Associated Utility and Offsites.	YES	From Polypropylene Control Room (PCR)
2	Dedicated		
2.1	Bagging and Palletizing System	YES	From Bagging Control Room inside Product Warehouse
2.2	Extruder System	YES	From Extruder Building

3.1.3 CONTROL ROOM/SATELLITE RACK ROOM REQUIREMENT

S.No.	Control Room/ SRR	Process/ Utility Units	Floor Location	Remarks
1	Polypropylene Control Room (PCR)	PP Unit, Associated Utility and Offsites.	Ground	Safe Area
2	Extruder Control Room (PP)	Extruder System	Ground	Classified Area
3	Bagging control room in ware house	Bagging and Palletizing System	Ground	Safe Area
4	Existing Main Control Room-2	-	Ground	Safe Area

Note-1: Chemical Filters shall be considered for HVAC system in Field and Polypropylene Control Room (PCR). Continuous corrosion monitor and humidity & temperature sensors are to be considered in Rack Room of Polypropylene Control Room (PCR) with DCS/control system trending. Corrosion monitor and humidity & temperature sensors shall be provided by the DCS/PLC system Vendor
Note-2: "Safe Area" means Non Hazardous Area As per IS/IEC 60079-10-1.

3.1.4 FLOORING REQUIREMENT IN INSTRUMENT ROOMS

S.No.	Rooms of SRR/ Control Room	Flooring Type (shall be as per Architecture)	Cable Routing inside C/R	Remarks
1	Rack Room of Polypropylene Control Room (PCR)	False Floor	Covered Tray only for system and special cables. All other cables including Inter panel cabling also to be routed through open Cable Trays. Parallel running of Low Voltage Communication cable and Power cable to be avoided.	Cable entry to building shall be through MCT.
2	Console Room	Solid Floor (Operator area), Console Area (trench for cable routing below consoles)	Trench	All the cables shall be laid inside the trenches in cable trays.

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S.No.	Rooms of SRR/ Control Room	Flooring Type (shall be as per Architecture)	Cable Routing inside C/R	Remarks
3	Engineering Room	Solid Floor (False floor/trench for cable routing below Engineering PCs)	Trench	All the cables shall be laid inside the trenches in cable trays.

3.1.5 TYPE OF CONTROL AND MONITORING

S.No.	Description	Units	Remarks
1	Centralised		
1.1	Distributed Control System	For PPU, Utility and Offsites	Smart "4-20mA DCwith HART" type analog signals to be used for all Open and Close loops
1.2	Control panel with Micro-processor based Instruments	NO	
2	Dedicated		
2.1	Programmable Logic Controller	Pneumatic Conveying System, Extruder Package, Membrane Package and Bagging & Palletizer Package.	Also as per Licensor requirement
3	Local Panel Control System		
3.1	Microprocessor based/PLC	NO	
3.2	Pneumatic	NO	
3.3	Hydraulic	NO	

3.1.6 INTERLOCK AND SHUT-DOWN SYSTEM

S.No.	Description	EIL Choice	Remarks
1	Logic Representation		
1.1	As per ISA	YES	
1.2	As per actual electronics	NO	
1.3	Other	NO	
2	Interlock Execution		
2.1	Independent of Shutdown System	NO	
2.1.1	With DCS		
2.1.2	Dedicated		
2.2	With Shutdown system	YES	
3	Shutdown System		
3.1	Dedicated unit wise	YES	
3.2	Common for all units	NO	
3.3	Type of hardware		
3.3.1	PLC	YES	
3.3.2	Relay	NO	

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S.No.	Description	EIL Choice	Remarks
4	PLC Configuration for ESD and F&G System		PLC configuration for Process units & Offsites shall be TMR or Quad, SIL-3 certified as per IEC 61508 and IEC 61511. Trending of ESD/F&G PLC tags shall be carried out in DCS. DCS & ESD-PLC of same make shall be specified. DCS & ESD-PLC shall be specified with minimum 1 second of real time trending capability.Plant DCS and ESD shall be sitting on/ hooked by common same native BUS. SIL Certification shall be from certifing agency as per the availability with system vendor.
4.1	Dual Modular Redundant	YES	For Bagging & Palletizing Package, Membrane Package PLCs
4.2	Triple Modular Redundant	YES	
4.3	Quad	YES	
5	SIL3 Classification	YES	
6	Others	YES	Licensor's specific requirement, if any, shall be considered.
7	Process bypass switch		
7.1	Software (as per approved P&IDs)	YES	Through DCS Operator console
7.2	Hardwired with Indication Lamp (as per approved P&IDs)	YES	Through Hardwired Console. Emergency shutdown + only most critical to be considered in Hardwired console in Polypropylene control room.
8	ESD switch Location		
8.1	Local control panel.	YES	As per P&IDs
8.2	Control Room	YES	As per P&IDs
8.3	Field	YES	As per P&IDs.
9	Maintenance Bypass switches	YES	In DCS Operator Console enabled through Master MOS in HWC

Note-1: 250 ms scan time for PLC shall be considered. However, Process requirement of faster scan time shall be considered as required.
Note-2: . The PLCs (Package PLC, ESD PLC, F&G) shall be fully redundant (right from power supply, CPU, communication, IOs) and functionality. The physical modular level redundancy shall be as per Standard system vendor configuration of approved PLC vendors.

3.1.7 LOCAL PANEL REQUIREMENT

S.No.	Description	EIL Choice	Remarks
1	Location		
1.1	Hazardous Area	YES	As per area classification
1.2	Non Hazardous Area	YES	As per area classification
2	Type		

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S.No.	Description	EIL Choice	Remarks
2.1	Weatherproof	YES	For local panel in hazardous area, local display unit (HMI) and Alarm annunicators shall be instrinsically safe and other components like lamps, switches, push buttons etc shall be flameproof. Redundant HMI unit (with touch facility) shall be considered with process graphics related to the Equipment.
2.2	Flame-proof	YES	Wherever Applicable
2.3	Purged	YES	Shall be avoided as far as possible
3	Instruments Type		
3.1	Pneumatic	NO	
3.2	Electronic	YES	

Note-1: All cable entries in the local panels shall be from bottom. All local panels including its digital display shall be protected from direct sun light using overhung FRP canopy.
Note-2: Cable entry to Local Control Panel shall preferably be through MCT, however, double compression type Exd cable glands along with PVC sleeves are also acceptable.
Note-3: All spare cable entries shall be sealed using double compression type SS Exd plugs.
Note-4: Local IS (intrinsically safe) hazardous area certified display unit shall be installed with required driver software and configured as MODBUS SLAVE instead of MODBUS MASTER. Since the DCS always acts as MODBUS MASTER, configuring the IS display unit as MODBUS slave only will ensure proper serial communication between DCS and IS display unit. Also, the interface link with DCS shall be MODBUS TCP/ IP.
Note-5: Cable entry to analyser shelter shall be through MCT
Note-6: Local Panel lamps shall be cluster LEDs type and ESD button shall be provided with protective cover.
Note-7: Lamp test logic to be implemented through Main Plant PLC.
Note-8: No dedicated proprietary type of Annunciation System should be considered. The entire Annunciation logics shall be built in the plant DCS/ESD. The annunciation lamps shall be driven from the DCS/ESD.
Note-9: Both the HMI of LCP shall be identical having same sets of graphics (MMS, Process etc.) so that redundancy can be achieved. Also both the HMI of LCP should be hooked up with the DCS via MODBUS TCP/ IP. No direct hook up with the MMS is required for the LCP HMI. The MMS data including the Process Data will be available at both the HMI of LCP via DCS (Note: DCS will be hooked up with MMS via soft link i.e. MODBUS TCP/ IP). Also, dedicated MMS graphics page should be provided in the DCS.

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3.2 PACKAGE UNITS PHILOSOPHY

3.2.1 OPERATING PHILOSOPHY

S.No.	Package Description	Control & Monitoring-Centralized DCS	Control & Monitoring-Dedicated PLC in CR	Control & Monitoring-Dedicated PLC in Local Panel	Interlock & Shutdown-Centralised PLC	Interlock & Shutdown-Dedicated PLC in CR	Interlock & Shutdown-Dedicated PLC in Local Panel	Remarks
1	Compressor Packages	YES			YES			
2	Extruder Package		YES			YES		Dedicated Package PLC in Extruder Control Room. Extruder Operation & Control, Operator cum Engineering station in Extruder Control Room. See note 2 & 3 below.
3	Pneumatic Conveying		YES			YES		Dedicated Package PLC in Polypropylene Control Room (PCR). See note 2 & 3 below.

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S.No.	Package Description	Control & Monitoring-Centralized DCS	Control & Monitoring-Dedicated PLC in CR	Control & Monitoring-Dedicated PLC in Local Panel	Interlock & Shutdown-Centralised PLC	Interlock & Shutdown-Dedicated PLC in CR	Interlock & Shutdown-Dedicated PLC in Local Panel	Remarks
4	Bagging and Palletizing			YES			YES	Dedicated Machine mounted PLC in Product Warehouse. See note 2 & 3 below.
5	Membrane unit		YES			YES		Dedicated Package PLC in Polypropylene Control Room (PCR). See note 2 & 3 below.
6	Others	YES			YES			See Note-1 below.

Note-1: Logic implementation for package units shall be through Main Plant PLC. However for proprietary items like or licensor specific requirements, Package vendor's proven and standard PLC/ Control System shall be used.
Note-2: Wherever dedicated PLC is considered for packages, the same shall be interfaced with DCS with MODBUS TCP IP (Redundant) for monitoring purposes and mapped to DCS with dedicated graphics.
Note-3: Process / safety interlock related tag communication between main plant PLC and third-party systems shall be hardwired.
Note-4: Interfacing with Electrical ECS/ Breaker etc. with DCS/ESD PLC: All the signals (Status/ Current indication etc.) of electrical equipments shall be via common MODBUS TCP IP Link (Redundant) from the ECS/breakers of electrical substation. All the other signals linked with Interlock shall be hardwired via Interposing Relay/ signal Panel

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3.2.2 PLC CONFIGURATION (FOR PACKAGE VENDOR SUPPLIED PLC)

S.No.	Description	EIL Choice	Remarks
1	Dual Processor, single I/O	NO	
2	Redundant Processor, Redundant I/O & Redundant Power Supply , Redundant Communication (DMR)	YES	For packages like Bagging & Palletizing, Membrane Package
3	DMR/TMR / Quad with SIL3	YES	For Extruder Package & Pneumatic Conveying packages
4	Vendor"s standard		
5	Others	YES	As per licensor specific requirements.

3.2.3 ANTI SURGE CONTROLLER

S.No.	Description	EIL Choice	Remarks
1	Type		
1.1	Conventional Single loop Controller	NO	
1.2	DCS	NO	
1.3	Dedicated Special Controller	YES	Minimum Duplex configuration having scan time of 40 msec and with redundant serial interface to DCS. Independant antisurge controller shall be considered with serial link to DCS and real time data recording facility in DCS. Refer Note-1 below
1.4	PLC	NO	
2	Location		
2.1	HMI in Polypropylene Control Room (PCR)	YES	ASC HMI
2.2	Rack room of Polypropylene Control Room (PCR)	YES	ASC Controller

Note-1: Anti surge controller hardware shall be located in Polypropylene Control Room (PCR). ASC shall be provided with provision of Real time trend ,event log facility in Anti surge controller & same shall be serially interfaced with DCS system.
Note-2: The operator interface system (HMI) shall be located in console room of the Polypropylene Control Room (PCR). HMI shall have configuration and monitoring capability. The HMI shall be console mounted type with 22" TFT screen and keyboard.
Note-3: License software of Antisurge controller shall be considered with laptop from machine vendor.
Note-4: If any vendor provides integrated control for antisurge, speed governing-electronic type, over speed, performance control, the same is acceptable, however, separate dedicated processor shall be considered for each application. Also, the over speed Trip system shall be SIL 3 Certified with 3 dedicated speed probes (2oo3 voting).

3.2.4 MACHINE MONITORING SYSTEM

S.No.	Description	EIL Choice	Remarks

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S.No.	Description	EIL Choice	Remarks
1	Type		
1.1	Machine Monitoring System	YES	with hardwired connection to PLC for interlocks and serial link to DCS
2	Machine Monitoring System Monitors Location		
2.1	SRR/ Control Room	YES	In Polypropylene Control Room (PCR)
2.2	Field Local Panel	YES	Note-4
3	MMS Display Unit Location		
3.1	Local Panel	YES	MMS data shall be preferably through IS PC (Panel Mounted HMI)

Note-1: MMS shall have Modbus TCP/IP serial link to DCS. MMS shall be provided with Redundant TCP/IP port for Modbus connectivity to DCS & Ethernet ports for machine condition monitoring system (MCMS) connectivity. Machine conditioning monitoring system (MCMS) which integrates and provides machine condition detail along with analysis for multiple machine is a separately procured item by Owner and is not envisaged as a part of MMS, hence interface provision to be provided for the same.
Note-2: Machine monitoring systems, independent racks/chassis are to be considered for individual machines.
Note-3: Buffered output shall be provided for each machine for interface with central machine conditioning system in MMS. Vendor shall provide ".rak" files for system integration with MCMS vendor.
Note-4: Location of MMS cabinet shall be based on distance of the equipment from Polypropylene Control Room (PCR). In case of distance limitations, MMS Racks can be located in Field Local Control Panel.
Note-5: MMS graphics shall be provided in the DCS also incorporating all the real time data like the MMS HMI.

3.2.5 LOCATION OF SPEED GOVERNOR

S.No.	Description	EIL Choice	Remarks
1	Polypropylene Control Room (PCR)	YES	HMI of Speed Governor
2	Polypropylene Control Room (PCR)	YES	Controllers of Speed Governor

Note-1: Speed governor hardware shall be redundant and located in Polypropylene Control Room (PCR) with redundant serial interface to DCS.

3.2.6 TYPE OF LOCAL PANEL

S.No.	Description	EIL Choice	Remarks
1	Weather proof to IP55	YES	
2	Purged, type-Z As per NFPA 496	NO	
3	Purged, type-X As per NFPA 496	YES	Only for Panels like Analyser panels etc. where components suitable for hazardous area are not available.
4	Components and terminals in flameproof box	YES	Push Buttons, Lamps, Selector Switches
5	Intrinsically Safe Alarm Annunciator	YES	

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S.No.	Description	EIL Choice	Remarks
6	IS PC's for Display of loop powered indicators.	YES	Process Graphics, Alarm,Status, process Data, MMS data

Note-1: Signals to Alarm Annunciators shall be from PLC for trip alarm and from DCS for any prealarm, if required. Same shall be configured accordingly in detail engineering

3.3 DCS REQUIREMENTS

3.3.1 OPERATOR CONSOLES

S.No.	Control Room	Units	Number of Operator Consoles	Number of display screens/ console
1	Polypropylene Control Room (PCR)			
1.1		PPU Unit	4	2 (Note-3)
1.2		Field Operator Room in PCR	1	2 (Note-3)
1.3		Pneumatic Conveying Package Console	2	1
1.4		Bagging & Palletizing Package Console	2	1
1.5		Extruder Package Console	2	1
1.6	Existing Fire Station building	DCS Console (view only)	1	1
3	Extruder Control Room	Extruder Package Console	1	1

Note-1: All the operator consoles in PCR shall be sit-stand type.
Note-2: One no. single stack DCS Operator Console shall be extended to Extruder Operator Room of PP unit.
Note-3: Dual Tier Operator Workstation Consoles.

3.3.2 CONSOLE CONFIGURATION

S.No.	Description	EIL Choice	Remarks
1	Console configuration		
1.1	Single	NO	
1.2	Dual	YES	
2	Type of monitor		
2.1	LED (TFT LCD with backlit LED)	YES	22" size with Touch screen
2.2	LCD	NA	
3	Engineering functions from operator console	NO	
4	Open system connectivity	YES	Through dedicated OPC server
5	Historic Trending on each console	YES	For all tags

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3.3.3 ENGINEERING CONSOLES

Number of consoles in Engineering Room of Polypropylene Control Room (PCR):

S.No.	Control	Unit	Number of Engineering Consoles	Remarks
1	Polypropylene Control Room (PCR)		YES	
1.1	Polypropylene Control Room (PCR)	PP Unit, Associated Utility and Offsites	1+1	2 engineering workstation consoles (1 for Plant DCS and 1 for Plant ESD PLC)
1.2	Polypropylene Control Room (PCR)	Membrane Package	1	1 no. common PLC Engineering cum operator Console common for Membrane Package.
1.3	Polypropylene Control Room (PCR)	Pneumatic Conveying Package.	1	1 no. common PLC Engineering cum operator Console common for Pneumatic Conveying Package.
1.4	Polypropylene Control Room (PCR)	PP Unit, Associated Utility and Offsites	2	2 No. DCS Operator Workstation consoles
1.5	Polypropylene Control Room (PCR)	PP Unit, Associated Utility and Offsites	1	1 No. Asset Management System
1.6	Polypropylene Control Room (PCR)	PP Unit, Associated Utility and Offsites	2	Note-3
1.7	Polypropylene Control Room (PCR)	PP Unit, Associated Utility and Offsites	1+1	OPC (redundant) servers. Note-4
2	Product Warehouse	Polymer Product Storage	1	1 no. common PLC Engineering cum operator Console common for all Bagging and Palletizing machine

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S.No.	Control	Unit	Number of Engineering Consoles	Remarks
3	Extruder Control Room	Extruder System	1	1 no. common PLC Engineering cum operator Console common for Extruder Package.

Note-1: In the Polypropylene Control Room (PCR), the DCS Engineering console shall be Engineering cum operator console.
Note-2: For Field Operator Room: 1 No. dual Tier DCS Console workstation should be considered.
Note-3: 2 Sets of System Backup Workstation Servers common for DCS/PLC and Package PLCs. One Server will be located at the Engineering Room of PCR and other server located at existing NREP MCR-2.
Note-4: OPC Servers (redundant) with data collection softwares shall be provided for interface with existing NREP MCR-2.

3.3.4 ENGINEERING & OPERATIONAL DATABASE

S.No.	Description	EIL Choice	Remarks
1	Historical Database		
1.1	Unitwise	YES	
1.2	Combined	YES	Associated Utility and Offsites
2	Type of Reports Required		
2.1	Hourly	YES	
2.2	Shiftwise	YES	
2.3	Daily	YES	
2.4	Alarm History	YES	
2.5	Alarm Summary	YES	
2.6	Shut Down Report	YES	
2.7	MIS Report	YES	
3	Plant History		
3.1	Required	YES	

3.3.5 ALARM INFORMATION MANAGEMENT SYSTEM

S.No.	Description	EIL Choice	Remarks
1	Required	YES	Common AIMS shall be considered in Polypropylene Control Room (PCR) and the same shall be provided separately Operator Console Wise.

Note-1: AIMS shall be in virtualized server.

3.3.6 GIANT SCREEN REQUIREMENT

S.No.	Description	EIL Choice	Remarks

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S.No.	Description	EIL Choice	Remarks
1	Giant Screen Required		
1.1	No. of Screens	Video wall. Full size screen covering the entire front wall of the operator console (atleast 1 meter gap from floor) having multiple video inputs (8 or above) of HDMI with multiple matrix view.	
1.2	Size	Per peice: 55" or above	Giant screen shall be of LED /LCD (LED backlight)/ IPS/ DLP (Laser(rear projection)), Pixel Pitch: 1.65 mm or better Bezel to Bezel distance among display panels: 3 mm or below.
1.3	Location	Polypropylene Control Room (PCR)	

Note-1: Plant CCTV Network shall be connected to Giant Screen as well.

3.3.7 SEQUENCE OF EVENT RECORDING

S.No.	Description	EIL Choice	Remarks
1	SER Functionality	YES	In PLC
2	Resolution	For Digital Input - 1 msec	The maximum resolution between two events shall not exceed 1 msec. For Analog signals SOE resolution time shall be same as PLC scan time
2.1	PLC Scan Time	250 msec for SIL3 PLC	Lower scan time as per Licensor requirement for specific loop would be considered
3	Dedicated SOE PC	YES	Dedicated PLC Engineering and Dedicated SOE Station

3.3.8 ADVANCED CONTROL FUNCTION REQUIREMENT

S.No.	Description	EIL Choice	Remarks
1	Advanced Process Control Functions.		
1.1	Through DCS	NO	
1.2	Through Dedicated System	NO	
1.3	Advance Auto tunning system	YES	

Advance process control platform is not part of project scope, however the DCS shall have the capability of integrating seamlessly with an APC system. OPC shall be considered in DCS system architecture for this purpose for future connectivity with APC.

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3.3.9 ASSET MANAGEMENT SYSTEM

S.No.	Description	EIL Choice	Remarks
1	Required	YES	
1.1	Integrated with DCS and PLC	YES	
1.2	Dedicated through multiplexer	NO	
2	Dedicated Asset Management system PC	YES	

Note-1: Dedicated station loaded with Instrument Asset Management System software is required on DCS network, through HART pass through DCS/ ESD/ F&G cards.
Note-2: For package PLCs, HART multiplexers (and dual input barriers in PLC) shall be used and connected to the Instrument Asset Management System.
Note-3: OPC Servers (redundant) with data collection softwares shall be provided in Engineering Room of PCR for further interface with existing NREP MCR-2.

3.3.10 DOCUMENTATION NODE

S.No.	Description	EIL Choice	Remarks
1	Required	YES	

Note-1: Common DON in virtualized server shall be considered with DCS system. Software license shall be provided for the documentation software.

3.3.11 TRAINING KIT

S.No.	Description	EIL Choice	Remarks
1	Required		
1.1	For DCS	YES	Training at OEM works and site
1.2	For PLC	YES	Training at OEM works and site

3.3.12 TRAINING SIMULATOR

S.No.	Description	EIL Choice	Remarks
1	Required	NO	

3.3.13 LOADING PHILOSOPHY

S.No.	Description	%	Remarks
1	Control Processor	60%	
2	Communication Processor / Bus	60%	
3	Maximum number of Nodes in the network	70% of the maximum capacity.	
4	Bulk Power Supply (BPS)	60%	

Plant DCS and Plant ESD/PLC: IO quantity, maximum 60% IO loading per controller.

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3.4 INSTRUMENTATION ON CONTROL ROOM PANEL / HARD-WIRED CONSOLE

S.No.	Type	Description	Remarks
1	Alarm Annunciator		As per P&ID.
1.1	On panel/ Hanging Type/ On console	On Console	Soft configuration through DCS graphics. On Hardwired console as per P&ID.
1.2	First out sequence Required	YES	
2	Multi-point Temperature Indicator Required	NO	
3	Auto Manual Station		
	On HWC/On Operator Console	On Console	Soft configuration through DCS graphics. On Hardwired control as per P&ID
4	Manual Loading Station		
	On HWC/On Operator Console	On Console	Soft configuration through DCS graphics. On Hardwired control as per P&ID
5	Selector Switch		
	On HWC/On Operator Console	On Console	Soft configuration through DCS graphics. On Hardwired control as per P&ID
6	Start/Stop, Push Button	Open/close	
	On HWC/On Operator Console	On Console	Soft configuration through DCS graphics. On Hardwired control as per P&ID
7	Emergengy Push Button location		
	On HWC/On Operator Console	On hardwired Console	
7.1	Type		
	Push Type With mushroom head and protective cover	YES	
	Pull Type With mushroom head	NO	
8	Process Bypass Switch/ Indication		The Bypass Status lamp should be driven from the related DO of DCS/ESD.

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S.No.	Type	Description	Remarks
	On HWC/On Operator Console	On HWC/On Operator Console	As per P&ID.

Note-1: In case of contradiction, Location as per P&IDs shall govern.
Note-2: The Hardware Console shall be of mosaic tile finish design for ease of adding/ deleting any hardware on the console. It shall be possible to add or remove any item from console front by removing or adding mosaic tiles.
Note-3: The Switches (Selector switch, Push buttons etc.) and lamps of Hardware Console at PCR shall be of miniature type i.e. max. 16 mm size.

3.5 GENERAL

3.5.1 TYPE OF POWER SUPPLY

S.No.	Type	Tolerance for Instruments	Back up time for UPS	Emergency Power Supply Requirement
1	110V AC UPS	±10 Hz%,±3Hz	As per Electrical Design Basis	As per Electrical Design Basis

Note-1: UPS Voltage indication & current will be repeated in DCS from each DCS 110 VAC PDB. For diagnostic data a Modbus serial link shall be considered from UPS to DCS.

3.5.2 POWER SUPPLY REQUIREMENT

For each of the items below, user shall select the power supply type from the choices available.

S.No.	Description	110V AC 50Hz UPS	110V DC	24V DC	110V AC Non UPS	240V AC 50Hz (UPS)	240V AC 50Hz (Non UPS)	415 V AC-3 phase	Remarks
1	Distributed Control system	YES							
2	Package Units including local panel where required	YES					YES		Non UPS for Lighting
3	Alarm Annunciator	YES							
4	PLC	YES							
5	Solenoid Valves			YES					
6	Smart Positioners, Transmitters			YES					
7	I/P Interrogation Voltage			YES					
8	Fire & Gas Detectors			YES					
9	Analyzers and Analyzer System	YES							
10	Gas Chromatographs	YES							

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S.No.	Description	110V AC 50Hz UPS	110V DC	24V DC	110V AC Non UPS	240V AC 50Hz (UPS)	240V AC 50Hz (Non UPS)	415 V AC-3 phase	Remarks
11	Training Kit for DCS/PLC								
12	Training Simulator for DCS								
13	Level Gauge Illumination						YES		
14	Cabinets Fan	YES					YES		UPS for System cabinets only
15	Cabinets Lighting	YES					YES		
15.1	Control Room						YES		
15.2	Local Panel						YES		
16	CCTV	YES							
17	Analyzer Cabinet Air Conditioning						YES		
18	Analyzer Shelter HVAC							YES	

Not-1: 24 V DC power supply will be derived from UPS using redundant bulk power supply.
Note-2: All Non-DCS loads shall be through isolation transformer only.
Note-3: 110V AC UPS shall be considered for DCS/ ESD system cabinets and operating consoles lighting & fan. For DCS/ ESD marshalling cabinets, 240 V AC Non-UPS supply shall be considered for cabinet lighting & fan.
Note-4: The UPS (110 VAC) output power supply of the UPS shall not be floating, the Neutral should be grounded. Additionally, the 24DC power supply shall also be grounded.

3.5.3 POWER SUPPLY DISTRIBUTION

S.No.	Description	EIL Choice	Remarks
1	Less than 1.5 kVA	PDB in Rack Room	
2	Greater than 1.5kVA	UPS ACDB in UPS Room	

Note-1: Surge protection device shall be used for 240VAC supply from PDB.
Note-2: UPS for Polypropylene Control Room (PCR) shall be considered as per Electrical Design Basis.

3.5.4 CABLE ENTRY

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S.No.	Description	EIL Choice	Remarks
1	Polypropylene Control Room (PCR)	MCT Block	
2	Local control Rooms	MCT Block	
3	Analyser Rooms / Shelter	MCT Block	

Note-1: MCT blocks : Frame material shall be Stainless Steel, Sealing module type- Removable layer type, Compression Wedge and stay plate are to be provided.

3.5.5 AIR SUPPLY AT BATTERY LIMIT

As per Process BDEP

3.5.6 SIZE OF INSTRUMENT NOZZLES

As per Process BDEP

3.5.7 INSTALLATION / TUBING HOOK-UPS

S.No.	Description	EIL Choice	Remarks
1	Instrument Installation		For licensor units, Licensor requirements to be followed
1.1	Close coupled	YES	For pressure Gauges and for other instruments where mandatorily recommended by Licensor.
1.2	Remote	YES	(i) For DP Type Level and PDT (ii) For PT & DP Type FT- Services above ASME 600 class.- Services with maximum operating temp. above325 Deg.C- Steam- Hydrogen (iii) For DP type FT pertaining to venturi, Flow Nozzle, D- D/2 Tapping, Meter Run. (iv) For Congealing services and corrosive services where diaphragm seal is used as per P&ID. (v) For Pressure Gauges:- Services with maximum operating temp. above100 Deg C.- Reciprocating Pump discharge line where vibration is expected.
1.3	Pre-fabricated Hook Ups	NO	
2	Instrument impulse lines		
2.1	Tubing Impulse Lines	YES	Note-3
2.1.1	Instrument manifolds-Integral		
2.1.1.1	For PT/pressure gauges	YES	Integral manifold with PT/pressure gauges
2.1.1.2	For flow DP transmitter	YES	Integral manifold with flow DP transmitter
2.1.2	Impulse Line Valves		

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S.No.	Description	EIL Choice	Remarks
2.1.2.1	Isolation valves	Gate	First isolation valve shall be Gate type nearthe main process tap-off and all otherisolation/ equalisation valve shall be Globetype.For hydrogen service (irrespective of rating) and for other services (600# rating and above), double isolation piping root isolation valves and double vent & drain valves shall be considered.
2.1.2.2	Vent/drain valves	Gate	
2.2	Tubing	YES (For rating up to 600#).	Note-3
2.2.1	Instrument valve manifolds		
2.2.1.1	For PT/pressure gauges	YES	2 valve manifold, Integral Manifold.
2.2.1.2	For flow DP transmitter	YES	5-Valve Manifold, Integral Manifold.
2.2.2	Impulse Line Valves		
2.2.2.1	Isolation valves	Gate	Equalisation valve shall be Globe type.
2.2.2.2	Vent/drain valves	Gate	
2.3	Prefabricated hook ups	NO	
2.3.1	For Flow DP, PT, PG		
2.3.2	Impulse Line valves		
2.3.2.1	Isolation valves		
2.3.2.2	Vent/drain valves		
2.4	Others	NO	
3	Air Supply Tubing		
3.1	Material		
3.1.1	SS 304		
3.1.2	SS 316		
3.1.3	SS 316L	YES	However, Fitting shall be SS316.
3.1.4	Others		
3.2	Tube size		
3.2.1	1/4" OD with 1mm wall thickness	NO	
3.2.2	6 mm OD with 1 mm wall thickness	YES	12mm OD with 1.2 mm wall thickness where valve requires higher size.
3.2.3	Others	NO	
4	Steam Tracing Tubing		
4.1	Material		
4.1.1	Bare Copper	YES	
4.1.2	SS 316	NO	
4.1.3	Others	NO	
4.2	Tube size		
4.2.1	1/4" OD with 1mm wall thickness		
4.2.2	3/8" OD with 0.049" wall thickness	YES	
4.2.3	Others	NO	
5	Impulse tubing		

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S.No.	Description	EIL Choice	Remarks
5.1	Material		
5.1.1	SS 316L	YES	However fitting shall be SS316
5.2	Tube size		
5.2.1	1/2" OD with 0.049" Wall Thickness	YES	
5.2.2	Other		

Note-1: After the Instrument Air main header, the Instrument Air branch header shall be of SS316 material and Instrument air manifold with Ball isolation valves shall be used for distribution to individual consumers in each branch.
Note-2: Electrical heat tracing shall be provided only where accurate temperature maintenance is called for as per Licensor or equipment manufacturer recommendation or if main process line is electrically traced.
Note-3: For Hydrogen service, Diaphragm seal, line rating above 600 class and as mandatorily recommended by Licensor, full piping shall be considered.

3.5.8 FIELD TRANSMITTER TYPE

S.No.	Description	Conventional	Smart	Fieldbus	Wireless	Remarks
1	Open loops		YES			
2	Close loops		YES			
3	For anti-surge loops		YES			As per vendors standard requirement
4	For interlock/ shut-down loops/ Safety system loops		YES			For shutdown, smart transmitters configuration facility shall be kept inhibited by default.
5	Pump Seal Instruments		YES			
6	Vibration type instruments for noncritical pumps(other than MMS)		YES			

Note-1: SIL2 certified transmitters, SOVs, barriers and shall be used in ESD/ SIS loops.

3.5.9 FIELD POSITIONER TYPE

S.No.	Description	EIL Choice	Remarks
1	Electro pneumatic, Smart (HART)	YES	
2	Electro pneumatic, Fieldbus	NO	
3	Pneumatic	NO	

Note-1: Smart type positioner shall be considered for close loops as per application

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requirement including dampers.
Note-2: All Positioners shall have capability to transmit the actual valve position feedback through HART.
Note-3: Control valves shall be provided with Contact Less positioner preferably (linkage less positioner is also acceptable). Contact/ linkage based positioner is also acceptable.

3.5.10 PROCESS INSTRUMENT TYPE FOR SHUT-DOWN

Only transmitters to be used . Any other specific requirements as per Process BEDB Part B / Process licensor to be followed.

3.5.11 HAZARDOUS AREA PROTECTION

S.No.	Description	Intrinsically Safe	Flame proof	Remarks
1	Field transmitters	YES		
2	Field switches	YES	YES only for limit switches pertaining to MOVs	Field Process Switches shall be used only if mandatorily recommended by Licensor.
3	I/P converters	YES (Wherever applicable)		I/P converters to be avoided in general.
4	Solenoid valves	YES		SOV shall be 24 VDC rated.
5	Positioners	YES		
6	Special instruments/ Analyzers etc.	YES	YES only where Intrinsic safe is not available.	
7	FieldBus Instrument	Not Applicable	Not Applicable	Not Applicable
7.1	IS(Entity Concept) with High Power Trunk			
7.2	FISCO			
7.3	FISCOIC/FNIICO			
8	Fire & Gas Detector		YES	

Note-1: If intrinsically safe item is not available for any instruments, then it must be Flame proof. MCC I/Os shall be non-intrinsically safe

3.5.12 JUNCTION BOXES AND ACCESSORIES

S.No.	Description	Weather proof	Flame proof + Weather proof	Remarks
1	For IS Instruments		YES	Blue Color JB for IS Signals.
2	For flame proof instruments		YES	Grey Color JB for Non-IS signals.

Note-1: All JBs shall have bottom entry for both single pair/ branch cables as well as multicables.
Note-2: All junction boxes shall be with self locking type allen screws (SS 316 make) type fasteners and hinges. Junction boxes shall have tag numbers engraved on front cover with PESO certificate number. JBs MOC shall be Die Cast Aluminium (LM-06).

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Note-3: Separate Junction boxes shall be considered for Analog input and output signals, Digital Input and Digital Output signals, IS and NIS Signals, RTD / Thermocouple signals respectively.

3.5.13 BARRIERS

S.No.	Description	EIL Choice	Remarks
1	Intrinsic Safety Barriers, with 3-port Isolating type	YES	Active isolaing type with 3 ports

Note-1: Barriers for ESD shall be SIL-2/3 certified as available with manufacturer.
Note-2: All 4 wire instruments signal shall be connected to control system through isolator.
Note-3: IS barriers shall be used for IS and Non IS I/Os in case of PLC. IS barriers shall be used for IS I/Os and Isolators for Non IS I/Os of DCS.

3.5.14 STACK ANALYZERS

S.No.	Description	EIL Choice	Remarks
1	Stack Monitoring System Required	NO	Not Applicable.
1.1	Separate for each stack	NO	
1.2	Common for all stacks	NO	
2	Sample Extraction	NO	Not Applicable.
2.1	Hot Extraction		
2.2	Dilution Type		
2.3	Types of Analyzer		
2.3.1	CO - ND IR		
2.3.2	SOx - UV Fluorescence		
2.3.3	NOx		
2.3.4	SPM - Opacity		
3	Analyser Shelter	NO	Not Applicable.
3.1	Required		
4	Shelter/Analyser Panel Location	NO	Not Applicable.
4.1	Hazardous area		
4.2	Safe area		

3.5.15 EARTHING SYSTEM

S.No.	Description	Earth Pit	Remarks
1	Panel Earth for Panels, racks, cabinets, consoles, shelters etc. with power >= 110 V	Plant Electrical Earth pit (Redundant earth pits- Minimum 3 Numbers)	Copper plate / rod earth with flexible cables shall be used for earthing of DCS/PLC system
2	Signal Earth	Separate signal earth pit/ Other (Redundant earth pits- Minimum 3 Numbers)	Copper plate / rod earth with flexible cables shall be used for earthing of DCS/PLC system
3	Surge Protection Earth	(Redundant earth pits)	If recommended by DCSvendor

Note-1: Field JB and LCPs will be connected to plant earth pit provided in the unit.
Note-2: Insulated copper cable shall be used as Earthing Cable from

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Instruments/JBs/Panels up to Earth Bus Bar and Earth Bus bar to Earth Pit. Earth Bus Bar in Polypropylene Control Room (PCR) shall be copper Earth Bus Bar.

3.5.16 TYPE OF CABLES

S.No.	Description	EIL Choice	Remarks
1	Flame retardant		
2	Flame retardant and low smoke	YES	
3	Flame retardant and Fire resistant	YES	Single pair cables pertaining to ESD signals for fire safe valves and for fire & gas detectors. Cable color shall be Red.
4	others		

Note-1: Blue cable shall be used for IS and Grey cable shall be used for Non-IS signals.
Note-2: XLPE insulated cables shall be used in all Gas Group areas. Black cable shall be used for Power cables only.
Note-3: Cables shall have Rated voltage of 500V.

3.5.17 UNITS OF MEASUREMENT

As per Process BEDB Part B

4.0 SPECIFIC DESIGN CONSIDERATIONS

4.1 TEMPERATURE INSTRUMENTS

4.1.1 TEMPERATURE MEASUREMENT

S.No.	Description	EIL Choice	Remarks
1	Temperature gauges		
1.1	Bimetallic	YES	Refer Section 4.1.4 of this document.
1.2	Filled system	YES	Refer Section 4.1.4 of this document.
2	Thermowell flange rating		
2.1	Vessel Nozzle rating	YES	For Rating greater than ASME Class 300
2.2	Minimum 300# rating	YES	Licensor"s specific requirement given in Process Package shall be adhered
3	Thermocouple	YES	
3.1	Type		
3.1.1	All K Types	YES	
3.1.2	S/R (as per range)	YES	For high temperature S & R Type shall be used.
3.2	Element		
3.2.1	Simplex	NO	
3.2.2	Duplex	YES	
3.3	Grounded	YES	For Skin thermocouple
3.4	Un-grounded	YES	Others

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S.No.	Description	EIL Choice	Remarks
4	RTD (Pt-100) 3 wire element	YES	RTD shall be used for operating temperature upto 400 Deg. C. Also RTD shall be used for motor bearing & winding temperatures only orfor any specific application required by Licensor in Process package. RTD accuracyclass shall be Class A as per IEC 60751
4.1	Simplex		
4.2	Duplex	YES	
5	Temperature Transmitter	YES	Dual Compartment
5.1	Required	YES	Temperature transmitters for both open andclose loops unless specified otherwiseby licensor or in special cases.Dual input capability with automatictransfer to back-up sensor shall beconsidered for all temperaturetransmitters. Accordingly, both theelements shall be wired to transmitters
5.2	Location		
5.2.1	Head-mounted	NO	
5.2.2	Remote-mounted	YES	On Yoke.
6	Multi input Temperature Transmitter	NO	

Note-1: For temperature elements in pits, the long nozzle shall be extended above ground.
Note-2: Temperature Transmitters shall be dual input capable, configured with Hot Back-up facility (auto switch facility) with bumpless transfer and both element of duplex thermocouple/ RTD shall be connected using 2 pair / triad cables.
Note-3. The Temperature Transmitter shall be HART Configurable by hand held HART communicator.

4.1.2 THERMOWELLS

S.No.	Project Philosophy
1	Thermowells and their flanges shall be minimum of 316 SS or better material to suit the service conditions. Pressure rating of flanges shall be minimum 300 ASME class rating (including heater / reformer body and duct). These shall be fabricated from bar-stock.
2	Immersion length of thermowells for different line sizes shall be as follows:- Line Size - Immersion length (U) 4" to 6" - 280 mm 8" to 20" - 320 mm Above 20" to 24" & Vessels/Columns(side mounted) - 400 mm Above 24" & upto 42" - 500 mm In special applications, not covered above, vendor shall decide the immersion length based on actual requirements. Immersion length is based on 200 mm length between flange face and outer wall of pipe. For vessels, 200 mm projections is from ID of vessel. In vessels, where fouling with vessel internals is expected, the immersion length shall be suitably modified. Length may also change as per vibration analysis.
3	Built-up thermowells may be considered in low pressure and low velocity services like in fired heaters and also where longer thermowell immersion length is required (for greater than 500 mm).

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S.No.	Project Philosophy
4	Design, manufacture and testing of Thermowell including vibration analysis of Thermowell wake frequency shall comply with PTC 19.3(Latest edition)
5	Above design temperature 600 Deg C, Inconel alloy 600 or other suitable material shall be used for Thermowell.
6	For reactors, Thermowell insertion length, support for thermowell to be as per licensor process equipment datasheet. In case of any deviation licensor concurrence to be obtained.
7	Vendor to carryout vibration analysis of Thermowell wake frequency and it shall not exceed 80% of natural frequency.

4.1.3 THERMOCOUPLES/RTD

S.No.	Project Philosophy
1	Thermocouples elements shall be 18 AWG for simplex & 20 AWG for duplex.
2	Heater skin thermocouples shall generally be extraction type with sheath material SS446/416 uto 600°C unless specified otherwise. All skin thermocouples shall be provided with heat shield assembly.
3.1	Temperature transmitters shall be provided for all temperature elements and shall be remote field mounted type.
3.2	Dual compartment type temperature transmitters shall be used.
3.3	RTD shall be with Class A accuracy.
3.4	Thermocouple wire & extension wire colour coding must be as per IEC 60584-3 standard.
4	RTD are to be utilized as temperature element for motor winding and bearing temperatures, operating temp. upto 400°C.
5	Multipoint thermocouples assembly in Reactors shall have Pressure Gauge with drain facility for High Pressure (900# & above)- Secondary pressure containment chamber / sealing arrangement along with pressure gauge for each thermocouple assembly shall be provided.

4.1.4 TEMPERATURE GAUGES

S.No.	Project Philosophy
1	All temperature gauges are to be bimetallic type. Filled type temperatures gauges are envisaged only for specific applications like sump/pit temperature, high temperature (above operating temp. 350 degC). Filled system if used shall be gas filled type with full compensation. Mercury filled temperature gauge shall not be used. Dial size shall be 150mm for main plant, background Fluorescent White for Clear Display in Low illumination. Case material for Gauges shall be SS 304.

4.2 PRESSURE INSTRUMENTS

S.No.	Project Philosophy
1	All pressure gauges in toxic service or with ranges more than 0 - 100 kg/cm2g shall have safety type, solid front case, white back ground fluorescent type. Dial size for gauges shall be 150 mm. End connection shall be ½" NPT. Pressure gauges shall have over range protection up to 1.3 times maximum pressure scale with out any calibration drift. Instruments which can be exposed to vacuum shall have under range protection. Case material for pressure gauges shall be SS 304.
2	All transmitters shall have an integral output meter with LCD/LED display. Remote mounted meters may be provided for specific applications as per P&IDs.

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S.No.	Project Philosophy
3	Diaphragm seal element with capillary shall be used for corrosive, congealing and highly viscous services as per P&ID. Diaphragm / flange material shall be as per process requirement, but SS316 is to be considered as minimum. On pulsating services like reciprocating pump discharge, pulsation dampners / snubbers & glycerine filled gauges shall be considered.
4	Remote surface mounting pressure gauges shall be considered for services of higher operating temperature ≥ 120 Deg C and pulsating services like reciprocating pump discharge. All suction and discharge pressure gauges of pump shall be remote mounted and shall be mounted on proper support
5	For hydrogen service, transmitter sensing diaphragm shall be SS316L with gold plating. Gold plated Passivated Hastelloy C is also acceptable subject to max process design temperature of 200 deg C.
6	Draft pressure gauge shall have blow out protection against overpressure of 15 psig.

Note-1: For differential pressure measurement across columns beds/vessel where length of HP and LP tappings are more than 6 meter , either remote sensor type differential pressure transmitter based on digital calculation shall be used or separate pressure transmitter shall be provided at respective points and DP shall be measured through soft calculation in DCS.

4.3 LEVEL INSTRUMENTS

4.3.1 LEVEL MEASUREMENT

S.No.	Description	EIL Choice	Remarks
1	Level Stand-pipe philosophy		Level transmitter in close loop and trip/ safety interlocks will be directly connected to Vessel/ column. However, Level transmitter in open loop and level gauge will be mounted on the standpipe. Also, multiple level gauges will be mounted on standpipe.
1.1	As per EIL standard		
1.2	Licensor Requirement	YES	For Licensed Unit
2	Tank Level Gauging	YES	Wherever redundant /two level gauges are considered in a tank, the measurement principle shall be as per process requirements.
2.1	Servo	YES	As per P&IDs (only for clean service and lighter liquid)
2.2	Mechanical Float or DP type		
2.3	Hydrostatic		
2.4	Radar	YES	
3	Tank Farm Management System(TFMS)	Not Applicable	
3.1	Dedicated Tank Farm Management (with redundant Serial Communication to DCS)	NO	

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S.No.	Description	EIL Choice	Remarks
3.2	With DCS	NO	
3.3	Redundancy Required for communication to DCS	NO	
4	Special Level Instruments	YES	Nucleonic Level Instruments with suitable source strength and proper shielding shall only be used wherever recommended by Licensor

a. Tuning fork type switches shall be used for tank overfill protection and where specified by licensor.

4.3.2 LEVEL GAUGES

S.No.	Project Philosophy
1	Level Gauges shall be Magnetic type only. All level gauges shall be provided with vent / drain valves with plug. C-C length of single level gauge shall not be more than 2500 mm.

4.3.3 LEVEL TRANSMITTER

S.No.	Project Philosophy
1	Displacer type level instruments shall be used preferably for level measurement depending upon application upto 1524 mm (C-C length) in clean service and in interface level measurement where level transmitter (GWR) is not mandated as per licensor P&ID / PDS in BEDP. Remote diaphragm seal type Differential pressure transmitter shall be used for level measurement above 1524 mm (C-C length).
2	Wherever Level Transmitter (Guided Wave Radar) type is shown by licensor in BEDP, the licensor recommendations will be retained. Also this will be applicable for 2oo3 voting Level Transmitter (GWR) type (used in trip / safety interlocks).
3	Displacer level transmitter/ DP Remote Seal type Level Transmitter can be considered for vessels (where atleast 2 Nos. of level transmitter with DCS indication) is required and currently where single LT (GWR) is shown in licensor P&IDs. (Note-1)
4	Non-Contact Radar type level shall be used on corrosive, congealing, slurry services where diaphragm seal type transmitter cannot be used.
5	For sump levels, Displacer type of level instrument shall be used upto 3 meters and connected with DCS. Non-contact type Radar level instrument shall be used for interlock or level measurement range greater than 3 meters within accuracy ±3mm.

Note-1: DP remote seal type level transmitter / Displacer LT shall be decided based on level sketch considering vessel / coloumn height and level to be measured.

4.3.4 LEVEL STANDPIPE PHILOSOPHY

S.No.	Project Philosophy
1	The usage of standpipe shall be considered for clean, non-viscous and non crystallizing services. The size of standpipe shall be 2" NB minimum for uncladded equipments (upto 600# rating) & 3" NB minimum for all cladded equipments & those uncladded equipments where rating is 900# and above

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S.No.	Project Philosophy
2	Level transmitters in open loop and level gauge will be mounted on the standpipe. Also, multiple level gauges will be mounted on standpipe. Level Transmitters in close loop and trip/ safety interlock will be directly connected to Vessel/ column.
3	Maximum number of nozzles on the standpipe shall be limited to 6 nos. Not more than two level transmitters shall be considered in one standpipe
4	Standpipe shall not have instruments other than for level.
5	Multiple level gauges shall be used for visible lengths more than 2500 mm.
6	Where Diaphragm seal type DP level transmitter already shown by licensor in P&IDs/ PDS, no displacer / GWR type LT shall be used, even for < 1524 mm C-C lengths.

4.3.5 LEVEL SWITCHES

Where ever applicable, refer Process BEDB.

S.No.	Project Philosophy
1	Level transmitter shall be used instead of level switches

4.4 FLOW INSTRUMENTS

4.4.1 FLOW MEASUREMENT

As per Process BEDB Part B

4.4.2 TYPES OF TAPS FOR ORIFICE

S.No.	Description	EIL Choice	Remarks
1	Flange	YES	
2	D-D/2 (for rating upto 150#:D-D/2 to be used for size >=16")	YES	
3	D-D/2 (for rating 300#:D-D/2 to be used for size >=20")	YES	
4	D2 1/2 - 8D	YES	
5	Integral Orifice	YES	

Note-1: Unless otherwise recommended by process licensor.
Note-2: All the Orifice flanges shall have 4 sets of tappings for installing multiple Differential type pressure transmitters required for voting and DCS indication (max. 1 for DCS Indication and 3 for 2oo3 voting for ESD System). Unused tapings shall remain capped. For hydrocarbon and high pressure steam service, unused holes in orifice flange should be plugged and seal welded, used holes from where the tappings are taken should also be welded.

4.4.3 PRIMARY DEVICES

S.No.	Project Philosophy
1	Orifice,Flow nozzles and Venturi shall be designed in accordance with ISO 5167 latest edition. The ratio of the orifice bore to inside pipe diameter (B=d/D) shall be between the limits as laid down by ISO 5167.

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S.No.	Project Philosophy
2	The orifice plate primary element shall generally be thin plate, square-edge concentric orifices plate mounted between a pair of weld-neck type orifice flanges with flange taps. The minimum pressure rating of flanges shall be 300 ASME class. Process tapping shall be flange tapping as per ISO5167. For orifice Plates where D-D/2 taps are required and for all restriction orifices, the ratings of the orifice flanges shall be as per piping specification and the flanges shall be procured by Piping.
3	Eccentric / Segmental type of orifice plates shall be used for specific applications.
4	Quadrant edge or conical entrance orifice plates shall be used for services with low Reynolds number.
5	Conditional Orifice Plates with multiholes to be used for special cases if required.

4.5 CONTROL VALVES

4.5.1 GENERAL

S.No.	Project Philosophy
1	Control valves shall normally be Globe type single seated. For clean services, guiding shall preferably be cage type. For highly viscous services, cage guiding shall be avoided.
2	Characteristic Ball valves shall be considered for services where solids in suspension, high rangeability, low pressure drops are required.
3	Butterfly valves shall be considered for services where solids in suspension, low pressure drops and high capacities are required.
4	Angle valves shall be considered for services where flashing, coking, solids in suspension or very large pressure drops are encountered
5	All control valve positioners shall have metallic casing.
6	Fugitive emission for all control valves & on-off valves, shall be avoided such that valve bonnet design complies with fugitive emission requirement as per Leakage Class-C of ISO 15848-1. Valve packing shall be Low emission packing / bellow seal shall be considered. For Hydrogen and H2S services, Leakage Class-A of ISO 15848-1 shall be followed
7	For high temperature application control valves, suitable precautions shall be taken in datasheet for gland packing and materials. Double packing shall be used for valves in vacuum service and for vessel Nitrogen pressurization/ Purge valves.
8	Generally TSO shall be considered for flare line valves.
9	Actuators
9.1	Diaphragm actuators shall generally be used with 0.2 - 1.0 kg/cm2 g spring range. For larger dP shut offs, higher spring range/higher areas shall be considered.
9.2	Piston actuators can be considered for high shut-off differential pressure ,for Fail lock valves and where specifically required by Licensor.
10	Flexible fire-proof jacket shall be considered for valve actuators and its accessories for fire safe valve with fire safe actuators. Fire jacket shall be removable and reusable type.

4.5.2 CONTROL VALVE RATING

For control valve, on-off valve and self actuated pressure control valves, pressure rating of body and flanges shall be minimum 300 ASME class or as per respective piping specification whichever is higher. Refer Process BEDB Part B.

4.5.3 TRIM DESIGNS

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S.No.	Project Philosophy
1	Material used for Trim shall be minimum 316 SS, with guide bushing of hardened stainless steel like 440 C, 17-4 PH all up to a pressure drop of 10 kg/cm2. For higher pressure drops or erosive and slurry services and in general for all steam services, hard-surfacing of plug, seal rings and sealing area of inner valve with stellite shall be used.
2	Special cases may require 17-4 PH seat ring and 440 C solid plugs or other materials like Hastelloy, Monel etc.
3	Multi-stage trims shall be used for where large differentials (> 40 kg/sq.cm) are encountered on case to case basis
4	For valves in services encountering particulate carry over along with high pressure drop, axial flow path trim design shall be used with angle body for continuous applications and globe body for intermittent applications

4.5.4 ON-OFF VALVE

S.No.	Description	EIL Choice	Remarks
1	Type	Ball	In general ball type valves shall be used for shutdown and on-off application unless any other type specifically required for any application

Note-1. For all Critical On-off Valves identified as per Licensor in Process Package or identified in Hazop/ SIL, Partial Stroke Testing (PST) positioners shall be considered which shall be operated from IAMS with corresponding AO card in DCS.
Note-2. Volume bottle for valves with double acting piston actuators and Fire safe valves shall be considered as per Process requirements.
Note-3. Fusible links/plugs to be provided near to the On-off Valve air tubing to have process isolation in case of fire only in case allowed by licensor.
Note-4: Dual SOV (2oo2 with independent DO from ESD) for On-off Valves shall be followed as per Licensor P&IDs wherever shown by the licensor.

4.5.5 SOLENOID VALVES

S.No.	Project Philosophy
1	Solenoid valves body material shall be SS 316.
2	Solenoid valves insulation class shall be H.

1. All solenoid valves shall be auto-reset type. For Solenoid valves requiring Field manual reset as per P&ID, separate push button station shall be considered in the field for this purpose.
2. Vent port of all solenoid valves are shall be provided with SS/ Brass bug screens, to prevent blockage of port because of bugs and to save the port from dust.
3. The SOV shall be IS (intrinsically safe) type.

4.5.6 LIMIT SWITCHES

S.No.	Project Philosophy
1	Limit switches shall be generally intrinsically safe proximity type as per NAMUR (DIN 19234) except for MOVs for which mechanical snap acting type is acceptable.

4.6 PRESSURE RELIEF DEVICES

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S.No.	Project Philosophy
1	Generally spring operated pressure relief valves may be used. Pilot operated relief valves may be used for special services and where set pressure is closer to the operating pressure by less than 10% or back pressure is above 50% of set pressure or as indicated by licensor. Spring loaded PSV's vents connected to flare/pressure shall be provided with balanced bellows depending on the process condition. Also bellows shall be required for corrosive and dirty fluids to isolate the spring and guiding surface. PSV's shall be manufactured in accordance with ASME Boiler and pressure vessel code section VIII. For Steam Drum application, Pressure Relief valve shall be as per ASME section-I, if required as per Process package.

4.7 ELECTRICAL FIELD WIRING

S.No.	Project Philosophy
1	Instrument electronic signal & alarm cables shall be 1.5 mm^2 for both single as well as multipair cable, twisted in pair individually and overall shielded with aluminium Mylar tape with drain wire and armoured.
2	For Control wiring of solenoid valves in interlock and shutdown system, single as well as multipair shall be 1.5 mm^2 (min.) twisted in pair individually and overall shielded with aluminium Mylar tape with drain wire and armoured. However Cable voltage drop shall be calculated for solenoid valves and Cable size to be decided accordingly.
3	Multicore extension cables for Thermocouples, wherever applicable, shall be 20 AWG single conductor twisted pairs, armoured, individual pair and overall aluminium mylar shielded with over all drain wire. Triad cable shall be 1.5 mm2 (min.) armored. Two pair/ Two Traid extension cables for connection between temperature element and temperature transmitters shall be armoured (individual and overall, as applicable) cable with 16 AWG single conductor wire.
4	Power supply cables and Fire & Gas detector cables shall be minimum 2.5 mm^2 armoured.
5	All cable glands shall be flameproof and SS304 MOC and they shall be of double compression type suitable for armoured cables. Slipper type PVC sleeves (cable shrouds) shall be used over cable glands for all cable entries in junction boxes
6	For longer distances, conductor sizes shall be selected based on voltage drop.
7	Ferrules used shall be single sleeve with source destination type. Cross ferruling philosophy shall be followed for wiring including MCC interface cabling to DCS / PLC systems.
8	All cables including spare pair / core shall be terminated inside Polypropylene Control Room (PCR) and no loose cables shall be allowed. All cables shall be glanded in Polypropylene Control Room (PCR).
9	For tankages, power distribution box with isolation switches for a group of tanks shall be located outside the dyke wall and power switch supplied by level instrument vendor shall be located along with the tank side indicator.
10	Cable glands shall be all 1/2" NPT type for all single pair gland requirements and 3/4" NPT for all two pair/triad gland requirement.
11	The cables at the Control Room ends should also be glanded at the panel end. Any spare holes to be closed to prevent any rodent entry to the panel.

4.8 CABLE TRAYS, CABLE DUCTS AND CABLE TRENCHES

S.No.	Project Philosophy

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S.No.	Project Philosophy
1	Instrument cable duct (fully covered) shall be primarily used wherever piperack/sleeper is available and all cables on the main/branch pipe racks shall be laid in cable duct fabricated out of GI and bolts and nuts of SS. RCC trench shall be used only where piperacks/ sleepers are not possible or not available. No duct shall be used inside RCC trenches. Standard Inst. cable duct sizes shall be: 1200x400 mm 1000x400 mm 800x300 mm 600x300 mm 400x200 mm
2	All branch cables shall be run on cable trays. These cable trays shall be made of anodized aluminium with standard sizes of 60mm, 150mm and 300mm width
3	Each individual cable routed through trays must be clamped or tied using SS wires. The overall clamping shall be with aluminium clamp instead of tying with cable armour. Nuts/Bolts for cable tray fixing shall be SS.
4	For Process units, all Instrument cable ducts on pipe rack and trays carrying multipair cables shall be fireproofed on all sides.
5	Main cable duct routing should avoid proximity to pump house , heat exchangers.RCC cable trench (If applicable) should be designed in a way so as to prevent accumulation of surface/rain water inside the trench and slope shall be away from Polypropylene Control Room (PCR). RCC trenches should be away from underground process lines of CBD/ ABD/ OWS etc.
6	The cable routing upto Polypropylene Control Room (PCR) shall be routed in overhead cable duct run through overhead structure with cable dropping only outside the Polypropylene Control Room (PCR) building to the cable pull-pit area for final entry to the Polypropylene Control Room (PCR) false floor through MCT. Walkways shall be provided in piperacks along Instrument cable ducts. For offsite/ utility areas, cable shall run on piperack/ sleepers as far as possible.

4.9 AIR FILTER REGULATOR

S.No.	Description	EIL Choice	Remarks
1	Filter Size	5 microns Max./Other	

4.10 CANOPY

S.No.	Description	EIL Choice	Remarks
1	Material		
1.1	FRP	YES	
1.2	GPR		
1.3	MS		
2	Canopy to be provided for :-		Tag number shall be painted on the canopy
2.1	Transmitter	YES	
2.2	JB's	YES	
2.3	Temperature Elements	YES	
2.4	Local Panels	YES	
2.5	Positioner	YES	
2.6	Gas Detector	YES	Heat and Rain protection shall be provided for Gas Detector

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S.No.	Description	EIL Choice	Remarks
2.7	Push button stations	YES	Canopy for Push button stations shall cover from top.

4.11 DESUPERHEATER

As per Process BEDB

4.12 TEST /LAB EQUIPMENT

S.No.	Description	EIL Choice	Remarks
1	Required. Electrical, Pressure and Temperature test bench is required at Workshop	YES	With supply of other measuring instruments such as multimeters, multiple function calibrator, temperature bath, dead weight tester, OFC tester etc.

4.13 CCTV SYSTEM

S.No.	Description	EIL Choice	Remarks
1			
1.1	For PPU Process unit	YES	
1.2	For Utilities & Offsite	YES	
1.3	For Warehouse	YES	
2	Monitor		
2.1	Location	Polypropylene Control Room (PCR)	
2.2	Number	No. of cameras and monitors shall be decided during detail engineering	
2.3	Type	LCD with backlit LED	
3	Recording facility Required		
3.1	All cameras	YES	NVR for CCTV shall be considered for 90 days video recording and LANconnectivity shall beprovided. It Shall be redundant (n+n or n+1).
3.2	Selective Number of points	NO	

1. All CCTV cameras shall be IP protocol based and high resolution type (4MP or Above).
2. CCTV cameras installed in Process Area (classified area) shall be weatherproof to IP-65 (min.) and explosion proof (Exd) certified with provision for daynight operation.
3. CCTV cameras installed in Safe Area such as inside Polypropylene Control Room (PCR) & substation buildings shall be weatherproof to IP-65 (min.).
4. All the camera shall be BIS and STQC (Cyber security) certified.
5. All the cameras to be installed at outdoor shall be PTZ Type.

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4.14 FIRE AND GAS DETECTION (F & G) SYSTEM

S.No.	Description	EIL Choice	Remarks
1	Integrated F&G System	YES	Only for Field Fire and Gas detectors. Also this shall be integrated in Plant ESD PLC system (SIL3). Separate PLC node is to be considered for the same. For Building Fire detection System (refer Electrical Design Basis)
1.1	Gas Detector Required	YES	SIL-2 certified gas detectors transmitters shall be provided
1.1.1	HC Detectors (Point IR Type)	YES	
1.1.2	Open Path Type	YES	As per Process requirement.
1.1.3	H2 Detectors(Catalytic diffusion)	YES	
1.2	H2S Detectors		
1.2.1	Electrochemical	YES	
1.2.2	Semiconductor	NO	
1.3	Output		
1.3.1	4~20 mA+ HART signal directly connected to PLC	YES	
1.3.2	Vendor Standard	NO	
2	Fire detection system		
2.1	Automatic fire detection Required	YES	Wherever required as per Process Operations
2.2	Plant Fire detection Required	YES	Wherever required as per Process Operations
2.3	Plant /Non Plant building	Refer Electrical Design Basis	
2.4	Flame detector	YES	
3	Separate F & G Network Required	NO	
4	Interlock Execution		
4.1	Separate F&G PLC (SIL-3)	NO	Gas detection shall be implemented in main plant ESD PLC with dedicated/separate ESD I/O modules , Controller and marshalling system for F&G.
4.2	Plant PLC		
4.3	Plant DCS		
4.4	Separate Controller/Monitor		
5	Console requirement		
5.1	Dedicated for F&G PLC (SIL3)	YES	
5.2	Part of ESD operator Console		

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S.No.	Description	EIL Choice	Remarks
5.3	Part of DCS Operator Console		
5.4	Console (view-only) at fire station	YES	
6	Solenoid Valve in Deluge Valve skid for process areas and offsites		
6.1	Fail Open without line monitoring	YES	
6.2	Fail Close with line monitoring		
7	Integration with DGFAP		

Note:
1. Process area Fire and Gas detectors shall be connected to Main Plant ESD PLC with dedicated I/O modules and controller for F&G.
2. Remote connectivity for the F&G system, limited to viewing only, shall be provided in Existing Fire Station building via DCS Console and Fire Alarm Panel (Existing and for the MCP and building Fire (Smoke/ Heat) detectors.

4.15 BOILER DRUM INSTRUMENTATION

S.No.	Description	EIL Choice	Remarks
1	Type of level instrument		
1.1	Conductivity	Not Applicable	
1.2	DP	Not Applicable	
1.3	Bicolour level Gauges	Not Applicable	
1.4	Level Instrumentation 2 out of 3	Not Applicable	
2	Safety valves		
2.1	Section-I	Not Applicable	
2.2	IBR	Not Applicable	

4.16 AMBIENT AIR QUALITY MONITORING SYSTEM

S.No.	Description	EIL Choice	Remarks
1	Required	Not Applicable	
1.1	No. of fixed stations		
1.2	No. of mobile stations		
2	Mobile van Required		

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4.17 SAFETY VALVE TESTING AT SITE

S.No.	Description	EIL Choice	Remarks
1	Required	YES	
1.1	By Contractor	YES	
1.2	By Purchaser	NO	
1.3	Test jig Required	YES	By Contractor

5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS

S.No.	Project Philosophy
1	In case of DI/DOs signals (NIS type) part of ESD and SIS loops, SIL 2 relay should be considered.
2	For hydrogen service irrespective of rating and for other services (600# rating and above), double isolation root valves and double vent & drain valves shall be considered.
3	Level transmitter in close loop and trip/ safety interlocks will be directly connected to Vessel/ column. However, Level transmitter in open loop and level gauge will be mounted on the standpipe. Also, multiple level gauges will be mounted on standpipe.
4	By default, atleast 2 numbers of level transmitters (with DCS indication) shall be considered for each vessel, column, hooper (except where installation limitations exists).
5	For Air Fin Coolers (AFC) / Cooling Tower Fans; Vibration transmitters signals shall be connected directly to PLC for tripping of fans.2oo2/ 2oo3 voting configuration in case of tripping shall be provided.
6	DP Transmitters selected for Level measurement shall be of remote diaphragm seal type only (except Steam drum level and other special service as specified by the licensor).
7	Tuning fork type level switches shall be used for tank overfill protection and where specified by licensor. Moreover, for Flare KOD, Tuning fork type level switches (High High Level) shall be used in addition to other level Transmitters.
8	Displacer type level instruments shall be used preferably for level measurement depending upon application upto 1524 mm (C-C length) in clean service and in interface level measurement where level transmitter (GWR) is not mandated as per licensor P&ID / PDS in BEDP. Remote diaphragm seal type Differential pressure transmitter shall be used for level measurement above 1524 mm (C-C length).
9	Dedicated Transmitters shall be used for BPC (DCS control) and ESD interlocks for the same service. Any Transmitter used for DCS Control should not be used/ shared for any trip/safety interlocks of ESD System and vice versa.
10	Each transmitter (PT/DPT/LT/FT) linked with closed loop control shall have redundant DCS indication for the same service with additional/ alternate transmitter.
11	Electromagnetic flow meter shall be used for water service (cooling water (main supply & return, Unit Supply& return), Drinking water, Raw water etc.) upto and including line size of 8″, mass balancing (for line size below 8″ subject to suitability as per pressure, temperature etc.), Above, 8″ line, clamp on Ultrasonic flowmeter should be used subject to suitability as per pressure, temperature etc.
12	For any interlocks linked with trip and safety, the input Instruments/ transmitters should be configured as 2oo3 (except for nucleonic level instruments and where installation limitations exists).

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S.No.	Project Philosophy
13	Flow transmitters related to feed-in and product-out of HC service and also essential for mass balancing shall be Coriolis type mass flow meter below 8″ and Ultrasonic flow meter, multi beam for high accuracy for line size 8″ and above subject consideration of suitability with the service conditions.

6.0 POST WARRANTY ANNUAL MAINTENANCE CONTRACT

S.No.	Description	EIL Choice	Remarks
1	PWAMC	YES	
1.1	Non-comprehensive	YES	For Plant DCS & ESD/PLC (Refer Note-1) For other system (Refer Note-2)
1.2	Comprehensive	NO	

Note-1: Post commissioning onsite support for the Plant DCS & ESD/PLC: Onsite support team (continuous basis at site, 24 x7) comprising of system engineers/expert for at least 1 year from the date of commissioning as intimated by Engineering In-charge. The validity of the contractual period shall be 3 years from the date of expiry of the warranty. Also, shall be non comprehensive.

Note-2: Post commissioning onsite support for other system (MMS, Package PLC, Analyzer System (except density (non Nucleonic based), moisture (Non GC based), PH/conductivity), Anti-surge Controller, Speed Governing System. Nucleonic Instruments, TFMS, CCTV system, FA System, PY System, Special Control System etc.): Non comprehensive, 2 Periodic visits of expert (at least @5 days at site per visit) on mutually agreed interval/schedule. The validity of the contractual period shall be 3 years from the expiry of the warranty. Also, shall be non comprehensive.

7.0 SPARE PHILOSOPHY

S.No.	Type	Description	Remarks
1	Mandatory Spares	10% of quantity or minimum one number of each type of complete instrument with respect to range, type & material of construction for each instrument. Exclusions are flame arrester, breather valve, level gauge, desuperheater, reactor skin thermoucouple etc.	

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S.No.	Type	Description	Remarks
1.1	Mandatory Spares	One complete valve should be considered as mandatory spare for critical valves like Emergency depressurization valve, Antisurge Control Valve etc. Also, for actuator of all types of valves, following spares to be considered: Piston & rod assembly, Diaphragm, complete soft parts, complete spring set: 10 % of the total quantity of each type of item of same make, model, Type & range, subject to minimum 1 set, whichever is higher.	
1.2	Mandatory Spares	For control valves/On-off Valves: SOV, Limit switches, AFR and positioner spares shall be provided as 10% of each type/ model or 1 number minimum, whichever is higher. Soft parts like gasket, O-ring, seal ring, packing material shall be considered as mandatory spares for each control valve, pressure relief valve, self actuated control valve (diaphragm also) etc.	
1.3	Mandatory spares:	For each Process analyser / Gas Chromatograph (except transmitter typed Analyser like pH, Conductivity etc.) : 1) Electronics, Source, detectors, modules, internal components : 10% subject to minimum 1 no. of each type of same specification. 2) Sample handl ing & conditioning system : Regulators, flowmeters , pressure gauges ,temp.gauges , solenoid valves, pumps, tubes, fittings, switches, set of fuses, O-rings : 10% subject to minimum 1 no. of each type of same specification for each analyser. 3) Consumables like filters, seals, reagents, calibration gas cylinders, Fuel and carrier gas cylinders : 2 sets for each type of item for each process analyser.	
2	For Startup and Commissioning	Required	As per vendor recommendation
3	Consumable spares for six months operation	Required (for DCS/PLC, analysers / Chromatographs, Machine Monitoring systems, Local / Main Control Panels)	

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S.No.	Type	Description	Remarks
4	DCS, PLC, Machine Monitoring System, Anti-surge Control System, Speed Governor Control, Overspeed Protection System Spare Philosophy		
4.1	System Spares (Control Room wise)	Bus Capacity- 40% Number of nodes- 30%	
4.2	Installed Spares	I/O Level- 20% Marshalling Level- 20%	
4.3	Spare Space	I/O Level- 10% Marshalling Rack- 10%	
4.4	Mandatory Spares	10% or minimum one of each type of modules/ items and system cables including processor modules whichever is higher	

Note-1: Spares related to DCS/PLC/F&G are only applicable for Control Room items/ Package PLC of other locations/ field of PPU unit.
Note-2: For Fibre Optic Cable 100% spare cores shall be considered.
Note-3: For TMR PLC, in general "Hot Slots" shall not be populated. However, one installed spare I/O card of each type shall be kept in the "Hot slot" in each PLC subsystem / each rack.

8.0 ADDITIONAL NOTES

S.No.	Notes
1	For smart remote output meters looping either through 3 ways JB or via transmitter test terminals shall be considered for open loops. In case of closed loops and interlocks, remote output meter signal shall be provided from AO card of the control system.
2	Dual SOV (2oo2 with independent DO from ESD) for On-off Valves shall be followed as per Licensor P&IDs wherever shown by the licensor.
3	Local / Remote switch shall be considered in Local Control station (LCS) which shall be directly wired to MCC. Auto/ Manual switch shall be considered in Control room (HWC or DCS Console, as per approved P&IDs) and wired to PLC
4	2oo3 signal wherever required shall be allocated in different JB and different PLC I/O cards. Each card shall be located in different racks.
5	Power supply from UPS to system/marshalling panel shall be redundant including cable and MCBs.
6	All control valve positioner shall be provided with advanced online diagnostic positioner and performance diagnostic software in asset management system of latest and advanced version available with OEM
7	Complete Instrument air line shall be of SS 316.
8	Time synchronization of DCS and PLC system shall be done by dedicated GPS system. This GPS system shall synchronize all the control system of complete unit. For devices/packages which are not serially connected, dedicated NTP connection shall be provided, however, any Operator station of package PLC shall be managed by vendor itself.
9	Control valve and on-off valve body rating of the valve shall be minimum 300#.
10	Access Control System shall be provided in Control Room .

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S.No.	Notes
11	The following documents attached as Annexures to this Design Basis shall be followed by contractor: 1. ANNEXURE 1-INSTRUMENT CONNECTION ON VESSEL, STANDPIPES AND TANKS, 7-52-0001 Rev. 7 2. ANNEXURE 2-INSTRUMENT CONNECTION ON PIPES, 7-52-0002 Rev. 5
12	Square root extraction shall be carried in field transmitter.
13	Air filter regulator shall be SS 316 material.
14	For all serial communication between various systems and DCS, TCP/IP MODBUS Ethernet shall be preferred mode of communication.
15	All Fibre optic cables shall be double armoured, single mode type.

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INSTRUMENT CONNECTION ON VESSEL, STANDPIPES AND TANKS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
			Approved by			
7	10.01.24	REVISED AND REISSUED	AJS	AR	MN	MN
6	13.02.20	REVISED AND REISSUED	MN	JJ	RG	RKT
5	10.10.19	REVISED AND REISSUED	MN	AJS	RG	RKT
4	27.01.15	REVISED AND REISSUED	MN	RKG	RG	SC
3	11.02.13	REVISED AND REISSUED	MN	RG	RP/JMS	DM

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

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SR. NO	TYPE OF INSTRUMENTS	UNCLADDED EQUIPMENTS		CLADDED /LINED EQUIPMENTS		INSTRUMENT CONNECTION
		EQUIPMENT/STANDPIPE CONNECTION	FIRST BLOCK VALVE	EQUIPMENT/STANDPIPE CONNECTION	FIRST BLOCK VALVE	
18.	EXTENDED DIAPHRAGM SEAL D.P. INSTR/ GAUGE ON VESSEL	3" FLGD. (4" NOTE-11) (NOTE-1)	-	4" FLGD. (NOTE-1)	-	3" FLGD. (4" NOTE-11) (NOTE-1)
19.	DIP TUBE LEVEL INSTRUMENT	6 " FLGD.	½ " SW (BY INST)	6" FLGD.	½ " SW (BY INST)	½ " SCRD
20.	TANK LEVEL INSTRUMENT (MECHANICAL)	1½ " FLGD	1½ " FLGD (BY INST)	-	-	½ " SCRD
21.	TANK LEVEL INSTRUMENT (SERVO) ON ATMOSPHERIC TANKS (NOTE-7,10)	6" FLGD.	-	-	-	6" FLGD
22	TANK LEVEL INSTRUMENT (SERVO) FOR PRESSURISED EQUIPMENT (NOTE-7,10)	6" FLGD.	6" FLGD. (BY INST)	6" FLGD.	6" FLGD. (BY INST)	6" FLGD
23.	TANK LEVEL INSTRUMENT (RADAR) ON ATMOSPHERIC TANK (GENERAL SERVICE WITH DESIGN TEMP ≤ 110 DEG C) (NOTE-8,10)	8" FLGD.	-	-	-	8" FLGD.
24.	TANK LEVEL INSTRUMENT (RADAR) ON ATMOSPHERIC TANK (VISCOUS SERVICE WITH DESIGN TEMP >110 DEG C)	24" FLGD	-	-	-	24" FLGD
25.	TANK LEVEL INSTRUMENT (RADAR) FOR PRESSURISED EQUIPMENTS (NOTE-9,10)	8" FLGD.	-	8" FLGD.	-	8" FLGD.
26.	TANK LEVEL INSTRUMENT – CAPACITANCE / ULTRASONIC/ RF TYPE ON ATMOSPHERIC TANKS/PRESSURISED EQUIPMENTS	2" FLGD.	-	3" FLGD.	-	2" /3" FLGD.
27.a	TUNING FORK LEVEL INSTRUMENT ON TANK	3"-FLGD	-	-	-	3" FLGD
27.b	TUNING FORK LEVEL INSTRUMENT ON VESSEL/PIPE	2" FLGD	-	3" FLGD	-	2" OR 3" FLGD.
27.c	TUNING FORK LEVEL INSTRUMENT ON SILOS	3" FLGD	-	-		3" FLGD
28.	PRESSURE INSTRUMENT/ GAUGE ON VESSEL	2" FLGD	2 " BW/ FLGD #	3" FLGD. (4" NOTE-11)	3" BW/FLGD. # (4" NOTE-11)	½ " SCRD

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SR. NO	TYPE OF INSTRUMENTS	UNCLADDED EQUIPMENTS		CLADDED /LINED EQUIPMENTS		INSTRUMENT CONNECTION
		EQUIPMENT/STANDPIPE CONNECTION	FIRST BLOCK VALVE	EQUIPMENT/STANDPIPE CONNECTION	FIRST BLOCK VALVE	
29.	PRESSURE INSTRUMENT/ GAUGE ON STANDPIPE	¾" SW/BW #	¾" SW/BW #	¾" SW/BW #	¾" SW/BW #	½ " SCRD
30.	DIAPHRAGM SEAL PRESSURE INSTRUMENT /GAUGE ON VESSEL	2 " FLGD	2 " FLGD	3" FLGD. (4" NOTE-11)	3" FLGD. (4" NOTE-11)	2"/3" FLGD.(4" NOTE-11)
31.	THERMOWELL ON EQUIPMENT	2 " FLGD	-	3" FLGD.	-	2 " FLGD/ 3" FLGD
32.	MULTI-POINT TEMPERATURE ELEMENTS FOR ATMOSPHERIC TANKS	3"FLGD.	-	3" FLGD.	-	3" FLGD
33.	MULTI-POINT TEMPERATURE ELEMENTS FOR PRESSURISED EQUIPMENTS	3"FLGD.	-	3" FLGD.	-	3" FLGD
34.	STANDPIPE (RATING UP TO 600#)	2"FLGD.	-	3" FLGD.	-	-
35.	STANDPIPE (RATING > 600#)	3"FLGD.	-	3" FLGD.	-	-
36.	LEVEL INSTRUMENT (NON-CONTACT RADAR) ON PROCESS VESSELS/ BURIED EQUIPMENT. (NOTE-6)	6" FLGD.				6" FLGD

NOTES: 1 O.D OF EXTENDED DIAPHRAGM OF INSTRUMENT SHALL BE SELECTED TO SUIT NOZZLE I.D OF EQUIPMENT.

2 ALL FLANGES/SW RATING SHALL BE AS PER PIPING SPECIFICATION UNLESS PROJECT SPECIFICATION REQUIRES MIN. 300#.

3 IN CASE OF DIRECT MOUNTED FLANGED INSTRUMENTS AND WHERE FLANGED TYPE FIRST ISOLATION VALVE ARE PROVIDED, STUD/BOLTS & NUTS AND GASKETS SHALL BE IN PIPING SCOPE.

4 INSTALLATION OF STLL WELLS FOR TANK LEVEL INSTRUMENTS IN TANKS ARE IN TANK VENDOR'S SCOPE.

5 FOR ANY OTHER INSTRUMENTS NOT REFERED ABOVE THE CONNECTION DETAILS SHALL BE AS PER PROJECT REQUIREMENT.

6 6" NOZZLE SHALL BE CONSIDERED IN VESSEL WITH CS METALLURGY SCH 160. STILLWELL SIZE SHALL BE 4" SCH. 40S WITH SS METALLURGY AND SHALL BE IN VESSEL VENDOR SCOPE ALONG WITH DATUM PLATE OF SS METALLURGY ON STILL WELL BOTTOM. LONG STUD &NUT SHALL BE IN RADAR VENDOR SCOPE

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7 STILLWELL SIZE SHALL BE 12" OF CS METALLURGY SCH. 40 AND SHALL BE IN TANK / EQUIPMENT VENDOR SCOPE.

8 8" TANK NOZZLE SHALL BE OF CS METALLURGY WITH SCH 60 (WHEN TANK ROOF CORROSION ALLOWANCE 1 MM) / SCH 80 (WHEN TANK ROOF CORROSION ALLOWANCE 3 MM) AND STILLWELL SIZE SHALL BE 8" SCH. 60 (WHEN TANK ROOF CORROSION ALLOWANCE 1 MM) / SCH 80 (WHEN TANK ROOF CORROSION ALLOWANCE 3 MM) WITH CS METALLURGY AND SHALL BE IN TANK / EQUIPMENT VENDOR SCOPE ALONG WITH DATUM PLATE OF CS METALLURGY ON STILL WELL BOTTOM.

9 8" TANK NOZZLE SHALL BE OF CS METALLURGY AND STILLWELL SIZE SHALL BE 6" OR 4" SCH. 40S WITH SS METALLURGY SHALL BE IN TANK VENDOR SCOPE ALONG WITH DEFLECTOR PLATE OF SS METALLURGY INCLINED AT 45 DEG FROM HORIZONTAL ON STILL WELL BOTTOM. LONG STUD & NUT SHALL BE IN THE RADAR VENDOR SCOPE.

10 WHERE ATMOSPHERIC TANK METALLURGY IS OTHER THEN CS, THEN NOZZLE, STILL WELL AND DATUM PLATE (AS APPLICABLE) SHALL BE PROVIDED WITH METALLURGY AS PER TANK MOC

11 4" FLANGED CONNECTION FOR GLASS FLAKE REINFORCED LINED EQUIPMENTS

AS PER PIPING SPECIFICATION/PROJECT PHILOSOPHY.

GENERAL NOTE: IN CASE OF LICENSOR SPECIFIC SIZE REQUIREMENT, THE SAME SHALL BE FOLLOWED

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INSTRUMENT CONNECTION ON PIPES

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
			Approved by			
6	26.12.24	RE-AFFIRMED AND REISSUED	MN/RS	AJS	MN	MN
5	10.10.19	REVISED AND REISSUED	MN	AJS	RG	RKT
4	27.01.15	REVISED AND REISSUED	MN	RKG	RG	SC
3	11.02.13	REVISED AND REISSUED	MN	RG	RP/JMS	DM
2	13.04.07	REVISED AND REISSUED	MN	TGM	HCJ	VC

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(A) BARE PIPES

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

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(B) CLADDED\CEMENTED\LINED PIPES

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

NOTES:
1. FOR ANY OTHER INSTRUMENTS NOT REFERRED ABOVE THE CONNECTION DETAILS SHALL BE AS PER INDIVIDUAL REQUIREMENT.
2. ALL FLANGES/SW RATING SHALL BE AS PER PIPING SPECIFICATION.
3. IN CASE OF DIRECT MOUNTED FLANGED INSTRUMENTS AND WHERE FLANGED FIRST ISOLATION VALVE ARE PROVIDED, STUD/BOLTS & NUTS AND GASKETS SHALL BE IN PIPING SCOPE.
4. INSTALLATION OF ALL IN LINE INSTRUMENTS SHALL BE IN PIPING SCOPE.
5. PRESSURE INSTRUMENTS INCLUDE PRESSURE TRANSMITTERS AND PRESSURE GAUGES.

* SEAL WELDING REQUIRED.
\# AS PER PIPING SPECIFICATION.
** STRENGTH WELD
\+ CONNECTIONS FOR D.P. INSTRUMENT ½" SCRD
++ WELDOLET, FLANGE, BOTTOM SUPPORT SHALL BE SUPPLIED BY INSTRUMENT VENDOR. HOWEVER ERECTION BY MECHANICAL CONTRACTOR.

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ENGINEERING DESIGN BASIS STATIC & MACHINERY EQUIPMENT (EQUIPMENT DIVISION)

JOB NO: C050

PROJECT: EPCM Services for setting up Polypropylene Unit at NRL

CLIENT: NRL - REFINERY

EIL SIGNATURE:

CLIENT SIGNATURE:

Rev. No.	Date	Purpose	Prepared by	Reviewed by	Approved by
0	21/Jul/2025	Issued For Implementation	RAKESH PRABU T	PLABAN KUMAR DAN	NALIN KUMAR
A	06/Mar/2025	Issued For Comments	RAKESH PRABU T	PLABAN KUMAR DAN	NALIN KUMAR

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

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1.0 STATIC EQUIPMENT

1.1.0 SCOPE

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

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

1.2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

1.2.1 ABBREVIATIONS

Code	Description
SMPV	Static and Mobile Pressure Vessel
MDMT	Minimum Metal Design Temperature

1.2.2 CODES & STANDARDS / PUBLICATIONS

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

S.No.	Description	Standards / Codes	Edition
1	For Pressure Vessels, Heat Exchangers	ASME SEC. VIII DIV.1	Latest
3	For Pressure vessels and heat exchangers (Selectively for high pressure/high thickness)	ASME SEC. VIII DIV.2	Latest
5	For Atmospheric Storage Tanks	API 650/IS: 803	Latest
6	For Low Pressure Storage Tanks	API 620	Latest
7	For Tank Inspection, Repair, Alteration & Reconstruction	API 653	Latest
8	For Cryogenic Storage Tanks (Double Wall)	API 620/BS-EN 14620	Latest
9	For Silos, hoppers and bins	IS: 9178/EN-1991-4/EN-1993-4-1	Latest
10	For steel vent stacks etc.	IS: 6533/ ASME Sec. VIII Div.1	Latest
11	For workmanship of Vessels not categorized under any other code	ASME SEC. VIII DIV.1	Latest
12	For FRP vessels and Tanks	BS : EN-13121/ASME Sec.X	Latest
13	For Mounded Vessel	ASME SEC. VIII DIV.2/PD 5500/EEUMA 190	Latest

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S.No.	Description	Standards / Codes	Edition
14	For Welded Aluminium Alloy Storage Tanks	ASME B 96.1	Latest
15	For material specification	ASME SEC. II	Latest
16	For material specification	ASTM/IS	Latest
17	For wind load consideration	IS:875/SITE DATA	Latest
18	For seismic design consideration	IS:1893/SITE DATA	Latest
19	For welding	ASME SEC. IX	Latest
20	For flanges	ASME B 16.5	Latest
21	For large diameter flanges	ASME B 16.47	Latest
22	For gaskets	ASME B 16.20/ B 16.21	Latest
23	For shell and tube Exchanger	TEMA Class R	Latest
24	For Air Cooled Exchanger	API 661	Latest
25	For Air Cooled Exchanger Structural Design	IS 800	Latest
26	For brazed aluminium plate fin exchanger	ALPEMA	Latest
27	For fabrication considerations for vanadium modified Cr-Mo steel heavy wall pressure vessels	API RP 934B	Latest
28	Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments.	NACE MR 0103	Latest
29	Petroleum and natural gas industries - Materials for use in H2S containing environments in oil and gas production	NACE MR 0175/ ISO 15156	Latest
30	Local Stresses in Spherical & Cylindrical Shells due to External Loadings	WRC Bulletin #107	Latest
31	Local Stresses in Cylindrical Shells due to External Loadings on Nozzles	WRC Bulletin #297	Latest
32	Methods and Controls to Prevent in-Service Environmental Cracking of Carbon Steel Weldments in Corrosive Petroleum Refining Environments	NACE-RP-0472	Latest
33	Materials and Fabrication of 2 1/4Cr-1 Mo, 2 1/4 Cr-1 Mo-1/4 V,3Cr-1 Mo and 3Cr-1 Mo-1/4 V Steel Heavy wall pressure vessels for High Temperature, High-pressure Hydrogen service	API RP 934 A	Latest
34	Materials and Fabrication of 1 1/4Cr-1/2 Mo Steel Pressure Vessels	API RP 934 C/E	Latest

STATUTORY PROVISIONS

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

1.3.0 GENERAL / DESIGN CONSIDERATIONS

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

1.3.1 EQUIPMENT SIZING

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

1.3.2 MINIMUM SHELL / HEAD THICKNESS

S.No.	Project Philosophy
1	Minimum thickness of equipment wall/components shall be as given below:
1.1	For carbon and low alloy steel vessels - 6mm (For corrosion allowance upto 3.0 mm. In case of higher corrosion allowance, thickness to be increased accordingly), but not less than that calculated as per following For diameters less than 2400 mm Wall thickness = (Dia./1000) + 1.5 + CA (if any) For diameters 2400 mm and above Wall thickness = (Dia./1000) + 2.5 + CA (if any) All dimensions are in mm.
1.2	For stainless steel vessels and high alloy vessels - 3 mm, but not less than that calculated as per following for diameter more than 1500mm. Wall thickness = (Dia./1000) + 2.5 + CA (if any) All dimensions are in mm.
1.3	Vertical vessel with Height (TL to TL) / Diameter ratio greater than 5 shall be considered as tall column and shall be designed accordingly.
1.4	For carbon steel, stainless steel, low alloy steel columns/towers & high alloy steel columns/tower - 8mm (For corrosion allowance up to 3.0 mm. In case of higher corrosion allowance, thickness to be increased accordingly).
1.5	For shell & tube heat exchangers, minimum thickness shall be as per TEMA.
1.6	For Air Cooled heat exchangers, minimum thickness shall be as per API 661, however minimum tube sheet thickness shall be 22mm (excluding corrosion allowance).

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1.3.3 EQUIPMENT END CLOSURES

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

1.3.4 DESIGN PRESSURE

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

1.3.5 TEST PRESSURE

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

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1.3.6 DESIGN TEMPERATURE

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

1.3.7 CORROSION ALLOWANCE

S.No.	Project Philosophy
1	Corrosion allowance shall be as per Process datasheet. If Corrosion allowance is not specified in Process datasheet the same shall be as per BEDP.
2	Unless otherwise specified in datasheet, corrosion allowance shall not be considered for tubes of Heat Exchangers & Air coolers.
3	For weld overlayed equipment, weld overlay thickness (after final machining) shall be provided such that undiluted chemistry (as required) from top is equal to the weld overlay thickness/corrosion allowance required by Process data sheet.
4	For alloy clad equipment, no corrosion allowance is required on the base metal. The cladding shall be in no case less than 3.0 mm and the same shall be considered as corrosion allowance for the purpose of stress analysis i.e. no contribution of clad thickness to be considered for stress calculations.
5	Corrosion allowance for nozzles and manhole neck shall be at least equal to that specified for the equipment. No Corrosion allowance is required for flange faces.

1.3.8 WIND CONSIDERATION

S.No.	Project Philosophy
1	Wind load shall be calculated on the basis of IS 875(part):2015 + Amend 1. a)Drag coefficient for cylindrical vessels shall be 0.7 minimum. b)Drag coefficient for spherical vessel shall be 0.6 minimum. c)Basic wind speed of 50 m/s shall be considered d)Other factors shall be as below K1 = 1.0 K2 shall be based on Category 3 for units and 2 for offsite K3 = 1.0 K4= 1.0 A contingency factor of 1.1 shall be applied to wind pressure.

1.3.9 EARTHQUAKE CONSIDERATION

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

1.3.10 CAPACITY

S.No.	Equipment Type	Project Philosophy
1	Tank	
1.1		Capacity shall be specified as Nominal capacity and Stored Capacity

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S.No.	Equipment Type	Project Philosophy
1.2		Nominal capacity for fixed roof tanks shall be volume of cylindrical shell.
1.3		Stored capacity for fixed roof tanks shall be equal to nominal capacity minus free board volume (equivalent to 1000 mm of shell height) or if overflow nozzle is provided then up to the bottom of overflow nozzle.
1.4		Nominal capacity (also the stored capacity) for floating roof tanks shall be volume of cylindrical shell minus free board volume (equivalent to 1800 mm of shell height).
1.5		Nominal capacity (also the stored capacity) for fixed cum floating roof tanks shall be volume of cylindrical shell minus free board volume (equivalent to 2500mm to 3500mm of shell height for tanks with vent / overflow slot in shell).
2	Bullets (above ground or underground)	
2.1		Nominal capacity is the geometric capacity of Bullet.
2.2		Stored capacity shall be 85% of nominal capacity.

1.3.11 SUPPORTS

S.No.	Project Philosophy
1	Skirt support shall be provided for all tall columns {Refer Section 3.2 (1.3)}, vertical vessels and reactors. However, small vertical equipment may be supported on legs (pipe or structural section) or brackets.
2	All Cr-Mo steel reactors shall be supported on skirts. Welding of external clips on Cr-Mo steel Reactors shall be avoided wherever possible.
3	Skirt Thickness- The thickness for the skirts inclusive of corrosion allowance shall be the maximum of following: a) 6 mm. b) Thickness required by analysis. c) 30 mm or 1/3 of the vessel wall thickness whichever is lower. Corrosion allowance of total 1mm minimum shall be considered for skirt unless otherwise specified in the project specifications to achieve final thickness of skirt shell.
4	All columns with diameter 1000 mm and more shall be self-supporting.
5	All columns with diameter less than 1000 mm shall be supported by superimposed structure around the column covering the entire height. Guy wires are not permitted to be used for supporting any equipment.
6	In specific cases, columns having diameter less than 1000 mm and total L/D ratio not exceeding 10 may be self-supported.
7	Flare and Vent stacks shall be supported structurally by super imposed structure all around for the entire height.
9	Buried vessels shall be suitably anchored to prevent the uplift due to underground water. Anchor bolts shall have corrosion allowance of 6 mm on diameter. Buried vessels shall be rested on concrete saddles with anchoring bracket at the centerline of the vessel.

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S.No.	Project Philosophy
10	All skirt supported equipment with height 20 m and above (irrespective of weight) and erection weight 50 MT and above (irrespective of height) are to be provided with tailing lug.
11	a) All columns and reactors shall be supplied with skirt template. b) All skirt supported vessels with height 20 m and above (irrespective of weight) and erection weight 50 MT and above (irrespective of height) shall be supplied with skirt template.

1.3.12 MANHOLES

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

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

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

1.3.13 FLOATING ROOF

Unless otherwise specified floating roof shall be of following construction.

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

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

1.3.14 FLANGES

S.No.	Project Philosophy
1	Nozzle flanges up to 600 NB shall be as per ASME B16.5 and above 600 NB shall be as per ASME B 16.47 (SERIES 'B') except that for high pressure heat exchanger. Non-standard flanges shall be designed as per ASME Sec. VIII Div. 1.

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S.No.	Project Philosophy
2	Unless otherwise specified, W.N. Flanges shall be used for all classes.
3	Unless otherwise specified, all girth flanges and intermediate body flanges shall be of weld neck type only.

1.3.15 INTERNALS

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

1.3.16 PIPE DAVIT

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

1.3.17 VENT/DRAIN NOZZLE CONNECTIONS

S.No.	Project Philosophy
1	Exchangers shall be provided with vent and drain connection of 40 NB nozzle with blind flange etc. Separate vent and drain will not be provided if vented / drained by process/other nozzles. For clad exchangers, minimum size of vent and drain nozzle connection shall be 50 NB LWN.

1.3.18 MP CONNECTIONS FOR PG/TI

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

1.3.19 IMPORTANT CONSIDERATIONS

S.No.	Project Philosophy
1	All columns and vessels shall be capable of withstanding water full condition during system testing in corroded condition.

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

1.3.20 HEAT EXCHANGERS

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

1.3.21 AIR COOLERS

S.No.	Type	Project Philosophy

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S.No.	Type	Project Philosophy
1	Noise level	The noise level shall be limited to 85 dB (A) max. measured at a distance of one meter from the bundle at the header access platform walkways and one meter from the bay limit on motor maintenance platform. The noise level within the air cooler bay shall be 90 dB (A) maximum, at locations defined as per API.
2	Type of Drives (Speed reducers)	HTD/PGGT of GATES or Torque Drive Plus belts of FENNER, UK up to 40 KW. Gear Drive above 40 KW.
3	Access Platform	Shall be provided wherever possible on all the four sides, (width - 900 mm) with stairs on one side and ladder on other side.
4	Maintenance Platform	Localized steel platform duly inter-connected along full length and width of air coolers for fan/motors etc.
5	Protective Covering (for finned tubes) on bundle top	By heavy-duty wire mesh.
6	Hot dip galvanizing of air cooler structural	Air coolers structural shall be hot dip galvanized for the following:
6.1		Plenum chambers, Bundle Frames
6.2		Motor suspension structure, Fan guards, Gratings for stairs and platforms
6.3		Wire mesh for fin tube protection
7	Final Painting	Final painting of header boxes shall be carried out at vendor's shop.

1.3.22 BOUGHT OUT SUPPLIERS

As per approved Project Vendor List.

1.4.0 SPECIFIC DESIGN REQUIREMENTS

1.4.1 LPG STORAGE SPHERES/BULLETS

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

1.4.2 TALL COLUMNS

S.No.	Type	Project Philosophy
1	Deflection of Column	Maximum allowable deflection at top of column shall be equal to height of the column divided by 200 up to a maximum of 300 mm.
2	Skirt Support Base	Base supporting including base plate, anchor chairs, compression ring, foundation bolting etc. shall be designed based on over-turning moment (greater of seismic or wind). A minimum number of 8 foundation bolts shall be provided. Nos. of foundation bolts shall be in multiple of four.

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S.No.	Type	Project Philosophy
3	Minimum Hydro test Pressure	Minimum Hydro test Pressure shall be equal to 1.3 x design pressure x temperature correction factor, as specified in ASME Code Section VIII Div. I.
4	Analysis of Column/Tower for Wind Induced Vibrations	Analysis of each column shall be carried out for stability under transverse wind induced vibrations as per standard design practice.

1.4.3 STORAGE TANKS

S.No.	Project Philosophy
1	All storage tanks shall be designed as per code considering liquid height up to top curb-angle of shell.
2	Tanks shell thickness calculation shall be carried out by the one (1) - foot method as per API 650 for tank diameters less than and equal to 60m (200 feet).
3	Maximum height of unstiffened shell shall be calculated based on the corroded thicknesses of shell courses. Section modulus of wind girders shall also based on corroded thickness of shell courses.
4	Seismic design as per API 650/API 620 is mandatory for storage tanks.
5	Annular bottom plates shall be provided for all storage tanks 12 meter diameter and above.
6	Anchor bolts shall be provided based on design considering wind/seismic loads, uplift due to internal pressure etc. However, tanks having diameter <= 10 meters shall be provided with anchor bolts and shall be spaced at maximum 3M of circumference.
7	Tanks having design temperature more than 93°C shall have thermal isolation barrier (suitable fire bricks) between tank bottom and foundation.
8	Roof slope shall be 1:6 for all cone roof storage tanks of diameter less than 12 M and shall be 1:12 for diameter 12M and above.

1.4.4 MOUNDED BULLET

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

1.4.5 REACTORS

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

1.4.6 SILENCERS/VENT SILENCERS

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

1.5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS

S.No.	Description	Selected Option	Remarks
1	Storage Tanks		
1.1	Type of External Floating Roof/ Internal Floating Roof	Pontoon Type Single Deck(without buoy) for dia. > 12 m & <= 60m Or Double Deck for sizes <=12 m dia.& > 60 m dia Or Any Other(Specify)	
1.2	Primary Drain	Mesa Pipe Or Coflexip pipe Or Articulated steel pipe with HMT PIVOT master Or Any other (Please specify)	

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S.No.	Description	Selected Option	Remarks
1.3	Primary Seal	Foam Seal (PU coated -(liquid mounted for external floating roof & vapour mounted for internal floating roof)) Or Liquid Filled Endless Seal Or Mechanical Seal	
1.4	Type of Floating Roof (for conversion of existing cone roof to covered floating roof)	Aluminium Or SS Or CS	
1.5	Requirement of primary drain for internal floating roof tanks	Yes / No	
1.6	Steps/Platforms	Painted Or Hot dip Galvanized,Bolting to be electrogalvanised	
1.7	Hand Railing on Tanks	GI pipe bolted to stairway,Bolting to be electrogalvanised Or CS with Painting	
1.8	Clean out Doors for tanks	For all tanks Or For tanks as per process data sheet	
1.9	Minimum size of Shell manholes	20" NB / 24" NB / 30" NB	
1.10	Minimum size of Roof manholes	20" NB / 24" NB / 30" NB	
1.11	Camouflage painting requirement meeting Defence/Strategic Location	Required / Not Required	
1.12	Under tank leak detection and subgrade protection for caustic & alkaline tanks	Required / Not Required	
1.13	Emergency overflow slots for internal floating roof tanks (non-pressure type)	Required (Owner to specify) / Not Required	
1.14	Emergency drain for single deck External Floating Roof tanks	Required / Not Required	
1.15	Pipe davit	Required / Not Required	
2	Air Cooler		
2.1	Roof on air cooler tube bundle	Required / Not Required	
3	Heat Exchangers		
3.1	Tube bundle extractor	Required(If required,Please specify quantity) / Not Required	

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Any other specific requirement of Owner:

1.6.0 MATERIAL HANDLING FACILITIES FOR NORMAL MAINTENANCE OF EQUIPMENT

1.6.1 TUBE BUNDLE EXTRACTOR

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

1.7.0 SPARE PARTS

1.7.1 MANDATORY SPARES

S.No.	Equipment Type	Project Philosophy
1	Vessels & Columns	Gaskets : Two sets for each installed gasket. Fasteners : 10% (Min. 2 in each size) of installed fasteners Sight/Light Glass : 4 sets for each installed glass.

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S.No.	Equipment Type	Project Philosophy
2	Shell & Tube Exchangers	400% Gaskets 20% Bolting (Min. 4 studs & 8 nuts per joint)
3	Air Coolers	400% gasket for header cover & nozzles with blind flange 200% gaskets for plugs 20% plugs 100% belts 20% Bolts & Nuts for all nozzle with BF & Cover plate One set of Diaphragm Actuator with positioner for each type of auto variable pitch fan (for Moore fans) (Alternatively vendor recommended spares for his type of auto variable pitch fans for make other than Moore).

1.7.2 COMMISSIONING SPARES

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

1.7.3 RECOMMENDED SPARES FOR NORMAL OPERATION & MAINTENANCE

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

1.7.4 SPECIAL TOOLS AND TACKLES

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

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2.0 PACKAGE EQUIPMENT

2.1.0 SCOPE

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

2.2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

2.2.1 ABBREVIATIONS

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

2.2.2 CODES & STANDARDS / PUBLICATIONS

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

S.No.	Description	Standards / Codes	Edition
1	MaterialAmerican National Standards Institute	ANSI	Latest
2	American Petroleum Institute	API	Latest
3	Air-conditioning, Heating & Refrigeration Institute	AHRI	Latest
4	American Society of Heating, Refrigerating and Air Conditioning Engineers	ASHRAE	Latest

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

STATUTORY PROVISIONS

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

2.3.0 GENERAL / DESIGN CONSIDERATIONS

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

S.No.	Project Philosophy
1	Reliability in service (assessed from vendor's relevant track record and ensured by incorporating certain minimum design features or requirements in the specifications).
2	Compliance with applicable national or international codes and standards as well as applicable statutory regulations in existence for a specific item.
3	Ease of operation and maintenance including any necessary measures for ensuring safety of personnel and equipment.
4	Standardization of components, wherever feasible.
5	Adherence to any limitation of available space for the equipment and for its operation/maintenance.
6	Provision for any known future expansion of plant capacity with a minimum modifications or shutdown.
7	Corrosion allowance for carbon steel vessels shall be minimum 3mm, unless otherwise specified.
8	All components/equipment shall meet the requirements of respective hazardous area classification.
9	Noise level of the running equipment shall not exceed 85dBA at 1m distance from source, if not specified otherwise in this document.
10	All couplings, gears, and exposed rotating parts shall be provided with adequate protection guards.
11	Minimum headroom clearance of 2.2 m for entry purpose in multi-tier package equipment shall be considered.

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S.No.	Project Philosophy
12	Heat exchanger inside the Packages like Air-conditioning system, Extruder and Pelletiser Package, Pneumatic Conveying Package and other utility packages not handling hydrocarbons shall be as per TEMA C unless otherwise specified in Licensor specification/Process datasheet.
13	Package item shall be skid mounted as far as possible.

2.4.0 SPECIFIC DESIGN REQUIREMENTS

2.4.1 AIR CONDITIONING SYSTEM

2.4.1.1 GENERAL

S.No.	Project Philosophy
1	All the areas as defined in Architectural drawings or as defined in Process specification are to be air conditioned.
2	Air-conditioning system shall be selected based on following guidelines:
2.1	In general, Package units may be provided for smaller capacity requirements upto 45 TR. For requirements upto 3 units (working), one standby unit shall be provided and above 3 units (working), 2 standby units shall be provided.
2.2	Air-conditioning requirement more than 45 TR, shall comprise of either of the following: a) Centralized AC system with Air/water cooled condensing units and DX coil AHUs. b) Centralized AC system with Air/water cooled chillers with chilled water coil AHUs and chilled water re-circulating pumps. The chiller shall be a skid mounted assembly of Air/water cooled condenser, reciprocating/scroll/screw/centrifugal compressor, DX/flooded evaporator. c) Vapour Absorption Refrigeration (VAR) system for 70 TR and above shall be considered, in case steam is available. Option b) shall be envisaged for higher air-conditioning requirements for which Option a) is not available.
2.3	Reciprocating/scroll compressor shall be used up to 80 TR and screw compressor for 81-250 TR. Centrifugal Compressor shall be used for 251 TR and above.
2.4	For option a) and b) in Sl. No. 2.2 above, air conditioning system shall have one unit of identical capacity as standby for condensing units/ chiller package and pumps, as applicable. If reciprocating compressors are provided, not more than 3 working compressors shall be provided for a system. For option c) in Sl. No 2.2 above instead of 100% standby, following requirement shall be considered: i) Two (2) nos. VAM machines (both working), each of 65% of the required tonnage capacity. ii) Pressure reducing & de-superheating station (PRDS) shall be common for both VAM units. iii) Condensate pumps, Dosing pumps and Chilled water pumps shall be one(1) working and One(1) standby.
2.5	Air-conditioning requirements for Individual area/room up to 5 TR and where no specific RH requirement is envisaged, may be provided with single/multiple split air-conditioners(inverter controlled, with 5-star rating). One unit shall be provided as a standby in all applications where round the clock air conditioning is required. Air-conditioning requirement of the areas where there is variation in load (viz. office area) and no specific RH control is envisaged, shall be catered by Variable Refrigerant Flow (VRF)/ Variable Refrigerant Volume (VRV) type HVAC System with air cooled Outdoor Units. No standby shall be considered in this case.

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S.No.	Project Philosophy
3	Combined Fire & Smoke Dampers shall be pneumatically operated for Control Room and Satellite rack room building. For other buildings, Combined Fire & Smoke Dampers shall be electrically operated motorized spring return type. All combined fire & smoke dampers shall be fail safe type (Closed position under power failure)and shall be UL-555 and UL-555S certified.
4	Air Conditioning equipment shall be interlocked with gas/smoke detection and fire fighting systems. For Control Room, Satellite Rack Room and Sub-Station buildings, provision for installation of Hydrocarbon and Toxic Gas (H2S) detection probes shall also be made in fresh air duct.
5	Minimum one (1) air change / hr or 17 CFM per person whichever is higher shall be considered for calculating fresh air quantity for all buildings. Licensor"s specification and ASHRAE guidelines shall also be followed for calculating fresh air/ventilation requirement, wherever applicable.
6	Refrigerant for vapour compression system shall be R-134A/R-407A/R-407C/R-410A/R-32 for central and package AC. Refrigerant for Split AC shall be non-CFC and non-ODP environmental friendly as per manufacturer"s standard.
7	Chemical laboratory Air Conditioning shall be once through system (i.e. no return air duct). Common header for compatible fumes can be provided with common fans (1 working + 1 standby). Chemical storage room/warehouse air conditioning and ventilation shall be as per Licensor"s requirement.
8	Chemical filter unit shall be provided to achieve G1 environment inside the air conditioned space from outside GX environment as per ISA-71.04 (Latest edition). Chemical filters shall be selected to capture Group-A gases as per ISA-71 - 04 standard as specified in S,. No. 2.4.1.5 given below. Chemical filter shall be provided for all air conditioned area except admin building, chemical warehouse building and operational staff rooms.
9	For Control Rooms & Satellite Rack Room (SRR), OISD-STD-163 shall be followed.
10	PLC/ Microprocessor based control system shall be provided for central HVAC.

2.4.1.2 INDOOR DESIGN CONDITIONS

S.No.	Area	DBT, DEG C	% RH
1	Control Room Building with all associated rooms except UPS and Battery Charger Room	23 ± 1 (For Cooling)/ 18 ± 1 (For Heating)	50 ± 5
2	UPS & Battery Charger Room and associated Operator Room	24 ± 1 (For Cooling)/ 18 ± 1 (For Heating)	50 ± 5
3	Laboratory Room	23 ± 1 (For Cooling)/ 18 ± 1 (For Heating)	50 ± 5
4	Switchgear Hall including VFD Panel Room	26 ± 1 (For Cooling)/ (Heating not envisaged)	50 ± 5
5	Data Concentrator /MMI Room of Substation Building	26 ± 1 (For Cooling)/ 18 ± 1 (For Heating)	50 ± 5
6	Administrative Building	24 ± 1(For Cooling)/ 20 ± 1 (For Heating)	30 to 70
7	Operational Staff Room	24 ± 1(For Cooling)/ 20 ± 1 (For Heating)	30 to 70

2.4.1.3 OUTDOOR DESIGN CONDITIONS

S.No.	SEASON	DBT (DEG C)	WBT (DEG C)

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S.No.	SEASON	DBT (DEG C)	WBT (DEG C)
1	Summer	34.4	28.2
2	Monsoon	32.7	28.7
3	Winter	7.5	4.3

Notes:
1) Outdoor design conditions specified shall be followed for Air conditioning system heat load calculation.

2.4.1.4 OUTDOOR AIR QUALITY

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

2.4.1.5 ADDITIONAL DESIGN REQUIREMENT

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

2.4.2 BASKET FILTER

S.No.	Project Philosophy
1	Basket filters shall be used when particles of 150 microns or larger size are to be filtered from a fluid stream, unless otherwise specified in Process Data Sheet.
2	In order to avoid the possibility of frequent basket cleaning, the gross basket area shall be at least 20 times of the filter inlet nozzle area and the free basket area shall be at least 8 times the filter inlet nozzle area.
3	Unless otherwise specified, filter shall be vertical type with facility for removal of the basket from the top after opening the top housing cover.
4	Filter housing design shall be as per ASME Section VIII, Division 1.For steam jacketed housings, applicable IBR requirements shall also be complied with.
5	For filter top cover, lifting/handling davit shall be provided irrespective of weight of top cover. For other blind flanges weighing more than 15 kg, lifting/handling davit shall be provided. Wherever davit arm cannot be provided due to size or weight constraint, suitable handling arrangement (i.e. lifting eye and monorail) shall be considered.
6	Filter top cover shall be of Weld neck blind flange type.

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S.No.	Project Philosophy
7	Filter basket shall be of straight cylindrical shape. Neither concentric nor pleated type basket are acceptable.
8	Unless otherwise specified, fluid flow direction shall be from inside to outside of the filter element.
9	For Filter with nozzle size higher than 16", multiple baskets may be provided considering the difficulty in strengthening and maintenance

2.4.3 BELT CONVEYORS (CONVENTIONAL TYPE)

NOT APPLICABLE

2.4.4 BELT FEEDER

NOT APPLICABLE

2.4.5 CARTRIDGE FILTER

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

2.4.6 CHAIN PULLEY BLOCK

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

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S.No.	Project Philosophy
4	Chain pulley blocks of standard capacities shall be provided. Chain Pulley Blocks shall be of detachable type suitable for mounting on trolleys of same rating/capacities.
5	The duty class of Chain pulley block shall be minimum M2 class as per IS 3832.

2.4.7 COKE DRUM UNHEADING SYSTEMS

NOT APPLICABLE

2.4.8 CRYOGENIC AIR SEPARATION PLANT

NOT APPLICABLE

2.4.9 DUST COLLECTION SYSTEM: BAG FILTER TYPE

S.No.	Project Philosophy
1	Dust collection system shall be designed for maximum inlet dust loading, dust characteristics and to meet the permissible dust emission level at stack outlet.
2	Dust filter shall be reverse pulse jet type bag filter controlled by electronic timer and/or pressure switch.
3	Pressure drop across the bag filter shall not exceed 150 mm WG, unless otherwise specified in the Process Data Sheet.
4	For bag filter system, air to cloth ratio shall be decided based on the application but shall not exceed 1.2 m^3/min/m^2, unless otherwise specified. The sizing of the duct shall be generally based on 20-25 m/s conveying velocity.
5	Large bag filters shall be of modular construction and it shall be possible to isolate any module for maintenance, while other modules are operational.
6	Operating temperature of bag filter shall be maintained so as to avoid condensation of any gas or vapour, and if required the bag filter casing shall be insulated.
7	For explosive dust, bag filter shall be suitably designed and provided with explosion vent.
8	The exhaust duct/piping shall be routed to a safe location and shall conform to local statutory requirements.
9	If discharging to atmosphere, filters shall be designed for an outlet dust emission of maximum 10 mg/Nm3 or process data sheet or as required by pollution control board requirement, whichever is stringent.
10	Isolation valves shall be provided upstream and downstream of each solenoid valve in the blowback line.

2.4.10 ELECTRIC TRACTION LIFT

S.No.	Project Philosophy
1	Capacity of goods lift shall be at least weight of the largest component to be handled with a design margin of minimum 20% subject to min. 1000kg.
2	The capacity of passenger Lift in the building shall be as per the peak traffic requirements or as decided by Client.
3	Doors shall be Automatic power operated central opening (single or multiple panels)sliding type (either central opening or side opening) for both passenger and goods lift. However for goods lift, manual override push button to be provided inside the car, to bypass the door closing interlock and keep the door in open position while on a landing level.
4	For lift having both side doors, doors shall be interlocked so as to open only one door at a time based on requirement.

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S.No.	Project Philosophy
5	Travel Speed of Lift and Recommended Speed shall be as below:
5.1	Passenger Lift: Up to 5 floors- 1.0 m/s From 6 to 12 floors-2.0 m/s More than 12 floors-2.5 m/s
5.2	Goods Lift: For Travel length <= 30 m - 0.5 m/s 30 m <= Travel Length < 50 m - 0.75 m/s Travel Length >= 50 m - 1.0 m/s
6	Infrared full curtain electronic door detection system shall be provided. Other type of door detection such as photocell type is also acceptable based on the Vendor"s proven track record.
7	The design, installation and testing of Lift shall comply with local laws and regulations, as per IS: 14665: Part 1& 2 or other International standards subject to prior approval of Owner/EIL.
8	No. of starts/stops per hour for motor shall be selected based on peak traffic requirement, lift speed and length of travel and number of landings. However, in no case number of starts/stop per hour shall be less than 120.
9	Controllers shall be micro processor based VVVF drive type.
10	Machine room shall be located above the highest landing level and shall be non-pressurized.

2.4.11 ELECTRIC WIRE ROPE HOIST

S.No.	Project Philosophy
1	Electrically operated Hoist with trolley will be generally provided for handling equipment / component weighing 10 MT or above and / or lift more than 10m or where frequency of maintenance/operation is relatively high. However, in cases where lifting weight is less than 10 MT and/ or lift is less than 10 m but frequency of operation is high or required for continuous operation, Electric Hoist may also be considered.
2	The capacity of the Electric Hoist shall be decided based on heaviest equipment to be handled during maintenance with 10% margin.
3	Up to 16 MT capacity Electric Wire Rope Hoist shall be as per IS 3938. For capacity above 16 MT, Electric hoist shall be manufacturer's standard based on satisfactory Proven Track Record.
4	Class designation for Electric hoist intended for maintenance shall be considered as 2 as per IS 3938. Class designation of electric hoist for process and continuous operation shall be considered as 4 as per IS 3938.
5	For electric hoists which are to operate in areas classified as hazardous, besides ensuring that all electrical components are certified for use in the specified hazardous areas, materials of construction for rubbing, non-lubricated metallic parts shall be in such a way that the possibility of sparking during operation is eliminated. This is done by having one part in every such pair made from a suitable non-sparking material such as HTB/ Aluminium bronze.

2.4.12 EOT & HOT CRANE

2.4.12.1 GENERAL

S.No.	Project Philosophy

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

2.4.12.2 EOT CRANES

S.No.	Project Philosophy
1	Unless otherwise stated, the following hoisting and travel speeds with corresponding acceleration shall be used:- * Hoisting Speed: 2.0 m/min * Hoisting Acceleration: 7 cm/s2 * Cross travel Speed: 10.0 m/min * Cross travel Acceleration:7 cm/s2 * Long travel Speed: 15.0 m/min * Long travel Acceleration: 8 cm/s2 #Higher operating speeds may be considered for higher lifts and longer bay lengths. Lower operating speed may be considered based on operation requirements.
2	Suitable inching (creep) speed mechanisms shall be provided for main hook and auxiliary hook (if applicable) to facilitate accurate spotting of the load. Creep speed for main hoist and Auxiliary hoist shall be 10% of the main hoisting speed and Auxiliary speed respectively.
3	EOT Crane shall be normally operated by remote control panel suitable for applicable electrical area classification. Minimum 2 numbers of radio remote control (1 operating + 1 spares) shall be provided for each crane. In such cases, pendant type control is not required.
4	EOT Crane shall be designed for duty class of M-5 as per IS: 3177 & IS: 807 unless otherwise specified.
5	DC electromagnetic or Electro hydraulic thrustor brake shall be used for the hoisting motion. Electro hydraulic thrustor-operated brakes shall be used for the cross and long travel motions.
6	Auxiliary hoist shall be provided in case of cranes having capacity 15 MT and above. Capacity of Auxiliary hook shall be 20% of the main hook capacity, unless otherwise specified.
7	Maintenance walkways shall be provided on both sides along the long travel.

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S.No.	Project Philosophy
8	EOT Crane shall be provided with annunciator to provide audio/visual alarm/warning at the time of starting of longitudinal and transverse movement of the crane.

2.4.12.3 HOT CRANES

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

2.4.13 FEED FILTER

NOT APPLICABLE

2.4.14 FILTER SEPERATOR/COALESCER

S.No.	Project Philosophy
1	Material and type of coalescing/separating elements shall be consistent with the service conditions as specified in data sheets. Coalescer pack/element supplier's recommendations shall be followed for meeting the performance requirements.
2	Type of Coalescer packs/elements shall be as per Process Data Sheet. Coalescing element shall be designed and fitted in such a way that it can be removed for maintenance and refixed.
3	Coalescer vessel shall be designed, as per ASME Section VIII, Div.1.For steam jacketed housings, applicable IBR requirements shall be complied with.
4	All Filter Separator/ Coalescer shall be provided with Weld neck blind flange type cover.
5	For any blind flange, weighing more than 15 kg, lifting/handling davit shall be provided.

2.4.15 FLARE STACK COMPONENTS

NOT APPLICABLE

2.4.16 HYDRAULIC DECOKING SYSTEM

NOT APPLICABLE

2.4.17 INSTRUMENT AIR DRYER

NOT APPLICABLE

2.4.18 LOADING ARM

S.No.	Project Philosophy
1	Loading arm shall be suitable for filling / unloading road tanker.
2	Loading arm shall be metallic type and shall be provided with swivel joints and load balancer.
3	The length of inboard arm, outboard arms and connecting pipe or drop pipes shall be such as to give adequate flexibility in loading or unloading operations. The following range of flexibility shall be provided, as a minimum:

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S.No.	Project Philosophy
3.1	Loading arms for road tankers: When road tanker is parked at the centre of clear space in the loading bay and with loading arm base riser centre line and tanker nozzle(s) centre lines(s) are on same axis, in plan view (Refer: 2.4.18.1 for Road Tanker Top Loading and 2.4.18.2 for Road Tanker Bottom Loading)
4	The loading arm shall be designed for manoeuvring of the arm with single man effort.
5	Client to inform end connection detail (size/type) between loading arm and tankers.
6	Dry break coupling (both male & female) shall be provided for the bottom loading arms. The companion part of the coupling (male/female) will be provided to NRL to ensure compatibility with the trucks available for loading. NRL shall consider suitable transition piece as per site requirement in case truck end connection is flanged type.

2.4.18.1 LOADING ARMS FOR ROAD TANKER-TOP LOADING

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

2.4.18.2 LOADING ARMS FOR ROAD TANKER-BOTTOM LOADING

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

2.4.18.3 LOADING ARMS FOR RAIL WAGON

NOT APPLICABLE

2.4.19 PASTILLATOR

NOT APPLICABLE

2.4.20 PIPE CONVEYER

NOT APPLICABLE

2.4.21 PRESSURISATION AND VENTILATION SYSTEM

NOT APPLICABLE

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2.4.22 PSA HYDROGEN PLANT

NOT APPLICABLE

2.4.23 PSA NITROGEN PLANT

NOT APPLICABLE

2.4.24 REFRIGERATION SYSTEM (FOR PROCESS APPLICATIONS)

S.No.	Project Philosophy
1	The refrigeration system design parameters including selection of refrigerant shall be as per process duty conditions.
2	Depending upon capacity of refrigeration system, refrigerant compressor shall be either reciprocating type, screw (oil flooded) type or centrifugal type.
3	Automatic capacity control shall be provided with refrigerant compressor to accommodate process load variation. This shall be through valve unloaders in case of reciprocating compressor, through automatic slide valve arrangement in case of screw compressor and variable inlet guide vanes at suction in case of centrifugal compressor.
4	Refrigerant compressor shall comply with applicable API code depending on type of compressor, unless otherwise specified.
5	Materials of construction shall be selected based upon the type of Refrigerant selected.
6	Area classification shall be dependent on the type of Refrigerant and on the location of the system in the plant complex.
7	Equipment noise level (Driver + Driven equipment train + auxiliaries) shall not exceed 85 dBA when measured at One-meter distance from the equipment skid in any direction.
8	All PSVs in the refrigerant line shall be coupled with Rupture discs at the upstream of PSVs to avoid any continuous leakage of refrigerant from PSVs.

2.4.25 ROLL CRUSHER

NOT APPLICABLE

2.4.26 STACKER CUM RECLAIMER

NOT APPLICABLE

2.4.27 TERTIARY SEPARATOR SYSTEM

NOT APPLICABLE

2.4.28 WEIGH BRIDGE-RAIL (IN-MOTION TYPE)

NOT APPLICABLE

2.4.29 WEIGH BRIDGE (ROAD)

S.No.	Project Philosophy
1	The weigh bridge shall be electronic type using load cells for weight measurement.

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S.No.	Project Philosophy
2	The weigh-bridge shall have overload capacity of at least 25% over the rated capacity.
3	Weighing accuracy shall be - 0. 025% to + 0. 025% of weight over complete capacity range.
4	The weigh-bridge shall be pitless type unless otherwise specified due to space/operational constraint.

2.4.30 BAGGING AND PALLETISATION UNIT

S.No.	Project Philosophy
1	General
1.1	Net weight of Product in each small bag : 25Kg. Net weight of Product in each jumbo bag : 1000 Kg.
1.2	Effective bagging hours : 12 hrs/day (2 shifts of 8 hours/day. 6.0 hrs effective time / shift).
1.3	Bagging Operation : 7 days/week.
1.4	Guaranteed weighing and filling accuracy: ± 15gm as an average and a standard deviation of 2 Sigma ± 20gm for every single weighment of 25kg.
1.5	a) Type of 25 kg bags : Woven PP bags (open mouth premade gusseted type) or FFS. [Type to be confirmed by NRL] b) Type of Jumbo bags : Details to be provided by NRL.
1.6	Size of 25 kg bags : a) Length : 870mm b) Layflat Width : 420mm c) Gusset : 2 x 60 mm Material of Bag: PP/PE
1.7	Size of Jumbo bags a) Length : 1100 mm b) Width : 1100 mm c) Height : 1500 mm Material of Bag: PP/PE
2	Bagging Machine
2.1	The bagging machine shall be automatic type with auto bag placer.
2.2	Suitable venting and de-dusting system shall be provided, if necessary.
3	Stitching Machine (for 25 kg bags)
3.1	Stitching machine shall be automatic and shall start with the feel of the bag.
3.2	Stitching shall be double lock chain stitch with top folding.
3.3	Stitching machine shall be revolving type double headed.
3.4	Stitch length shall be approx. 8 mm as per industry practice.
4	Palletisation System (for 25 kg bags)
4.1	Palletisation system shall include feeding belt conveyors, palletisation units and pallet roller accumulators.
4.2	Palletisation system shall be completely automatic floor type, PLC controlled.
4.3	a) Wooden/ plastic pallets shall be used. b) The empty pallet of size 1300mmX1100mmX150mm shall be used. However, the machine shall be suitable for handling pallet of size upto 1500mmX1200mmX150mm.
4.4	Each pallet shall have 40 bags, each of 25 kg capacity, in 8 layers.
4.5	The palletiser shall effectively form the layers such that it shall be possible to stack the pallets 3 high in warehouse, ensuring stability.
4.6	Pallet magazine shall be suitable for minimum 13 number pallets.
4.7	Specified number of bags shall be stacked in individual pallets by automatic Palletiser. The Pallets will be stacked in warehouse using Forklift Trucks.

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S.No.	Project Philosophy
4.8	The system shall be provided with following machines/equipment also: i) Check weigher. ii) Metal Detector. iii) Bag Rejection Device. iv) Ink Jet Printer for printing alpha-numeric digits including "Inaccurate Weight" & "Metal" contaminated bags, as applicable. v) Auto bag placer. vi) Interconnecting belt/roller conveyors.
4.9	Pallets of 25kg bags will be Stretched hood wrapped. [to be confirmed by NRL]

2.4.31 EXTRUSION AND PELLETIZATION SYSTEM

S.No.	Project Philosophy
1	Extrusion and Pelletization system shall be as per Licensor"s Process Data sheet.
2	All lube oil pumps, hot oil pumps and water pumps shall have 100% installed standby.
3	Service factor for gear boxes shall be minimum 1.5.
4	Life of bearings (L-10) shall be considered minimum 40000hrs.
5	The pellet dryer shall be centrifugal type capable of operating continuously and shall be provided with pre-dewatering screen.
6	Wet air fan shall be of centrifugal type, preferably with straight radial blades.
7	The pellet vibrating screen shall be double deck type and shall have flexible connections at inlet, outlet, oversize and undersize nozzles.
8	All equipment piping/chutes etc. shall be earthed properly.
9	Extruder start-up material shall go through a trench to water basin where separation of polymer and water will take place.
10	Machine monitoring system for following shall be considered (to be confirmed by Client): a) Extruder main motor & gear box b) Gear Pump motor & gear box c) Under Water Pelletizer motor & gear box. Machine monitoring/conditioning system shall monitor the following minimum parameters: I. Motor Bearing temperature and vibration II. Motor winding temperature III. Motor Shaft displacement/imbalance IV. Gear box shaft bearing vibration/imbalance V. Gear box temperature
11	PCW tank shall be sized for higher of following criteria: a) To cater requirement of minimum three start-ups without needing any make-up water b)Three minutes of PCW pump capacity c) As per Licensor′s specifications.
12	For sizing of PCW circuit, minimum flow rate of PCW shall be considered as 12 m3/hr/ ton of pellet produced or as specified in Licensor specification/Process data sheet, whichever is higher.

2.4.32 PNEUMATIC CONVEYING SYSTEM

S.No.	Project Philosophy
1	General

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S.No.	Project Philosophy
1.1	The system shall be designed taking into consideration the following factors: a) Material and its characteristics b) Capacity and turndown requirements, and c) System Configuration and Piping layout The designed system shall have least consumption of energy per tonne of material transported. A conservative material to air ratio shall be selected to avoid salutation in horizontal lines and to keep the pressure drop minimum. While deciding conveying velocity, product degradation and pressure drop shall be taken into account. If necessary, the conveying lines may have different cross sections in various zones of transportation. The conveying system shall have programmable logic controllers for automatic operation and shall be provided with control panel and graphic display unless stated otherwise
2	Conveying Blowers/Compressor
2.1	Adequacy of blowers (positive displacement blowers may be used for system pressure limited to 0.9 kg/cm2 g)shall be checked for the required conveying capacity and distance. Either blower (if adequate) or compressor shall be used optimizing the overall cost.
2.2	The conveying blowers/compressor shall be supplied with suction and discharge silencers, coolers, filters etc. The blower/compressor shall be statically and dynamically balanced. Atleast 20% margin over BkW at maximum operating pressure or 5% margin over BkW at relief valve set pressure, whichever is higher, shall be considered for selection of Motor for all compressors/blowers. Design operating point of blower/compressor shall be at a point not exceeding 80% of maximum permissible flow and 90% of maximum permissible pressure for the selected blower/ compressor, unless otherwise specified in the job specification.
3	Rotary Feeders
3.1	Only proven models already satisfactorily used in similar services shall be used. Rotor radial and lateral clearances shall be carefully decided considering the operating temperature and consequential thermal expansion. Insulation shall be considered to prevent local cooling, if required
3.2	The rotary feeder shall be tested for gas or air leakage. The feeder shall be provided with vent line for conveying application. Rotary feeder shall be so designed as to prevent product smearing or pinching.
3.3	Seal purging with air or nitrogen shall be provided for rotary feeder handling powder materials. In case of rotary valves with closed end rotors, purging of end plates shall also be provided
4	Piping
4.1	The conveying line routing shall take into account (a) minimum conveying line length (b) least number of bends (c) no abrupt change in direction and (d) installation of long radius bends
4.2	Piping material shall be compatible with the material being handled
4.3	For polymer products, all gaskets must be white neoprene only. Piping shall have continuity with static jump over at every flange and shall be earthed, wherever there is a possibility of static charge generation
4.4	Piping for polymer pellet conveying shall have special type proven treatment to avoid snake skins
4.5	Straight length between any two flanged joints shall not exceed 6m
4.6	Clean out pocket at strategic locations shall be provided
4.7	Bend radius of conveying line shall be generally 8 to 10 D, and bend shall be smooth wrinkle free. Any special proven proprietary bends of lower bend radius are also acceptable.

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2.4.33 ADDITIONAL PACKAGE/EQUIPMENT

S.No.	Project Philosophy
1	

2.5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS

Notes:

2.6.0 MATERIAL HANDLING FACILITIES FOR NORMAL MAINTENANCE OF EQUIPMENT

2.6.1 MATERIAL HANDLING FACILITIES

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

2.7.0 SPARE PARTS

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

2.7.1 MANDATORY SPARES

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

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

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S.No.	Type	Description
3	CARTRIDGE FILTER [For each cartridge filter tag]	
3.1	Gaskets/O-rings	Two (2) sets of each size and type
3.2	Filter element along with mounting nut, bolt, and washer	Two (2) Complete Sets
3.3	Fasteners	10% (Min 2 nos.) of each type and size
4.0	CHAIN PULLEY BLOCK	NIL
5.0	DUST COLLECTION SYSTEM: BAG FILTER TYPE	
5.1	Gaskets	Two (2) sets of each size and type
5.2	Filter element (bag) along with mounting nut, bolt, and washer	10% (Min 2 nos.) of each type and size
5.3	Fasteners	10% (Min 2 nos.) of each type and size
6.0	ELECTRIC TRACTION LIFT	NIL
7.0	ELECTRIC WIRE ROPE HOIST	NIL
8.0	EOT& HOT CRANE	One (1) No. Radio Remote Type Control along with battery (for each EOT Crane)
9.0	FILTER SEPARATOR/COALESCER (For each tag)	
9.1	Filter/coalescer/separator element along with mounting nut, bolt, and washer	Two (2) Complete Sets
9.2	Gasket/O-rings	Two (2) sets of each size and type
9.3	Fasteners	10% (Min 2 nos.) of each type and size
10	LOADING ARM	NIL
11	REFRIGERATION SYSTEM (For Process Applications)	
11.1	Refrigeration Compressor	As per Sl.No. 2.10 under Cl. No of 3.7.1 of Engineering Design Basis (SME)
11.2	Refrigerant Charging Pump, if applicable	One (1) no.
11.3	Lubricant charging Pump, if applicable	One (1) no.
11.4	Gaskets for Vessels	Two (2) sets gaskets of each type and size
11.5	Fasteners for Vessels	10% (Minimum 2 in each size) of installed fasteners
11.6	Gaskets for Heat Exchangers	400 %
11.7	Fasteners for Heat Exchangers	20% Bolting (Min. 4 studs and 8 nuts per joint)
12	WEIGH BRIDGE (ROAD)	NIL
13	BAGGING AND PALLETISATION SYSTEM	NIL
14	EXTRUDER	
14.1	Extruder Die Plate	1 (One) no.
14.2	Extruder Knife Holder	1 (One) no.
14.3	Extruder knives	10 (Ten) sets
14.4	Seal for Extruder shaft (wearing parts)	1 (One) set
14.5	Wearing Parts of coupling for Extruder	1 (One) set
14.6	Plates and Gaskets of Plate heat Exchanger	1 (One) set

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S.No.	Type	Description
14.7	Rotor for auxiliary driven equipment	1 (One) set except for the following items: a) Extruder main screw b) Melt pump rotor c) Pelletizer rotor d) PCW pump rotor e) Pellet dryer
14.8	All bearings, oil seals, O rings, gaskets,filters, rupture discs installed in entire Extruder package	1 (One) set each
14.9	Fasteners for Heat Exchangers	20% bolting (Min 4 studs and 8 nuts) per joint
14.10	Gaskets for Heat Exchangers	400% of installed gaskets
14.11	Screen packs	10 (Ten) sets of each mesh size
14.12	Flexible connections for Inlet, Outlet, Oversize and Undersize nozzles of Pellet Classifier	One(1) set for each nozzle connection
14.13	Extruder gear pump seals and bearing	One (1) set
14.14	Pump seals and bearing	One (1) set for each pump tag [common for both working and standby] in the package
14.15	Gaskets for all interface and package intermediate flange connections blinds and body flange	Four (4) sets of each installed gaskets
15	PNEUMATIC CONVEYING SYSTEM	
15.1	Screw Compressor	As per Sl. No. 2.10 under Cl. 3.7.1 of Engineering Design basis(SME)
15.2	Roots Blower	As per Sl. No. 2.12 under Cl. 3.7.1 of Engineering Design basis(SME)
15.3	Cartridge filter	Two (2) complete sets of installed Filter elements along with mounting nut, bolt, and washer for each filter
15.4	Bag Filter	20% of total installed Filter element (bag) along with mounting nut, bolt, and washer for each filter
15.5	Fasteners for vessels	10% (min 2 nos) of each type and size
15.6	Gaskets for Vessels	Two (2) sets of each size and type
15.7	Fasteners for Heat Exchangers	20% bolting (Min 4 studs and 8 nuts) per joint
15.8	Gaskets for Heat Exchangers	400% of installed gaskets

2.7.2 COMMISSIONING SPARES

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

2.7.3 RECOMMENDED SPARES FOR NORMAL OPERATION & MAINTENANCE

Vendor shall quote for spare parts with recommended quantities and itemised prices for first

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two years of operation of the equipment. Proper coding and referencing of spare parts shall be done so that later identification with appropriate equipment is facilitated.
Recommended spares and their quantities should take into account related factors of equipment reliability, effect of equipment downtime upon production or safety, cost of parts and availability of vendor's service facilities around the proposed location of equipment.

2.7.4 SPECIAL TOOLS AND TACKLES

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

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3.0 ROTATING EQUIPMENT

3.1 SCOPE

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

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

3.2 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

3.2.1 ABBREVIATIONS

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

3.2.2 CODES & STANDARDS / PUBLICATIONS

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

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

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

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

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S.No.	Description	Standards / Codes	Edition	Note
2.9	Centrifugal Fans	EIL Std. Spec. 6-42-0002		Note-4
2.1	Induced Draft / Forced Draft Fans	API Std 673 3rd Ed & EIL Std. Spec 6-42-0016		Note-4
2.11	Roots Blowers	Mfr. Std.		
2.12	Diaphragm Compressors	EIL Std. Spec. 6-42-0012		
3	MECHANICAL DRIVERS / GEAR BOXES			
3.1	Diesel Engines	ISO 3046 & EILStd. Spec. 6-43-0040		
3.2	Gas Turbines	API Std. 616 5thEd. & EIL Std. Spec 6-43-0041		
3.3	Steam Turbines (General Purpose)	API Std. 611 6th Ed. & EIL Std.Spec. 6-43-0042		Note-5
3.4	Steam Turbines (Special Purpose)	API Std. 612 7thEd. & EIL Std.Spec. 6-43-0043		
3.5	Special Purpose Gear Units	API Std. 613 5th Ed		
3.6	General Purpose Gear Units	API Std. 677 3rd Ed		
3.7	Special Purpose Coupling	API Std. 671 4th Ed.		Note-6
4	AUXILIARIES	API Std. 671		
4.1	Lubrication, shaft sealing and control-oil systems and auxiliaries	API Std. 614 5th Ed		Note-7
4.2	Shaft sealing for centrifugal & rotary pumps	API Std. 682 4th Ed.		
4.3	Vibration, Axial Position & Bearing Temp. Monitoring Systems	API Std. 670		
4.4	Steam Condensers	HEI + TEMA		
4.5	All other rotating equipment not listed above	Mfr. Std.		

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

2 Centrifugal pumps for general purpose process service are classified as pumps for applications where maximum pressure by all considerations does not exceed 16.0 kg/cm2 g, pumping temperature remains within -29 DEG C to 150 DEG C, Specific gravity is not less than 0.7 at the specified operating conditions or when dual pressurised / un-pressurised mechanical seals are not required/ specified. Typical areas of application are non-process services & utility services such as De-mineralised Water (DMW) plants, Raw Water Treatment Plants (RWTP), Effluent Treatment Plants (ETP), Blow-down services etc.

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

4 These centrifugal Fans are to be considered as meant for non process services and utility services such as DMW, RWTP, ETP plants etc.

5 General-purpose steam turbines (conforming to API Std. 611) in addition to criteria specified in API 611, General-purpose steam turbines may also be used, subject to market availability & with proven track record, for cases where all the following conditions exist:
- Inlet pressure <= 60 bar g;
- Inlet temperature <= 475 DEG C;
- Speed <= 6000 rpm;
- Turbine rating <= 3000 kW; and

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

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

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

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

3.3.0 GENERAL / DESIGN CONSIDERATIONS

3.3.1 UNIT RESPONSIBILITY

S.No.	Equipment Type	Unit Responsibility
1	All equipment (except for Steam /Gas Turbine Generating Sets, Gas/ Crude/ Diesel Engine Power Generating sets, Gas Turbine driven Compressors, Integrally Geared Air Compressors, Oil flooded Screw Compressors & Dosing Skids	With the driven equipment manufacturer, who shall also be the SPRV (Single Point Responsibility Vendor) for the complete equipment unit including driver, driven equipment & all other associated auxiliary systems, instrumentation & controls etc. All Rotating Equipment complete with drivers & all associated auxiliary systems shall be procured from the respective driven equipment manufacturers.

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S.No.	Equipment Type	Unit Responsibility
2	Steam/Gas Turbine Generating Sets	With the Steam/Gas Turbine manufacturer, who shall also be the SPRV of the package. Steam/Gas Turbine Generating Sets shall be procured along with alternators from the Steam/Gas Turbine Manufacturers, complete with all associated auxiliary systems.
3	Gas/Diesel/Crude Oil Engine Power Generating Sets	With either the Gas/Diesel/Crude engine manufacturer or the GEG/DG/CEG Set Packager, who shall also be the SPRV of the package. Gas/Diesel/Crude Oil Power Generating Sets shall be procured along with alternator from an engine manufacturer or from an established GEG/DG/CEG Set Packager. The packager shall be authorized packager of engine manufacturer.
4	Gas Turbine Compressors	With either GT or Compressor manufacturer, who shall be the SPRV of the package. GTCs shall be procured either from compressor manufacturer or from Gas Turbine manufacturer, complete with all associated auxiliary systems.
5	Integrally Geared Air Compressors& Screw Compressors (Oil flooded)	With either the manufacturer of integrally geared air compressor/ screw compressor or their authorised subsidiary/ packager (as applicable), who shall be the SPRV of the package. Above packages shall be procured from the manufacturer of integrally geared compressor or screw compressor or their authorised packager.
6	Dosing Skids	With the packager of the proposed dosing skids, who shall also be the SPRV of the package. Dosing Skids shall be procured from an established dosing skid packager.

3.3.2 UNITISATION

Rotating equipment units shall be unitised along with their respective drivers as under:

S.No.	Equipment Unit	Unitisation Location

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S.No.	Equipment Unit	Unitisation Location
1	Electric Motor driven Centrifugal Gas Compressors	At Compressor manufacturer works
2	Steam Turbine driven Centrifugal Gas Compressors	At Compressor manufacturer works
3	Gas Turbine Compressors	At GT manufacturer"s shop or at compressor manufacturer"s shop
4	Steam turbine electric power generating sets	At Steam turbine manufacturer works or at Site
5	Gas Turbine electric power generating sets	At gas turbine manufacturer works or GTG packager works
6	Gas/Diesel/Crude Oil Engine electric power generating sets	At GEG/DG/CEG packager works or engine manufacturer works
7	Electric Motor driven Reciprocating Compressors (non skid mounted i.e.directly mounted on foundation)	At Site
8	Centrifugal Fans (not provided on baseplate/ skid)	At Site
9	Integrally Geared Centrifugal Air Compressor & Screw Compressor (Oil flooded)	At compressor manufacturer works or their authorised subsidiary/ packager works (as applicable)
10	Dosing Skids	At dosing skid packager works
11	All other rotating equipments	At respective rotating equipment manufacturer"s works

3.3.3 EQUIPMENT SELECTION AND SIZING CRITERIA

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

3.3.4 ECONOMIC COMPARISION OF VENDORS OFFER

S.No.	Project Philosophy
1	Loading & Penalty (on account of equipment energy consumption/ Specific fuel consumption) shall be done only for the following equipment: - Centrifugal Pumps - Hydraulic Power Recovery Turbine - Centrifugal Compressors - Screw Compressors - Reciprocating Air Compressors with atmospheric suction pressure - Centrifugal Fans/Forced Draft Fans/Induced Draft Fans - Gas Turbines - Gas Engine Generators - Diesel Engines (except for emergency & fire water service)

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S.No.	Project Philosophy
2	In case of driven equipment, their shaft power consumption shall be considered for economic comparison of vendor offers. However for Gas turbine, gas engine/ diesel engine drivers, specific fuel consumption shall be considered for economic comparison of vendor offers. For HPRT, power generated shall be considered for economic comparison of vendor offers.
3	Vendor's offers shall be loaded by Net Present Value of the cost of excess energy consumption (over the vendor having least energy consumption) over a period of Five years starting from one year after delivery.
4	Loading shall be applied on operating units only and not on standby units.
5	Loading shall not be done on equipment, which are for intermittent operation.
6	Commercial comparison on account of supervision charges: The rotating equipment vendor shall provide his services for supervision during erection, commissioning & field testing (as applicable for main equipment or its driver) of the rotating equipment packages. Electrical & Instrumentation engineers shall also be present along with vendor""s erection and commissioning engineers, as required. The supervisory cost of mandays as specified for each rotating equipment package (as specified in cl 3.4.1) shall be considered for the purpose of commercial comparison (which he may decide between days for Indian/Foreign supervisors and also discipline wise but total of man days per equipment package). The vendor shall indicate in his proposal the cost of providing the above services on per diem basis. The presence of OEM vendor for the purpose of erection, commissioning & field testing (as applicable) shall be on need basis and criticality of the equipment as decided at site, based on the site conditions. Per diem rates, as quoted by the vendor shall be the basis of payment, based on actual requirements.
7	For economic comparison of equipment vendor"s offer, "Equipment Cost including the Cost of mandatory spares (if specified), commissioning spares, special tools & tackles + Loading (as defined above) + Supervision charges (as defined above)shall be considered as a minimum. Any other cost which are part of commercial comparison can also be made part of this economic comparison.
8	The following values for estimatingloading & penalty shall be considered: i) Cost of Electrical Power : Rs. 6.50 per per kWh ii) Rate of Interest : 12.00% per year iii) No of years :5 Years iv) Cost of Fuel: ____ per ton
9	The maximum loading & penalty to be applied on account of equipment power consumption/specific fuel consumption however shall not exceed 10 % of the total package cost.
10	Guarantee parameters shall be submitted as part of bids. In case of suo- moto change in guaranteed parameters (used for techno-commercial evaluation of offers) by the bidder after submission of their offer, the changed guaranteed parameters shall be considered for techno-commercial evaluation for Loading & Penalty purposes as per the methodology given below:

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S.No.	Project Philosophy
10.1	For Power consuming equipment (e.g. pumps / compressors etc.): (1) In-case the changed guaranteed values are higher than the originally quoted guaranteed values, bidder's bid/offer shall be rejected. (2) In-case the changed guaranteed values are lower than the originally quoted guaranteed values, the guaranteed parameters contained in original proposal are to be considered for the purpose of loading for commercial evaluation. (3) In-case, after commercial loading as per above, the bidder (who had lowered the guaranteed values as compared to the originally quoted guaranteed values) turns out to be L1, the changed guaranteed values (which are lower than the originally quoted guaranteed values) are to be considered for ordering and applicable performance penalties during Performance Test.
10.2	For Power generating equipment (e.g. GTG/ STG/ Expander-Generator/ Expander-Compressor/HPRT, etc.): a) In-case the changed guaranteed values are lower than the originally quoted guaranteed values, bidder's bid/offer shall be rejected. b) In-case the changed guaranteed values are higher than the originally quoted guaranteed values, the guaranteed parameters contained in original proposal are to be considered for the purpose of loading for commercial evaluation. c) In-case, after commercial loading as per above, the bidder (who had increased the guaranteed values as compared to the originally quoted guaranteed values) turns out to be L1, the changed guaranteed values (which are higher than the originally quoted guaranteed values) are to be considered for ordering and applicable performance penalties during Performance Test.
11	Loading and penalty criteria proposed for economic comparison shall be considered for cases wherein procurement is being done by BPCL/EIL in EPCM mode.

3.3.4.1 NO OF MANDAYS

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

S.No.	Rotating Equipment Package	No. of Mandays
1	Centrifugal Pumps (Single/Two Stages) - Electric Motor Driven Package	5
2	Centrifugal Pumps (Single/Two Stages) - Steam Turbine Driven Package	20
3	Centrifugal Pumps (Multistage) - Electric Motor Driven Package	20
4	Centrifugal Pumps (Multistage) - Steam Turbine Driven Package	25
5	Large Capacity Centrifugal Pump - Electric Motor Driven Package	5
6	Fire Water Pumps - Diesel Engine Driven Package	10
7	Rotary Pump - Electric Motor Driven Package	3
8	Metering Pump - Electric Motor Driven Package	3

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S.No.	Rotating Equipment Package	No. of Mandays
9	Reciprocating Pump - Electric Motor Driven Package	10
10	Reciprocating Pump - Diesel Engine Driven Package	15
11	Centrifugal Compressor (Single Casing) - Electric Motor Driven Package (without inter-stage process piping)	50
12	Centrifugal Compressor (Single Casing) - Steam Turbine Driven Package (without inter-stage process piping)	70
13	Centrifugal Compressor (Single Casing) - Gas Turbine Driven package (without inter-stage process piping)	80
14	Centrifugal Compressor (Multi Casing) - Steam Turbine Driven Package (without inter-stage process piping)	80
15	Centrifugal Compressor (Multi Casing) - Gas Turbine Driven package (without inter-stage process piping)	80
16	Axial Compressor - Steam Turbine Driven Package (without inter-stage process piping)	80
17	Package integrally geared centrifugal compressor-electric motor driven package	30
18	Screw Compressor - Electric Motor Driven Package	40
19	Skid mounted Reciprocating Compressor - Electric Motor Driven Package	25
20	Reciprocating Compressor - Electric Motor Driven Package (without inter-stage process piping)	70
21	Reciprocating Compressor - Electric Motor Driven (with inter-stage process piping)	80
22	Reciprocating compressor + Electric Motor + Soft Starter (with inter-stage process piping)	90
23	Reciprocating compressor + Electric Motor + Soft Starter (without inter-stage process piping)	90
24	Diaphragm Compressor - Electric Motor Driven Package	15
25	Induced Draft (ID) Fan - Electric Motor Driven Package	25
26	Induced Draft (ID) Fan - Electric Motor Driven Package with variable speed fluid coupling	30
27	Forced Draft (FD) Fan - Electric Motor Driven Package	25
28	Forced Draft (FD) Fan - Electric Motor Driven Package with variable speed fluid coupling	30
29	Steam Turbine driven Induced Draft (ID)/ Forced Draft (FD) fans	35
30	Diesel/Gas Engine - Generator Sets	45
31	Steam Turbine - Generator Sets	90
32	Gas Turbine Generator sets	120
33	Chemical Dosing/Injection Package	10

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S.No.	Rotating Equipment Package	No. of Mandays
34	Dual drive-Turbine + Motor driven Centrifugal compressor (applicable for Cycle gas compressor)	100
35	Sealless Centrifugal pumps	5

3.3.5 EQUIPMENT QUALIFICATION CRITERIA (EQC)

All Rotating Equipment shall meet the EQC* as specified in the standard specification of the relevant rotating equipment, as applicable. Rotating Equipment Vendor shall complete the Experience Record Proforma enclosed with the inquiry document to amply prove that the offered Rotating Equipment meet the EQC for technical acceptance.
* Alternatively, Indian Subsidiary of Foreign Principal can be qualified based on prevalent 'Make in India' Policy of EIL.

3.3.6 EQUIPMENT SUPPLIERS

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

3.3.7 SEALING SYSTEM SELECTION CRITERIA

3.3.7.1 CENTRIFUGAL PUMPS

S.No.	Project Philosophy
1	All Pumps shall be provided with mechanical seals (except general water service pumps handling clean cold water), unless specified otherwise. The type of mechanical seal (i.e. single or dual un-pressurised / pressurised) shall be as defined in the process package.
2	Unless otherwise specified, mechanical seals shall conform to API Standard 682, 4th edition for centrifugal pumps. However, Large capacity water service pumps (i.e. pumps with rated flow above 500 m3/hr) shall be provided with Non-API horizontally split mechanical seals.
3	Seal Qualification tests (SQT) shall have been conducted on the proposed mechanical seal model(s) for standard API 682 seals.
4	In case the offered mechanical seal is intended to be supplied by the Indian counterparts of the seal manufacturers, following requirements shall be met: - For standard mechanical seals, for which SQT has been conducted by the principals, critical components such as Bellows, Springs and Seal Faces shall be sourced from their principals. - For Engineered seals, the complete mechanical seal along with sleeve and gland plate shall be sourced from their principals. Seal drawings shall be from the principal or duly vetted by principal.

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S.No.	Project Philosophy
5	Any seal offered under "Engineered Seal" category or when seal area/stuffing box is subjected to operating pressure >=20Kg/cm2g (i.e. seals having MDSP>=20Kg/cm2G) shall undergo the following Seal Acceptance Test (SAT): All seals installed in one pump per item / tag shall undergo SAT as per the following: "Four hour static test, four hour dynamic test and one hour cyclic test with test fluid selection as per API 682 and test conditions commensurate with either API 682 test conditions or the conditions expected during operation in normal as well as start-up / shut-down conditions, whichever is more stringent. However for temperature, API limit of 260 degree C may be followed for testing in case of high temperature applications." Propane testing, as per API 682 4th Edn. Conditions, shall be carried out only for liquids with S.G < 0.6 & pumping temperature of -5degC to 176degC or for all flashing hydrocarbons with pumping temperature < -5degC. Additionally, for propane testing, in case operating pressures are higher than API 682 4th Edn. test conditions, additional seal acceptance testing with Diesel/Mineral oil (as applicable) shall be carried out at actual operating pressures(as per above). SAT certificates shall also be furnished as part of final documentation.
6	Mechanical seals to be suitable for maximum shut-off pressure under static conditions for pusher type seals. For Bellows seal, mechanical seal shall be suitable upto bellows design pressure, as a minimum.
7	Unless otherwise specified, Tank/Pit mounted vertical pumps, type VS4 (process service) shall be provided with dry running vapour seals as per vendor"s standard. However, VS1 type pump (if specified) shall be provided with seals as per API 682. However, VS1 type pump (if specified) shall be provided with seals as per API 682.
8	In LPG service or HC containing LPG, double seals with dry running out board seals(with Plan 75, 76) shall not be used.

3.3.7.2 CENTRIFUGAL/SCREW COMPRESSORS

S.No.	Project Philosophy
1	Centrifugal Compressors/Oil free screw compressors (for gas service) shall be provided with Dry Gas Seals except for services (like Air, N2 etc.) where normally labyrinths shall be used for sealing. Even for N2 service (with some contaminant) dry gas seal may be considered. Oil flooded screw compressors shall be provided with mechanical contact seals with seal oil system.
2	The offered model of Dry Gas Seal shall be field proven and similar in terms of specified process gas service, shaft diameters, speeds, sealing pressures and configuration as compared to at least Two Units designed, manufactured, tested and supplied and at least ONE of these units shall have completed atleast one year of operation as on the bid due date of main (driven) equipment. Compressor vendor shall be asked to furnish past supply experience list of the seal manufacturer for the offered model of seal and justify meeting acceptance criteria.
3	The offered dry gas seal skid and panel shall be field proven and similar to the specified operating parameters as compared to at least TWO UNITS designed, manufactured, tested and supplied by the proposed manufacturer and at least ONE of these units shall have completed atleast one year of operation as on the bid due date of main (driven) equipment. Compressor vendor shall be asked to furnish past supply experience list of the seal manufacturer for the offered model of dry gas seal skid and panel and justify meeting acceptance criteria. In case PTR of the foreign principal is provided for qualification, dry gas seal skid and panel drawing shall be either from principal or duly vetted by principal.

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S.No.	Project Philosophy
4	Dry gas seals shall be bi-directional and of cartridge design. Configuration for Dry Gas Seal shall be Tandem with intermediate labyrinth unless specified otherwise. Lift off speed of seal faces shall be below the compressor train minimum operating speed including the shop speed for performance test.
5	Dry gas seals & sealing system (Primary seal gas supply and vent) shall be designed for Compressor Casing MAWP.
6	Seal gas skid shall be compact and design shall ensure that there is no condensate ingress in dry gas seals.
7	Unless otherwise specified, Dry Gas seal skid & panel (including all related instrumentation) shall be procured from Dry Gas Seal supplier.

3.3.7.3 ADDITIONAL EQUIPMENT

S.No.	Project Philosophy
1	

3.3.8 DRIVE ARRANGEMENT

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

3.3.9 COUPLINGS

S.No.	Project Philosophy
1	Unless otherwise specified, Couplings shall be of metallic, non-lubricated, flexible element type (i.e. either diaphragm or discs) with spacer, for all equipment. All coupling models shall be selected for a minimum service factor of 1.5 over driver rating.DBSE shall be more than the seal cartridge length.
2	Couplings for the following equipment shall conform to API Standard 671: - Centrifugal compressors (API Std. 617) - Special purpose Steam Turbines (API Std. 612) - Gas Turbines (API Std. 616) - Rotary Screw Compressors (API Std. 619) - Packaged Integrally Geared Air Compressor (API Std 672) - Multi-stage (greater than two stages) centrifugal pumps with Forced lubrication system & speed greater than 3000 rpm. However, in case of gearbox driven multistage pumps, both low speed and high speed couplings shall conform to API 671.

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S.No.	Project Philosophy
3	Couplings as per manufacturer"s standard may be supplied for the following equipment: - Reciprocating Compressors - Packaged Rotary Compressors (Screw type for Plant & Instrument Air Service) - Diesel/Gas/Crude Oil Engine driven equipment - High speed integrally geared pumps The couplings for the above equipment shall however comply to the requirements of the individual codes as applicable for the equipment above (e.g. API-618 for Recip Compressors etc.).
4	Universal type coupling (hook joint) can be used for engine and driven equipments.
5	Removable coupling guard shall be provided which shall be fabricated from non-sparking material, and shall be open at the bottom to permit manual shaft rotation. The guard shall be sufficiently rigid to withstand deflections as a result of bodily contact of nominally 100 kgs. Centrifugal compressors and Gas Turbines coupling guards may have vendor standard features.

3.3.10 ALLOWABLE NOISE LEVEL

S.No.	Project Philosophy
1	Equipment noise level (Driver + Driven equipment train + auxiliaries) shall not exceed 85 dBA when measured at One-meter distance from the equipment skid in any direction. This requirement is not applicable for equipment for infrequent operation such as diesel engine driven fire water pump package/emergency DG/GEG/CEG Sets.
2	Acoustic hoods shall not be used for any equipment excepting for DG sets (rating up-to 1500 kVA), gas turbines, rotary compressors & roots blowers. DG Sets of rating higher than 1500 kVA shall be installed in an acoustically treated DG Room/Building. GEG/CEG sets can be installed in an acoustically treated room/ building.
3	All equipment shall meet the local/central statutory requirements for Noise and emission controls.

3.3.11 EQUIPMENT STORAGE

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

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

3.3.12 INITIAL FILL

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

3.3.13 INSTALLATION CRITERIA

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3.3.13.1 PUMPS

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

3.3.13.2 COMPRESSORS

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

3.3.13.3 STEAM TURBINE GENERATORS

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

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

S.No.	Project Philosophy
1	All GEG/DG & GTGs shall be installed on ground floor (i.e. on finished floor level) under roof/generator set room.

3.3.13.5 GENERAL

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

3.3.14 MATERIALS

The material of construction of the wetted parts of rotating equipment shall be as specified in the process package.

3.3.15 HEAT EXCHANGERS

3.3.15.1 LUBE OIL COOLERS

S.No.	Project Philosophy
1	Coolers shall be water-cooled, shell and tube type as per TEMA 'C' with oil in shell and water in tube.
2	The oil side operating pressure shall be higher than water side operating pressure.
3	For shell-and-tube heat exchangers, the low pressure (LP) side shall be preferably specified with a design pressure at least equal to 10/13 of high pressure (HP) side design pressure.
4	The material of construction shall be suitable for the specified service. However as a minimum, MOC shall be as follows:
4.1	Shell :CS
4.2	Channel/Channel Covers :CS
4.3	Tubes :Inhibited Admiralty Brass
4.4	Tube Sheet :Naval Brass
4.5	Fouling Factors
4.5.1	- Shell Side-Oil : 0.0001 hr m^2 DEG C/kcal
4.5.2	- Tube Side-Water : 0.0004 hr m^2 DEG C/kc

3.3.16 SAFETY

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

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S.No.	Project Philosophy
3	All electrical components & installations, instruments shall be suitable for the electrical area classification and grouping in which the equipment is installed.

3.3.17 INSPECTION AND TESTING

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

3.3.18 SCOPE OF SUPPLY AND WORK

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

3.3.19 INTERFACE

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

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

3.3.20 ERECTION OF EQUIPMENT

Erection of all rotating equipment shall be carried out by the mechanical works contractor, under the supervision of equipment vendor, except for diesel/gas/crude oil engine power generating sets. Erection of these power generation sets shall be in equipment vendor's scope.

3.4.0 SPECIFIC DESIGN REQUIREMENTS

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

3.4.1 CENTRIFUGAL PUMPS

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S.No.	Project Philosophy
1	I(SF) [as per equation K.2 of Annexure K of API 610 12th Edn] ≤ 1.2 times the value from equation K.4 of Annexure K (Refer API 610 12th Ed. for Annexure – K & L3/D4 calculations) shall be followed for all pumps operating with 2-pole (50Hz) motor.
2	Pumps shall be selected to have their rated operating point falling in the range of 70% to 110% of best efficiency point (BEP) flow of the rated impeller except for low flow pumps (< 20 m3/hr) or pump rated BKW upto 15 kW.
3	Double suction single stage, two-stage & multi-stage pumps shall be of in-between bearing types.
4	Suction flange rating shall be same as that of discharge flange for all pumps.
5	Hydraulic Power Recovery Turbines shall be optimised for best efficiency at Normal Flow.
6	No cast iron pressure containing parts shall be used for hydrocarbon service except for shaft driven lube oil pumps.
7	Inducers shall not be used except for integrally geared type of pumps.
8	All high temperature pumps with hot circulation provision shall have provision of hot liquid circulation from pump bottom to suction line. This will ensure uniform heating of complete pump.
9	All pumps shall be provided with constant level oiler & bearing isolators suitable for normal splash lubrication. Bearing isolators shall be of non contact type and shall meet the requirements of API 610.
10	For the bearing housings, a gate valve and a magnetic drain plug shall be provided for inspecting the oil level while the pump is running.
11	Single and two-stage pumps operating at temperatures less than 150°C and multi-stage pumps operating at temperatures less than 120°C shall be suitable for instantaneous startup from ambient to full operating temperature. For higher operating temperatures the vendor shall provide suitable hardware (i.e. piping, valves & fittings) & as part of the operating manual a suitable startup procedure shall be provided. Any required monitoring equipment (i.e., skin thermo couples) to ensure that the pump, including seal(s), does not incur damage due to rapid heat up shall be supplied by pump vendor.
12	All multistage horizontal centrifugal pumps intended for high temperature service (PT>120C) shall be provided with pump casing - skin temperature monitoring system consisting of the following: - Four thermocouples along with Yoke mounted temperature transmitters with integral indicators for each thermocouple. - One Junction Box (JB) to be mounted on pump base plate. - Cables between the thermocouples and transmitters. - Cables between transmitters and junction box.
13	For non API pumps, unfiltered vibration limit at vendor test bed and site test shall be governed by ISO 10816-7 (Table: A.1 & A.2). Limits mentioned in this standard shall be measured & applicable in radial (X & Y direction) and axial directions.
14	All LCWS pumps shall be provided with suitable internal performance enhancement coating. However during pump evaluation & testing will be carried out without considering coating. Pumps & internals shall be coated before dispatch.
15	All rotating equipment base plates shall have jacking provision for aligning the prime movers.
16	Baseplate drain shall be provided with 2" flanged connection.

3.4.2 RECIPROCATING PUMPS

S.No.	Project Philosophy

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

3.4.3 PACKAGED INTEGRALLY GEARED CENTRIFUGAL AIR COMPRESSOR

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

3.4.4 RECIPROCATING COMPRESSORS

S.No.	Project Philosophy
1	Horizontal Reciprocating compressor of BKW greater than 160kW will be balanced opposed type.
2	Unless otherwise specified, rotational speeds of reciprocating compressors in hydrogen rich service (Mol Wt. Less than 12) shall be limited to a maximum of 350 rpm.
3	Unless otherwise specified, reciprocating compressors shall be skid mounted packages upto a motor rating of 300 kW.
4	Mechanical Run Test shall be carried out with shop lube oil system.

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

3.4.5 LIQUID RING VACUUM PUMPS/COMPRESSORS

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

3.4.6 POSITIVE DISPLACEMENT (ROOTS TYPE) BLOWER

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

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

3.4.7 SEALLESS PUMPS

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

3.4.8 CRYOGENIC PUMPS

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

3.4.9 SPECIAL PURPOSE GEAR UNITS

S.No.	Project Philosophy

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

3.4.10 ADDITIONAL EQUIPMENTS

S.No.	Project Philosophy
1	ID Fans / FD Fans / Centrifugal fans and blowers: (a) First critical speed of the rotor shall be higher than 120% of rated speed. (b) The fan/ blower casing shall be suitably split such that impeller assembly can be removed for maintenance without disturbing inlet and outlet ducting. (c) SS Bolt and nuts shall be provided for the split casing joints of fans/blowers for corrosive services. (d) Fans operating in hot gas service shall be provided with a deflector plate or other suitable provision between shaft seal and bearing housing to deflect hot gas leakage away from the bearing housing. (e) Inlet guide vanes, if specified, shall be provided with following: • An external guide vane position indicator. • Spindles shall be supported at both ends. • Manual operation of guide vane from grade level shall be possible. • The guide vane ring shall be protected by a dust cover which shall allow full access to all parts for inspection. • Dampers shall be louver type with opposed blade.
2	Axial Flow Propeller Pumps :The vendor shall be a Axial Flow Propeller pump manufacturer having engineering, manufacturing and testing facilities for the same.
3	The pump model offered shall be from the existing regular manufacturing range of the vendor. The mechanical as well as the hydraulic performance (including NPSHR) for the complete range of operation of the offered model shall have been established in the shop test. The offered pump model shall meet the following minimum experience requirements: Pumps shall be identical in terms of model & similar in terms of Mechanical Design and Operating/Service conditions of Capacity, Differential Head, NPSHR, Temperature, Pressure and Power rating, pump speed etc. as compared to at least ONE UNIT of the proposed model designed, manufactured, tested and supplied from the proposed manufacturing plant in the last ten years and as a minimum, this package shall have completed one year of operation at site, as on bid due date.(similar mean 80% or higher operating/service condition of capacity, differential head, NPSHR, Temperature, Pressure and Power Rating , pump speed. etc.)

3.5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS

S.No.	Project Philosophy

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S.No.	Project Philosophy
1	

Notes:

3.6.0 MATERIAL HANDLING FACILITIES FOR NORMAL MAINTENANCE OF EQUIPMENT

3.6.1 MATERIAL HANDLING FACILITIES

Equipment layout shall incorporate adequate maintenance platforms, support structures, hand rails, operational access, material handling facilities for inspection and maintenance of equipment & for operation of these facilities. Non-skid decking covering all walk & work areas shall be provided on top of the base plate, as required.

Material handling facilities for normal maintenance of rotating equipment shall be provided as per the following criteria:

S.No.	Type of Equipment	Type of Maintenance Facility
1	Centrifugal Pumps	Refer Piping EDB
2	Reciprocating Pumps excluding Metering Pumps	Refer Piping EDB
3	Centrifugal Compressor (Gas)	EOT Crane
4	Plant & Inst. Air Compressor (Centrifugal)	EOT Crane
5	Reciprocating Compressor (Gas)	EOT Crane
6	STG/GTG	EOT Crane
7	GEG/DG/CEG Sheds	
8	< 1000 kVA	Trolley mounted CP Block + Monorail
9	> 1000 kVA	EOT Crane / HOT Crane
10	Pump Houses	HOT Crane

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

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

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

3.7.0 SPARE PARTS

3.7.1 MANDATORY SPARES

Mandatory spares shall be procured along with the main equipment, if specified by the client. Such spares for each equipment item shall be as per the below table. These spares include only those spares, which are critical for equipment and require longer delivery periods. Spare rotors where supplied shall be boxed in a metal containers for vertical storage with N2 purging. Unit price of each of the listed spares shall be indicated separately in the Proposal.

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S.No.	Description	Description of Mandatory Spares(Qty per Item Tag No.)(i.e. Total qty for working and standby)
1	PUMPS:	
1.1	Centrifugal Pumps Multistage Horizontal (Special Purpose Process Service) / Hydraulic Power Recovery Turbine	1 set of pump element assembly including dynamically balanced rotor (Only for multi-stage horizontal centrifugal barrel type) -- OR -- 1 set of dynamically balanced rotor (Only for multi-stage horizontal centrifugal axial split type) + 1 set of mechanical seals + 1 set of bearings
1.2	Centrifugal Pumps Single/Two stage (Special Purpose Process Service) Horizontal/Vertical	1 set of shaft & impellers + 1 set of mechanical seals
1.3	Centrifugal Pumps (General Purpose Process Service)	1 set of shaft & impellers + 1 set of mechanical seals
1.4	Centrifugal Pumps (General Water Service)	1 set of shaft & impellers +1 set of mechanical seals (if applicable)
1.5	Centrifugal Pumps (Slurry & Liquor Service)	1 set of shaft & impellers + 1 set of mechanical seals
1.6	Positive Displacement Pumps (Reciprocating)	1 set of valve assembly
1.7	Positive Displacement Pumps (Controlled Volume)	1 set of valve assembly + 1 set of diaphragms
1.8	Positive Displacement Pumps (Rotary)	1 set of rotor assembly + 1 set of mechanical seals
1.9	Liquid Ring Vacuum Pumps/Compressors	1 set of dynamically balanced rotor
1.10	Seal-less Pumps	1 set of impellers/rotor (If multistage)
2	COMPRESSORS / FANS & BLOWERS	
2.1	Centrifugal Compressors/Blowers	1 set of dynamically balanced rotor + 1 set of compressor seals + 1 set of bearings
2.2	Axial Compressors	1 set of dynamically balanced rotor + 1 set of compressor seals(including Laby's) + 1 set of bearings
2.3	Expander-Compressors	1 set of dynamically balanced rotor (Rotor implies complete machine centre section including bearing and seals.)
2.4	Integrally Geared Process Centrifugal Compressors	1 Set of Dynamically balanced Rotors (including all pinions, shafts and impeller) + 1 set of bearings + 1 set of compressor seals
2.5	Centrifugal Fans	1 set of shaft & impeller + 1 set of seals + 1 set of bearings
2.6	Induced Draft / Forced Draft Fans	1 set of dynamically balanced rotor + 1 set of seals + 1 set of bearings

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S.No.	Description	Description of Mandatory Spares(Qty per Item Tag No.)(i.e. Total qty for working and standby)
2.7	Packaged Integrally Geared Centrifugal Air Compressors	1 Set of Dynamically balanced Rotors (including all pinions, shafts and impeller) + 1 set of shaft seals + 1 set of bearing assemblies
2.8	Reciprocating Compressors (Utility & Instrument Air Service)	1 set of cylinder valve assemblies + 1 set of piston ring & rider band + 2 sets of packing (stuffing box + intermediate box). + 1 set of big end, small end and crank shaft bearings
2.9	Reciprocating Compressors (Process Service)	1 set of cylinder valve assemblies + 1 set of piston ring & rider band + 2 sets of packing (stuffing box + intermediate box). + 1 set of big end, small end and crank shaft bearings
2.10	Positive Displacement Compressors (Rotary)	1 set of dynamically balanced rotor + 1 set of compressor seals + 1 set of bearing assemblies
2.11	Diaphragm Type Positive Displacement Compressors	4 Sets of Diaphragm + 1 set of bearings
2.12	Roots Blowers	1 set of dynamically balanced rotor + 1 set of bearings
3	MECHANICAL DRIVERS / GEAR BOXES	
3.1	Diesel Engines	NIL
3.2	Gas Turbines	NIL
3.3	Steam Turbines (General Purpose)	1 set of dynamically balanced rotor + 1 set of mechanical seals (if applicable) + 1 set of bearings
3.4	Steam Turbines (Special Purpose)	1 set of dynamically balanced rotor + 1 set of bearings
3.5	Special Purpose Gear Box	1 set of bearings
3.6	General Purpose Gear Box	1 set of bearings
3.7	Special Purpose Coupling	1 set of Coupling Shim Membranes

Notes:
1 Element consists of assembled rotor plus stationary hydraulic parts [diffuser(s) or volute(s)].
2 The word "set" means the quantity required for full replacement of that part in one machine.
3 Spare rotors shall be boxed in a metal containers for vertical storage with nitrogen purging.Storage container shall be property of the owner.

3.7.2 COMMISSIONING SPARES

Commissioning Spare Parts shall be procured along with the main equipment as per equipment manufacturer's recommendations. The list of such recommended spares shall be obtained along with the offer. Any commissioning spare consumed over and above the recommended commissioning spares, during commissioning shall be supplied free of cost

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by the equipment vendor. Any leftover (unused) spares after commissioning, out of those included by vendor in his offer, shall be handed over to the owner.

3.7.3 RECOMMENDED SPARE PARTS FOR NORMAL OPERATION & MAINTAINENCE

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

3.7.4 SPECIAL TOOLS AND TACKLES

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

3.8.0 INSTRUMENTATION ASSOCIATED WITH EQUIPMENTS

3.8.1 MACHINE HEALTH MONITORING THROUGH DEDICATED MACHINE CONDITION MONITORING SYSTEM

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

3.8.2 MACHINE HEALTH MONITORING THROUGH PLC / DCS

S.No.	Project Philosophy
1	Packaged Integrally Geared Instrument Air Compressor, General Purpose Steam Turbine (with forced feed lubrication) (Driver rating >= 160KW), Multi stage Centrifugal Pumps (without forced feed lubrication) (Driver rating >= 160KW), General Purpose Gear Box (Driver rating >= 160KW) shall be provided with probes/detector for measuring vibration and bearing temperature.Set points for Alarm (alert) and shutdown (danger) shall be provided for each of the monitored variables.

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S.No.	Project Philosophy
2	Reciprocating Gas Compressors (Driver rating >= 300KW) shall be provided with probes/detector and transmitters, for measuring frame and cylinder vibrations, piston rod drop (each cylinder) and bearing temperatures suitable for configuration through PLC/DCS. Set points for Alarm (alert) and shutdown (danger) shall be provided for each of the monitored variables.

3.8.3 VIBRATION MONITORING INSTRUMENTATION

Vibration monitoring instrumentation shall be provided as follows:

S.No.	Project Philosophy
1	Hydrodynamic radial bearings with forced feed lubrication shall be fitted with X-Y proximity probes except for Reciprocating Compressors & high speed integrally geared pumps.
2	Hydrodynamic thrust bearings shall be fitted with two numbers proximity type axial probes.
3	A key-phasor is required for each speed change of the shaft system for hydrodynamic bearings.
4	Casing mounted accelerometers(X & Y) shall be provided for special purpose gearboxes and gas turbines.
5	Reciprocating Gas Compressor Frame & cylinder shall be fitted with accelerometers.
6	Bearing housings with anti-friction bearings, for equipments covered in 8.2 above, shall be fitted with accelerometers(X & Y).
7	Integrally geared air compressors shall be fitted with minimum one number proximity radial probe for each bearing & one number axial position probe for each shaft.

3.8.4 TEMPERATURE MONITORING INSTRUMENTATION

For temperature monitoring instrumentation shall be fitted as follows:

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

3.8.5 GENERAL INSTRUMENTATION

S.No.	Project Philosophy
1	Also refer Electrical Specifications for Instrumentation requirements w.r.t. motors.

3.9 VENDOR DATA REQUIREMENT

Vendor Data Requirement as indicated in the respective equipment Material Requisitions shall be followed.
Only critical vendor data/documents such as Equipment Data Sheets, P&ID's, Foundation Drawing, Equipment Layout, Major Inspection & Test Procedures etc. shall be taken for Owners/Consultant's review. All other drawings/documents shall be retained for Owners/Consultant's records.

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ENGINEERING DESIGN BASIS

(STRUCTURAL)

JOBNO.	:	C050
PROJECT	:	Polypropylene (PP) Project at Numaligarh Refinery
CLIENT	:	M/S NRL

EIL SIGNATURE

OWNER SIGNATURE

Rev. No.	Date	Purpose	Prepared by	Reviewed by	Approved by
0	04.08.25	Issued for Engineering	RD	VIKRAM	AS
B	16.05.25	Issued For Owner's Comments/Approval	RD	VIKRAM	AS
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ENGINEERING DESIGN BASIS

(STRUCTURAL)

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1.0 SCOPE

This document specifies the design criteria and loads that shall be taken into account for the civil-structural design of all industrial plant and non-plant structures and buildings pertaining to the project.

2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

2.1 ABBREVIATIONS

Code	Description
EDB	Engineering design basis
FBEC	Fusion bonded epoxy coating
FFL	Finished floor level
FGL	Finished grade level
FOS	Factor of safety
HPP	High point of pavement
MOC	Material of construction
NA	Not applicable
PCC	Plain cement concrete
RCC	Reinforced cement concrete
SBC	Safe bearing capacity
TMT	Thermo-mechanically treated
UOM	Unit of measurement

2.2 CODES & STANDARDS /PUBLICATIONS

S.No.	Description	Standards/Codes
1	Ordinary Portland Cement - Specification	IS 269
2	Coarse and Fine Aggregates For Concrete - Specification	IS 383
3	Expanded Metal Steel Sheets for General Purposes - Specification	IS 412
4	Mild Steel and Medium Tensile Steel Bars and Hard-Drawn Steel Wire for Concrete Reinforcement - Specification	IS 432
5	Portland Slag Cement - Specification	IS 455
6	Plain & Reinforced Concrete - Code of practice	IS 456
7	Specification for Test Sieves: Part-I Wire Cloth Test Sieves	IS 460
8	Methods of Test for Strength of Concrete	IS 516
9	General Construction in steel - Code of practice	IS 800
10	Code of practice for Use of Cold Formed Light Gauge Steel Structural Members In General Building Construction.	IS 801
11	Use of Structural Steel in Overhead Transmission Line Towers - Code of Practice	IS 802
12	Code of Practice for Design, Fabrication and Erection of Vertical Mild Steel Cylindrical Welded Oil Storage Tanks	IS 803
13	Code of Practice for Use of Steel Tubes in General Building Construction	IS 806
14	Hot Rolled Steel Beam, Column, Channel and Angle Sections – Dimensions and Properties	IS 808
15	Cold Formed Light Gauge Structural Steel Sections	IS 811
16	Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon Manganese Steel	IS 814

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S.No.	Description	Standards/Codes
17	Code of practice for use of metal arc welding for general construction in mild steel	IS 816
18	Code of practice for Design Loads	IS 875
19	Design of Structural Timber In Building - Code of Practice	IS 883
20	Steel Tubes for Structural Purposes - Specification	IS 1161
21	Bitumen-Mastic for Flooring-Specification	IS 1195
22	Steel Tubes, Tubular and other Wrought Steel Fittings-Specification	IS 1239
23	Specification for Bitumen Felts for Water Proofing and Damp-Proofing	IS 1322
24	Hexagon Head Bolts, Screws and Nuts of Product Grade 'C' - Part-1: Hexagon Head Bolts	IS 1363
25	Technical Supply Conditions for Threaded Steel Fasteners	IS 1367
26	Specification for Portland Pozzolana Cement	IS 1489
27	Specification for Hard-Drawn Steel Wire Fabric for Concrete Reinforcement	IS 1566
28	Code of practice for construction of stone masonry	IS 1597
29	High Strength Deformed Steel Bars And Wires for Concrete Reinforcement– Specification	IS 1786
30	Preformed Fillers for Expansion Joint in Concrete Pavement and Structures (non extruding and resilient type)	IS 1838
31	Criteria for earthquake resistant design of structures	IS 1893
32	Code of practice for design & construction of foundations in soil-general requirements	IS 1904
33	Code of practice for structural use of un-reinforced masonry	IS 1905
34	Specification for Plain Washers	IS 2016
35	Hot Rolled Low, Medium and High Tensile Structural Steel	IS 2062
36	Specification for Sand for Masonry Mortars	IS 2116
37	Specification for Concrete Masonry Units	IS2185
38	Code of Practice for Brickworks	IS 2212
39	Steel Wire Ropes for General Engineering Purposes-Specification	IS 2266
40	Recommended practice for hot dipped galvanizing of iron and steel	IS 2629
41	Methods for testing uniformity of coating of zinc coated articles	IS 2633
42	Integral Waterproofing Compounds for Cement Mortar and Concrete -Specification	IS 2645
43	Code of practice for Design and construction of Pile foundations	IS 2911
44	Code of practice for design & construction of Raft foundations	IS 2950
45	Code of practice for design & construction of machine foundations	IS 2974
46	Code of practice for concrete structures for storage of liquids	IS 3370
47	Steel Chequered Plates–Specification	IS 3502
48	Specification for Structural Timber in Building	IS 3629
49	Specification for High Strength Structural Bolts	IS 3757
50	High Strength Bolts in Steel Structures-Code of Practice	IS 4000
51	Code of practice for design and construction of foundation for Transmission line towers and poles	IS 4091
52	Code of practice for earthquake resistant design and construction of Buildings	IS 4326
53	Hollow Steel Sections for Structural Use	IS 4923

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S.No.	Description	Standards/Codes
54	Criteria for blast resistant design of structures for explosions above Ground	IS 4991
55	Criteria for design of Reinforced concrete bins	IS 4995
56	Criteria for design of RCC chimneys	IS 4998
57	Determination of dynamic properties of soil	IS 5249
58	Code of practice for Autoclaved Cellular Concrete Block Masonry	IS 6041
59	Code of practice for anti-termite measures in Buildings	IS 6313
60	Code of practice for determination of bearing Capacity of shallow foundations	IS 6403
61	Specification for High Alumina Cement For Structural Use	IS 6452
62	Code of practice for design & construction of steel chimney	IS 6533
63	Method for determination of mass of zinc coating on zinc coated iron And steel articles	IS 6745
64	Code of practice for calculation of settlements of foundations	IS 8009
65	Chlorpyrifos Emulsifiable concentrates	IS 8944
66	Concrete Admixtures –Specification	IS 9103
67	Criteria for design of steel bins for storage of bulk materials	IS 9178
68	Recommendations for metal arc welding of carbon and carbon Manganese steel	IS 9595
69	Code of Practice for Design and Construction of Shallow Foundations on Rocks	IS 12070
70	Two parts polysulphide based sealants	IS 12118
71	Provision of Water-Stops at Transverse Contraction Joints in Masonry and Concrete	IS 12200
72	Specification for sulphate resisting Portland cement	IS 12330
73	Pulverised Fuel Ash Lime Bricks - Specifications	IS 12894
74	Fusion Bonded Epoxy Coated Reinforcing Bars	IS 13620
75	Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces	IS 13920
76	Pesticide - Bifenthrin, technical - Specification	IS 15936
77	Imidacloprid Suspension Concentrate (SC) - Specification	IS 16131
78	Process control room safety	OISD-STD-163
79	Fire-proofing in Oil & Gas industry	OISD-STD-164
80	Fire Prevention and Protection System for Electrical Installations	OISD-STD-173
81	Welded tanks for oil storage	API 650
82	Code of practice for road bridges	IRC: 6
83	Standard Specification for Thin-bed Mortar for Autoclaved Aerated Concrete (AAC) Masonry	ASTM C1660

Note: The above list is suggestive and not exhaustive. Apart from these basic codes any other related codes shall also be followed wherever required. Where Indian codes are not available, any other suitable international codes shall be referred. All codes & standards shall be latest revision with all amendments issued thereto.

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3.0 GENERAL /DESIGN CONSIDERATIONS

3.1 MATERIAL OF CONSTRUCTION

S.No.	Name of Structure	Material of Construction	Level up to	Fire Proofing up to	Remarks
1.0	Technological structures				
1.1	Supporting Process equipment's, with/ without air coolers	RCC	2.5m above HPP	NA	-
1.2	Supporting process equipment's with air coolers	Steel	Above RCC Portion upto top	Air cooler supporting level.	For MOC, Refer Note-a
1.3	Supporting process equipment's without air coolers	Steel	Above RCC Portion up to top	As per OISD-STD-164 or min. 9.1m above HPP, whichever is higher.	-
2.0	Pipe Rack				
2.1	Inside process unit (without air cooler)	RCC (Precast/ Cast-in-situ)	Upto first tier level above HPP.	NA	-
		Steel	Above RCC Portion up to top	As per OISD-STD-164 or min. 9.1m above HPP, whichever is higher.	-
2.2	Inside process unit (with air cooler)	RCC (Precast/ Cast-in-situ)	Upto first tier level above HPP.	NA	
		Steel	Above RCC Portion upto top	Air cooler supporting level.	For MOC, refer Note-a
2.3	Offsite area	Steel	Top	NA	-
3.0	All Shed type structures e.g. compressor house, pump house etc.	Steel	Top	NA	Ref. Note-b
4.0	All plant &non-plant buildings, including blast-resistant buildings	RCC (Precast/ Cast-in-situ)	Top	NA	Ref. Note-c
5.0	All enabling buildings e.g. Warehouse, cement godown etc.	RCC(Precast/ Cast-in-situ) /Steel	Top	NA	Ref. Note-d
6.0	Cable trenches	RCC(Precast/ Cast-in-situ) / Bricks	NA	NA	-

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S.No.	Name of Structure	Material of Construction	Level up to	Fire Proofing up to	Remarks
7.0	Extruder/ Pelletizer Building	RCC	Purged Bin supporting	NA	
		Steel	Above RCC Portion upto top	As per OISD-STD-164	
8.0	Bagging Silo/ Product Blending Bin/Silo supporting structure	RCC	Silo supporting	NA	
		Steel	Above RCC Portion upto top	As per OISD-STD-164	
9.0	Blending Bin/Silo supporting structure	RCC	Silo supporting	NA	
		Steel	Above RCC Portion upto top	As per OISD-STD-164	

Notes:

a) Blind floor below air cooler shall be in RCC over metal decking (left-in/ sacrificial shuttering). To avoid pooling, curb walls, drainage arrangement and slope shall be provided on blind floor.

b) Roofing & side cladding shall be as per Architecture Design Basis.

c) Buildings shall have RCC floors & masonry infill walls; however blast-resistant buildings shall have RCC walls & precast buildings shall have RCC precast wall panels/ AAC Blocks. Material of construction of masonry shall be as per Architecture Design Basis.

d) Material of construction for buildings shall be as per Architecture Design Basis.

e) Electro-forged galvanized grating shall be used for flooring at all operating floors, unless RCC floor is required from operations considerations (e.g. blind floor below air coolers supported on technological structure & piperack, plant & non-plant buildings), however chequered plate shall be provided for walkway along crane girders.

f) Air cooler Structure shall be fire-proofed as per requirement of OISD-STD-164.

g) Fire-proofing material for steel structures wherever required, shall be as follows:

i) Concrete for structures, supporting transfer line & two phase flow line above 6" diameter.
ii) Vermiculite for all other structures, however fire-proofing up to minimum 1.8 m from HPP shall be in concrete.

3.2 LOADS

3.2.1 DEAD LOADS

The weight of all permanent construction, including foundation, walls, floors, roofs, partitions, fire-proofing, stairways and fixed service and other equipments including all fixtures, platforms, ladders and attached piping but excluding their content. If piping weight is not indicated separately or included in the weight of the equipment, the same shall be taken as 10% of the

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empty weight of the equipment. Component of soil backfill weight over foundation slab shall be considered as foundation dead load.

The dead load of panels in sub-station & control room shall be considered as 12.0 kN/Sq.m or actual panel load, whichever is higher, for panel area only. The dead load of false ceiling & false flooring shall be considered as 0.75kN/Sq.m, wherever applicable.

In absence of actual panel area/load, for foundation and column design, panel load shall be considered as 7.0 kN/Sq.m distributed uniformly on entire switch gear hall (including panel area).

The unit weight of materials in general, should be in accordance with IS 875 Part 1.

3.2.2 IMPOSED LOADS

Following may be considered under Imposed Loads:

3.2.2.1 LIVE LOADS

Live loads shall, in general, be as per IS 875 Part-2. However, the following minimum live loads shall be considered in the design of structures to account for maintenance and erection as well:

S.No.	Title/Description	Value	UOM	Remarks
1.0	**Process Building/ Technological Structure (open/closed)**			
1.1	Operating area	5.0	kN/sqm	
1.2	Maintenance area	7.5	kN/sqm	
2.0	**Compressor House/ TG house**			
2.1	Operating area	7.5	kN/sqm	
2.2	Maintenance area	7.5	kN/sqm	(or as specified by machine vendor)
3.0	**Platforms**			
3.1	Service platform around/ on Vessel/ Tower	3.0	kN/sqm	
3.2	Isolated platform (for valve operation)	3.0	kN/sqm	
3.3	Access way	3.0	kN/sqm	
3.4	Cross over	2.0	kN/sqm	
4.0	**Sub-station/Control Room floors**			
4.1	Panel floor- Operating	5.0	kN/sqm	Refer note- b/d
4.2	Panel floor- Maintenance	10	kN/sqm	Refer note- c/d
4.3	Unknown partition (Definition as per Cl.3.1.2 of IS 875 Part-2)	1.0	kN/sqm	
5.0	**Office building**			
5.1	Office area	3.0	kN/sqm	
5.2	Lobby	5.0	kN/sqm	
5.3	Exit way	5.0	kN/sqm	
5.4	Unknown partition (Definition as per Cl. 3.1.2 of IS 875 Part-2)	1.0	kN/sqm	
6.0	**Laboratory**			
6.1	Upper floors	4.0	kN/sqm	

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S.No.	Title/Description	Value	UOM	Remarks
7.0	**Cooling tower**			
7.1	Operating platform/ Hot water basin cover slab	3.0	kN/sqm	
8.0	**Staircase**			
8.1	Process building/ Technological structure	5.0	kN/sqm	
8.2	Office	5.0	kN/sqm	
8.3	Sub-station/ Control room	5.0	kN/sqm	
8.4	Laboratory	3.0	kN/sqm	
8.5	Service platforms	2.5	kN/sqm	
9.0	**Walkway**			
9.1	Gantry girder	3.0	kN/sqm	
10.0	**RCC UG sump**			
10.1	Sump top slab	3.0	kN/sqm	

Notes:

a) Live load on various types of roofs shall be as per requirements given in IS 875 Part-2.
b) Live load shall be on entire panel floor excluding panel area. Load shall be combined with wind and seismic loads.
c) Live load shall be on entire panel floor excluding panel area. Load shall not be combined with wind and seismic loads.
d) In absence of actual panel area, for foundation and column design, live load shall be considered as 3.0 kN/Sq.m for operating case and 6.0 kN/Sq.m for maintenance case, distributed uniformly on entire switch gear hall (including panel area).

3.2.2.2 HYDRO-TEST LOAD

All equipment foundations & supporting structures shall be designed for Hydro-test loads. Hydro-test shall be considered for one equipment at a time. Further, under hydro-test condition the wind force shall be taken as 25% of normal wind loading. Seismic forces shall not be considered while hydro-testing.

3.2.2.3 OPERATING LOAD OF EQUIPMENT

Operating loads shall include the maximum designed equipment inventory in the operating cycle of the plant. For silos, the contents shall be considered as operating loads.

3.2.2.4 BUNDLE PULL

S.No.	Project Philosophy
1.0	Bundle pull for different types of Exchangers shall be taken as under unless otherwise specified in the equipment data sheet:
1.1	For Fixed type, no bundle pull is considered.
1.2	For Kettle type, bundle pull to be considered as 0.3 times the bundle weight.
1.3	For all other types, bundle pull to be considered as 0.86 times the bundle weight or 30N/mm of diameter, whichever is greater.
2.0	Total Bundle Pull shall be considered on fixed pedestal alone.

3.2.2.5 PIPING LOAD

Piping loads shall be considered as follows:

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A. Actual load as given by piping department, for structures other than pipe racks.
B. For piperacks, it shall be as per Clause No 4.5.1

3.2.2.6 IMPACT & VIBRATORYLOADS

Structures subjected to impact or vibratory loads shall be designed as per the provisions of IS 875 Part-5 & IS 2974.

3.2.2.7 MAINTENANCE LOADS

These are temporary loads (i.e. monorail etc.) and are not to be combined with wind loads/ Seismic loads.

3.2.3 WIND LOAD

Wind loads shall generally be as per IS 875 Part-3 except for switch yard structures & Transmission towers for which IS 802 shall be applicable.

S.No.	Title/Description	Value	UOM	Remarks
1.0	Basic wind Speed, V_b	50	m/sec	
2.0	k_1 (Probability factor, risk coefficient)			
2.1	For permanent structures	1.00	-NA-	
2.2	For temporary structures	0.70	-NA-	Based on V_b
2.3	For boundary wall/ barricading	0.70	-NA-	
3.0	k_2 (Terrain roughness & height factor)		-NA-	
3.1	Category for k_2	2	-NA-	
4.0	k_3 (Topography factor)	1.00	-NA-	
5.0	K_4 (Importance factor for the cyclonic region)			
5.1		NA	-NA-	Industrial Structures
5.2		1.00	-NA-	All other Structures
6.0	Mean probable design life for computation of wind forces shall be considered as follows:			
6.1	All structures (units & offsite)	50	Years	
6.2	Temporary sheds, structures such as those used during construction operations (for example, formwork and false work), structures during construction stages and boundary walls	5	Years	

Note: To account for surface area of piping, platforms and other attachments fixed to the equipment the surface area of the equipment (vessel / column) exposed to wind shall be increased by 20% or as specified in the mechanical datasheet of the equipment.

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3.2.4 SEISMIC LOAD

Seismic forces shall be based on IS 1893 (Part 1 & Part 4), site specific recommendations & response spectra document as issued for the project, whichever is more stringent.

3.2.5 BLAST FORCES

S.No.	Project Philosophy
1.0	Structures subjected to blast forces generated due to accidental blasts from hydrocarbon ignitions shall be designed corresponding to Blast Pressure as recommended in Rapid Risk Analysis (RRA) report, subjected to minimum static incident overpressure of 3psi (20.7KN/sq.m). In absence of RRA report, minimum static incident overpressure shall be considered as 3psi (20.7KN/sq.m) as specified in OISD-STD-163.
2.0	Following load configurations with respect to design of wall panel, roof slab and frame members shall be considered: a. Front wall loading: Each wall shall be designed as front wall to withstand load due to peak reflected overpressure. b. Roof slabs & beams shall sustain peak incident overpressure. c. Main frame shall sustain peak reflected overpressure on any one wall and incident overpressure on roof & side walls.
3.0	Static Analysis Load Combination for Blast Load: a) for Flexural / Axial Design 1.0 (Dead Load + Live Load + Blast Load) b) for shear Design 1.2 (Dead Load + Live Load + Blast Load)

3.2.6 OTHER LOADS

S.No.	Project Philosophy
1.0	Apart from the specified live loads, any other equipment load or possible overloading during construction / erection / hydro-test of equipment or piping / maintenance shall also be considered in the design.
2.0	Design of all structures shall also consider any other relevant and consequential load / stress imparted to the structure.
3.0	All liquid retaining / storage structures shall be designed assuming liquid up to the full height of wall irrespective of provision of any over flow arrangement.
4.0	Pressure relief valves or similar pressure relieving devices for relieving ground water pressure shall not be made in underground water retaining/ storage RCC structures.
5.0	Hot water basin in cooling tower shall be designed for the weight of water upto top of parapet wall.
6.0	All buildings / structures shall be designed to resist the worst combination of the above loads (in accordance with IS 875Part-5, other than seismic loads).However wind/ seismic loads shall not be considered in combination together or with loads during maintenance.
7.0	Box culverts are designed for class A & class AA loading as per IRC-6.

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3.3 FLOORING DETAILS FOR BUILDINGS & SHEDS

S.No.	Description	Flooring Type I	Flooring Type II	Flooring Type III
1.0	Sub Grade			
1.1	Earth-fill base compacted to 95% dry density.	To be provided	To be provided	To be provided
1.2	Compacted layer of sand over thoroughly compacted Earth fill	200 mm thick	200 mm thick	150 mm thick
2.0	Structural Grade Slab			
2.1	Lean concrete 1:5:10 over sand layer	50 mm thick	50 mm thick	50 mm thick
2.2	Structural non suspended slab in M20 Grade concrete (Reinforced with 8 mm dia. Bars @ 200c/c both ways) over lean concrete	150 mm thick slab with reinforcement placed centrally.	150 mm thick slab with reinforcement placed in two layers (at top & bottom).	100 mm thick slab without reinforcement.

Notes:

a) Flooring details as given above shall be adopted for the non-suspended ground floor slabs for buildings & sheds only as categorized for various flooring types.

b) Flooring Type I shall be considered for Control Rooms, Satellite Rack Rooms, Sub-Stations, Pump Houses, Utility Compressor Houses, Parking Areas, Stores, Porches.

c) Flooring Type II shall be considered for Ware Houses, Workshops, Cement Go-downs, Fire Stations, Process Compressor Houses.

d) Flooring Type III shall be considered for Administration, Laboratory, Canteen, Time Office, Gate House, Training Centre, Guest House, Residential buildings.

e) Floor finish for all the above three types of flooring shall be as per Engineering Design Basis (Architecture).

f) Reinforcement steel shall be as per clause 4.2.3 of this document.

g) Expansion gap if provided in the building shall be provided in flooring also.

h) Outdoor pavements shall be as per Engineering Design Basis–General Civil. However, 20 mm gap to be provided between floor slab and equipment foundation / column and shall be sealed using joint sealing compound.

i) All contraction/ expansion joints of building floor shall be filled with liquid polysulphide sealant as per IS 12118.

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4.0 SPECIFIC DESIGN CONSIDERATIONS

4.1 FOUNDATION DESIGN

4.1.1 MINIMUM REQUIREMENTS

S.No.	Project Philosophy
1.0	Minimum depth of foundation for all structures/ buildings shall be as per Geotechnical Recommendations.
2.0	Factors of safety against overturning and sliding shall be as per clause 4.1.2 of this document.
3.0	For stability checks the weight of soil as overburden (soil backfill weight over foundation slab) shall be as per clause 4.1.2 of this document.
4.0	The design ground water level shall be as per the Geotechnical Recommendations and the hydrostatic pressure shall be adequately accounted for in design.
5.0	Allowable Net Safe Bearing Capacity (SBC) of soil for isolated/ raft/ pile/ tank Foundations shall be based on the settlement criteria for dead plus imposed load conditions, as follows:
5.1	For isolated foundations in Unit areas, Utility areas and foundations of Plant buildings, settlement shall be considered as 25 mm.
5.2	For isolated foundations of Non-plant buildings, settlement shall be considered as 40mm.
5.3	For Raft foundations, settlement shall be considered as 40 mm.
5.4	Cone roof/ Dome roof Storage Tanks resting on sand pad foundation, permissible settlement shall be as per API-650.
5.5	Floating roof Storage Tanks resting on sand pad foundation, permissible settlement shall be as per API-650.
6.0	Pile capacities (compression, shear and uplift/tension) shall be as per Geotechnical Recommendations.
7.0	For transient loadings, e.g., wind/seismic, SBC (safe bearing capacity) shall be considered based on shear criteria instead of settlement criteria.
8.0	Permissible increase in SBC/Pile capacities (for compression, shear and uplift/tension) shall be as per the Geotechnical Recommendations.
8.1	Under blast (due to hydrocarbon explosion) load combinations the SBC of soil shall not exceed 2.0 times allowable static bearing pressure of soil.
8.2	Under blast (due to hydrocarbon explosion) load combinations Pile capacity shall not exceed 2.0 times the permissible capacity under compression, tension and shear modes.
9.0	Foundation for vibrating equipment shall be kept independent of building floors/ Foundations and other adjacent foundations.
10.0	Foundation for tanks upto 10m diameter shall be of RCC ring wall type. Foundation for tanks above 10m diameter shall also be of RCC ring wall type if required from anchorage or counter weight considerations or as per geotechnical recommendations.
11.0	Foundation for acid/ alkali storage tanks shall have acid/ alkali resistant lining & under tank drainage arrangement.

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4.1.2 FACTORS OF SAFETY IN FOUNDATION DESIGN

S.No.	Type of Structure	FOS OT-W/S (EL)(i)	FOS OT-N- W/S (EL)(ii)	FOS OT-W/S (OL) (iii)	FOS OT-N-W/S (OL) (iv)	FOS SL-W/S(v)	FOS SL-N-W/S (vi)
1.0	All Structures, Equipment's in Units & Offsite	1.5	1.5	1.5	2.0	1.5	1.5
2.0	Overhead tank	1.5	-	2.0	-	1.5	-
3.0	Flood Light Mast	1.5	-	1.5	-	1.5	-
4.0	Retaining Wall	-	-	1.5	2.0	1.5	1.5
5.0	Flare supporting structure	1.5	-	1.5	-	1.5	-
6.0	Blast-resistant structure	-	-	1.5	2.0 or 1.2*	1.5	1.5 or 1.2*
7.0	Transmission Tower/ Switch Yard Structure	1.5	2.0	1.5	2.0	1.5	1.75

Legend:

(i) OT-W/S(EL) –FOS against Overturning with Wind/Seismic in Erection condition.
(ii) OT-N-W/S(EL) - FOS against Overturning without Wind/Seismic in Erection condition.
(iii) OT-W/S (OL) - FOS against Overturning with Wind/Seismic in operating condition.
(iv) OT-N-W/S(OL) –FOS against Overturning without Wind/ Seismic in operating condition.
(v) SL-W/S- FOS against Sliding with Wind/Seismic.
(vi) SL-N-W/S- FOS against Sliding without Wind/Seismic.

Notes:

a) *-with blast pressure.

b) Minimum factor of safety against uplift & overturning of liquid retaining structures shall be as per IS 3370 (Part 1) (in case of sumps, lining weight shall not be included). Minimum factor of safety against uplift shall be 1.2 for all other structures.

c) Percentage weight of overburden shall be taken as 100% & to be considered on projected plan area of footing.

4.1.3 ANTI-TERMITE TREATMENT

All buildings coming in units, offsite and utility shall be provided with anti-termite treatment as per IS 6313, IS 8944, IS 15936 and IS 16131.

4.1.4 MINIMUM COVER TO FOUNDATION BOLT/POCKET

S.No.	Project Philosophy
1.0	Minimum distance from the center line of foundation bolt/anchor bolt to edge of pedestal shall be the maximum of the following:
1.1	Clear distance from the edge of the base plate/base frame to the outer edge of the pedestal shall be minimum 50 mm.
1.2	Clear distance from the face of pocket to the outer edge of the pedestal shall be 100 mm.

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1.3	Clear distance from the edge of the sleeve or anchor plate to the edge of pedestal shall be 100 mm
2.0	The tension capacities of anchor bolts shall be worked out based on the bolt to bolt spacing and the distance between anchor bolt to the edge of concrete. If required, additional reinforcement around anchor bolts shall be provided in the concrete pedestal.

4.1.5 HEIGHT OF PEDESTAL

S.No.	Project Philosophy
1.0	The minimum projection of pedestals supporting any steel structure/column bases shall be 300 mm/ 150 mm above the high point of pavement/ finished grade/ finished floor level whichever is higher, for outdoor and indoor located pedestals respectively.
2.0	Off-site pipe rack/ pipe bridge/ pipe-support pedestals shall be of minimum 500 mm Height above FGL.
3.0	The maximum projection of pedestals for staircase/ladder shall be 200 mm.

4.1.6 GROUTING & MINIMUM GROUT THICKNESS

S.No.	Project Philosophy
1.0	The thickness of grout shall be as follows:
1.1	Minimum 50 mm for process columns(equipment) unless otherwise required in equipment datasheet.
1.2	Minimum 30 mm & maximum 50 mm for all other foundations/structures, unless otherwise required in equipment/ vendor data sheet
2.0	All anchor bolt sleeves/pockets and spaces under column bases, shoe plates etc. Shall be grouted with free flow, non-shrink (pre-mix type) grout with 28 day minimum cube crushing strength of 40N/sqmm.
3.0	Ordinary cement sand (1:2) grout shall only be used under the base plates of cross-overs, short pipe supports (not exceeding 1.5 m height) and small operating platforms (not exceeding 2.0 m height) not supporting any equipment.
4.0	Grouting requirement for machines and equipment's are not covered here. The same shall be governed by vendor's requirement.

4.2 RCC STRUCTURES & FOUNDATIONS

4.2.1 GENERAL/ DESIGN METHODS

S.No.	Project Philosophy
1.0	All buildings, structures, foundations, machine/ equipment foundations, liquid retaining/ storage structures, trenches, pits etc. shall be of RCC and designed based on the following IS Codes in general and other relevant IS Codes applicable: IS 456, IS 875, IS 1893, IS 1904, IS 2911, IS 2950, IS 2974, IS 3370, IS 4091, IS 4326, IS 4991, IS 4995, IS 4998, IS 5249, IS 6403, IS 8009, IS 13920.
2.0	Only limit state method as per IS 456 shall be followed in the design unless Otherwise specified elsewhere in this document for special structures.
3.0	All structures shall be of frame type construction. Ductile detailing requirement, if any, shall be as per IS 13920 for RCC Structures.
4.0	Where the specified design depth of ground water table so warrants all underground pits, tunnels, basements etc. (excluding appurtenances of stormwater/ effluent collection system, cable trench, pipe trench) shall be of leak-proof RCC construction using approved make of crystalline water-proofing compounds.

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S.No.	Project Philosophy
5.0	All liquid retaining/storage RCC structures shall be leak-proof and designed as un-Cracked section (or with limited crack width in limit state design) as per IS 3370. However, the parts of such structures not coming in direct contact with liquid shall be designed according to IS 456 except ribs of beams of suspended floor slabs, counterforts of walls (located on the side remote from the liquid) and roof which shall be designed as un-cracked section (or with limited crack width in limit state design). No increase in permissible stresses in concrete and reinforcement shall be made under wind or seismic conditions for such structures.
6.0	The walls and base slabs of liquid retaining/storage structures shall be provided with reinforcement on both faces for thickness greater than or equal to150mm.In All liquid retaining structures, PVC water bars (minimum size 230mm wide x 5mm thick) shall be provided at each construction joint (horizontal and vertical).
7.0	Water basin and other primary framing members of Cooling towers or similar liquid retaining structures which remain constantly in contact with water(stored/sprayed) shall be designed as un-cracked sections (or with limited crack width in limit state design) as per IS 3370.
8.0	Ground improvement below & around foundation & back-filling shall be as per Geotechnical recommendation.
9.0	Corrosion resistant protective coating around footing shall be as per Geotechnical recommendation.

4.2.2 CONCRETE

S.No.	Project Philosophy
1.0	The minimum grade of reinforced cement concrete to be used for super-structure & sub-structure (in case otherwise specified in Geotechnical Recommendation, higher grade shall be followed for sub-structure) shall be **M30** (design mix) as per IS 456 based on **Severe** exposure condition. However, for liquid retaining structures the minimum grade of reinforced cement concrete shall be as per IS 3370.
1.1	From durability considerations the minimum cement content and maximum water-cement ratio shall be **320** Kg/Cu.m and **0.45** for **M30** (design mix). However, the maximum cement content shall not exceed 450 kg/m3. For liquid retaining structures the minimum cement content and maximum water-cement ratio shall be as per IS 3370.
2.0	Generally, the use of one of the following type of cements shall be considered:
2.1	43 Grade Ordinary Portland Cement (OPC) conforming to IS 269. (Shall be used only when mentioned in drawings)
2.2	Portland Pozzolana Cement (PPC, fly ash based) confirming to IS 1489 Part 1.
2.3	Portland Pozzolana Cement (PPC, calcined based) confirming to IS 1489Part 2.
2.4	Portland Slag Cement (PSC) confirming to IS 455.
2.5	Sulphate Resistant Portland Cement (SRC) confirming to IS 12330 shall be used (if required as per soil recommendation for respective site).
3.0	Minimum cement content for concrete in foundation shall be as per Geotechnical Recommendations document.
4.0	75mm thick lean concrete of grade 1:5:10 shall be provided under all RCC foundations (except under base slab of liquid retaining structures). The lean concrete shall extend 50mm beyond the foundation edges on all sides.
5.0	100mm thick lean concrete of grade M20 (nominal mix) shall be provided under Base slab of liquid retaining structures. The lean concrete shall extend 75mm beyond the foundation edges on all sides.
6.0	Plain Cement Concrete (PCC) mud mat of grade M20 (nominal mix) of minimum150 mm thickness shall be provided under all masonry wall foundations.

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S.No.	Project Philosophy
6.1	From durability considerations the minimum cement content and maximum water-cement ratio for PCC shall be 250 Kg/Cu.m and 0.5 respectively. However, the maximum cement content shall not exceed 450 kg/m3.
7.0	Plain cement concrete of grade M20 (nominal mix) of minimum 40mm thickness Shall be provided as dampproof course at plinth level of all masonry walls. Integral water-proofing compound conforming to IS 2645 shall be mixed with concrete (as per manufacturer's specifications) and coated with bitumen emulsion.
8.0	Crystalline water-proofing compound of approved make as per CPWD specification shall be mixed with concrete for all liquid retaining/leak-proof structures.
9.0	Self-compacting concrete shall be provided as per EIL Specification for concrete works wherever required as directed by Engineer-in-charge.
10.0	Water based solvent free white pigmented curing compound as per manufacturer's specification and satisfying National or International standards for all concrete surfaces wherever required as directed by Engineer-in-charge.

4.2.3 REINFORCEMENT BARS

S.No.	Project Philosophy	
1.0	High Strength deformed steel bars (TMT) of Grade Fe500D shall be used as reinforcement for all structures. Alternatively, if Fe500D is not available, Fe550D can be technically accepted with below mentioned condition. 1. Fe550D shall comply with the elongation requirement of Fe500D as per IS:1786. 2. Fe550D shall comply with chemical & physical properties of Fe500D as per IS: 1786. 3. In a single structure/element mixing of two grades is not allowed.	
2.0	18 gauge black soft annealed SWG wire shall be used for binding of reinforcement bars.	
3.0	Corrosion protection of reinforcement bars:	
3.1	Bi-polar concrete penetrating Corrosion inhibiting admixture in concrete	
4.0	Minimum and maximum bar spacing for foundations, slabs, stirrups for beams, Ties for columns, pedestals, walls etc. should be100 mm and 300 mm respectively. However, for main reinforcement in blast resistant wall and roof slab, maximum bar spacing shall be 150 mm. Bar spacing should be provided in multiples of 25 mm.	
5.0	Minimum bar diameter shall be as follows:	
5.1	Piles: Main Bars:	12 mm
5.2	Piles: Tie Bars:	8 mm
5.3	Major & Minor Foundations:	12 mm
5.4	Block Foundations: Main Bars & Tie Bars:	12 mm
5.5	Pedestals, Columns: Main Bars:	12 mm
5.6	Pedestals, Columns: Tie Bars:	8 mm
5.7	Beams: Main Bars:	12 mm
5.8	Beams: Anchor Bars:	10 mm
5.9	Beams: Stirrups:	8 mm
5.10	Slabs & Walls: Main Bars:	10 mm
5.11	Slabs & Walls: Distribution Bars:	8 mm
5.12	Minor Elements (e.g. chajja, parapet, lintel, etc.):	8 mm
5.13	Slabs & Walls (blast-resistant buildings):	12 mm

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4.2.4 MINIMUM COVER TO MAIN REINFORCEMENT

Clear cover shall be considered over links/ stirrups/ ties. Unless otherwise specified in Geotechnical Recommendations, minimum clear cover to RCC elements shall be provided as follows:

S.No.	Title/Description	Value	UOM
1.0	Foundation slab, base slab, pedestal, plinth beam	50	mm
2.0	Pile Cap		
2.1	Bottom face	100	mm
2.2	Top& sides	50	mm
3.0	Retaining Wall, Basement and Pit Wall:		
3.1	Face in contact with earth	50	mm
3.2	Free face	45	mm
4.0	Column	50	mm
5.0	Tie beam, Floor beam, Roof Beam	45	mm
6.0	Floor slab, Roof slab, Canopy, Lintel	40	mm
7.0	Liquid retaining structure		
7.1	Face in contact with liquid	50	mm
7.2	Face away from liquid but in Contact with earth	50	mm
7.3	Free face	45	mm

4.2.5 MINIMUM THICKNESS OF STRUCTURAL CONCRETE ELEMENT

The following minimum thickness shall be followed:

S.No.	Title/Description	Value	UOM
1.0	Footings (all types, with or without beams)	300	mm
1.1	Tapered Footings (all types, with or without beams)	150 (at edge) 300 (average)	mm
2.0	Pile Cap	500	mm
3.0	Liquid retaining/ Leak-proof structure/ Basement/ Underground Pit:		
3.1	Base slab	300	mm
3.2	Walls	150	mm
4.0	Floor/ Roof Slab, Walkway, Canopy slab	150	mm
5.0	Cable/ Pipe Trench/ Launder Walls & Base Slab	125	mm
6.0	Parapet	125	mm
7.0	Louver/Fin	125	mm
8.0	Louver (in contact with liquid)	125	mm
9.0	Precast Trench Cover/ Precast Floor Slab	125	mm
10.	Blast resistant Structure		
10.1	Blast Resistant Wall	250	mm
10.2	Blast Resistant Roof	As per OISD 163	

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4.3 STEEL STRUCTURES

4.3.1 GENERAL/DESIGN METHODS

S.No.	Project Philosophy
1.0	Design, fabrication and erection of the above work shall be carried out in accordance with the following IS Codes as applicable to the specific structures, viz. IS 800, IS 801, IS 802, IS 806, IS 814, IS 816, IS 875, IS 1893, IS 6533, IS 9178, IS 9595, etc. Basic consideration of structural framework shall primarily be stability, ease of fabrication/ erection and overall economy satisfying relevant Indian Standard Codes of Practice. Simple and fully rigid design as per IS 800 shall be used. Where fully rigid joints are adopted, they shall generally be confined to the major axis of the column member.
2.0	All Structural Steel elements continuously exposed to temperatures above 215^0 C shall be designed for reduced stress as per Clause 16.4 (Fig 24) of IS 800.
3.0	Ductile detailing requirement (if any) shall be as per IS 800 Section 12 for Steel Structures.
4.0	Crane gantry girders shall generally be of welded construction and of single span lengths.
5.0	Steel staircases for main approaches to operating platforms shall have channels provided as stringers with minimum clear width of 750 mm and slope of approximately 41^0.The vertical height between successive landings shall not be less than 2.6 m or exceed 4.0 m. Treads shall be minimum 230 mm wide made of electro-forged galvanized grating (with suitable nosing) spaced equally so as to restrict the rise to maximum 200 mm.
6.0	Hand rails 1000 mm high (from top of grating/top of chequered plate/FFL), shall be provided to all walkways, platforms, staircases. Toeplate (100 mm x 5 mm) shall be provided for all horizontal handrailing (except for handrailing in inclined portion of staircases & platforms around circular vessels). Spacing of vertical posts shall be 1500 mm (maximum). Two types of handrailing shall be provided as follows:
6.1	For technological structures, walkways, platforms (except platform around/ on circular/horizontal vessels), staircases: Top rail, mid-rail and vertical post shall be NB 32 mm diameter medium grade MS tubes.
6.2	For platforms around circular vessels: Top rail shall be NB 32 mm diameter medium grade MS tubes, mid rail shall be 50x6 MS flat and vertical post shall be of angle section L50x50x6.
7.0	Electro-forged hot-dipped galvanized MS Gratings shall be as per EIL Standard No. 7-68-0697.
8.0	Welded connections shall be adopted during shop fabrication, except where only bolted connections are required (viz. removable members, galvanized electrical Switchyard structures and transmission towers). Field/site connections shall be bolted.
9.0	Structural connections shall have minimum two bolts of 16 mm diameter, unless otherwise limited by the size of members.
10.0	Minimum two nuts shall be used for all anchor bolts except for crossovers, platforms on grade & T- supports.

4.3.2 GRADE OF STEEL

S.No.	Project Philosophy
1.0	Structural steel shall be of Grade E250 Quality BR/B0 conforming to IS 2062. Anchor bolts shall be of Grade E250 Quality BR/B0 conforming to IS 2062. Minimum grade of steel for insert plate, grating, chequered plate & steel structure in platforms taken from equipment shall be of Grade E250 Quality BR/B0 conforming to IS 2062.
2.0	Tubular/hollow steel shall be of Grade Yst310.
3.0	Properties of steel sections shall be as follows:
3.1	Rolled Section as per IS 808

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3.2	Circular Hollow Sections (CHS)as per IS 1161
3.3	Square Hollow Sections (SHS)/ Rectangular Hollow Sections (RHS) as per IS 4923
4.0	Connection Bolts shall be High Strength Structural Steel (Galvanized) Bolts of Property Class 8.8 (minimum) conforming to IS 3757 & IS 4000. Hexagonal Nuts shall conform to IS 6623. Washers shall conform to IS 6649.

4.3.3 LIMITING PERMISSIBLE STRESSES

S.No.	Project Philosophy
1.0	Permissible stresses in structural members shall be as follows:
1.1	Hot rolled sections (excluding transmission towers and switchyard structures) as specified in IS 800
1.2	Cold formed light gauge sections as specified in IS 801
1.3	Transmission towers & switchyard structures as specified in IS 802
1.4	Tubular structures as specified in IS 806
2.0	Permissible stresses in bolts shall be as follows:
2.1	Hot rolled sections (excluding transmission towers and switchyard structures) as specified in IS 800
2.2	Cold formed light gauge sections as specified in IS 801
2.3	Transmission towers & switchyard structures as specified in IS 802
3.0	Permissible stresses in welds shall be as follows:
3.1	Cold formed light gauge sections as specified in IS 801
3.2	Metal Arc Welding as specified in IS 816

4.3.4 LIMITING DEFLECTION

4.3.4.1 LIMITING VERTICAL DEFLECTION

The limiting permissible vertical deflection for structural steel members such as gantry girder for electric overhead crane, manually operated crane, purlin supporting any type of roofing material under dead + live load or dead + wind load conditions shall be as specified in IS 800, however for girder/beam for supporting dynamic equipment/hoist, the same shall be Span/450.

Note: Limiting permissible vertical deflection for grating/ chequered plate shall be Span/200 or 6 mm whichever is minimum.

4.3.4.2 LIMITING HORIZONTAL DEFLECTION

The limiting permissible horizontal deflection for structural steel members shall be as specified below, where 'H' represents the height:

S.No.	Title/Description	Value	UOM
1.0	Multi storeyed steel structure/ Building	as per IS 800	Same as 'H'
2.0	Flare stack supporting structure	H/200	Same as 'H'

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4.3.5 MINIMUM THICKNESS

The minimum thickness of various structural components (hot rolled sections) shall be as given:

Sl. No.	Title/Description	Value	UOM	Remarks
1.0	Trusses, purlins, sideGirts & bracings	6	mm	
2.0	Columns, beams	7	mm	
3.0	Gussets in trusses &Girders			
3.1	Up to and including12m span	8	mm	
3.2	above 12m span	10	mm	
4.0	Stiffeners	8	mm	
5.0	Base plates	10	mm	
6.0	Chequered plate	6	mm	(on plain)
7.0	Grating	3	mm	
8.0	Hollow RHS & SHS section upto 80 mm depth	4	mm	
9.0	Hollow RHS & SHS section above 80 mm depth	6	mm	
10.0	Plate thickness for primary framing members of PEB	8	mm	
11.0	Plate thickness for cold formed secondary members of PEB	2.5	mm	GI coated

Notes:

a) For transmission towers & switchyard structures the minimum thickness of various structural components shall be as per IS 802.

b) The minimum thickness for rolled beams and channels shall be mean flange thickness regardless of the web thickness.

c) The minimum thickness of structural components (except gratings & chequered plates) which are directly exposed to weather and in accessible for repainting shall be 8 mm.

d) The minimum thickness of tubes shall be as specified in IS 806.

e) Structural members exposed to marked corrosive action shall be increased in thickness or otherwise suitably protected against corrosion.

f) Chequered plates shall be avoided on structures exposed to atmosphere.

4.3.6 ELECTRICAL SWITCHYARD STRUCTURE & TRANSMISSION TOWER

S.No.	Project Philosophy
1.0	All electrical switchyard structure and transmission tower shall be of structural steel with bolted connections and designed as per of IS 802.
2.0	Structural steel members including bolts, nuts and washers shall be hot dip galvanized in accordance with relevant IS Codes. The Zinc coating on tower members shall not be less than 900g/sqm of the surface area.

4.3.7 FLARE STACK

S. No.	Project Philosophy
1.0	Structural steel members including bolts, nuts and washers shall be hot dip galvanized in accordance with relevant IS Codes. The Zinc coating on tower members shall not be less than 900g/sqm of the surface area.

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4.3.8 PROTECTIVE COATING

Protective Coating (including surface preparation, shop primer, field primer & finish coat) to Concrete, Structural Steel, Ladders, Spiral Stairways & Hand Rails shall be as per the Project Specification. Protective Coating (including surface preparation, shop primer, field primer & finish coat) to Gratings shall be as per Standard No. 7-68-0697.

4.4 MASONRY WORKS

4.4.1 GENERAL

S.No.	Project Philosophy
1.0	All masonry works shall be designed in accordance with IS 1077, IS 1905, IS 1597, IS 2185, IS 4326, IS 12894 and other relevant IS Codes as applicable.
2.0	Fly ash Brick masonry shall be of Class 5.0 as per IS 12894 / AAC Block masonry shall be of Grade 1 (with minimum compressive strength as 5 N/mm^2) as per IS 2185 (Part 3)/ Solid concrete block shall be of Grade C(5.0) as per IS 2185 (Part 1)/ Hollow concrete block masonry(closed cavity) shall be of Grade A(5.5) as per IS 2185 (Part 1).
3.0	AAC concrete blocks shall not be used in foundations and for masonry below damp-proof course.
4.0	All external masonry wall shall be of minimum 200 mm thickness for AAC block masonry / 230 mm thickness for other than AAC block masonry, except for fire walls.

4.4.2 CEMENT MORTAR

All masonry work except AAC block shall be constructed in cements sand mortar 1:4 for load bearing walls and 1:6 cements and mortar for non-load bearing walls except half brick partition walls which shall be constructed in 1:4 cements and mortar with two numbers of 6 mm diameter MS bars provided at every fourth course properly anchored with cross walls or pillars.

All AAC block masonry walls shall be constructed with premixed thin-bed mortar as per ASTM C1660 with prior approval of Engineer-in-Charge. Construction of AAC block masonry including bond beam etc. shall be as per IS 6041 or as directed by Engineer-in-Charge

4.4.3 FIREWALLS

All fire walls shall be of minimum 300 mm thickness for AAC block masonry / 345 mm thickness for other than AAC block masonry as per OISD-STD-173.

4.5 SPECIFIC APPLICATIONS

4.5.1 PIPE RACK

Pipe rack shall be designed as per pipe loading from piping department.

4.5.2 RCC & STEEL CHIMNEYS

RCC and Steel chimneys shall be designed as per the requirements of EIL Standard Specification No.6-68-0053, IS 4998 and IS 6533.

4.5.3 MACHINE FOUNDATIONS

Machine foundations shall satisfy the requirements of IS 2974 and any other parameter as specified by the machine manufacturer.

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4.5.4 BARRICADING

Foundation and superstructure shall be designed as per Safety/ Client requirements for location & height, keeping in view the mean probable design life of structure.

4.5.5 TANK FOUNDATIONS

Storage tanks shall be supported either on ring wall type pile/ open foundations or sand pads in accordance with the Geotech recommendations.

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ENGINEERING DESIGN BASIS

(ARCHITECTURE)

JOB NO. : C050

PROJECT : EPCM SERVICES FOR POLYPROPYLENE (PP) PROJECT, NUMALIGARH REFINERY

CLIENT : M/S NUMALIGARH REFINERIES LIMITED

EIL **NRL**

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A.1.0 GENERAL

The purpose of this document is to establish the design philosophy/ criteria to be incorporated in Architectural design.

A.2.0 REFERENCED PUBLICATIONS

Architectural design shall be in conformity with following:

1. National Building Code of India (NBC) – Latest Revision.
2. Factory law/ state government factory acts.
3. Local Municipality or any other authority's bye-laws as applicable.
4. Oil industry safety directorate (OISD) standards (for oil industry projects).
5. Urban and Regional Development Plans Formulation and Implementation (URDPFI) guidelines of Town & Country Planning Organization (for Townships).
6. BIS (Bureau of Indian standards) codes.
7. Indian Electricity Rules.
8. Defense and Aviation bye-laws as applicable.
9. TAC (Tariff Advisory Committee) Rules.
10. BPE (Bureau of Public Enterprise) Norms.
11. CEA (Central Electricity Authority).
12. Guidelines of IGBC/ GRIHA/ LEED for Green Building concept.
13. Pollution Control Board norms.
14. Any other applicable law, rules, standard as referred in respective clause.

Note: All Latest Edition and amendments thereof of the referred publications mentioned in above clause A 2.0 shall be followed as applicable.

A.3.0 STANDARDS AND SPECIFICATIONS

Architectural design incorporates codes and standards as referred in the design philosophy of respective engineering disciplines as well as applicable engineering standards and specifications of Engineers India Limited (EIL).

A.4.0 DESIGN PHILOSOPHY/ CRITERIA

Architectural design of buildings shall be in accordance with this design basis, publications, standards and specifications stated above.

Unless otherwise specified, licensors/ process/ safety guidelines and recommendations shall be followed for building design. The most stringent guidelines shall override in case of conflict between above references publications mentioned in clause no. A.2.0 and A.3.0

Note:
Reference shall be made to NBC for meanings of terminologies and definitions.

A.4.1 Building lay-out

Required rooms, facilities and spaces shall be integrated to arrive at the lay-out meeting the functional, operational and HSE (health, safety and environment) requirements.

A.4.1.1 Spatial requirement

Spatial requirements i.e., requirement of various rooms and spaces to be accommodated in the building shall be identified based on functional requirement and related activities, occupancies, amenities, services and utilities and statutory requirements.

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Following spaces are classified as amenity spaces

i. Toilet (Gents & Ladies)
ii. Drinking Water Facility
iii. Locker & Change room.
iv. Rest room/Lunch room.
v. Washrooms & space for drying clothes.
vi. Canteen/Pantry room.
vii. First-aid room.

Out of the above-mentioned areas Toilet, Drinking Water and First aid room enclosure shall be mandatory requirement for buildings with human occupancy. Other requirements shall be provided as specified.

Utility spaces are the spaces required for the provision of services like Airconditioning, pressurization, firefighting, electrical, telephone etc. These spaces shall be provided as per specified building services. Following are the examples:

i. Air-conditioning plant room
ii. Air handling rooms
iii. Pressurization blower plant room
iv. Electrical distribution panel rooms
v. Service Ducts
vi. Fire Fighting Equipment room
vii. Telephone Exchange Equipment room
viii. UPS room
ix. Battery room

Requirement of services/utilities such as air-conditioning, LAN etc. shall be finalized as per Owner's specific requirement.

A.4.1.2 Sizing of rooms/spaces

In case of plant buildings, sizing shall be decided based on equipment/ panel/ machinery lay-out considering operation, maintenance, clearances, HSE requirement etc. obtained from originating discipline of the facility.

In case of non-plant buildings, sizing shall be done based on guidelines of NBC and Owner's specific requirements. In absence of guidelines in NBC, publications such as "Time saver standard", "Neufert – Architects data" shall be followed.

A.4.1.2.1 Minimum dimensions of rooms/ spaces:

Minimum area for room shall be 9 m^2 with minimum dimension of one side as 3m.

Minimum ceiling height shall be as follows:

Residential, business and mercantile buildings:

3.0 m measured from the floor to bottom of slab. Minimum clear head room under beam shall be 2.4 m. In case of air-conditioned rooms, height shall not be less than 2.4 m measured from floor to the lowest point of AC duct or the false ceiling or as applicable factory Act.

Educational buildings : 3.6 m

Industrial buildings : 3.6 m or as per applicable Factory Act

Minimum ceiling height for Fire station Building/ Control Room shall be 5.0 m measured from the floor to bottom of slab.

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A.4.1.3 Lay-out

Individual spaces of buildings shall be integrated and arranged with circulation system (consisting of Building Access, Entry, Lobby, Corridors, Passages, Staircases, Lifts etc.) to generate the lay-out considering following design parameters:

- Functional, operational requirement, equipment/panel/machinery lay-out, activities and inter-relationship of the rooms/ spaces.
- Fire & Life safety.
- Statutory requirements.
- Site conditions i.e., site dimensions, approaches, safety distances, contours etc.
- Circulation system & accessibility
- Energy efficiency.
- Amenities, services and utilities.

A.4.1.3.1 Circulation system:

Circulation system shall consist of building entry, exits, means of egress, lobby, corridor, passage, staircase, ramp, lift (as required) entrance lobby/ foyer including reception & waiting, gangway/walkways, equipment loading/ unloading platforms, emergency exits, ramps for physically challenged and equipment entry/exit as applicable.

A.4.1.3.2 Accessibility:

These requirements deal with barrier free access to, movement within and around buildings. In industrial complexes, which are normally not open to public, requirement of accessibility shall be applicable to following building occupancy types where occupancy of differently abled staff/ visitor is expected.

- Main gate house
- Administration and other office buildings
- Laboratory.
- Canteen
- First aid/ Occupational health center
- Control Rooms
- Auditoriums

Requirements of accessibility:

- At least one entrance, preferably main entrance per building shall be accessible to persons with disabilities.
- All common area open to public and staff and all facilities such as lobby, toilets, lifts, parking etc. shall be accessible to all persons with disabilities.
- Accessible toilet shall be provided.

Note: Reference shall be made to chapter-3, NBC for further details on accessibility.

A.4.1.3.3 Fire & Life safety:

Provisions for life safety in relation to fire prevention and fire protection of buildings shall be applicable to:

a) All high-rise buildings (15 meter or above in height, irrespective of its occupancy, height being vertical distance measured from average ground level around to the terrace of last livable floor of the building adjacent to external wall)

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b) Special buildings
   1) Hotel, educational, institutional, business, mercantile, industrial, storage, hazardous and mixed occupancies, where any of these buildings have floor area more than 500 m^2 on any one or more floors;
   2) Educational buildings having height 9 m and above;
   3) Institutional buildings having height 9 m and above;
   4) All assembly buildings;
   5) Buildings, having area more than 300 m^2 of incidental assembly occupancy on any floor; and
   6) Buildings with two basements or more, or with one basement of area more than 500 m^2.

Note:
Reference shall be made to chapter-4, NBC for further details on life safety

Requirements of exits for life safety:

a) Every building having human occupancy shall be provided with exits sufficient to permit safe egress of occupants in case of fire or other emergency.

b) Exit

Exit is that unobstructed component of means of egress *(A continuous way of travel from any point of in a building to a public way, consisting of three separate and distinct parts, i.e. exit access, exit and exit discharge)* which is between the exit access *(portion of means of egress that leads to an exit, i.e. doors, staircase, lobby, ramps, corridor leading to exit, a common path of travel leading to two independent directions to separate exits)* and the exit discharge *(The component of means of egress between the termination of an exit and a public way*) or public way *(street, alley open to outside)*.

An exit may be a fire exit doorway, an internal staircase, exit passageway, external doorway, external staircase having access to the street or to a veranda or to a refuge area *(An area within the building for a temporary use during egress, staging area which is protected from the effect of fire and smoke)* or to the terrace or roof of a building.

Exit doorway

Every exit doorway shall open into an enclosed stairway or a horizontal exit of a corridor/ passageway providing continuous and protected means of egress.

Corridors and passageways

Width of Corridors and passageways shall not be less than calculated width of exit doorways leading from them in the direction of travel to the exit.

In case of central corridor which is part of exit access of the building, doors of rooms (except for rooms having assembly occupancy) shall open inwards.

Doors provided in exit passageway (from exit-to-exit discharge) shall be fire rated doors of 120 minutes rating.

Lifts, escalators, moving walks, and revolving doors

Lifts, escalators, moving walks, and revolving doors shall not be considered as exits.

c) For non-naturally ventilated areas, fire doors with 120 min fire resistance rating shall be provided and particularly at the entrance to lift lobby and stair well where a funnel of flue effect

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may be created, including and upward spread of fire, to prevent spread of fire and smoke.

d) Exits shall be so arranged that they may be reached without passing through another occupied unit/passage in other's control, if they pose challenge or restriction in means of egress

e) Doors in exits shall open it the direction of exit. In case of assembly buildings (Group D) and institutional buildings (Group C-1), exit door shall not open immediately upon a flight of stair and all such entries to the stair shall be through a landing, so that such doors do not impede movement of people descending from a higher floor when fully opened. While for other occupancies, such doors shall not reduce the pathway in the landing by more than half the width of such staircase. Overhead or sliding doors shall not be installed.

f) At least half of the required exit stairs from upper floors (rounded to the next higher number) shall discharge directly to the exterior or through exit passageways.

g) All the exits and exit passageways *(An exit component that is separated from other interior spaces of building by fire rated construction and opening protective, and provides for a protected path of egress travel in a horizontal direction to an exit or exit discharge)* to exit discharge shall have a clear ceiling height of at least 2.4m. however the height of exit door shall be at least 2.0m.

h) Number of exits

Minimum required number of exits shall be determined based on:

A. Occupant load

Occupant load factor:

Occupant load shall be based on actual number of occupants but not less than specified in the table below.

Occupancy	**Occupant load factor (sqm/person)**
Group A: Residential	12.50
Group B: Educational	4.00
Group C: Institutional	
Indoor patients' area	15.00
Outdoor patients' area	10.00
Group D: Assembly	
Concentrated use without fixed seating	0.65
Less concentrated use without fixed seating	1.40
Fixed seating	
Dining areas and restaurants with seating and table	1.80
Group F: Mercantile:	
Street floor and sales basement	3.0
Upper sales flour	6.00
Storage/warehouse, receiving and the like	20.00
Group E: Business	10.00
Group G: Industrial	10.00
Group H: Storage	30.00
Group J: Hazardous	10.00

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Width per person for exit:

Width per person for stairway, door, corridor, ramp shall be as per following table.

Occupancy	Width per person (mm)	
	stairway	Door, corridor, ramp
Residential (Group A)	10	6.5
Educational (Group B)	10	6.5
Institutional (Group C)	15	13
Assembly (Group D)	10	6.5
Business (Group E)	10	6.5
Mercantile (Group F)	10	6.5
Industrial (Group G)	10	6.5
Storage (Group H)	10	6.5
Hazardous (Group J)	18	10

Note:
Unit of exit width is 500mm, clear width of 250mm shall be additional half unit. Less than 250mm width shall not be considered.

Example:

An exit doorway measuring 1000mm in residential occupancy would provide exit capacity for 1000/6.5 = 153 persons. The capacity for 1000mm wide stairway shall be 1000/10 = 100 persons.

B. Maximum travel distance

Numbers and arrangement:

Exits shall be so located that the travel distance (*The distance to be travelled from any point in a building to a protected exit or external escape route or final exit measured along the line of travel*) on the floor shall not exceed the distance given below.

Exits shall be placed as remote from each other as possible and shall be in separate directions from any point in the area served.

Occupancy group	Maximum travel distance (Metre)	
	Type 1, 2 construction	Type 3, 4 construction
Residential (Group A)	30.00	22.50
Educational (Group B)	30.00	22.50
Institutional (Group C)	30.00	22.50
Assembly (Group D)	30.00	30.00
Business (Group E)	30.00	30.00
Mercantile (Group F)	30.00	30.00
Industrial (Group G)		
G-1, G-2	45.00	Construction type not permitted
G-3	22.50	Construction type not permitted
Storage (Group H)	30.00	Construction type not permitted
Hazardous (Group J)	22.50	Construction type not permitted

Note: 1. These types of construction are as per NBC classification

2. For fully sprinkled building, travel distance may be increased by 50 percent

3. Travel distance shall be measured from the most remote point within a storey along the natural un

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obstructed path of horizontal or vertical egress travel to the door to the exit.

Dead end corridor:

Dead end corridor length in exit access shall not exceed:

- Educational, Institutional, assembly occupancy : 6 metre
- Others : 15 metre

A.4.1.3.4 Energy efficiency:

In order to achieve energy efficiency in the building design, following passive measures shall be incorporated to the extent feasible in developing the layout.

Orientation

The buildings should be oriented optimally based on sun-path. Exposure on the eastern and western side should be minimum.

Building form

Building volume should be reduced with optimum foot-print area.

A.4.2 Lighting and Natural Ventilation

A.4.2.1 Lighting

Recommended values of illuminance in accordance with Table-4, section-1, part-8 of NBC, shall be maintained in buildings.

Illuminance values shall be achieved by combination of natural day lighting and artificial lighting. Dependency on artificial lighting shall be minimized by optimum use of fenestration.

Note:

Reference shall be made to Engineering Design Basis (Electrical) for artificial and solar lighting.

A.4.2.2 Natural Ventilation

Recommended values of air changes in accordance with clause 5.2.2.1, section-1, part-8 of NBC, shall be maintained in buildings.

Recommended air changes shall be achieved by natural ventilation and shall be supplemented by mechanical ventilation (if required).

Natural Ventilation in Industrial Sheds:

a) Stores, Warehouses:

These shall be closed type sheds having full height external walls/ metal sheeting. Natural ventilation shall be by means of windows/ ventilators on side walls.

In case of sheds wider than 30 metre, ventilation shall be augmented by roof ventilation by means of Roof Monitor, wind driven Ridge Ventilator and Air Extractors etc. as necessary for required air change

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b) Equipment/ machine sheds:

Generally, these sheds shall be open on all sides up to 3000 mm, thereafter side cladding shall be provided for the remaining height. Continuous sheet louvers shall be provided in the cladding on longer sides.

Roof Monitor, wind driven Ridge Ventilator and Air Extractors etc. as necessary for required air change shall also be provided.

A.4.3 Heating, Ventilation and Air-conditioning (HVAC)

Reference shall be made to Engineering Design Basis (Mechanical Equipment).

Necessary space, rooms, provisions such as AC plant, AHU, Blower room etc. required for HVAC system shall be provided in buildings.

A.4.4 Electrical Services

Reference shall be made to Engineering Design Basis (Electrical).

Necessary space, rooms, provisions such as Electrical Room, Building/ BMS Control Room, Battery Room, UPS Room etc. which are required for electrical system shall be provided in buildings.

A.4.5 Instrumentation Services

Reference shall be made to Engineering Design Basis (Instrumentation).

Necessary space, rooms, provisions such as Building/ BMS Control Room UPS Room etc. required for Instrumentation system shall be provided in buildings.

A.4.6 Plumbing Services

All human occupied buildings shall have toilet and drinking water facility. Accordingly plumbing system consisting of water supply, distribution, plumbing and sanitary fittings and fixtures, drains, sewer disposal etc. shall be provided in these buildings.

Note:

Reference shall be made to Engineering Design Basis (Civil-Structural) for supply, distribution and disposal system including piping and other required accessories, devices, drains, rain water harvesting etc. This design basis covers roof drainage, plumbing and sanitary fixtures only.

Roof drainage:

a) Flat roof

Rain water drainage of flat roof shall be through PVC rain water pipes. For small areas, drainage may be by means of spouts. Slope of finished roof shall not be flatter than 1:100.

Roof gutters shall be provided in cases of large drainage area of roof.

b) Pitched roof

Rain water drainage of pitched roof shall be through valley/ eaves gutter and rain water pipes.

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For small roof drainage area (up to 36m^2) and lesser roof height (up to 6m), free fall of roof water shall be considered.

A.4.7 Information technology (IT) Services

Reference shall be made to Engineering Design Basis (IT).

Necessary space, rooms, provisions such as Server Room, IT Hubs etc. which are required for IT system shall be provided in buildings.

A.4.8 Site Planning and Landscape

Site planning of building shall take into account aspects like interrelationship of the buildings with the whole system, movement pattern, traffic and road net-work, safety regulations, service network, fire safety, climatic and environmental aspects, site conditions like site dimension, contour, drainage, noise level, view, future expansion, visual aspects, Natural Light and Ventilation etc.

Main and service/ maintenance entrances of buildings shall be provided with vehicular access. All exit points shall also be provided with footpath/ vehicular access. Truck movement space in accordance with traffic pattern shall be provided for the building as per the location of hoisting bay/loading, unloading platform. Road network and open space around the buildings shall be designed considering movement and functioning of Fire tenders and cranes etc. Parking space in accordance with traffic load shall be provided to all buildings.

Climatic factors like wind direction, solar geometry shall be taken into account in orienting the buildings depending on type of climate. Orientation of building shall also consider noise and smell propagation, views, and visual effect from various directions.

Sufficient open space shall be provided for planned expansion of buildings. Sufficient open space shall also be provided around the buildings for lighting and ventilation in accordance with Factory Acts & National Building Code. Open spaces in a plot and around buildings proportional to the height of the structure shall satisfy the requirements of the local byelaws.
Landscape shall be done if included in the scope.

Landscape shall be done if included in the scope.

Environmental sustainability shall be considered in Landscape planning by adopting land, vegetation and water sensitive design options. Cut and fill of the land shall be minimized. Storm water runoff in the landscaped area shall be planned in line with the drainage system of the whole complex.

Generally, Landscaping shall be done in following areas:

- Green belt around the complex
- Non plant areas (road sides, open spaces, Entrance area, court-yards and spaces around buildings, car-parking)
- Complex entry areas
- Reservoir areas
- Any other area within complex which can be utilized for landscaping.

Landscaping elements:

Generally following elements shall be part of landscaping.

- Tree plantation
- Hedges, shrubs, ground covers, creepers and climbers

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- Flowering, ornamental plants
- Lawns
- Pavings
- Earth-forms
- Water body (if feasible)
- Landscape lighting
- Landscaping furniture

A.4.9 Aesthetics

Buildings shall be aesthetically pleasant designed incorporating general principles of Aesthetics. Building facades shall reflect such principles like symmetry, balance, proportion, etc.

Building elements like building entry, canopies, overhangs & shading devices, gutters, roof projections, parapets, door& window composition, External wall/ facade shall be considered as contributory elements to aesthetics.

An Architectural control scheme shall be developed for the whole complex. The purpose of the control scheme shall be uniform Architectural style and identification of various building types.

A.4.10 Acoustics and Sound Insulation

Specified acceptable noise level shall be maintained inside a building/ shed as per provisions in NBC

Required noise level in any space shall be maintained by means of

- Segregating noise sources by buffer zones
- Dampening of noise levels by damping devices especially in AHU or other noise producing areas.

Providing Acoustic treatment with acoustic material (on walls, ceilings, floors, as required).

A.5.0 BUILDING ELEMENTS

A.5.1 Plinth Protection

The buildings shall be provided with minimum 1000 mm wide plinth protection around the building perimeter. Top of plinth protection to be 100 mm high from top of approach road level with drain (covered with grating) around the building. In case of approaches with different top levels, the highest top level of access road/ pavement shall be considered.

A.5.2 Finished Floor Level (FFL)

FFL of the Buildings shall be determined with respect to top level of building access (approach road/ pavement), surrounding ground level and requirements of under-floor cabling, cable trenches etc.

FFL shall generally not be less than 450mm from the surrounding ground level.

Following schedule shall be adhered to for FFL of the building:

Building	**FFL**
Control Room & other buildings having cavity/ false flooring	Top level of Building access + 150 mm + cavity depth (as per Instrumentation requirements) + floor finish
Sub Station (single story)	Transformer bays: Top level of Building access + 150 mm

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	Other areas: Top of Building access + 300 mm
Sub Station (more than one story)	Transformer bays: Top level of Building access + 150 mm Other areas: Top level of Building access + Electrical requirement (minimum 300 mm)
Industrial sheds located in paved areas of units	Highest point of paving + 150mm
Stores, Warehouses having raised platform for loading/ unloading bays	Top of Building access + 450 mm (minimum) Truck dock height: Generally, Top of loading bays pavement level + 1100 mm
Other buildings	Top of Building access + 300 mm (minimum)

Notes:

1. In case of approaches with different top levels, the highest top level of access road/ pavement shall be considered.

2. FFL of external loading/unloading bays/ platforms, toilet, pantry, and kitchen shall be 10-15 mm lower than adjoining building level to check ingress/spillage of water along with provision of slope towards drain.

A.5.3 Access to the building

Vehicular access shall be provided for buildings.

Buildings shall be accessible through building entrance from the approach road/ paving by means of steps/ ramps.

A.5.4 Steps

Tread and riser of steps shall be 300mm & 150mm respectively. Edge of treads shall be provided with friction grip strips or similar anti-skid arrangement.

A.5.5 Ramps

For equipment entry:

Minimum width : 1500 mm
Slope : 1: 7

For persons with disability:
(Refer clause A.4.1.3.2 for applicability and other details)

- Ramp shall not be curved.

- Single row of tactile warning block (TGSI) shall be placed at 300mm before the beginning and 300mm after the end of each ramp.

- Internal ramps should be avoided. Where required, internal ramps should not rise more than 2000mm. Maximum gradient shall be 1:15.

- End landing shall be provided both at bottom and top of the sloped path and also where the run changes direction. Length of end and intermediate landing shall not be

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less than 1500mm. Where the ramp run changes direction, minimum landing dimension shall be 1500mm x 1500mm.

- Width, slope and other requirements of ramps shall be as per following table:

Level difference	Maximum gradient	Ramp width	Handrail on both side	Other requirements
150 to 300mm	1:12	1200mm	Yes	-
301 to 750mm	1:12	1500mm	Yes	Landing after every 5metre ramp run
751 to 3000mm	1:15	1800mm	Yes	Landing after every 9metre ramp run
More than 3000mm	1:20	1800mm	Yes	Landing after every 9metre ramp run

A.5.6 Building Entrance

Building entrance shall consist of steps, ramps, building access platform, entrance door, canopies/ overhangs/ portico and entrance lobby.

A.5.7 Access Platform

Minimum 1000 mm wide platform shall be provided in between entrance door and steps/ramps.

Requirement for persons with disability:
(Refer clause A.4.1.3.2 for applicability and other details)

- A clear, firm and level landing of at least 1800mm x 1800mm shall be provided on either side of the entrance door.

- Appropriate tactile ground surface indicator (TGSI) should be provided for leading to entrance.

A.5.8 Canopy /Overhang/ Portico

Canopy /Overhang/ Portico (projected outwards to access road/ pavement) shall be provided in building entrance.

Portico shall be provided in buildings having frequent vehicular movement for access such as Administration Building, Training Centre, Auditorium, Canteen, Laboratory etc.

Canopy/ Overhangs shall be provided in all other buildings.

In place of projected Canopy/ Overhang/ Portico, covered space, recessed inside the building may also be provided depending on building design.

Canopy/ Overhang/ Portico shall be of pleasant aesthetic design contributing to the building aesthetics.
Water proofing and drainage provision shall be provided for canopies and overhangs.

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Blast proof Control Rooms shall not have any projections with outer face of its walls except with false treatment for aesthetics of the building.

A.5.9 Entrance Lobby

Buildings having multiple rooms/ spaces connected by corridor/ passage shall be provided and connected with Entrance lobby located immediately after entrance door.

Space provision for security check, waiting lounge, reception etc. shall be kept in Entrance lobby as required.

Size of the entrance lobby shall be decided on the basis of volume of the movement subjected to the minimum requirement of 9.5 sq.m.

Air-lock Lobby:

Air lock lobby shall be provided in centrally air-conditioned areas and large air-conditioned rooms.

A.5.10 Corridors and Passageways

Corridors and passageways shall be provided as a part of circulation system to connect individual rooms/ spaces of the buildings for smooth circulation within the building and as means of egress.

Width of corridors and passageways shall be finalized based on requirements of Fire and Life safety, accessibility and packing size of equipment (if equipment movement is envisaged) subjected to minimum width of 1500 mm.

Requirements for fire and life safety:

(Refer clause A.4.1.3.3 for applicability and other details)

- Width of Corridors and passageways shall not be less than calculated width of exit doorways leading from them in the direction of travel to the exit.

- Dead end corridor length in exit access shall not exceed:

- Educational, Institutional, assembly occupancy : 6 metre
- Others :15 metre

Requirements for accessibility:
(Refer clause A.4.1.3.2 for applicability and other details)

- Minimum unobstructed width of corridor shall be 1500mm, preferably 1800mm.
- For wheel chair turning (90 degree), width shall be 1500mm, 1500mm long in the direction of travel.
- For wheel chair turning (180 degree), width shall be 1800mm, 2000mm long in the direction of travel.

A.5.11 Stairs

Staircases shall be provided for vertical circulation system, Exits and roof access.

Staircases shall be provided in required numbers with requisite components such as Treads, Risers, Landings, Handrails etc. as below:

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Minimum width of tread (without nosing)	300mm	
Maximum height of riser	190mm (residential buildings, A-2 type) 150mm (other buildings)	
Maximum no. of risers per flight	12	
Minimum width of flight (Building occupancy wise)	Residential (A-2)	1000 mm
	Residential (A-1,3,4)	1250 mm
	Residential (A-5,6)	1500 mm
	Assembly	2000 mm
	Educational	1500 mm
	Institutional	2000 mm
	Others	1500 mm

Note: Category classification are as per NBC.

Requirements for Fire & Life safety:
(Refer clause A.4.1.3.3 for applicability and other details)

Requirements of stairs for fire and life safety are tabulated below:

Types of staircases:		
Internal staircase	Internal staircases are located inside the building and may be with an external wall.	
External staircase	These are the staircases provided on the external wall/façade. These shall be open on at-least one side.	
Curved staircase	Curved stairs shall not treated as part of means of egress. These may be used as part of exit access, provided depth of tread is not less than 280mm.	
Spiral staircase	Shall be limited to low occupant load and to a building not exceeding 9 metre in height. Diameter shall not be less than 1500mm	
Number of staircases	- Minimum 2 numbers - Actual numbers shall be based on occupant load and travel distance.	
Discharge through staircase	Discharge from stairs to exit discharge shall be a) directly, or b) through exit passageway, or c) through lobby. At least 50 % of the staircases shall discharge as per a) and/ or b)	
Minimum width of tread (without nosing)	250mm (residential buildings) 300mm (other buildings)	
Maximum height of riser	190mm (residential buildings, A-2 type) 150mm (other buildings)	
Maximum no. of risers per flight	12	
Internal staircases: Internal staircases shall meet following requirements:		
- Shall have minimum 120-minute fire rating - Shall not be arranged around lift shaft - Access to staircase shall be through minimum 120 minutes fire rated door. - Shall terminate at the level of exit discharge. Access to basement shall be by separate staircase		
Minimum width of flight (Building occupancy wise)	Residential (A-2)	1000 mm
	Residential (A-1,3,4)	1250 mm
	Residential (A-5,6)	1500 mm

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	Assembly	2000 mm
	Educational	1500 mm
	Institutional	2000 mm
	Others	1500 mm
Handrail	- Handrail shall be provided on one side for width less than 1500mm and on both sides for width 1500mm and more - Projections of handrails in the staircase width shall not be more than 115mm	
External staircases: External staircases shall meet following requirements:		
Discharge	External stairs shall be directly connected to the ground.	
Door to external staircase	Any doorway leading to external staircase shall be minimum 120 minutes fire rated door	
Inclination of staircase	Inclination shall not be more than 45 degrees	
Width	Not less than 1500mm	
Handrails	1000mm high, on both sides with provisions of balusters with maximum gap of 150 mm.	

Stairs for roof access:

- In case of buildings of more than one story, where staircases are already provided for vertical circulation, minimum one stair case shall be continued for roof access.

- In case of single storied buildings having provision for future expansion, minimum one staircase shall be provided for roof access.

- In case of other single storied buildings, steel ladder or staircase shall be provided for roof access.

If there are equipment placed on roof of such buildings, staircase on shall be provided for operation / maintenance of the equipment.

Also, if the height of the building is more than 4.5 metre, staircase shall be provided.

For very small single storied buildings of normal height like security cabin, scale room, small pump houses etc. ladder or staircase may be avoided as roof of such buildings can be accessed by normal maintenance ladders.

A.5.12 Lifts

Lifts shall be provided for vertical circulation in high rise (15 metre or above in height) buildings.

Capacity and number of lifts:

Capacity and numbers of lift shall be decided in accordance with the NBC

Requirements for accessibility:

- It is recommended that in multistoried buildings there be at least one lift accessible to transport persons with disabilities at all usable levels. This requirement shall be finalised in consultation with the owner.

- The minimum size of the lift shall be 1500mm x 1500mm

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- Handrails shall be placed at height of 1000 mm from the floor level and shall be fixed on both sides and at the rear of the lift.

A.5.13 Toilets

Toilets shall be provided in all buildings having human occupancy.

- Separate toilets for Gents and Ladies shall be provided. However, in small buildings or for a smaller number of occupants, Unisex Toilet may be provided.

- Shaft for plumbing pipes etc. shall preferably be provided for maintenance and hiding the pipes etc. for aesthetic reason.

- Janitor space shall be provided in the Toilet block of Satellite Rack Rooms, Substations and Warehouses only.

- Waterproofing shall be done for Toilets on first floor and above.

Number of fixtures:

Number of fixtures shall be in accordance with clause 4.2.5, Part-9 of NBC. Generally applicable requirements are tabulated below.

Building Type: Office

User	Number of fixtures		
	WC	Urinals	Wash Basin
Male	1 no per 25	1 no for 7 to 20 2 nos for 21 to 45 3 nos for 46 to 70 4 nos for 71 to 100	1 no per 25
Female	1 no per 15	-	1 no per 25

Building Type: Factories

User	Number of fixtures		
	WC	Urinals	Wash Basin
Male	1 no for up to 15 2 nos for 16 to 35 3 nos for 36 to 65 4nos for 66 to 100	1 no for up to 20 2 nos for 21 to 45 3 nos for 46 to 70 4 nos for 71 to 100	1 no per 25 or part of thereof
Female	1 no for up to 12 2 nos for 13 to 25 3 nos for 26 to 40 4 nos for 41 to 57	-	1 no per 25 or part of thereof

Building Type: Restaurants, Dining Halls

User	Number of fixtures		
	WC	Urinals	Wash Basin
Male	1 no for 50 seats up to 200 Add 1 no per additional 100 or part thereof	1 no per 50 seats or part thereof	1 no per WC
Female	2 no for 50 seats up	-	1 no per WC

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	to 200 Add 1 no per additional 100 or part thereof		

Toilets for persons with disability:

- Minimum one number Unisex Toilet for persons with disability shall be provided in each floor fulfilling following requirements:
- Suitable arrangement of fixtures, grab rails (horizontal, vertical) and manoeuvring space for both wheel chair users and Ambulant Disabled People.
- Toilet door shall be outward opening door with clear opening width of 900mm. The door shall be provided with minimum 600 mm long horizontal pull bar at a height of 900 mm and horizontal pull handle at 700 mm height, both on the inside of the door.

A.5.14 Drinking Water

Drinking water facility shall be provided in all buildings having human occupancy. The facility shall either be provided inside the pantry or in some convenient area having provisions of water supply, RO facilities (including space required for RO equipment) and water disposal.

Requirement of drinking water fountain/ taps:

Number of fixtures shall be in accordance with clause 4.2.5, Part-9 of NBC. Generally, widely applicable requirements are tabulated below.

Building Type	Number of fixtures
Office	1 per every 100 or part thereof
Factory	1 per every 100 or part thereof

A.5.15 Pantry

Pantry (for tea/ coffee preparation, drinking water, snacks distribution etc.) shall be provided in all buildings having considerable human occupancy. In case of low occupancy, provisions for Tea/ Coffee dispenser/ preparation facility etc. shall be kept in some convenient area having provisions of water supply, washing facilities, water disposal etc.

A.5.16 Walls

Walls shall be of Concrete block/ fly ash brick/ AAC masonry. For blast resistance, walls shall be of RCC.

Thickness of brick walls:

Wall Type	Thickness
External wall	230mm brick wall/ fly ash brick wall or 200 mm concrete/ AAC block masonry
Internal partition wall	230mm or combination of 230 & 115-mm brick wall / fly ash brick wall OR 200/100 mm or combination of 200 and 100-mm concrete/ AAC block masonry
Walls abutting Transformers	200 thick RCC or 345 mm brick wall/ fly ash brick wall or 300 mm AAC/ Concrete block masonry

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Fire rated wall	Minimum 115 mm brick wall/ fly ash brick wall or 100 mm concrete block masonry for 2-hour fire rating
Blast resistant wall	RCC wall as/ structural design (minimum 230 mm brick wall/ fly ash brick wall or 200 mm concrete/ AAC block masonry)

Notes:

1. The selection of type of bricks/ masonry to be carried out as per owner's approval.

2. 115 mm thk. Brick partition walls (with nominal steel requirement as per structure design) shall be provided with 230 mm thk. brick pillars for stability depending upon the length and height of wall.

3. For internal partition walls, wherever conduits or pipes are required to be concealed, thickness shall preferably be 220mm brick wall or 200 mm concrete blocks.

Fire rated walls:

Fire rated walls of required rating (minimum 2 hours) shall be provided in following areas of applicable buildings indicated in clause A.4.1.3.3

- Enclosure of internal staircase : 2 hours fire rating.
- Exit passageway/ corridor : 2 hours fire rating

- Walls separating various fire zones and separation walls between protected and non-protected areas of Process Control Rooms / Satellite Rack Rooms shall also be of 2 hours fire rating.

A.5.17 Partitions

Internal partitions shall be of engineered wood (block/ particle/MDF/ Gypsum board) and metal frame construction with specified finish. Fire rating requirement shall be similar to walls. Glazed panels shall be provided for visibility on the partitions as per requirements.

A.5.18 Doors

Doors shall be provided for access, security and safety at entry & exits of rooms/areas& the buildings.

Sizing of doors shall be based on Equipment size (including package) and Fire & Life Safety (Refer clause A.4.1.3.3).

Rolling shutters shall be provided in place of door when size exceeds 2500 mm x 2500 mm.

Requirements of Fire and Life Safety:
(Refer clause A.4.1.3.3 for applicability and other details)

- Doors provided in exit passageway (from exit-to-exit discharge) shall be fire rated doors of 120 minutes rating.
- All main entry and exit doors, doors leading towards exit corridor shall have panic push bar in all buildings.
- Fire doors with 120 min fire resistance rating shall be provided particularly at the entrance to lift lobby and stair well where a funnel of flue effect may be created, including upward spread of fire, to prevent spread of fire and smoke.
- Any doorway leading to external staircase shall be minimum 120 minutes fire rated door.
- Access door to internal staircase shall be minimum 120 minutes fire rated door.
- In case of central corridor which is part of exit access of the building, doors of rooms

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(except for rooms having assembly occupancy) shall open inwards.
- Width of Doors shall not be less than 1000 mm except assembly buildings, where door width shall not be less than 2000 mm and for WC cubicles, where door width shall not be less than 750mm.
- Blast resistant Control rooms shall be provided with Blast resistant Baffle wall as per OISD – STD – 163.

A.5.19 Windows/ Ventilators (Glazed & with Louvers)

Windows/ ventilators shall be provided in all areas for visibility, natural lighting & ventilation.

Minimum area of window/ ventilator:

Minimum window/ ventilator area shall be 10 percent of floor area in general.

Windows/ Ventilators in various areas:

Buildings/ Areas	Windows/ Ventilators (glazed & with Louvers)
Office and other work spaces	Normally full-length windows for visibility and natural day-light
Storage areas, Stores, Warehouses	Ventilators at high level with safety bars.
Equipment / Panel Rooms	Mostly ventilators at high level, windows
Process Control Rooms/ Satellite Rack Rooms	Refer OISD-STD-163
Security Cabins/ Watch Tower	Windows for maximum visibility
Battery room	Windows shall be provided with sun control film Provision of exhaust fans for ventilation

A.5.20 Shading Devices (for windows/ ventilators etc.)

Glazed windows/ ventilators shall be provided with shading devices for rain and sun protection having min 600mm width. The devices shall be in forms of horizontal/ vertical projections/ recesses and shall be part of façade aesthetics. Provision for water proofing and drainage shall be suitably made for projections.

A.5.21 Roof Monitor

Roof Monitors shall be located over openings at ridge of metal sheet roofing mainly for natural ventilation.

The Monitors shall consist of metal sheet roofing and louvers at the sides. Glass may also be used in combination with louvers for additional benefit of natural light. Bird wire mesh should be provided to prevent entry of birds.

The Monitors shall be suitably designed and detailed to ensure that the leakage of rain water is prevented.

Size of the Monitor:

Opening size at roofing sheet near ridge should be minimum 10% of the span. Height shall be suitably decided.

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A.5.22 Ridge Ventilator

Ridge ventilators shall be wind driven/operated type and shall be factory made. The size shall be as required for required ventilation.

Suggested calculation of size / numbers:

Qv = (VxN)/ (Rx3600)

Qv = Quantity of Ridge Ventilators required.

V = Volume of the building

N = Number of air changes

R = Exhaust capacity of ridge vent @ stack height (considering available throat size, length of ridge ventilator etc.)

The Ridge ventilators shall be suitably designed and detailed to ensure that the leakage of rain water is prevented.

If required for necessary ventilation, wind driven/ operated Roof Air Extractors shall also be provided

A.5.23 Roof Air Extractor

Roof Air Extractors shall be Wind Driven/operated type and shall be factory made. The size and numbers shall be as required for required ventilation.

Suggested calculation of size and numbers:

Number of Air extractors =
Volume of the Room X Required air-change per hour
Exhaust capacity of one extractor (considering throat size, height etc.)

They shall be suitably designed and detailed to ensure that the leakage of rain water is prevented.

A.5.24 Roofing/ Cladding light sheets

Transparent roofing sheets shall be provided in combination with metal sheet roofing/ cladding for adequate uniform natural lighting. Minimum area of roof light sheets shall be 10% of roof area.

A.5.25 Roof Gutters

Slope on RCC roof slab shall be provided for rain water drainage from exposed PVC pipes

RCC Roof Gutters shall be provided for large RCC roof areas and where providing necessary slope of finished roof is difficult.

Metal sheet Eaves & Valley Gutters shall be provided for metal sheet roof.

Suggested calculation of Gutter sizing:

A = Roof area to be drained in Sq. M

B = Rainfall Intensity (mm/ hr) of the place

C = Runoff coefficient for roof surface (Concrete -0.8 to 0.95, Metal sheet -0.95)

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D = Runoff in Cubic m / hr (D = A x B x C)

E = Total rain water coming from roof = D / No. of gutters

V = Velocity of water to be discharged by gutter drain (as per Manning's formula)

$$V = \left[\frac{1}{n}\right] x \left[R^{\frac{2}{3}} x S^{\frac{1}{2}}\right]$$

Where:

V= Velocity in meter per second

R= Hydraulic radius in M [For gutter R= (d x w)/ 2 x d +w), where d=effective depth of gutter & w = width of gutter]

n = Manning Coefficient of Roughness

S= Slope of Hydraulic gradient

Q = d x w x V (discharge)

If Q> D, gutter size is correct. If Q<D then d and w of the gutter need to be resized.

Roof water accumulated in gutters shall be drained through Rain Water Pipes

A.5.26 Rain Water Pipes

Rain water pipes shall be provided in adequate numbers ensuring roof water drainage. The Rain Water Pipes if visible on facades of important buildings shall be suitably concealed.

If feasible, the pipes shall be located at the back-side of the buildings, which, in cases of un-important buildings (visually) may be kept exposed.

Suggested Rain Water Pipe sizing and numbers:

Diameter Rain water Pipe (mm)	**Rainfall rate (mm/hour)**					
	50	**75**	**100**	**125**	**150**	**200**
	Roof Area (Flat roof, sq. metre)					
50	29.70	19.80	14.85	11.88	9.90	7.42
75	81.84	54.56	40.92	32.74	27.28	20.46
100	168.00	112.00	84.00	67.20	56.00	42.00
125	293.48	195.66	146.74	117.39	97.83	73.37
150	462.95	308.64	231.48	185.18	154.32	115.74

The pipes shall be located at suitable spacing considering slope of finished roof etc.

A.5.27 Parapet wall

Parapet walls or Handrails shall be provided on the edges of roof terraces, Balconies, Verandahs etc.

Height of the Parapet walls shall not be less than 1000 mm except for small buildings with such as Security Cabins, Weigh- Bridges etc. where height of Parapet walls may be not less than 600 mm.

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Railings (1000 mm high) shall be provided in stairs, and in all unprotected openings in slabs as a safety device. Steel railings in loading/ unloading bay of shall be of removable type. Parapets shall be given precedence over railings on roofs.

A.6.0 SCHEDULE FOR ARCHITECTURAL FINISHES.

Colour Scheme for all Architectural items shall be as approved by the Owner. For the purposes of schedule of Architectural finishes, buildings are categorized into following types.

Type	Buildings
Type A	- Office Building - Training Centre - Gate House - Marketing Office Building - Canteen/Dining Hall - Guest House - Control Rooms - Satellite Rack Room
Type B	- Substation - Switchgear Building - MCC Room etc.
Type C	- Laboratory - Occupational Health Centre - Fire Station - Gate Houses (other than Main Gate House) - Other non-plant/ process building not listed in any other category
Type D	All process/ plant buildings not listed in other category.
Type E	- Stores - Ware house - Workshop - Cement Godown - Site Office - Weigh Bridge - Watch Towers - Other storage/ maintenance buildings
Type F	- Utility storage Sheds like DG Shed, Pump Houses, Compressor House, Analyzer Room etc. - Process sheds & other sheds

Note: In case of conflict between licensor/ process/ safety/ statutory requirement and this schedule of Architectural finishes, the former shall override.

A.6.1 INTERNAL FINISHES

A.6.1.1 Floor finishes:

A. Entrance Lobby, Reception, lounge, Waiting area, Viewing Gallery etc.:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Granite stone • Vitrified tiles • Combination of granite	• Granite stone • Vitrified tiles • Combination of granite	• Granite stone • Vitrified tiles • Combination of granite	• Vitrified tiles	• Vitrified tiles	• Vitrified tiles

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stone and vitrified tiles	stone and vitrified tiles	stone and vitrified tiles			

B. Office and associated office areas like records/ storage, meeting/ conference room etc.:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Granite stone • Vitrified tiles • Combination of granite stone and vitrified tiles	• Granite stone • Vitrified tiles • Combination of granite stone and vitrified tiles	• Granite stone • Vitrified tiles • Combination of granite stone and vitrified tiles	• Vitrified tiles	• Vitrified tiles	• Vitrified tiles

C. Circulation area (Corridor, passage, etc.):

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Granite stone • Vitrified tiles • Combination of granite stone and vitrified tiles	• Granite stone • Vitrified tiles • Combination of granite stone and vitrified tiles	• Granite stone • Vitrified tiles • Combination of granite stone and vitrified tiles	• Vitrified tiles	• Vitrified tiles	• Vitrified tiles

D. Kitchen, Pantry & Dining hall etc.:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Vitrified tiles • Granite stone	• Vitrified tiles	• Vitrified tiles • Granite stone	• Vitrified tiles	• Vitrified tiles	• Vitrified tiles

E. Toilet, Drinking water area etc.:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Combination of Granite and vitrified tile	• Ceramic tiles (anti-skid)	Ceramic tiles (anti-skid)	• Ceramic tiles (anti-skid)	• Ceramic tiles (anti-skid)	• Ceramic tiles (anti-skid)

F. Staircase:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Granite stone	• Kota Stone	• Granite stone	• Kota stone	• Kota stone	• Kota stone

Note: Above finishes shall be applicable for RCC staircase. For steel staircase, refer structure part in design basis.

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G. Battery Room & Chemical Handling areas (All type of Buildings):

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Chemical/ abrasion resistant Epoxy coating over heavy duty cement concrete floor finish					

H. Electrical Room, Pressurization Room, AC Plant, Loading / Unloading bays, Equipment handling areas, Product storage areas, Switchgear, MCC, Ware House, Work Shop, Process/ Utility Sheds etc. (All type of buildings):

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Heavy Duty Cement concrete flooring. • Vacuum de-watering flooring in large Rooms/ areas of Storage/ Warehouse/ Workshop					

Note: Vacuum dewatering shall be done as per Structure Design Basis and specification

I. Console, Rack room, UPS Room, areas housing instrumentation equipments requiring under-floor cabling (All type of buildings):

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Combination of granite stone, vitrified Tile and false flooring in case of trench arrangement • Raised access/ Cavity / False flooring					

Note: Criteria for false floor/ trench shall be established based on electrical/ instrumentation design basis.

J. Executive Block Including all office areas, lounge, lobby, dining room, meeting/ conference room, etc. of admin building:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Combination of Granite and Vitrified Tiles					

A.6.1.2 Internal Wall Finishes

A. Entrance Lobby, Reception, lounge, Waiting area etc.:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Cement Plaster, POP punning & Plastic emulsion paint • Combination of Granite stone cladding up to False ceiling and Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster, POP punning & Plastic emulsion paint • Combination of Granite stone cladding up to 1500 mm and Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster, POP punning & Plastic emulsion paint

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B. Office and associated office areas like records/ storage, meeting/ conference room etc.:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster, POP punning & Plastic emulsion paint

C. Circulation area (Corridor, passage, etc.):

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Cement Plaster, POP punning & Plastic emulsion paint • Combination of Granite stone cladding up to 2100 mm high and Cement Plaster, POP punning & Plastic emulsion paint above	• Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster, POP punning & Plastic emulsion paint • Combination of Granite stone cladding up to 1500 high and Cement Plaster, POP punning & Plastic emulsion paint above	• Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster, POP punning & Plastic emulsion paint

D. Kitchen, Pantry & Dining hall etc.:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Cement Plaster, POP punning & Plastic emulsion paint • Combination of Granite stone cladding up to 2100 high and Cement Plaster, POP punning & Plastic emulsion paint above	• Combination of Ceramic Tile Dado up to 2100mm and Cement Plaster, POP punning & Plastic emulsion paint above	• Cement Plaster, POP punning & Plastic emulsion paint • Combination of Granite stone cladding up to 2100 high and Cement Plaster, POP punning & Plastic emulsion paint	• Combination of Ceramic Tile Dado up to 2100mm and Cement Plaster, POP punning & Plastic emulsion paint above	• Combination of Ceramic Tile Dado up to 2100mm and Cement Plaster, POP punning & Plastic emulsion paint above	• Combination of Ceramic Tile Dado up to 2100mm and Cement Plaster, POP punning & Plastic emulsion paint above

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E. Toilet, Drinking water area etc.:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Granite Tile Dado up to Ceiling/ False Ceiling • Vitrified Tile Dado up to Ceiling/ False Ceiling	• Ceramic Tile Dado up to 2100 mm.	• Granite Tile Dado up to Ceiling/ False Ceiling • Vitrified Tile Dado up to Ceiling/ False Ceiling	• Ceramic Tile Dado up to 2100 mm.	• Ceramic Tile Dado up to 2100 mm.	• Ceramic Tile Dado up to 2100 mm.

F. Staircase:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster, POP punning & Plastic emulsion paint	• Cement Plaster & Acrylic Distemper	• Cement Plaster & Acrylic Distemper

Note: Above finishes shall be applicable for brick wall, Concrete staircase enclosure.

G. Battery Room & Chemical Handling areas (<u>All type of Buildings</u>):

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Chemical resistant epoxy coating over cement plaster up to 2500mm height and Cement Plaster, Acrylic Distemper above 2500mm height.					

H. Electrical Room, AC Plant, Loading / Unloading bays, Equipment handling areas, Storage areas, Switchgear, MCC, Ware House, Work Shop, Process/ utility Sheds etc. (<u>All type of buildings</u>):

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Cement Plaster & Acrylic Distemper • Cement Plaster, POP punning & Plastic emulsion paint (Switchgear hall & MCC) • Cement Plaster & exterior acrylic paint (in weather exposed areas)					

I. Rack room, Engineering room, UPS Room (<u>All type of buildings</u>):

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Cement Plaster, POP punning & Plastic emulsion paint					

J. Console Room:

• Granite stone dado up to 2100mm height Cement plaster, POP punning & Plastic emulsion paint above
• Cement Plaster, POP punning with plastic emulsion paint (For consoles rooms other than in Main Control Room)

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A 6.1.3 Internal ceiling finishes:

A. Entrance Lobby, Reception, lounge, Waiting area etc.:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Gypsum False Ceiling • Combination of Gypsum & Mineral fibre tiles false ceiling • Cement Plaster, POP punning & Plastic emulsion paint	• Gypsum False Ceiling • Combination of Gypsum & Mineral fibre tiles false ceiling • Cement Plaster, POP punning & Plastic emulsion paint	• Gypsum False Ceiling • Combination of Gypsum & Mineral fibre tiles false ceiling • Cement Plaster, POP punning & Plastic emulsion paint	• Gypsum False Ceiling • Combination of Gypsum & Mineral fibre tiles false ceiling • Cement Plaster, POP punning & Plastic emulsion paint	• Gypsum False Ceiling • Cement Plaster, POP punning & Plastic emulsion paint	• Gypsum False Ceiling • Cement Plaster, POP punning & Plastic emulsion paint

B. Office and associated areas like records/ storage, meeting/ conference room etc.:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Combination of Gypsum & Mineral fibre tiles false ceiling • Cement Plaster, POP punning & Plastic emulsion paint in records/ storage rooms					

C. Circulation area (Corridor, passage, etc.):

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Gypsum False Ceiling • Combination of Gypsum & Mineral fibre tiles false ceiling • Cement Plaster, POP punning & Plastic emulsion paint	• Gypsum False Ceiling • Combination of Gypsum & Mineral fibre tiles false ceiling • Cement Plaster, POP punning & Plastic emulsion paint	• Gypsum False Ceiling • Combination of Gypsum & Mineral fibre tiles false ceiling • Cement Plaster, POP punning & Plastic emulsion	• Gypsum False Ceiling • Combination of Gypsum & Mineral fibre tiles false ceiling • Cement Plaster, POP punning & Plastic emulsion paint	• Gypsum False Ceiling • Cement Plaster, POP punning & Plastic emulsion paint	• Gypsum False Ceiling • Cement Plaster, POP punning & Plastic emulsion paint

D. Other AC areas etc., where false ceiling required:
- Combination of Gypsum & Mineral fibre tiles false ceiling
- Aluminum panel false ceiling

Notes:

1. False ceilings shall be provided in the all-air-conditioned areas for the purpose of reducing room volume and to hide air-conditioned ducting etc. and also to maintain acoustic level inside any space.

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2. In fire rated areas where walls and doors are required to be fire rated, false ceiling shall also have complementing fire rating.

E. Rack room, Engineering room, Switchgear hall, UPS Room (All type of buildings):

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Combination of Gypsum & Mineral fibre tiles false ceiling • Aluminum panel false ceiling					

F. Other area not indicated above etc.:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Cement Plaster &plastic emulsion paint			• Cement Plaster & Acrylic Distemper		

Note: For non-air-conditioned utility areas such as electrical room, AC package, AHU etc Cement Plaster & Acrylic Distemper shall be provided.

A.6.2 EXTERNAL FINISHES

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
Combination of: • Plain cement plaster and texture coating • Exterior Plastic Emulsion Paint • Granite stone/sand stone cladding • Plain cement plaster and Acrylic paint • Composite Aluminum Panel & structural glazing • GFRC Jaali/ Cladding	• Exterior Plastic Emulsion Paint • Plain cement plaster and Acrylic paint	Combination of: • Plain cement plaster and texture coating • Exterior Plastic Emulsion Paint • Granite stone/sand stone cladding • Plain cement plaster and Acrylic paint Composite Aluminum Panel & structural glazing	• Exterior Plastic Emulsion Paint • Plain cement plaster and Acrylic paint	• Exterior Plastic Emulsion Paint • Plain cement plaster and Acrylic paint	• Exterior Plastic Emulsion Paint • Plain cement plaster and Acrylic paint

Notes:

1. Grooves in plaster shall be provided at junction of different materials and as per external facade treatment.
2. Weather resistant waterproof wall putty to be provided for weather exposed faces of walls.

A.6.3 DOORS

A. Entrance/ exit Doors

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Powder coated Aluminum glazed doors with partly etched/ frosted film over glass					

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B. Doors in circulation area of <u>all type of Buildings</u>:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Powder coated Aluminum glazed doors with partly etched/ frosted film over glass					

C. Office area doors

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Powder coated Aluminium glazed doors with partly etched/ frosted film over glass					

D. All Electrical Room, A.C. Plant Room, Battery Room doors of all type of Buildings:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Pressed steel frame with Pressed steel shutter, Powder coated • Powder coated Aluminium doors partly glazed/ partly with Aluminium sheet					

E. Toilet doors

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Cubicle system (with compact laminated board) • Wooden Door	• PVC Doors • Powder coated Aluminium doors with ACP sheet	• Cubicle system (with compact laminated board) • PVC Doors • Wooden Door	• PVC Doors	• PVC Doors	• PVC Doors

F. Fire check/ resistant doors

Irrespective of above schedule, Fire check doors (minimum 2 hours rated) shall be provided wherever required as per OISD/ Statutory requirements.

1. Fire check doors In Control Room / Satellite Rack Room Building

A. Main entrance/ entry to Console:
- Glazed steel Fire check door

B. Other Rooms:
- Glazed steel Fire check door
- Solid type steel fire check door (with 300mm x 300mm vision panel)

2. Fire check doors In Administration Building

A. Main entrance/ entry/ circulation area:
- Glazed steel Fire check door

B. Other Rooms:
- Glazed steel Fire check door
- Solid type steel fire check door (with 300mm x 300mm vision panel)

3. Fire check doors In other Buildings

A. Main entrance/ entry/ circulation area:

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- Glazed steel Fire check door
- Solid type steel fire check door (with 300mm x 300mm vision panel)

B. Other Rooms:

- Glazed steel Fire check door
- Solid type steel fire check door (with 300mm x 300mm vision panel)

Note:

1. Steel gate of suitable size in front of transformer bays in substation buildings to be provided as per electrical requirement.
2. Rolling shutters shall be provided in equipment areas like Switchgear/ MCC Room, Workshop, Ware House, AC Plant room etc. where opening size for door exceeds 2500 x 2500mm.
3. Mechanically operated Rolling Shutters shall be provided in the main equipment entry door and for opening Sizes exceeding 8.0 sq.m.
4. Doors/windows/ventilators shall be complete with all fittings & fixtures for easy smooth operation & locking facility.
5. All main entry and exit doors, doors leading towards exit corridor shall have panic push bar button in all buildings.
6. 6mm Toughened glass shall be used for glazing in Aluminum Doors and Windows

A.6.4 WINDOWS & VENTILATORS

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Powder coated Aluminum glazed windows & ventilators					

Note: For Green buildings. Double glazed units (DGU) shall be provided as per the requirement and orientation of openings.

A.6.5 ROOF TREATMENT

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• PU waterproofing system with underdeck insulation (for central air conditioning buildings)					

Notes: 1. PU waterproofing system without underdeck insulation shall be provided in all Non-Air-Conditioned spaces/ buildings.

2. HVAC room with roof exposed to sunlight shall be provided with PU waterproofing system with underdeck insulation.

A.6.6 ROOFING / CLADDING (sheds/workshop)

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Precoated, profiled color coated zincalume steel sheet roofing & cladding in compressor shed, pump house etc. with translucent roof light sheets where applicable • Insulated Pre-coated, profiled color coated zincalume steel sheet roofing & cladding in Warehouse, workshops, storage sheds and other sheds with translucent roof light sheets where applicable					

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A.6.7 SANITARY FITTINGS & FIXTURES

A. Water Closet (European type):

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Water efficient (dual flush) Wall hung type, coloured (premium luxury model)	• Water efficient (dual flush Pedestal type, coloured	• Water efficient (dual flush) Wall hung type, coloured (premium luxury model)	• Water efficient (dual flush Pedestal type, coloured /white	• Water efficient (dual flush Pedestal type, coloured /white	• Water efficient (dual flush Pedestal type, coloured/ white

Note: Indian Water closet shall be provided as per functional requirement and applicability

B. Wash Basins:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• Round/oval , coloured, with electronic sensor over granite counter • Round/oval , coloured, over granite counter	• Round/oval , coloured, over granite counter	• Round/oval , coloured, with electronic sensor over granite counter • Round/oval , coloured, over granite counter	• White, wall hung type	• Round/oval , coloured, over granite counter • White, wall hung type	• White, Wall hung type

Note: Battery Rooms to be provided with facility of sink and washing facility (with drinking water)

C. Urinals:

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• With electronic sensor (premium luxury model) • Standard Wall hung type	• Standard Wall hung type	• With electronic sensor (premium luxury model) • Standard Wall hung type	• Standard Wall hung type	• Standard Wall hung type	• Standard Wall hung type

D. Plumbing fixtures (stop/ bib/ pillar cocks, flash valves etc.):

Type-A	Type-B	Type-C	Type-D	Type-E	Type-F
• CP brass (Premium luxury model)	• CP brass	• CP brass	• CP brass	• CP brass	• CP brass

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Notes:

1. All plumbing fixtures shall be low flow type.
2. Stainless steel sink shall be provided in kitchen/ pantry.
3. Auto/ Self closing push cocks shall be used where electronic sensor fitted fixtures are not used.
4. All drain points shall be provided with floor trap.
5. All PVC pipes shall be used for drinking water network.
6. All toilets shall be provided with exhaust fans for ventilation
7. All battery rooms shall be provided with Stainless sink with water connection and drawing below.

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DESIGN BASIS
FOR
ACTIVE FIRE PROTECTION SYSTEM

PROJECT : EPCM SERVICES FOR POLYPROPYLENE PROJECT, NRL REFINERY

OWNER : NUMALIGARH REFINERIES LIMITED

CONSULTANT : ENGINEERS INDIA LIMITED

JOB NO. : C050

02.09.25. 02/09/25.

Abdulbari 2/9/25

EIL NRL

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1 INTRODUCTION

Numaligarh Refinery Limited (NRL/Owner/Client), a subsidiary of M/s Oil India Limited (OIL) is operating a 3 MMTPA refinery located at Golaghat District in Assam, India, with associated crude receipt and handling facilities, cross country pipelines, marketing terminal etc. NRL is augmenting the processing capacity of the facilities from present 3MMTPA to 9.0 MMTPA under Numaligarh Refinery Expansion Project (NREP). This project is integrated with a new crude oil pipeline from Paradip (Odisha) to Numaligarh (Assam) and a product pipeline from Numaligarh to Siliguri where NRL has its own Marketing Terminal for distribution of product. Under NREP project, a high severity PFCCU unit with a capacity of 1.955 MMTPA is being implemented. The LPG that will be generated in the high severity mode of PFCCU will contain a significant potential of propylene which is a good feedstock for production of high valued polymer i.e. Polypropylene. In view of expected growth in demand for petrochemicals products in India and to remain competitive in the market with products self-sufficiency, NRL plans to set up a Polypropylene (PP) Unit along with its associated facilities under Polypropylene (PP) project, beside the NREP refinery. NRL has undertaken DFR study wherein Polypropylene Unit of design capacity of 360 KTPA for production of homo-polymer PP was envisaged along with associated utilities and offsite facilities. Licensor selection has been completed and BDEP is obtained from Licensor (M/s Novolene). NRL now intends to appoint a consultant for execution of PP Project along with its associated site enabling infrastructure, utility and offsite facilities on EPCM basis. NRL now intends to implement 360 KTPA Polypropylene (PP) Unit, wherein the Polymer Grade Propylene produced in the PRU section of the PFCC Unit opf NREP shall be further processed to produce Homo-polymer grade Polypropylene Product.

This document is prepared as a part of scope of services for Polypropylene project.

2 SCOPE

This document covers design basis for Active Fire Protection system for Polypropylene Project of M/s NRL which includes

1. PP unit
2. Associated Offsite & Utilities

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3 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

3.1 ABBREVIATIONS

CODE	DESCRIPTION
FGL	Finished Ground Level
FM	Factory Mutual
NFPA	National Fire Protection Association
OISD	Oil Industry Safety Directorate
PNGRB	Petroleum and Natural Gas Regulatory Board
P/L	Pipeline
PESO	Petroleum and Explosives Safety Organization
UL	Underwriters Laboratory
NRL	NRL Refinery

3.2 CODES & STANDARDS / PUBLICATIONS

S. NO.	DESCRIPTION	STANDARDS / CODES
a.	Fire Protection Facilities for Petroleum Refineries & Oil/Gas Processing Plants	OISD- STD- 116
b.	Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Petroleum Refineries and Gas Processing Plants) Regulations, 2023.	PNGRB/Tech/8-T4SR&GP/ (1)/2023 (P-4247)
c.	Fire Protection System for Electrical Installations	OISD- STD-173
d.	Recommended Practice for Oil Storage and Handling	OISD- RP-108
e.	Standard for Low-, Medium-, and High-Expansion Foam	NFPA 11
f.	Standard on Carbon Dioxide Extinguishing Systems	NFPA 12
g.	Standard for Water Spray Fixed Systems for	NFPA 15

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S. NO.	DESCRIPTION	STANDARDS / CODES
	Fire Protection	
h.	Standard for Dry Chemical Extinguishing Systems	NFPA 17
i.	Standard on Clean Agent Fire Extinguishing Systems	NFPA- 2001
j.	Codes for Fire Fighting Equipment's	BIS
k.	Process Licensors requirement, if any	
l.	Client specific requirement, if any	

3.3 STATUTORY PROVISIONS

a. Petroleum Rules (for Hydrocarbon Storage under Chief Controller of Explosives of PESO)

b. Petroleum and Natural Gas Regulatory Board (Technical Standards and Specifications including Safety Standards for Petroleum Refineries and Gas Processing Plants) Regulations, 2023.

c. The Static and Mobile Pressure Vessels (unfired) rules- (For Pressure Storage of gases under Chief Controller of Explosives)

d. Gas Cylinder Rules (for filling and handling of gas cylinders under Chief Controller of Explosives)

4 DESIGN PHILOSOPHY / CRITERIA – FIRE PROTECTION SYSTEM

4.1 GENERAL

This specification described below gives minimum design and functional requirements for active fire protection system. The Active Fire Protection system shall be conceived to operate both in prevention and fighting mode, depending on the relevant actions selected, either manual or automatic.

The firefighting shall be based on the following fighting agents.

i. Water (ETP Treated Water)
ii. Foam
iii. Clean Agent System
iv. DCP/CO_2

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4.2 DESIGN PHILOSOPHY

4.2.1 GENERAL

Sl. No	PHILOSOPHY
1.	The Fire protection facilities for this project shall be designed by extending the existing fire water network of refinery to cover the new facilities envisaged under Polypropylene Project of NRL.
2.	Existing Fire Protection facilities in refinery complex are already designed to fight two major fires scenarios simultaneously anywhere in the complex. However, if the water demand calculated for facilities under Polypropylene project is more than the present water demand calculated for the two major fires, then the requirement of additional pumping capacity shall be looked into.
3.	Process units, storages, utilities etc. shall be fully covered by hydrants and Monitors system as per OISD-116 / PNGRB regulations (whichever is more stringent shall be followed), design requirements, safe engineering practices and process licensor's requirements & client specific requirements.
4.	Transformers having oil capacity more than 2000 liters/10 MVA shall be provided with High velocity water spray system.
5.	Computer room, Console room, Rack room, Engg. Room, UPS room, battery room, etc. of control room shall be protected by clean agent system as per OISD /PNGRB /NFPA-2001.
6.	Hydrocarbon storage viz tanks, spheres, mounded bullets shall be protected with water spray systems as applicable. Further foam systems and automatic actuated rim seal protection as per OISD / PNGRB standards for Hydrocarbon storages shall be considered.
7.	Fire protection facilities will be based on following: a. Monitoring and Alarm by alerting, locating fire and operating advise b. Detection of fire and toxic gas c. Action by water/ foam/ CO_2/ Clean agent/ DCP d. Communication system (As per Electrical EDB) e. Actuation system (As per Electrical & Instrumentation EDB) f. Portable Fire Fighting equipment g. Mobile Fire Fighting equipment h. First Aid Fire Fighting equipment

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4.2.2 DESIGN CRITERIA FOR VARIOUS FACILITIES IN PROCESS UNIT HANDLING FLAMMABLE/COMBUSTIBLE FLUIDS

S. No	DESCRIPTION	PHILOSOPHY
1.	Water Application Rate for process unit (General)	As per OISD-116/PNGRB
	a. Pumps handling petroleum products Class 'A' under pipe racks b. Pumps handling products above auto-ignition temperature under pipe racks.	Water spray system as per OISD-116 / PNGRB & process licensor's requirement.
	a. Vessel: Un-insulated vessels having liquid holdup capacity larger than 50 m^3 and containing class A or B flammable liquid. b. Vessel inaccessible to Fire Tender/mobile equipment, fire hydrant.	Water spray system as per OISD-116 / PNGRB & process licensor's requirement.
	c. Air Fin Coolers for Hydrocarbon services located above Pipe rack /Elevated location	Water spray system as per OISD-116 / PNGRB.
	d. Columns and Reactors of height more than 45 m	Water spray system as per OISD-116 /PNGRB & as per process licensor's requirement.
	e. Compressor (Hydrocarbon & Hydrogen)	Water Spray system as per OISD-116 / PNGRB.
	f. Dry Risers	Elevated platforms/ Tall towers
	g. Landing Valves	On technological structures/Building Stairs.

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S. No	DESCRIPTION	PHILOSOPHY
2.	Hose Reels	With each landing valves & at every 40m distance along pipe rack (If internal fire water header is provided).
3.	TEAL Handling area	Automatic DCP flooding system as per NFPA 17
4.	Peroxide building & peroxide preparation area	Water Fog system as per NFPA 750
5.	First Aid Equipment.	As per OISD / PNGRB standards.
6.	Water Monitors and Hydrants	As per OISD / PNGRB standards & additionally hydrant at every 30m distance along pipe rack (If internal fire water header is provided).
7.	High-volume long-range variable flow Water cum Foam Monitor (Manual/Remote Operated)	As per OISD-116 / PNGRB (boosting arrangement shall be provided if adequate pressure is not available) Elevated HVLRM shall be provided to protect column more than 30 m height. MOV of Remote operated HVLRM shall be accessible form Grade.

4.2.3 DESIGN CRITERIA FOR VARIOUS PROCESS FACILITIES IN OFFSITE

S. No	DESCRIPTION	PHILOSOPHY
1.	Hydrocarbon Storage Tanks	
	a. Fixed Water Spray system	Not Applicable
	b. Foam system	Not Applicable
2.	Pressurized storages (Bullets, Mounded Bullets etc.)	
	Automatic Deluge system	As per OISD-116 / PNGRB
3.	Transformers (Individual oil capacity	Automatic deluge system (High

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S. No	DESCRIPTION	PHILOSOPHY
	more than 2000 liters/10 MVA).	Velocity Water Spray (HVWS) fire protection system)
4.	a. Buildings & Other Miscellaneous Structures	As per PNGRB & OISD
	b. Multi storied buildings at first floor and above at sub-stations with cellars	Landing valves & Hose Reel
	c. Polypropylene product warehouse & workshop	Sprinkler system as per NFPA-13 and internal hydrant system.
	d. First Aid Equipment's	As per OISD / PNGRB standards
	e. Process Control room/SRR	Clean agent system as per NFPA-2001 and Portable extinguishers as per OISD- 116 / PNGRB
	f. Equipment (acoustic enclosure-based compressor/ Turbine etc)	CO_2 flooding system as per NFPA-12.
	g. C4 and light ends and hydrogen pressure storage vessels Pressurized storages including LPG or Hydrogen	Automatic water spray system (as per OISD-116)/ Process requirement /Licensor requirement

4.3 FIRE WATER SUPPLY AND STORAGE

S. No.	DESCRIPTION	PHILOSOPHY
1.	Supply	Existing supply network of refinery
2.	Storage capacity	Existing Storage of Refinery

4.4 FIRE WATER PUMP HOUSE

Existing fire water pump house in refinery area shall supply the fire water to Polypropylene project facilities area.

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4.5 FIRE WATER PUMPS

MAIN PUMPS AND JOCKEY PUMPS

1.	Capacity	Existing.
2.	Type	Existing

4.6 FIRE WATER NETWORK SYSTEM

4.6.1 SYSTEM DESCRIPTION

S. No	PHILOSOPHY
1.	Fire water network shall be installed in a closed loop.
2.	The Ring main network shall be laid on sleepers 300 to 500 mm above FGL and shall not be laid along with process piping on common sleepers. Flushing connection with isolation valve and pressure gauge points shall be provided at critical locations.
3.	Around PP unit multiple entry point for manpower and machinery to the plant area to be ensured as per project requirement and fire water to be kept underground at these locations. At remaining locations Fire water to be kept above ground. In offsite and utilities areas fire water headers shall be laid above ground, on independent sleepers. Refer General Civil Design Basis for underground piping in plant area and underground portions in offsite area.
4.	The minimum header size for hydrant and monitor branches shall be as under:
	Hydrant connection -4” Hydrant with pumper connection-6”
	Water Monitor/Foam Monitor connection -6”
	Long Range Monitor Connection -8”/10”
	Minimum Size of Network: 10”- Utility area and Non plant building area. 14”- Process area.
5.	At least 10% of all welded joints shall be radio-graphed and at least 50% of welded joints selected for radiography shall be field joints.

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S. No	PHILOSOPHY
6.	Above ground fire water piping shall be painted as per OISD/PNGRB painting specification.
7.	All fire water networks should be hydro tested to a pressure of 27.3 kg/cm^2(g) as per existing network philosophy.

4.6.2 NETWORK SIZING

S. No	PHILOSOPHY
1.	The Fire water network shall be designed by extending fire water network to cover the new facilities envisaged. For this ring main for the new facilities shall be extended by taking tapping from the existing network and hydraulics of that section will be checked.
2.	Fire water network shall be designed as per OISD-116 / PNGRB requirements.
3.	Firewater demand shall be calculated as per OISD-116/PNGRB/Licensor requirement.
4.	Fire water main network shall be analyzed for 120% of design water rate using "PIPENET" software. The velocity in the system should not exceed 5 m/sec. with minimum residual pressure at hydraulically remotest point as 7 kg/sq.cm(g).

4.6.3 ISOLATION VALVES

S. No	PHILOSOPHY
1.	Isolation valves shall be provided at crossings (Junctions) to ensure easy maintenance and uninterrupted water supply in case of break down (as per OISD-116 / PNGRB).
2.	Isolation valve shall also be provided below monitors and hydrants. Isolation valves shall be provided for all landing valves in technical structures/buildings.
3.	Isolation valve shall be provided at all tapping points on firewater header.
4.	Additional isolation valves shall be provided in segments where length of

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S. No	PHILOSOPHY
	segment exceeds 300 m.
5.	Only carbon steel valves shall be used. No cast iron valves shall be used. All valves for fire water system shall be Gate Valve with open or closed indication and shall be of rising spindle type. Proper approach & operating platform for operation of isolation valve shall be provided.

4.6.4 RESTRICTION ORIFICE (RO)

S. No	PHILOSOPHY
1.	RO shall be provided at each hydrant outlet & at each Landing valve outlet to reduce the pressure to 7kg/sq.cm(g) wherever required.
2.	RO shall be provided at tapping of fire water MV spray system and HV spray system shall be provided to keep the system pressure within range of 1.4 to 3.5 bar(g) and 3.5 to 5.0 bar(g) respectively

4.7 FIRE FIGHTING EQUIPMENT

4.7.1 GENERAL

Hydrants or water monitors shall be located keeping in view the fire hazards at different sections of premises to be located and to give most effective coverage.

4.7.2 HYDRANTS

a) Hydrants shall be provided at 30 m of external perimeter of process units, storage tank areas, Gantry area, hydrocarbon pumping station/ house, blending station etc. and one hydrant at every 45 m of external perimeter of utilities & Non-Plant Building area.

   One variable flow monitor shall be provided in between two hydrants along the process plant and utility area.

b) Hydrants shall be located at a minimum distance of 15 m from the periphery of storage tanks or hazardous equipment under protection. In case of buildings this distance shall not be less than 5 m and more than 15 m from the face of building

c) Double headed Hydrants (Size on 6” stand post) around the tanks shall be provided with 4” pumper connection. Hydrants shall be generally located with branch

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connection and not directly over main header along road side berms for easy accessibility as far as possible.

d) At all other locations in the network double headed hydrants with two separate landing valves (Type A) with instantaneous female coupling of 2 1/2 " size on 4" stand post shall be used. All Hydrant outlets shall be situated at a workable height of about 1.2 m above ground level.

4.7.3 HYDRANT AT LANDING (LANDING VALVES)

Double headed landing valves (Two numbers of Type A as per IS: 5290) shall be provided on the landings of first floor and above at each landing levels on all the buildings/ technological structures/ platforms with stairs.

Hydrant shall be BIS approved with following detail -

S. No	DESCRIPTION	REQUIREMENT
1.	Outlet	63 mm double headed (with two separate landing valves (Type A as per IS:5290)
2.	Type	Oblique angle type
3.	Inlet /Standpost Pipe size	4"/6"
4.	Capacity	900 lpm each valve
5.	Outlet Valves MOC	SS-316
6.	Standpost	Carbon Steel (As per PMS)
7.	Landing valve Mating flange size with standpost	3"

4.7.4 HOSE CABINET AND HOSE REEL

Hose cabinet shall be installed at every alternate hydrant point and every landing valve. Two nos. hoses 15m long each shall be kept in each hose cabinet. Hose cabinet shall be installed for every Hydrant below pipe rack in process units. Hoses shall be Non-Percolating Flexible Fire Fighting Delivery Hose as per IS 636 (Type-III).

1.	Hose Box	
	a. Type	Type II as per EIL specification

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	b. Hose Size	63 mm & 15 m long
2.	Hose reel	
	a. Length	40 m
	b. Bore size	25 mm

Note: Hose reel (Type B) shall be considered inside plant area along pipe rack only.

4.7.5 MONITORS

Water Cum Foam Monitors shall be located at strategic locations for protection of cluster of columns, heaters, gassifiers and other high structures, where it may not be possible to approach the higher levels. A minimum of two monitors shall be provided for each such area. Monitors should not be installed less than 15 m from hazardous equipment to be protected.

S. No	DESCRIPTION	REQUIREMENT
1.	Capacity	500-750-1000 US GPM (Variable Flow)
2.	Nozzle Type	Non-aspirating type with arrangement of jet and spray (aqua fog)

4.7.6 FIXED REMOTE/MANUAL OPERATED HIGH VOLUME WATER CUM FOAM MONITORS

Min. two nos. of Remote / Manual operated high-volume long-range water cum foam monitors shall be variable flow type, with foam induction to monitor being possible from minimum 60 m distance from the monitor and shall be provided in

1. Inaccessible areas such as column, reactor and compressor house in Process Units.
2. Critical equipments at higher locations (above 30 m.)
3. HVLRs to be located such that throw of the monitors is safely delivered at the aimed object. Location of monitors shall not exceed 45 m from the hazard to be protected.
4. Tank Farm area

S. No	DESCRIPTION	REQUIREMENT
a.	Capacity	500-750-1000 US GPM (Variable Flow) and above

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S. No	DESCRIPTION	REQUIREMENT
b.	Nozzle Type	Non-aspirating type with arrangement of jet and spray (Aqua Fog)

Note:

i. Foam provision not required for elevated monitors located within unit as per PNGRB.

ii. Foam Feeding system without foam storage to be considered for monitor located at grade level in and around unit.

iii. Foam feeding along with foam storage tank (Delivery rates for 10 minutes) shall be considered for tank farm area only.

iv. For operation HVLRM operation located at ground level manual operation is considered.

v. Remote operated HVLRM to be considered for HVLRM located in elevated location.

4.8 FIRE WATER SPRAY SYSTEM

S. No	PHILOSOPHY
1.	Water spray system shall be provided on proposed hydrocarbon tanks, process equipment, etc. to meet the requirements of OISD / PNGRB standards. The rate of water applications & mode of operation shall be as per Sec. 4.8.1 of this document and as per process licensor's requirement.
2.	Water spray on Hydrocarbon storage tanks shall be provided with two tapping's, each for 100% flow from two different main headers. Water spray on equipment, vessel, column, air fin cooler and pumps within the process unit shall have single connection from main header for 100% flow.
3.	While providing water spray on equipment's/ vessels, Air fin coolers, columns, special care shall be taken to provide water spray on flanges of nozzle connected to equipment's/ vessels.
4.	All Spray tapping shall be taken from top instead of existing side/bottom tapping to prevent under deposit corrosion in line by stagnant water.

4.8.1 RATE OF WATER APPLICATION & MODE OF OPERATION OF WATER SPRAY SYSTEM

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A. OFFSITE

S. No	FACILITIES	MODE OF OPERATION	RATE OF APPLICATION
a.	Pressurized Hydrocarbon /Hydrogen Storage	Auto (Deluge system)	10.2 lpm/sqm

B. PROCESS UNIT HANDLING HYDROCARBON

S. NO.	FACILITIES	MODE OF OPERATION	RATE OF APPLICATION
1.	Pumps handling petroleum products class 'A' under pipe rack or above auto-ignition temperature under pipe racks	Auto (Deluge system)	20.4 lpm/sqm.
2.	Any Other equipment or pressure vessels as per licensor/designer requirements	Manual /Auto (Deluge system)	As per licensor/ designer requirements (min 10.2lpm/sqm for exposure protection of vessels)
3.	Tall column of height more than 45 m	Auto (Deluge system)	10.2 lpm/sqm.
4.	Un-insulated vessels having liquid holdup capacity larger than 50 m3 and containing class A or B flammable liquid;	Auto (Deluge system)	10.2 lpm/sqm.
5.	Air fin coolers in hydrocarbon service located above pipe racks / elevated location	. Auto (Deluge valve) upto 182 °C operating temp. of process fluid at inlet of Air fin cooler. . Manual above 182 °C operating	10.2 lpm/sqm.

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S. NO.	FACILITIES	MODE OF OPERATION	RATE OF APPLICATION
		temp. of process fluid at inlet of Air fin cooler.	
6.	Hydrocarbon /Hydrogen Compressors	Auto (Deluge system)	20.4 lpm/sqm.
7.	Uninsulated Flare KOD having any hold up capacity	Auto (Deluge system)	10.2 lpm/sqm.

NOTE: (1) All the Automatic Fire water spray system shall have manual start facility in case of failure of auto system.

4.9 MATERIAL OF CONSTRUCTION

The material of construction for fire water system shall be in line with relevant section of OISD/PNGRB.

Pipes, fittings	As per PMS
Valves and flanges	As per PMS/ VMS
Spray nozzles	Cu Alloy (UL Listed/ FM Approved)
Deluge valves	Ductile Iron (UL / FM / VDS/ LPCB Approved)
Detector piping	As per PMS
Hydrant, landing valves	Stainless steel (Grade IV as per IS:3444) (BIS Approved)
Hose Boxes and Accessories:	Type II as per EIL specification. Hose kept in hose boxes shall be fitted with stainless steel (SS 316) couplings. Jet/Spray Nozzle with branch pipe and Universal branch pipe: Stainless steel (Grade IV as per IS:3444) (BIS Approved) (gun metal/Brass parts shall not be used)

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Hose reels	Hub / Sides: Mild Steel. Hose reel valves and nozzles: Stainless steel (Grade IV as per IS:3444)
Variable Flow water monitor / water cum foam Monitors	Stainless steel (Grade IV as per IS:3444 or SS 316 (As per applicable code) (BIS approved / UL Listed/ FM Approved).
Fixed Flow water monitor	SS-316 (UL Listed/ FM Approved)

4.10 CLEAN AGENT FIRE EXTINGUISHING SYSTEM FOR CONTROL ROOM

S. NO.	PHILOSOPHY
1.	Clean agent (Inert gas) fire extinguisher system shall be provided as per NFPA- 2001 in Process control rooms and SRR buildings (both blast resistant and non-blast resistant buildings).
2.	The system shall be automatic and detection and actuation shall also meet the requirement of OISD/PNGRB/NFPA 2001.

4.11 FIRST AID FIRE FIGHTING EQUIPMENT'S

S. NO.	PHILOSOPHY
1.	Dry chemical powder (DCP) fire extinguishers- 9 kg capacity as per IS:15683. All 9 kg DCP extinguisher shall be placed inside a extinguisher cabinet of LLDPE, provided at a 750mm from finished grade level. Extinguisher to be located in process units, pump houses, pump area, LPG storage area, LPG bottling plant, Oil separator, tank truck or tank wagon loading areas, substations, Workshops, laboratory, power station buildings and like other locations. The number should be determined based on the maximum traveling distance of 15m in above areas. At least one fire extinguisher shall be provided for every 250 m2 of hazardous operating area. There shall be not less than two extinguishers at one designated location that is to say pump house.
2.	Dry chemical powder (DCP) fire extinguishers- 25/50/75 kg capacity as per IS:16018.

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S. NO.	PHILOSOPHY
	The wheeled extinguishers shall be located at strategic points near hazardous equipment such as transformer area, lube oil tank, turbine generator and hydrocarbon pumps etc. At least one fire extinguisher shall be provided for every 750 m^2 of hazardous operating area.
3.	CO_2 extinguishers- 4.5/6.5/9.0/22.5 kg capacity (IS:15683 or 16018): To be located in substations, power stations, office buildings, SRR and control rooms etc. The number of fire extinguishers shall be determined based on the maximum traveling distance of 15 m. At least one fire extinguisher shall be provided for every 250 m^2 of hazardous operating area. There shall not be less than 2nos. extinguishers at one designated location that is to say the control room.
4.	Water Mist cum Compressed Air Foam System: 50 liters trolly mounted water mist cum compressed air foam technology should be used to fight fire at critical location such as hot pumps handing fluids above auto ignition temperature.
5.	Portable Clean Agent Extinguisher System:2/4/6 kg capacity (UL Listed) To be located in substations, power stations, office buildings, SRR and control rooms etc. The number of fire extinguishers shall be determined based on the maximum traveling distance of 15 m. At least one fire extinguisher shall be provided for every 250 m^2 of hazardous operating area. There shall not be less than 2nos. extinguishers at one designated location that is to say the control room.

4.12 MOBILE FIRE FIGHTING EQUIPMENT'S

Existing Mobile firefighting equipment.

4.13 FIRE STATION

Existing fire station shall be used

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4.14 OTHER FIREFIGHTING EQUIPMENT'S

Firefighting Equipment's given below shall also be considered as per OISD-116 / PNGRB in sufficient quantity.

a. Self-Contained breathing apparatus sets for 45 minutes operation

b. Hoses - Non-Percolating Flexible Fire Fighting Delivery Hose as per IS 636 (Type-III)

c. Portable gas detectors, Emergency lighting etc.

d. Chemicals - DCP and foam compound.

e. Communication equipment - Manual call Points, Public address System, Fire siren etc.

5 SPECIFIC REQUIREMENTS

a. Powder used in DCP type Fire Extinguishers (Portable fire extinguisher shall be standardized to 9 kg stored pressure type as per IS 15683. Specification shall be approved by NRL) shall be "80 % potassium bi-carbonate (Purple K) based UL 721-p classified powder and as per the approval specification from NRL.

b. Thickness of body plate used in 9 Kg. Capacity DCP Fire extinguisher shall be minimum 2 mm. The nozzle shall be SS make with ball valve (not squeeze grip type).

c. Thickness of body plate used in 50/70 Kg. Capacity DCP Fire extinguisher shall be minimum 5 mm. The nozzle shall be SS make with ball valve.

d. Foam/water type extinguisher shall not be provided. Only DCP/CO_2 type extinguisher shall be provided. Fire extinguisher shall be stored pressure type.

e. Fire Extinguisher caps & drain cap shall be made of stainless steel.

f. Self-contained breathing apparatus sets for 45 minutes operation (35 minutes working time +10 minutes escape time), carrying harness, face mask and necessary regulator.

g. Booster pump (Electrical Driven with emergency power) shall be provided in case of wherever pressure boosting in Fire water line is required for monitor and spray only. One standby booster pump shall also be provided. Suction of booster pump to be taken from two distinct headers. Capacity of booster pumps shall be based on largest fire water spray demand or two no. of HVLRM(2000 UG GPM) in operation, whichever is higher.

h. MOC of Fire water system shall be suitable for Fresh Water & external corrosive environment.

i. Elevated HVLRM shall be provided to protect tall structure/column more than 30 m.

j. Sand filled buckets shall be provided near to transformers.

k. Multiple deluge valves in a house shall be installed on manifold of adequate size to feed all deluge valves connected to it. This manifold shall be connected to the peripheral firewater network at couple of points (Two separate header)

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l. For spray/sprinklers and foam systems: GI coated piping with flange joints in place of welding shall be used for ease of maintenance during operation. For small bore piping/fittings GI socket can be used.

m. All hydrants and monitor shall be fixed to main fire water line as per the existing practice in NRL. The operating platforms shall be provided for hydrants, monitors and isolation valves as per the requirement.

n. Tag number shall be provided for each hydrants, monitors and isolation valves in the fire network system. Drawing to be modified accordingly and to be submitted to NRL fire station.

o. Carbon dioxide extinguishers as per IS 2878/UL 154 and portable clean agent extinguishers shall be provided as OISD 116.

p. Sprinklers/spray system shall be provided with easy opening valve, suitable strainer and drain valves in sprinkler line.

q. Sprinkler/spray riser lines shall be flanged joints.

r. Tag number shall be provided in each sprinkler hook up lines.

s. All long-range monitors shall be non-aspirating type water cum foam with arrangement of jet and spray (aqua fog/foam). All HVLRM monitors with jet/fog or diffuser type shall be provided with suitable strainer on the line.

t. All isolation gate valves above 12 “size shall be gear operated valves.

u. C4 and lighter vessels spray criteria for unit also

v. List of buildings which require clean agent should be listed clearly in design basis

w. Booster pump criteria to be defined, water supply for hydrant to be included in booster pump criteria

x. C4 and lighter pumps to be included for spray requirement located anyhwere in unit and not only under piperack as specified by oisd.

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A10A** Sheet 1 of 6

PIPE CLASS : **A10A**
RATING : 150
BASE MATERIAL : CARBON STEEL
CORROSION ALLOWANCE : 1.60 MM
SPECIAL REQUIREMENT :

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP	-29	38	93	149	204	260	316	343	371
PRESS	20.03	20.03	18.28	16.17	14.06	11.95	9.84	8.78	7.73

SERVICE

NON-CORROSIVE HYDROCARBONS, PETROLEUM PRODUCTS, AROMATICS, SWEET GAS, AMMONIA, LOW-PRESSURE STEAM & CONDENSATE, FLUSHING OIL, INHIBITOR, FLARE, RAW-WATER (BEYOND A3A). THIS SPEC. SHALL BE USED ONLY IN OFF-SITES EXCEPT FOR WATER SERVICES WHERE IT AMY BE USED IN THE PROCESS UNITS AS WELL.

NOTES

7 FOR RESTRICTION ON USE OF BALL,PLUG & BUTTERFLY VALVES,REFER GENERAL NOTES.
36 THIS IS A PRESSURE BALANCED PLUG VALVES WHICH SHALL BE USED ONLY IF SPECIFIED IN P&ID.
150 THIS IS JOB SPECIFIC PIPING CLASS.
151 NDT REQUIREMENTS AS PER EIL JOB SPECIFICATION C050-6-44-0016.
152 VALVE SHALL BE PROVIDED WITH PUP PIECE.

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	1.5" & BELOW	SW COUPLING	
	2.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER JOB STD C050-7-44-0350, DF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER JOB STD. C050-7-44-0351, D4	
VENTS	ON LINES <= 1.5"	REFER JOB STD. C050-7-44-0350, VF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER JOB STD C050-7-44-0351, V4	
TEMP.CONN	1.5"	FLANGED. REFER JOB STD C050-7-44-0353	
PRESS.CONN	0.75"	SW NIPPLE WITH VALVE TO SPEC AS PER JOB STD C050-7-44-0354	

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A10A** Sheet 2 of 6

BRANCH PIPE (SIZE IN INCHES)

	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.50	4.00	5.00	6.00	8.00	10.00	12.00	14.00
84.00																
80.00																
76.00																
72.00																
70.00																
68.00																
66.00																
64.00																
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2.00						T		R		R		R	R	R	R	R
1.50					T	T		S		S		H	H	H	H	H
1.25																
1.00			T		T	S		S		H		H	H	H	H	H
0.75		T	T		T	S		H		H		H	H	H	H	H
0.50	T	T	T		T	H		H		H		H	H	H	H	H

RUN PIPE (SIZE IN INCHES)

CODE	DESCRIPTION				
F	SADDLE FUSED JT	T	TEES	J	THREADOLET
H	H.COUPLING	W	WELDOLETS	N	NIPPOLET
P	PIPE TO PIPE	I	INSTRUMENT TEE	U	UNLISTED B31.3 COMP
R	REINFORCED	X	REFER NOTES		
S	SOCKOLETS	L	SWEEPOLET		

Package : IPMCS
Report No. : 50

A10A

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Client :	**NRL**	**Dept./Sect :**	**16\43**
Project :	**PPU**		
Location :	**NUMALIGARH, ASSAM**	**Pipe Class :**	**A10A** Sheet 3 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	0.75	S160	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z0	
PIP	PIPE	1.00	1.50	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z0	
PIP	PIPE	2.00	2.00	XS	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z0	
PIP	PIPE	3.00	14.00	STD	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z0	
NIP	NIPPLE	0.50	0.75	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z0	
NIP	NIPPLE	1.00	1.50	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z0	
Flange Group									
FLG	FLNG.WN	0.50	14.00	M	B-16.5	ASTM A 105 (NORMALISED)	150, RF/125AARH	FWC0427Z0	
FLB	FLNG.BLIND	0.50	14.00		B-16.5	ASTM A 105 (NORMALISED)	150, RF/125AARH	FBC0427Z0	
FEF	FLNG.FIG.8	0.50	8.00		ASME-B16.48	ASTM A 105 (NORMALISED)	150, RF/125AARH	FGK0427Z0	
FEF	SPCR&BLND	10.00	14.00		ASME-B16.48	ASTM A 105 (NORMALISED)	150, RF/125AARH	FCK0427Z0	
Fitting Group									
ELB90	ELBOW.90	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WA605D3Z0	
ELB90	ELBOW.90	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WA605D2Z0	
ELB90	ELBOW.90	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW , 1.5D	WAG684Z10	
ELB45	ELBOW.45	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WB605D3Z0	
ELB45	ELBOW.45	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WB605D2Z0	
ELB45	ELBOW.45	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW , 1.5D	WBG684Z10	
TEQ	T.EQUAL	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WE605D3Z0	
TEQ	T.EQUAL	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WE605D2Z0	
TEQ	T.EQUAL	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ0	

Package : IPMCS
Report No. : 50

A10A

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A10A** Sheet 4 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
TRED	T.RED	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WR605D3Z0	
TRED	T.RED	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WR605D2Z0	
TRED	T.RED	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ0	
REDC	REDUC.CONC	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ0	
REDE	REDUC.ECC	2.00	14.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ0	
SWGC	SWAGE.CONC	0.50	3.00	M, M	BS-3799	ASTM A 105 (NORMALISED)	PBE	WNH056ZZ0	
SWGE	SWAGE.ECC	0.50	3.00	M, M	BS-3799	ASTM A 105 (NORMALISED)	PBE	WPH056ZZ0	
CAP	CAP	2.00	14.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ0	
CPLF	CPLNG.FULL	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WJ605D3Z0	
CPLF	CPLNG.FULL	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WJ605D2Z0	
CPLH	CPLNG.HALF	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WK605D3Z0	
CPLH	CPLNG.HALF	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WK605D2Z0	
CPLL	CPLNG.LH	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WL605D3Z0	
CPLL	CPLNG.LH	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WL605D2Z0	
CPLR	CPLNG.RED	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WM605D3Z0	
CPLR	CPLNG.RED	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WM605D2Z0	
Olet Group									
SLT	SOCKOLET	0.50	0.75		MSS-SP97	ASTM A 105 (NORMALISED)	SW, 6000	YSS05D3Z0	
SLT	SOCKOLET	1.00	1.50		MSS-SP97	ASTM A 105 (NORMALISED)	SW, 3000	YSS05D2Z0	
Valves Group									

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A10A** Sheet 5 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Valves Group									
GAV	VLV.GATE	0.50	1.50		API-602	ASTM A105 (NORMALIZED), TRIM-STELLITED,STEM-13% CR.STEEL	SW, 800, 3000, B-16.11, SHT NO. -510AA	510AAZZZ0	
GAV	VLV.GATE	2.00	24.00		API-600	BODY-ASTM A 216 GR.WCB, TRIM-STELLITED,STEM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-513AA	513AAZZZ0	
GLV	VLV.GLOBE	0.50	1.50		API-602	ASTM A105 (NORMALIZED), TRIM-STELLITED,STEM-13% CR.STEEL	SW, 800, 3000, B-16.11, SHT NO. -520AA	520AAZZZ0	
GLV	VLV.GLOBE	2.00	16.00		API-623	BODY-ASTM A 216 GR.WCB, TRIM-STELLITED,STEM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-523AA	523AAZZZ0	
CHV	VLV.CHECK	0.50	1.50		API-602	ASTM A105 (NORMALIZED), TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO. -530AA	530AAZZZ0	
CHV	VLV.CHECK	2.00	24.00		API-594	BODY-ASTM A 216 GR.WCB, TRIM-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-533AA	533AAZZZ0	
BFV	VLV.BTRFLY	3.00	24.00		API-609	BODY-ASTM A 216 GR.WCB, TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-563AA	563AAZZZ0	
Bolt Group									
BOS	BOLT.STUD	0.50	14.00		B-18.2	BOLT:A193 GR.B7, NUT: A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	0.50	14.00		B-16.20-ANSI B16.5	SP.WND SS316L+GRAFIL+ I RING	SPIRAL, 150	GK66372Z0	
Trap/Strainer Group									
TSR	STRNR.TEMP	1.50	14.00		EIL'STD	B:A516GR.70 (NORM);INT:SS316L	CONETYPE , 150,FF/125AARH	ST1O831Z0	
PSR	STRNR.PERM	0.50	1.50		MNF'STD	B:A105(NORMALIZED);INT:SS316L	SW, Y-TYPE, 800	SP3E9D510	
PSR	STRNR.PERM	2.00	14.00	M	EIL'STD	B:A234GR.WPB;INT:SS316L	BW, T-TYPE	SP14044Z0	

Package : IPMCS
Report No. : 50

A10A

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A10A** Sheet 6 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A1N** Sheet 1 of 4

PIPE CLASS : **A1N**
RATING : 150
BASE MATERIAL : SS 316L
CORROSION ALLOWANCE : 0.00 MM
SPECIAL REQUIREMENT :

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP	-29	38	93	149	204	260	316	343	371
PRESS	16.17	16.17	13.71	12.3	11.24	10.54	9.84	8.78	7.73

SERVICE

MILD TO MODERATE CORROSIVE PROCESS SERVICES - FLAMMABLE/NON FLAMMABLE & NON LETHAL.

NOTES

7 FOR RESTRICTION ON USE OF BALL,PLUG & BUTTERFLY VALVES,REFER GENERAL NOTES.
102 ALL MATERIAL IN THIS PIPING CLASS SHALL BE DUAL GRADE (SS316/SS316L) CERTIFIED. CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES OF BOTH GRADES SPECIFIED SHALL BE ENSURED.
150 THIS IS JOB SPECIFIC PIPING CLASS.
151 NDT REQUIREMENTS AS PER EIL JOB SPECIFICATION C050-6-44-0016.
152 VALVE SHALL BE PROVIDED WITH PUP PIECE.

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	ALL	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER JOB STD C050-7-44-0350, DF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER JOB STD. C050-7-44-0351, D4	
VENTS	ON LINES <= 1.5"	REFER JOB STD. C050-7-44-0350, VF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER JOB STD C050-7-44-0351, V4	
TEMP.CONN	1.5"	FLANGED. REFER JOB STD C050-7-44-0353	
PRESS.CONN	0.75"	SW NIPPLE WITH VALVE TO SPEC AS PER JOB STD C050-7-44-0354	

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Client	**NRL**	**Dept./Sect :**	**16\43**
Project	**PPU**		
Location	**NUMALIGARH, ASSAM**	**Pipe Class :**	**A1N** Sheet 2 of 4

BRANCH PIPE (SIZE IN INCHES)

	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.50	4.00
84.00										
80.00										
76.00										
72.00										
70.00										
68.00										
66.00										
64.00										
62.00										
60.00										
58.00										
56.00										
54.00										
52.00										
50.00										
48.00										
46.00										
44.00										
42.00										
40.00										
38.00										
36.00										
34.00										
32.00										
30.00										
28.00										
26.00										
24.00										
22.00										
20.00										
18.00										
16.00										
14.00										
12.00										
10.00										
8.00										
6.00										
5.00										
4.00										T
3.50										
3.00								T		T
2.50										
2.00						T		R		R
1.50					T	T		W		W
1.25										
1.00			T		T	W		W		W
0.75		T	T		T	W		W		W
0.50	T	T	T		T	W		W		W

RUN PIPE (SIZE IN INCHES)

CODE	DESCRIPTION				
F	SADDLE FUSED JT	T	TEES	J	THREADOLET
H	H.COUPLING	W	WELDOLETS	N	NIPPOLET
P	PIPE TO PIPE	I	INSTRUMENT TEE	U	UNLISTED B31.3 COMP
R	REINFORCED	X	REFER NOTES		
S	SOCKOLETS	L	SWEEPOLET		

Package : IPMCS
Report No. : 50

A1N

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Client :	**NRL**	**Dept./Sect :**	**16\43**
Project :	**PPU**		
Location :	**NUMALIGARH, ASSAM**	**Pipe Class :**	**A1N** Sheet 3 of 4

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	0.75	80S	B-36.19	ASTM A 312 TP316L	BE, SEAMLESS	PI34017Z0	
PIP	PIPE	1.00	1.50	40S	B-36.19	ASTM A 312 TP316L	BE, SEAMLESS	PI34017Z0	
PIP	PIPE	2.00	2.00	40S	B-36.19	ASTM A 312 TP316L	BE, SEAMLESS	PI34017Z0	
PIP	PIPE	3.00	4.00	10S	B-36.19	ASTM A 312 TP316L	BE, SEAMLESS	PI34017Z0	
NIP	NIPPLE	0.50	0.75	M	B-36.19	ASTM A 312 TP316L	PBE, SEAMLESS	PN34067Z0	
NIP	NIPPLE	1.00	1.50	M	B-36.19	ASTM A 312 TP316L	PBE, SEAMLESS	PN34067Z0	
Flange Group									
FLG	FLNG.WN	0.50	4.00	M	B-16.5	ASTM A 182 GR.F316L	150, RF/125AARH	FWC4627Z0	
FLB	FLNG.BLIND	0.50	4.00		B-16.5	ASTM A 182 GR.F316L	150, RF/125AARH	FBC4627Z0	
FEF	FLNG.FIG.8	0.50	4.00		ASME-B16.48	ASTM A 182 GR.F316L	150, RF/125AARH	FGK4627Z0	
Fitting Group									
ELB90	ELBOW.90	0.50	4.00	M	B-16.9	ASTM A 403 GR.WP316L-S	BW , 1.5D	WAGA34Z10	
ELB45	ELBOW.45	0.50	4.00	M	B-16.9	ASTM A 403 GR.WP316L-S	BW , 1.5D	WBGA34Z10	
TEQ	T.EQUAL	0.50	4.00	M	B-16.9	ASTM A 403 GR.WP316L-S	BW	WEGA34ZZ0	
TRED	T.RED	0.50	4.00	M, M	B-16.9	ASTM A 403 GR.WP316L-S	BW	WRGA34ZZ0	
REDC	REDUC.CONC	0.50	4.00	M, M	B-16.9	ASTM A 403 GR.WP316L-S	BW	WUGA34ZZ0	
REDE	REDUC.ECC	0.50	4.00	M, M	B-16.9	ASTM A 403 GR.WP316L-S	BW	WVGA34ZZ0	
CAP	CAP	0.50	4.00	M	B-16.9	ASTM A 403 GR.WP316L-S	BW	WFGA34ZZ0	
Olet Group									
WLT	WELDOLET	0.50	1.50	M, M	MSS-SP97	ASTM A 182 GR.F316L	BW	YWS474ZZ0	
Valves Group									

Package : IPMCS
Report No. : 50

A1N

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A1N** Sheet 4 of 4

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Valves Group									
GAV	VLV.GATE	0.50	1.50		API-602	BODY-ASTM A 182 GR.F316L, TRIM-STELLITED,STEM-SS 316L	BW, 150, B-16.25, SHT NO.-51921	51921ZZZ0	
GLV	VLV.GLOBE	0.50	1.50		API-602	BODY-ASTM A 182 GR.F316L, TRIM-STELLITED,STEM-SS 316L	BW, 150, B-16.25, SHT NO.-52921	52921ZZZ0	
CHV	VLV.CHECK	0.50	1.50		API-602	BODY-ASTM A 182 GR.F316L, TRIM-STELLITED	BW, 150, B-16.25, SHT NO.-53921	53921ZZZ0	
CHV	VLV.CHECK	2.00	4.00		API-594	BODY-ASTM A 351 GR.CF3M, TRIM-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-533DM	533DMZZZ0	
BLV	VLV.BALL	0.50	1.50		API-608	BODY-ASTM A 182 GR.F316L, TRIM-BODY SEAT : RPTFE	BW, 150, B-16.25, SHT NO.-54921	54921ZZZ0	152
BLV	VLV.BALL	2.00	4.00		API-608	BODY-ASTM A 351 GR.CF3M / ASTM A 182 GR.F316L, TRIM-BODY SEAT : RPTFE	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-543DM	543DMZZZ0	
Bolt Group									
BOS	BOLT.STUD	0.50	4.00		B-18.2	BOLT:A193 GR.B7, NUT: A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	0.50	4.00		B-16.20-ANSI B16.5	SP.WND SS316L+GRAFIL+ I RING	SPIRAL, 150	GK66372Z0	
Trap/Strainer Group									
TSR	STRNR.TEMP	1.50	4.00		EIL'STD	B:A240TP316L;INT:SS316L	CONETYPE , 150,FF/125AARH	ST14331Z0	
PSR	STRNR.PERM	0.50	1.50	M	MNF'STD	B:A182GR.F316L;INT:SS316L	BW, Y-TYPE	SP31645Z0	
PSR	STRNR.PERM	2.00	4.00	M	EIL'STD	B:A403WP316L-S;I:SS316L	BW, T-TYPE	SP15944Z0	

Package : IPMCS
Report No. : 50

A1N

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A2A** Sheet 1 of 6

PIPE CLASS : **A2A**
RATING : 150
BASE MATERIAL : CARBON STEEL
CORROSION ALLOWANCE : 1.60 MM
SPECIAL REQUIREMENT : IBR SERVICE

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP	0	38	93	149	204	260	280	300	371
PRESS	20.03	20.03	18.28	16.17	14.06	11.95	11.19	10.44	7.73

SERVICE

STEAM (IBR), BOILER FEED WATER (IBR) & CONDENSATE (IBR)

NOTES

7 FOR RESTRICTION ON USE OF BALL,PLUG & BUTTERFLY VALVES,REFER GENERAL NOTES.

8 ALL PIPES,FITTINGS,VALVES,FLANGES,TRAPS AND STRAINERS SHALL BE TESTED AND TEST CERTIFICATE IN FORM III A FOR PIPE AND FORM III C FOR OTHERS SHALL BE REQD. DULY COUNTERSIGNED BY IBR AUTHORITY OR ITS APPROVED REPRESENTATIVE.

9 CARBON CONTENT SHALL NOT EXCEED 0.25% FOR ALL PIPES,FITTINGS FLANGES ETC. THAT MAY REQUIRE WELDING. MOREOVER,FOR FLANGES THE SULPHUR AND PHOSPHOROUS SHALL ALSO BE LIMITED TO 0.05% EACH.

150 THIS IS JOB SPECIFIC PIPING CLASS.

151 NDT REQUIREMENTS AS PER EIL JOB SPECIFICATION C050-6-44-0016.

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	1.5" & BELOW	SW COUPLING	
	2.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER JOB STD C050-7-44-0350, DF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER JOB STD. C050-7-44-0351, D4	
VENTS	ON LINES <= 1.5"	REFER JOB STD. C050-7-44-0350, VF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER JOB STD C050-7-44-0351, V4	
TEMP.CONN	1.5"	FLANGED. REFER JOB STD C050-7-44-0353	
PRESS.CONN	0.75"	SW NIPPLE WITH VALVE TO SPEC AS PER JOB STD C050-7-44-0354	

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Client	**NRL**	**Dept./Sect :**	**16\43**
Project	**PPU**		
Location	**NUMALIGARH, ASSAM**	**Pipe Class :**	**A2A** Sheet 2 of 6

BRANCH PIPE (SIZE IN INCHES)

	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.50	4.00	5.00	6.00	8.00	10.00
84.00														
80.00														
76.00														
72.00														
70.00														
68.00														
66.00														
64.00														
62.00														
60.00														
58.00														
56.00														
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22.00														
20.00														
18.00														
16.00														
14.00														
12.00														
10.00														T
8.00													T	T
6.00												T	T	R
5.00														
4.00										T		T	R	R
3.50														
3.00								T		T		R	R	R
2.50														
2.00						T		R		R		R	R	R
1.50					T	T		S		S		H	H	H
1.25														
1.00			T		T	S		S		H		H	H	H
0.75		T	T		T	S		H		H		H	H	H
0.50	T	T	T		T	H		H		H		H	H	H

RUN PIPE (SIZE IN INCHES)

CODE	DESCRIPTION				
F	SADDLE FUSED JT	T	TEES	J	THREADOLET
H	H.COUPLING	W	WELDOLETS	N	NIPPOLET
P	PIPE TO PIPE	I	INSTRUMENT TEE	U	UNLISTED B31.3 COMP
R	REINFORCED	X	REFER NOTES		
S	SOCKOLETS	L	SWEEPOLET		

Package : IPMCS
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A2A

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A2A** Sheet 3 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	0.75	S160	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z1	
PIP	PIPE	1.00	1.50	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z1	
PIP	PIPE	2.00	2.00	XS	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	
PIP	PIPE	3.00	10.00	STD	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z1	
NIP	NIPPLE	0.50	0.75	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z1	
NIP	NIPPLE	1.00	1.50	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z1	
Flange Group									
FLG/300	FLNG.SW	0.50	1.50	M	B-16.5	ASTM A 105 (NORMALISED)	300, RF/125AARH	FSC0447Z1	
FLG	FLNG.WN	0.50	1.50	M	B-16.5	ASTM A 105 (NORMALISED)	150, RF/125AARH	FWC0427Z1	
FLG	FLNG.WN	2.00	10.00	M	B-16.5	ASTM A 105 (NORMALISED)	150, RF/125AARH	FWC0427Z1	
FLG/600	FLNG.WN	2.00	2.00	M	B-16.5	ASTM A 105 (NORMALISED)	600, RF/125AARH	FWC0467Z1	
FLG/300	FLNG.WN	2.00	10.00	M	B-16.5	ASTM A 105 (NORMALISED)	300, RF/125AARH	FWC0447Z1	
FLB	FLNG.BLIND	0.50	10.00		B-16.5	ASTM A 105 (NORMALISED)	150, RF/125AARH	FBC0427Z1	
FEF	FLNG.FIG.8	0.50	8.00		ASME-B16.48	ASTM A 105 (NORMALISED)	150, RF/125AARH	FGK0427Z1	
FEF	SPCR&BLND	10.00	10.00		ASME-B16.48	ASTM A 105 (NORMALISED)	150, RF/125AARH	FCK0427Z1	
Fitting Group									
ELB90	ELBOW.90	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WA605D3Z1	
ELB90	ELBOW.90	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WA605D2Z1	
ELB90	ELBOW.90	2.00	10.00	M	B-16.9	ASTM A 234 GR.WPB	BW , 1.5D	WAG684Z11	
ELB45	ELBOW.45	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WB605D3Z1	
ELB45	ELBOW.45	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WB605D2Z1	

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A2A** Sheet 4 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
ELB45	ELBOW.45	2.00	10.00	M	B-16.9	ASTM A 234 GR.WPB	BW , 1.5D	WBG684Z11	
TEQ	T.EQUAL	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WE605D3Z1	
TEQ	T.EQUAL	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WE605D2Z1	
TEQ	T.EQUAL	2.00	10.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ1	
TRED	T.RED	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WR605D3Z1	
TRED	T.RED	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WR605D2Z1	
TRED	T.RED	2.00	10.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ1	
REDC	REDUC.CONC	2.00	10.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ1	
REDE	REDUC.ECC	2.00	10.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ1	
SWGC	SWAGE.CONC	0.50	3.00	M, M	BS-3799	ASTM A 105 (NORMALISED)	PBE	WNH056ZZ1	
SWGE	SWAGE.ECC	0.50	3.00	M, M	BS-3799	ASTM A 105 (NORMALISED)	PBE	WPH056ZZ1	
CAP	CAP	2.00	10.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ1	
CPLF	CPLNG.FULL	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WJ605D3Z1	
CPLF	CPLNG.FULL	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WJ605D2Z1	
CPLH	CPLNG.HALF	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WK605D3Z1	
CPLH	CPLNG.HALF	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WK605D2Z1	
CPLL	CPLNG.LH	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WL605D3Z1	
CPLL	CPLNG.LH	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WL605D2Z1	
CPLR	CPLNG.RED	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WM605D3Z1	

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A2A** Sheet 5 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
CPLR	CPLNG.RED	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WM605D2Z1	
Olet Group									
SLT	SOCKOLET	0.50	0.75		MSS-SP97	ASTM A 105 (NORMALISED)	SW, 6000	YSS05D3Z1	
SLT	SOCKOLET	1.00	1.50		MSS-SP97	ASTM A 105 (NORMALISED)	SW, 3000	YSS05D2Z1	
Valves Group									
GAV	VLV.GATE	0.50	1.50		API-602	ASTM A105 (NORMALIZED), TRIM-STELLITED,STEM-13% CR.STEEL	SW, 800, 3000, B-16.11, SHT NO. -510HC	510HCZZZ1	
GAV	VLV.GATE	2.00	10.00		API-600	BODY-ASTM A 216 GR.WCB, TRIM-13%CR.STEEL, SEATS-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-513HC	513HCZZZ1	
GLV	VLV.GLOBE	0.50	1.50		API-602	ASTM A105 (NORMALIZED), TRIM-STELLITED,STEM-13% CR.STEEL	SW, 800, 3000, B-16.11, SHT NO. -520HC	520HCZZZ1	
GLV	VLV.GLOBE	2.00	10.00		API-623	BODY-ASTM A 216 GR.WCB, TRIM-13%CR.STEEL, SEATS-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-523HC	523HCZZZ1	
CHV	VLV.CHECK	0.50	1.50		API-602	ASTM A105 (NORMALIZED), TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO. -530HC	530HCZZZ1	
CHV	VLV.CHECK	2.00	10.00		API-594	BODY-ASTM A 216 GR.WCB, TRIM-13%CR.STEEL, SEATS-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-533HC	533HCZZZ1	
NDV	VLV.NEEDLE	0.75	0.75		API-602	ASTM A105 (NORMALIZED), TRIM-STELLITED,STEM-13% CR.STEEL	SW, 800, 3000, B-16.11, SHT NO. -580HC	580HCZZZ1	
G3V	VLV.PISTON	0.50	1.00		MNF'STD	ASTM A105 (NORMALIZED), TRIM-13% CR.STEEL	SW, 800, 3000, B-16.11, SHT NO. -640HC	640HCZZZ1	
Bolt Group									

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Client :	**NRL**	**Dept./Sect :**	**16\43**
Project :	**PPU**		
Location :	**NUMALIGARH, ASSAM**	**Pipe Class :**	**A2A** Sheet 6 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Bolt Group									
BOS	BOLT.STUD	0.50	10.00		B-18.2	BOLT:A193 GR.B7, NUT: A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	0.50	10.00		B-16.20-ANSI B16.5	SP.WND SS316L+GRAFIL+ I RING	SPIRAL, 150	GK66372Z0	
GAS/600	GASKET	2.00	2.00		B-16.20-ANSI B16.5	SP.WND SS316L+GRAFIL+ I RING	SPIRAL, 600	GK66376Z0	
GAS/300	GASKET	0.50	10.00		B-16.20-ANSI B16.5	SP.WND SS316L+GRAFIL+ I RING	SPIRAL, 300	GK66374Z0	
Trap/Strainer Group									
TRP	TRAP.STEAM	0.50	1.50		MNF'STD	B:A105 (NORM);T:13%CR;S: SS316L	FLGD, THRMDNMC , 150,RF/125AARH	TR3O75531	

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A3A** Sheet 1 of 6

PIPE CLASS : **A3A**
RATING : 150
BASE MATERIAL : CARBON STEEL
CORROSION ALLOWANCE : 1.60 MM
SPECIAL REQUIREMENT :

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP	0	38	50	65	100	150	180
PRESS	10.55	10.55	10.55	10.55	10.55	10.55	10.55

SERVICE

NON-CORROSIVE UTILITIES (ABOVE-GROUND), RAW-WATER, INSTRUMENT AIR (2" & ABOVE), PLANT AIR, INERT GAS, NITROGEN. CATEGORY -D FLUID.

NOTES

86 BUTTERFLY VALVES FOR THE SPEC ARE PN10 RATED WITH A MAXIMUM PRESSURE OF 10.2 KG/CM2G.
150 THIS IS JOB SPECIFIC PIPING CLASS.
151 NDT REQUIREMENTS AS PER EIL JOB SPECIFICATION C050-6-44-0016.

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	1.5" & BELOW	SW COUPLING	
	2.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER JOB STD C050-7-44-350, DF3	
	ON LINES >= 2.0"	0.75" OR AS PER P&ID. REFER JOB STD. C050-7-44-351, D4	
VENTS	ON LINES <= 1.5"	REFER JOB STD. C050-7-44-350, VC1	
	ON LINES >= 2.0"	0.75" OR AS PER P&ID. REFER JOB STD C050-7-44-351, V1	
TEMP.CONN	1.5"	FLANGED. REFER JOB STD C050-7-44-353	
PRESS.CONN	0.75"	WITH GATE VALVE TO SPEC AS PER JOB STD C050-7-44-354	

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Client	**NRL**	**Dept./Sect :**	**16\43**
Project	**PPU**		
Location	**NUMALIGARH, ASSAM**	**Pipe Class :**	**A3A** Sheet 2 of 6

BRANCH PIPE (SIZE IN INCHES)

	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.50	4.00	5.00	6.00	8.00	10.00
84.00														
80.00														
76.00														
72.00														
70.00														
68.00														
66.00														
64.00														
62.00														
60.00														
58.00														
56.00														
54.00														
52.00														
50.00														
48.00														
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44.00														
42.00														
40.00														
38.00														
36.00														
34.00														
32.00														
30.00														
28.00														
26.00														
24.00														
22.00														
20.00														
18.00														
16.00														
14.00														
12.00														
10.00														T
8.00													T	T
6.00												T	T	R
5.00														
4.00										T		T	R	R
3.50														
3.00								T		T		R	R	R
2.50														
2.00						T		R		R		R	R	R
1.50					T	T		S		S		H	H	H
1.25														
1.00			T		T	S		S		H		H	H	H
0.75		T	T		T	S		H		H		H	H	H
0.50	T	T	T		T	H		H		H		H	H	H

RUN PIPE (SIZE IN INCHES)

CODE	DESCRIPTION				
F	SADDLE FUSED JT	T	TEES	J	THREADOLET
H	H.COUPLING	W	WELDOLETS	N	NIPPOLET
P	PIPE TO PIPE	I	INSTRUMENT TEE	U	UNLISTED B31.3 COMP
R	REINFORCED	X	REFER NOTES		
S	SOCKOLETS	L	SWEEPOLET		

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A3A** Sheet 3 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	1.50	HVY	IS-1239-I	IS-1239 (BLACK)	PE, C.WELDED	PI6D471Z0	
PIP	PIPE	2.00	6.00	HVY	IS-1239-I	IS-1239 (BLACK)	BE, C.WELDED	PI6D411Z0	
PIP	PIPE	8.00	10.00	6.0	IS-3589	IS-3589 GR.330	BE, WELDED	PI7D919Z0	
NIP	NIPPLE	0.50	0.50	S160	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z0	
NIP	NIPPLE	0.75	1.50	XS	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z0	
Flange Group									
FLG/300	FLNG.SW	1.50	1.50	XS	B-16.5	ASTM A 105 (NORMALISED)	300, RF/125AARH	FSC0447Z0	
FLG	FLNG.WN	0.75	1.50	XS	B-16.5	ASTM A 105 (NORMALISED)	150, RF/125AARH	FWC0427Z0	
FLG	FLNG.WN	2.00	6.00	STD	B-16.5	ASTM A 105 (NORMALISED)	150, RF/125AARH	FWC0427Z0	
FLG	FLNG.WN	8.00	10.00	M	B-16.5	ASTM A 105 (NORMALISED)	150, RF/125AARH	FWC0427Z0	
FLB	FLNG.BLIND	0.50	10.00		B-16.5	ASTM A 105 (NORMALISED)	150, RF/125AARH	FBC0427Z0	
FEF	FLNG.FIG.8	0.50	8.00		ASME-B16.48	ASTM A 105 (NORMALISED)	150, RF/125AARH	FGK0427Z0	
FEF	SPCR&BLND	10.00	10.00		ASME-B16.48	ASTM A 105 (NORMALISED)	150, RF/125AARH	FCK0427Z0	
Fitting Group									
ELB90	ELBOW.90	0.50	0.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WA605D3Z0	
ELB90	ELBOW.90	0.75	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WA605D2Z0	
ELB90	ELBOW.90	2.00	6.00	STD	B-16.9	ASTM A 234 GR.WPB	BW , 1.5D	WAG684Z10	
ELB90	ELBOW.90	8.00	10.00	M	B-16.9	ASTM A 234 GR.WPB	BW , 1.5D	WAG684Z10	
ELB45	ELBOW.45	0.50	0.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WB605D3Z0	
ELB45	ELBOW.45	0.75	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WB605D2Z0	
ELB45	ELBOW.45	2.00	6.00	STD	B-16.9	ASTM A 234 GR.WPB	BW , 1.5D	WBG684Z10	

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A3A** Sheet 4 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
ELB45	ELBOW.45	8.00	10.00	M	B-16.9	ASTM A 234 GR.WPB	BW , 1.5D	WBG684Z10	
TEQ	T.EQUAL	0.50	0.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WE605D3Z0	
TEQ	T.EQUAL	0.75	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WE605D2Z0	
TEQ	T.EQUAL	2.00	6.00	STD	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ0	
TEQ	T.EQUAL	8.00	10.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ0	
TRED	T.RED	0.50	0.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WR605D3Z0	
TRED	T.RED	0.75	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WR605D2Z0	
TRED	T.RED	2.00	6.00	STD, STD	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ0	
TRED	T.RED	8.00	10.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ0	
REDC	REDUC.CONC	2.00	6.00	STD, STD	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ0	
REDC	REDUC.CONC	8.00	10.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WUG684ZZ0	
REDE	REDUC.ECC	2.00	6.00	STD, STD	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ0	
REDE	REDUC.ECC	8.00	10.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WVG684ZZ0	
SWGC	SWAGE.CONC	0.75	1.50	XS, XS	MSS-SP95	ASTM A 105 (NORMALISED)	PBE	WNZ056ZZ0	
SWGC	SWAGE.CONC	2.00	3.00	STD, STD	MSS-SP95	ASTM A 105 (NORMALISED)	PBE	WNZ056ZZ0	
SWGE	SWAGE.ECC	0.75	1.50	XS, XS	MSS-SP95	ASTM A 105 (NORMALISED)	PBE	WPZ056ZZ0	
SWGE	SWAGE.ECC	2.00	3.00	STD, STD	MSS-SP95	ASTM A 105 (NORMALISED)	PBE	WPZ056ZZ0	
CAP	CAP	0.50	1.50		B-16.11	ASTM A 105 (NORMALISED)	SCRF, 3000	WF60582Z0	
CAP	CAP	2.00	6.00	STD	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ0	

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A3A** Sheet 5 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
CAP	CAP	8.00	10.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ0	
CPLF	CPLNG.FULL	0.50	0.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WJ605D3Z0	
CPLF	CPLNG.FULL	0.75	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WJ605D2Z0	
CPLH	CPLNG.HALF	0.50	0.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WK605D3Z0	
CPLH	CPLNG.HALF	0.75	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WK605D2Z0	
CPLL	CPLNG.LH	0.50	0.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WL605D3Z0	
CPLL	CPLNG.LH	0.75	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WL605D2Z0	
CPLR	CPLNG.RED	0.50	0.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WM605D3Z0	
CPLR	CPLNG.RED	0.75	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 3000	WM605D2Z0	
Olet Group									
SLT	SOCKOLET	0.50	0.50		MSS-SP97	ASTM A 105 (NORMALISED)	SW, 6000	YSS05D3Z0	
SLT	SOCKOLET	0.75	1.50		MSS-SP97	ASTM A 105 (NORMALISED)	SW, 3000	YSS05D2Z0	
Valves Group									
GAV	VLV.GATE	0.50	1.50		API-602	ASTM A105 (NORMALIZED), TRIM-STELLITED,STEM-13% CR.STEEL	SW, 800, 3000, B-16.11, SHT NO. -510AA	510AAZZZ0	
GAV	VLV.GATE	2.00	10.00		API-600	BODY-ASTM A 216 GR.WCB, TRIM-STELLITED,STEM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-513DA	513DAZZZ0	
GLV	VLV.GLOBE	0.50	1.50		API-602	ASTM A105 (NORMALIZED), TRIM-STELLITED,STEM-13% CR.STEEL	SW, 800, 3000, B-16.11, SHT NO. -520AA	520AAZZZ0	
GLV	VLV.GLOBE	2.00	10.00		API-623	BODY-ASTM A 216 GR.WCB, TRIM-STELLITED,STEM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-523DA	523DAZZZ0	

Package : IPMCS
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A3A

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A3A** Sheet 6 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Valves Group									
CHV	VLV.CHECK	0.50	1.50		API-602	ASTM A105 (NORMALIZED), TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO. -530AA	530AAZZZ0	
CHV	VLV.CHECK	2.00	10.00		API-594	BODY-ASTM A 216 GR.WCB, TRIM-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-533DA	533DAZZZ0	
Bolt Group									
BOS	BOLT.STUD	0.50	10.00		B-18.2	BOLT:A193 GR.B7, NUT: A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	0.50	10.00		B-16.20-ANSI B16.5	SP.WND SS316L+GRAFIL+ I RING	SPIRAL, 150	GK66372Z0	
GAS/300	GASKET	1.50	1.50		B-16.20-ANSI B16.5	SP.WND SS316L+GRAFIL+ I RING	SPIRAL, 300	GK66374Z0	
Trap/Strainer Group									
TSR	STRNR.TEMP	2.00	10.00		EIL'STD	B:A516GR.70 (NORM);INT:SS316L	CONETYPE , 150,FF/125AARH	ST1O831Z0	
PSR	STRNR.PERM	0.50	1.50		MNF'STD	B:A105(NORMALIZED);INT:SS316L	SW, Y-TYPE, 800	SP3E9D510	
PSR	STRNR.PERM	2.00	6.00	STD	EIL'STD	B:A234GR.WPB;INT:SS316L	BW, T-TYPE	SP14044Z0	
PSR	STRNR.PERM	8.00	10.00	M	EIL'STD	B:A234GR.WPB;INT:SS316L	BW, T-TYPE	SP14044Z0	

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Client :	**NRL**	**Dept./Sect :**	**16\43**
Project :	**PPU**		
Location :	**NUMALIGARH, ASSAM**	**Pipe Class :**	**A3AL** Sheet 1 of 9

PIPE CLASS : **A3AL**
RATING : 150
BASE MATERIAL : CS(INT.COATED)
CORROSION ALLOWANCE : 1.60 MM
SPECIAL REQUIREMENT :

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP	0	38	50	65	100	150	180
PRESS	10.55	10.55	10.55	10.55	10.55	10.55	10.55

SERVICE

ABOVE-GROUND COOLING WATER SERVICES. CATEGORY-D SERVICE.
(DESIGN PRESSURE: <= 10.5 KG/CM2 AND DESIGN TEMPERATURE: <= 180 °C).

NOTES

18 FOR SIZES ABOVE 30", TEMPERATURE AND PRESSURE RATINGS SHALL BE 70 DEG.C & 8 KG/CM2G RESPECTIVELY.
86 BUTTERFLY VALVES FOR THE SPEC ARE PN10 RATED WITH A MAXIMUM PRESSURE OF 10.2 KG/CM2G.
151 NDT REQUIREMENTS AS PER EIL JOB SPECIFICATION C050-6-44-0016.
155 FOR SIZES > 24", SPACER & BLIND SHALL BE DESIGNED BY THE MANUFACTURER AS PER ASME B31.3.
174 ALL PIPING ITEMS (4" & ABOVE) SHALL BE INTERNALLY EPOXY COATED.

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	3" & BELOW	SCREWED	
	4.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER JOB STD C050-7-44-350, DF3	
	ON LINES >= 2.0"	0.75" OR AS PER P&ID. REFER JOB STD. C050-7-44-351, D4	
VENTS	ON LINES <= 1.5"	REFER JOB STD. C050-7-44-350, VC1	
	ON LINES >= 2.0"	0.75" OR AS PER P&ID. REFER JOB STD C050-7-44-351, V1	
TEMP.CONN	1.5"	FLANGED. REFER JOB STD C050-7-44-353	
PRESS.CONN	0.75"	WITH GATE VALVE TO SPEC AS PER JOB STD C050-7-44-354	

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Client :	**NRL**	**Dept./Sect :**	**16\43**
Project :	**PPU**		
Location :	**NUMALIGARH, ASSAM**	**Pipe Class :**	**A3AL** Sheet 2 of 9

BRANCH PIPE (SIZE IN INCHES)

	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.50	4.00	5.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	22.00	24.00	26.00	28.00	30.00	32.00	34.00	36.00	38.00	40.00	42.00	44.00	46.00	48.00	50.00	52.00
84.00																																			
80.00																																			
76.00																																			
72.00																																			
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50.00																																			
48.00																																	T		T
46.00																																T	T		R
44.00																																			
42.00																														T		T	R		R
40.00																													T	T		R	R		R
38.00																												T	T	T		R	R		R
36.00																											T	T	T	R		R	R		R
34.00																										T	T	T	R	R		R	R		R
32.00																									T	T	T	R	R	R		R	R		R
30.00																								T	T	T	R	R	R	R		R	R		R
28.00																							T	T	T	R	R	R	R	R		R	R		R
26.00																						T	T	T	R	R	R	R	R	R		R	R		R
24.00																					T	T	T	R	R	R	R	R	R	R		R	R		R
22.00																																			
20.00																			T		T	T	R	R	R	R	R	R	R	R		R	R		R
18.00																		T	T		T	R	R	R	R	R	R	R	R	R		R	R		R
16.00																	T	T	T		R	R	R	R	R	R	R	R	R	R		R	R		R
14.00																T	T	T	T		R	R	R	R	R	R	R	R	R	R		R	R		R
12.00															T	T	T	R	R		R	R	R	R	R	R	R	R	R	R		R	R		R
10.00														T	T	T	R	R	R		R	R	R	R	R	R	R	R	R	R		R	R		R
8.00													T	T	T	R	R	R	R		R	R	R	R	R	R	R	R	R	R		R	R		R
6.00												T	T	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R		R	R		R
5.00																																			
4.00										T		T	R	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R		R	R		R
3.50																																			
3.00								T		J		J	J	J	J	J	J	J	J		J	J	J	J	J	J	J	J	J	J		J	J		J
2.50																																			
2.00						T		J		J		J	J	J	J	J	J	J	J		J	J	J	J	J	J	J	J	J	J		J	J		J
1.50					T	T		J		J		H	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H		H	H		H
1.25																																			
1.00			T		T	J		J		H		H	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H		H	H		H
0.75		T	T		T	J		H		H		H	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H		H	H		H
0.50	T	T	T		T	H		H		H		H	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H		H	H		H

RUN PIPE (SIZE IN INCHES)

CODE	DESCRIPTION				
F	SADDLE FUSED JT	**T**	TEES	**J**	THREADOLET
H	H.COUPLING	**W**	WELDOLETS	**N**	NIPPOLET
P	PIPE TO PIPE	**I**	INSTRUMENT TEE	**U**	UNLISTED B31.3 COMP
R	REINFORCED	**X**	REFER NOTES		
S	SOCKOLETS	**L**	SWEEPOLET		

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A3AL

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A3AL** Sheet 3 of 9

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	1.50	HVY	IS-1239-I	IS-1239 (BLACK) (GALV.)	SCRM, C.WELDED	PI6BQ91Z0	
PIP	PIPE	2.00	3.00	HVY	IS-1239-I	IS-1239 (BLACK) (GALV.)	SCRM, C.WELDED	PI6BQ91Z0	
PIP	PIPE	4.00	6.00	HVY	IS-1239-I	IS-1239 (BLACK) (EPOXY COATED)	BE, C.WELDED	PI6S511Z0	
PIP	PIPE	8.00	14.00	6.0	IS-3589	IS-3589 GR.330(EPOXY COATED)	BE, WELDED	PI7BP19Z0	
PIP	PIPE	16.00	18.00	8.0	IS-3589	IS-3589 GR.330(EPOXY COATED)	BE, WELDED	PI7BP19Z0	
PIP	PIPE	20.00	24.00	10.0	IS-3589	IS-3589 GR.330(EPOXY COATED)	BE, WELDED	PI7BP19Z0	
PIP	PIPE	26.00	48.00	12.0	IS-3589	IS-3589 GR.330(EPOXY COATED)	BE, WELDED	PI7BP19Z0	
PIP	PIPE	50.00	52.00	14.0	IS-3589	IS-3589 GR.330(EPOXY COATED)	BE, WELDED	PI7BP19Z0	
NIP	NIPPLE	0.50	0.50	S160	B-36.10	ASTM A 106 GR.B(GALV)	TBE, SEAMLESS	PN222E7Z0	
NIP	NIPPLE	0.75	1.50	XS	B-36.10	ASTM A 106 GR.B(GALV)	TBE, SEAMLESS	PN222E7Z0	
Flange Group									
FLG	FLNG.SCRD	0.50	3.00		B-16.5	ASTM A 105 N (GALV.)	150, FF/125AARH	FTCL621Z0	
FLG/300	FLNG.SCRD	1.50	2.00		B-16.5	ASTM A 105 N (GALV.)	300, RF/125AARH	FTCL647Z0	
FLG	FLNG.WN	4.00	6.00	STD	B-16.5	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FWCL821Z0	
FLG	FLNG.WN	8.00	24.00	M	B-16.5	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FWCL821Z0	
FLG	FLNG.WN	26.00	52.00	M	B-16.47-B	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FWBL821Z0	
FLG/300	FLNG.WN	28.00	28.00	M	B-16.47-B	ASTM A105 N (EPOXY COATED)	300, RF/125AARH	FWBL847Z0	

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Report No. : 50

A3AL

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Client :	**NRL**	**Dept./Sect :**	**16\43**
Project :	**PPU**		
Location :	**NUMALIGARH, ASSAM**	**Pipe Class :**	**A3AL** Sheet 4 of 9

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Flange Group									
FLG/300	FLNG.WN	20.00	20.00	M	B-16.5	ASTM A105 N (EPOXY COATED)	300, RF/125AARH	FWCL847Z0	
FLB	FLNG.BLIND	0.50	3.00		B-16.5	ASTM A 105 N (GALV.)	150, FF/125AARH	FBCL621Z0	
FLB	FLNG.BLIND	4.00	24.00		B-16.5	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FBCL821Z0	
FLB	FLNG.BLIND	26.00	52.00		B-16.47-B	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FBBL821Z0	
FEF	FLNG.FIG.8	0.50	3.00		ASME-B16.48	ASTM A 105 N (GALV.)	150, FF/125AARH	FGKL621Z0	
FEF	FLNG.FIG.8	4.00	8.00		ASME-B16.48	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FGKL821Z0	
FEF	SPCR&BLND	10.00	24.00		ASME-B16.48	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FCKL821Z0	
FEF	SPCR&BLND	26.00	48.00		MNF'STD	ASTM A516GR.70 N(EPOXY COATED)	150, FF/125AARH	FCGL921Z0	155
Fitting Group									
ELB90	ELBOW.90	0.50	0.50		B-16.11	ASTM A 105 N (GALV.)	SCRF, 6000	WA6CT83Z0	
ELB90	ELBOW.90	0.75	3.00		B-16.11	ASTM A 105 N (GALV.)	SCRF, 3000	WA6CT82Z0	
ELB90	ELBOW.90	4.00	6.00	STD	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW , 1.5D	WAGBL4Z10	
ELB90	ELBOW.90	8.00	18.00	M	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW , 1.5D	WAGBL4Z10	
ELB90	ELBOW.90	20.00	48.00	M	B-16.9	A234 GR WPB-W(INT:EPOXY CTD)	BW , 1.5D	WAGBN4Z10	
ELB90	ELBOW.90	50.00	52.00	M	MSS-SP75	A234 GR WPB-W(INT:EPOXY CTD)	BW , 1.5D	WAUBN4Z10	
ELB45	ELBOW.45	0.50	0.50		B-16.11	ASTM A 105 N (GALV.)	SCRF, 6000	WB6CT83Z0	
ELB45	ELBOW.45	0.75	3.00		B-16.11	ASTM A 105 N (GALV.)	SCRF, 3000	WB6CT82Z0	
ELB45	ELBOW.45	4.00	6.00	STD	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW , 1.5D	WBGBL4Z10	

Package : IPMCS
Report No. : 50

A3AL

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A3AL** Sheet 5 of 9

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
ELB45	ELBOW.45	8.00	18.00	M	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW , 1.5D	WBGBL4Z10	
ELB45	ELBOW.45	20.00	48.00	M	B-16.9	A234 GR WPB-W(INT:EPOXY CTD)	BW , 1.5D	WBGBN4Z10	
ELB45	ELBOW.45	50.00	52.00	M	MSS-SP75	A234 GR WPB-W(INT:EPOXY CTD)	BW , 1.5D	WBUBN4Z10	
TEQ	T.EQUAL	0.50	0.50		B-16.11	ASTM A 105 N (GALV.)	SCRF, 6000	WE6CT83Z0	
TEQ	T.EQUAL	0.75	3.00		B-16.11	ASTM A 105 N (GALV.)	SCRF, 3000	WE6CT82Z0	
TEQ	T.EQUAL	4.00	6.00	STD	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WEGBL4ZZ0	
TEQ	T.EQUAL	8.00	18.00	M	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WEGBL4ZZ0	
TEQ	T.EQUAL	20.00	48.00	M	B-16.9	A234 GR WPB-W(INT:EPOXY CTD)	BW	WEGBN4ZZ0	
TEQ	T.EQUAL	50.00	52.00	M	MSS-SP75	A234 GR WPB-W(INT:EPOXY CTD)	BW	WEUBN4ZZ0	
TRED	T.RED	0.50	0.50		B-16.11	ASTM A 105 N (GALV.)	SCRF, 6000	WR6CT83Z0	
TRED	T.RED	0.75	3.00		B-16.11	ASTM A 105 N (GALV.)	SCRF, 3000	WR6CT82Z0	
TRED	T.RED	4.00	6.00	STD, STD	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WRGBL4ZZ0	
TRED	T.RED	8.00	18.00	M, M	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WRGBL4ZZ0	
TRED	T.RED	20.00	48.00	M, M	B-16.9	A234 GR WPB-W(INT:EPOXY CTD)	BW	WRGBN4ZZ0	
TRED	T.RED	50.00	52.00	M, M	MSS-SP75	A234 GR WPB-W(INT:EPOXY CTD)	BW	WRUBN4ZZ0	

Package : IPMCS
Report No. : 50

A3AL

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Client	**: NRL**	**Dept./Sect :**	**16\43**
Project	**: PPU**		
Location	**: NUMALIGARH, ASSAM**	**Pipe Class :**	**A3AL** Sheet 6 of 9

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
REDC	REDUC.CONC	4.00	6.00	STD, STD	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WUGBL4ZZ0	
REDC	REDUC.CONC	8.00	18.00	M, M	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WUGBL4ZZ0	
REDC	REDUC.CONC	20.00	48.00	M, M	B-16.9	A234 GR WPB-W(INT:EPOXY CTD)	BW	WUGBN4ZZ0	
REDC	REDUC.CONC	50.00	52.00	M, M	MSS-SP75	A234 GR WPB-W(INT:EPOXY CTD)	BW	WUUBN4ZZ0	
REDE	REDUC.ECC	4.00	6.00	STD, STD	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WVGBL4ZZ0	
REDE	REDUC.ECC	8.00	18.00	M, M	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WVGBL4ZZ0	
REDE	REDUC.ECC	20.00	48.00	M, M	B-16.9	A234 GR WPB-W(INT:EPOXY CTD)	BW	WVGBN4ZZ0	
REDE	REDUC.ECC	50.00	52.00	M, M	MSS-SP75	A234 GR WPB-W(INT:EPOXY CTD)	BW	WVUBN4ZZ0	
SWGC	SWAGE.CONC	0.75	1.50	XS, XS	MSS-SP95	ASTM A 105 N (GALV.)	TBE	WNZCTEZZ0	
SWGC	SWAGE.CONC	2.00	3.00	STD, STD	MSS-SP95	ASTM A 105 N (GALV.)	TBE	WNZCTEZZ0	
SWGE	SWAGE.ECC	0.75	1.50	XS, XS	MSS-SP95	ASTM A 105 N (GALV.)	TBE	WPZCTEZZ0	
SWGE	SWAGE.ECC	2.00	3.00	STD, STD	MSS-SP95	ASTM A 105 N (GALV.)	TBE	WPZCTEZZ0	
CAP	CAP	0.50	0.50		B-16.11	ASTM A 105 N (GALV.)	SCRF, 6000	WF6CT83Z0	
CAP	CAP	0.75	3.00		B-16.11	ASTM A 105 N (GALV.)	SCRF, 3000	WF6CT82Z0	
CAP	CAP	4.00	6.00	STD	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WFGBL4ZZ0	

Package : IPMCS
Report No. : 50

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A3AL** Sheet 7 of 9

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
CAP	CAP	8.00	48.00	M	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WFGBL4ZZ0	
CPLF	CPLNG.FULL	0.50	0.50		B-16.11	ASTM A 105 N (GALV.)	SCRF, 6000	WJ6CT83Z0	
CPLF	CPLNG.FULL	0.75	3.00		B-16.11	ASTM A 105 N (GALV.)	SCRF, 3000	WJ6CT82Z0	
CPLH	CPLNG.HALF	0.50	0.50		B-16.11	ASTM A 105 N (GALV.)	SCRF, 6000	WK6CT83Z0	
CPLH	CPLNG.HALF	0.75	3.00		B-16.11	ASTM A 105 N (GALV.)	SCRF, 3000	WK6CT82Z0	
CPLL	CPLNG.LH	0.50	0.50		B-16.11	ASTM A 105 N (GALV.)	SCRF, 6000	WL6CT83Z0	
CPLL	CPLNG.LH	0.75	3.00		B-16.11	ASTM A 105 N (GALV.)	SCRF, 3000	WL6CT82Z0	
CPLR	CPLNG.RED	0.50	0.50		B-16.11	ASTM A 105 N (GALV.)	SCRF, 6000	WM6CT83Z 0	
CPLR	CPLNG.RED	0.75	3.00		B-16.11	ASTM A 105 N (GALV.)	SCRF, 3000	WM6CT82Z 0	
Olet Group									
TLT	THREADOLE T	0.50	0.50		MSS-SP97	ASTM A 105 N (GALV.)	SCRF, 6000	YTSCT83Z0	
TLT	THREADOLE T	0.75	3.00		MSS-SP97	ASTM A 105 N (GALV.)	SCRF, 3000	YTSCT82Z0	
Valves Group									
GAV	VLV.GATE	0.50	1.50		API-602	BODY-ASTM A 105-N (GALV.), TRIM-STELLITED,S TEM-13% CR.STEEL	SCRF, 800, 3000, B-1.20.1, SHT NO.-510TD	510TDZZZ0	
GAV	VLV.GATE	2.00	3.00		API-600	BODY-ASTM A 216 GR.WCB(GALV.), TRIM-STELLITED,S TEM-13% CR.STEEL	FLGD, 150, B-16.5, FF/125AARH, SHT NO.-513TD	513TDZZZ0	
GAV	VLV.GATE	4.00	24.00		API-600	BODY-ASTM A 216 GR.WCB (EPOXY COATED), TRIM-STELLITED,S TEM-13% CR.STEEL	FLGD, 150, B-16.5, FF/125AARH, SHT NO.-513UD	513UDZZZ0	

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A3AL** Sheet 8 of 9

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Valves Group									
GLV	VLV.GLOBE	0.50	1.50		API-602	BODY-ASTM A 105-N (GALV.), TRIM-STELLITED,STEM-13% CR.STEEL	SCRF, 800, 3000, B-1.20.1, SHT NO.-520TD	520TDZZZ0	
GLV	VLV.GLOBE	2.00	3.00		API-623	BODY-ASTM A 216 GR.WCB(GALV.), TRIM-STELLITED,STEM-13% CR.STEEL	FLGD, 150, B-16.5, FF/125AARH, SHT NO.-523TD	523TDZZZ0	
GLV	VLV.GLOBE	4.00	16.00		API-623	ASTM A 216 GR.WCB (INTERNALLY EPOXY COATED), TRIM-STELLITED,STEM-13% CR.STEEL	FLGD, 150, B-16.5, FF/125AARH, SHT NO.-523UD	523UDZZZ0	
CHV	VLV.CHECK	0.50	1.50		API-602	BODY-ASTM A 105-N (GALV.), TRIM-STELLITED	SCRF, 800, 3000, B-1.20.1, SHT NO.-530TD	530TDZZZ0	
CHV	VLV.CHECK	2.00	3.00		API-594	BODY-ASTM A 216 GR.WCB(GALV.), TRIM-STELLITED	FLGD, 150, B-16.5, FF/125AARH, SHT NO.-533TD	533TDZZZ0	
CHV	VLV.CHECK	4.00	24.00		API-594	ASTM A 216 GR.WCB (INTERNALLY EPOXY COATED), TRIM-STELLITED	FLGD, 150, B-16.5, FF/125AARH, SHT NO.-533UD	533UDZZZ0	
BFV	VLV.BTRFLY	3.00	3.00		API-609	BODY-ASTM A 216 GR.WCB(GALV.), TRIM-13% CR.STEEL	WAFL, 150, B-16.5, FF/125AARH, SHT NO.-563TD	563TDZZZ0	
BFV	VLV.BTRFLY	4.00	24.00		API-609	ASTM A 216 GR.WCB (INTERNALLY EPOXY COATED), TRIM-13% CR.STEEL	WAFL, 150, B-16.5, FF/125AARH, SHT NO.-563UD	563UDZZZ0	
BFV	VLV.BTRFLY	26.00	48.00		API-609	ASTM A 216 GR.WCB (INTERNALLY EPOXY COATED), TRIM-13% CR.STEEL	FLGD, 150, B-16.47 B, FF/125AARH, SHT NO.-563VD	563VDZZZ0	
Bolt Group									

Package : IPMCS
Report No. : 50

A3AL

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Client :	**NRL**	**Dept./Sect :**	**16\43**
Project :	**PPU**		
Location :	**NUMALIGARH, ASSAM**	**Pipe Class :**	**A3AL** Sheet 9 of 9

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Bolt Group									
BOS	BOLT.STUD	0.50	52.00		B-18.2	BOLT:A193 GR.B7, NUT: A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	0.50	24.00		B-16.21-ANSI B16.5	EPDM	FULLFACE, 150, 3 MM	GKBEX22Z0	
GAS	GASKET	26.00	52.00		B-16.21-ANSI B16.47B	EPDM	FULLFACE, 150, 3 MM	GKAEX22Z0	
GAS/300	GASKET	28.00	28.00		B-16.20-ANSI B16.47B	SP.WND SS316L+GRAFIL+ I RING	SPIRAL, 300	GK56374Z0	
GAS/300	GASKET	20.00	20.00		B-16.20-ANSI B16.5	SP.WND SS316L+GRAFIL+ I RING	SPIRAL, 300	GK66374Z0	
GAS/300	GASKET	1.50	2.00		B-16.20-ANSI B16.5	SP.WND SS316L+GRAFIL+ I RING	SPIRAL, 300	GK66374Z0	
Trap/Strainer Group									
TSR	STRNR.TEMP	2.00	24.00		EIL'STD	B:A516GR.70 (NORM);INT:SS316L	CONETYPE , 150,FF/125AARH	ST1O831Z0	
PSR	STRNR.PERM	0.50	1.50		MNF'STD	B:A105-N (GALV);INT:SS316L	SCRF, Y-TYPE, 800	SP3P48510	
PSR	STRNR.PERM	4.00	6.00	STD	EIL'STD	B:A234GR.WPB(CT D);INT:SS316L	BW, T-TYPE	SP1P644Z0	
PSR	STRNR.PERM	8.00	18.00	M	EIL'STD	B:A234GR.WPB(CT D);INT:SS316L	BW, T-TYPE	SP1P644Z0	
PSR	STRNR.PERM	20.00	24.00	M	EIL'STD	B:A234GR.WPB-W(CTD);INT:SS316L	BW, T-TYPE	SP1P744Z0	

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A3ALU** Sheet 1 of 6

PIPE CLASS : **A3ALU**
RATING : 150
BASE MATERIAL : CS(INT.COATED)
CORROSION ALLOWANCE : 1.60 MM
SPECIAL REQUIREMENT :

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP	0	38	50	65	100
PRESS	10.55	10.55	10.55	10.55	10.55

SERVICE

UNDER-GROUND COOLING WATER SERVICES. CATEGORY-D SERVICE.

NOTES

18 FOR SIZES ABOVE 30", TEMPERATURE AND PRESSURE RATINGS SHALL BE 70 DEG.C & 8 KG/CM2G RESPECTIVELY.
86 BUTTERFLY VALVES FOR THE SPEC ARE PN10 RATED WITH A MAXIMUM PRESSURE OF 10.2 KG/CM2G.
151 NDT REQUIREMENTS AS PER EIL JOB SPECIFICATION C050-6-44-0016.
155 FOR SIZES > 24", SPACER & BLIND SHALL BE DESIGNED BY THE MANUFACTURER AS PER ASME B31.3.
174 ALL PIPING ITEMS (4" & ABOVE) SHALL BE INTERNALLY EPOXY COATED.
175 ALL BURIED PIPING SHALL BE EXTERNALLY COATED.
178 PIPE WALL THICKNESS ARE BASED ON SOIL PARAMETERS AND BURIAL DEPTH OF 2500 MM. MINIMUM SOIL COVER FROM TOP OF PIPE FOR U/G PIPING SHALL BE 0.6M (0.5"-24.0" SIZE), 0.8M (26.0"-36.0" SIZE), 1.0M (40.0"-52.0" SIZE).

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	4.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER JOB STD C050-7-44-350, DF3	
	ON LINES >= 2.0"	0.75" OR AS PER P&ID. REFER JOB STD. C050-7-44-351, D4	
VENTS	ON LINES <= 1.5"	REFER JOB STD. C050-7-44-350, VC1	
	ON LINES >= 2.0"	0.75" OR AS PER P&ID. REFER JOB STD C050-7-44-351, V1	
TEMP.CONN	1.5"	FLANGED. REFER JOB STD C050-7-44-353	
PRESS.CONN	0.75"	WITH GATE VALVE TO SPEC AS PER JOB STD C050-7-44-354	

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A3ALU** Sheet 2 of 6

BRANCH PIPE (SIZE IN INCHES)

	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.50	4.00	5.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	22.00	24.00	26.00	28.00	30.00	32.00	34.00	36.00	38.00	40.00	42.00	44.00	46.00	48.00	50.00	52.00
84.00																																			
80.00																																			
76.00																																			
72.00																																			
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52.00																																			T
50.00																																			
48.00																																	T		R
46.00																																T	R		R
44.00																																			
42.00																														T		R	R		R
40.00																													T	R		R	R		R
38.00																												T	R	R		R	R		R
36.00																											T	R	R	R		R	R		R
34.00																										T	R	R	R	R		R	R		R
32.00																									T	R	R	R	R	R		R	R		R
30.00																								T	R	R	R	R	R	R		R	R		R
28.00																							T	R	R	R	R	R	R	R		R	R		R
26.00																						T	R	R	R	R	R	R	R	R		R	R		R
24.00																					T	R	R	R	R	R	R	R	R	R		R	R		R
22.00																																			
20.00																			T		R	R	R	R	R	R	R	R	R	R		R	R		R
18.00																		T	R		R	R	R	R	R	R	R	R	R	R		R	R		R
16.00																	T	R	R		R	R	R	R	R	R	R	R	R	R		R	R		R
14.00																T	R	R	R		R	R	R	R	R	R	R	R	R	R		R	R		R
12.00															T	R	R	R	R		R	R	R	R	R	R	R	R	R	R		R	R		R
10.00														T	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R		R	R		R
8.00													T	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R		R	R		R
6.00												T	R	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R		R	R		R
5.00																																			
4.00										T		R	R	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R		R	R		R
3.50																																			
3.00																																			
2.50																																			
2.00																																			
1.50																																			
1.25																																			
1.00																																			
0.75																																			
0.50																																			

RUN PIPE (SIZE IN INCHES)

CODE	DESCRIPTION				
F	SADDLE FUSED JT	T	TEES	J	THREADOLET
H	H.COUPLING	W	WELDOLETS	N	NIPPOLET
P	PIPE TO PIPE	I	INSTRUMENT TEE	U	UNLISTED B31.3 COMP
R	REINFORCED	X	REFER NOTES		
S	SOCKOLETS	L	SWEEPOLET		

Package : IPMCS
Report No. : 50

A3ALU

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Client :	**NRL**	**Dept./Sect :**	**16\43**
Project :	**PPU**		
Location :	**NUMALIGARH, ASSAM**	**Pipe Class :**	**A3ALU** Sheet 3 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	4.00	6.00	HVY	IS-1239-I	IS-1239(BLACK),I:EPXY,E:PE CTD	BE, C.WELDED	PI6BR11Z0	
PIP	PIPE	8.00	14.00	6.0	IS-3589	IS-3589 GR.330,I:EPXY,E:PE CTD	BE, WELDED	PI7BT19Z0	
PIP	PIPE	16.00	18.00	8.0	IS-3589	IS-3589 GR.330,I:EPXY,E:PE CTD	BE, WELDED	PI7BT19Z0	
PIP	PIPE	20.00	24.00	10.0	IS-3589	IS-3589 GR.330,I:EPXY,E:PE CTD	BE, WELDED	PI7BT19Z0	
PIP	PIPE	26.00	48.00	12.0	IS-3589	IS-3589 GR.330,I:EPXY,E:PE CTD	BE, WELDED	PI7BT19Z0	
PIP	PIPE	50.00	52.00	14.0	IS-3589	IS-3589 GR.330,I:EPXY,E:PE CTD	BE, WELDED	PI7BT19Z0	
Flange Group									
FLG	FLNG.WN	4.00	6.00	STD	B-16.5	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FWCL821Z0	
FLG	FLNG.WN	8.00	24.00	M	B-16.5	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FWCL821Z0	
FLG	FLNG.WN	26.00	52.00	M	B-16.47-B	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FWBL821Z0	
FLB	FLNG.BLIND	4.00	24.00		B-16.5	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FBCL821Z0	
FLB	FLNG.BLIND	26.00	52.00		B-16.47-B	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FBBL821Z0	
FEF	FLNG.FIG.8	4.00	8.00		ASME-B16.48	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FGKL821Z0	
FEF	SPCR&BLND	10.00	24.00		ASME-B16.48	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FCKL821Z0	
FEF	SPCR&BLND	26.00	48.00		MNF'STD	ASTM A516GR.70 N(EPOXY COATED)	150, FF/125AARH	FCGL921Z0	155
Fitting Group									
ELB90	ELBOW.90	4.00	6.00	STD	B-16.9	A234GR.WPB(I:EPOXY,E:PE COATD)	BW , 1.5D	WAGCU4Z10	

Package : IPMCS
Report No. : 50

A3ALU

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A3ALU** Sheet 4 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
ELB90	ELBOW.90	8.00	18.00	M	B-16.9	A234GR.WPB(I:EPOXY,E:PE COATD)	BW , 1.5D	WAGCU4Z10	
ELB90	ELBOW.90	20.00	48.00	M	B-16.9	A234GR.WPB-W(I:EPOXY,E:PE CTD)	BW , 1.5D	WAGEG4Z10	
ELB90	ELBOW.90	50.00	52.00	M	MSS-SP75	A234GR.WPB-W(I:EPOXY,E:PE CTD)	BW , 1.5D	WAUEG4Z10	
ELB45	ELBOW.45	4.00	6.00	STD	B-16.9	A234GR.WPB(I:EPOXY,E:PE COATD)	BW , 1.5D	WBGCU4Z10	
ELB45	ELBOW.45	8.00	18.00	M	B-16.9	A234GR.WPB(I:EPOXY,E:PE COATD)	BW , 1.5D	WBGCU4Z10	
ELB45	ELBOW.45	20.00	48.00	M	B-16.9	A234GR.WPB-W(I:EPOXY,E:PE CTD)	BW , 1.5D	WBGEG4Z10	
ELB45	ELBOW.45	50.00	52.00	M	MSS-SP75	A234GR.WPB-W(I:EPOXY,E:PE CTD)	BW , 1.5D	WBUEG4Z10	
TEQ	T.EQUAL	4.00	6.00	STD	B-16.9	A234GR.WPB(I:EPOXY,E:PE COATD)	BW	WEGCU4ZZ0	
TEQ	T.EQUAL	8.00	18.00	M	B-16.9	A234GR.WPB(I:EPOXY,E:PE COATD)	BW	WEGCU4ZZ0	
TEQ	T.EQUAL	20.00	48.00	M	B-16.9	A234GR.WPB-W(I:EPOXY,E:PE CTD)	BW	WEGEG4ZZ0	
TEQ	T.EQUAL	50.00	52.00	M	MSS-SP75	A234GR.WPB-W(I:EPOXY,E:PE CTD)	BW	WEUEG4ZZ0	
TRED	T.RED	4.00	6.00	STD, STD	B-16.9	A234GR.WPB(I:EPOXY,E:PE COATD)	BW	WRGCU4ZZ0	
TRED	T.RED	8.00	18.00	M, M	B-16.9	A234GR.WPB(I:EPOXY,E:PE COATD)	BW	WRGCU4ZZ0	
TRED	T.RED	20.00	48.00	M, M	B-16.9	A234GR.WPB-W(I:EPOXY,E:PE CTD)	BW	WRGEG4ZZ0	
TRED	T.RED	50.00	52.00	M, M	MSS-SP75	A234GR.WPB-W(I:EPOXY,E:PE CTD)	BW	WRUEG4ZZ0	
REDC	REDUC.CONC	4.00	6.00	STD, STD	B-16.9	A234GR.WPB(I:EPOXY,E:PE COATD)	BW	WUGCU4ZZ0	
REDC	REDUC.CONC	8.00	18.00	M, M	B-16.9	A234GR.WPB(I:EPOXY,E:PE COATD)	BW	WUGCU4ZZ0	
REDC	REDUC.CONC	20.00	48.00	M, M	B-16.9	A234GR.WPB-W(I:EPOXY,E:PE CTD)	BW	WUGEG4ZZ0	
REDC	REDUC.CONC	50.00	52.00	M, M	MSS-SP75	A234GR.WPB-W(I:EPOXY,E:PE CTD)	BW	WUUEG4ZZ0	

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Client :	**NRL**	**Dept./Sect :**	**16\43**
Project :	**PPU**		
Location :	**NUMALIGARH, ASSAM**	**Pipe Class :**	**A3ALU** Sheet 5 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
REDE	REDUC.ECC	4.00	6.00	STD, STD	B-16.9	A234GR.WPB(I:EPOXY,E:PE COATD)	BW	WVGCU4ZZ0	
REDE	REDUC.ECC	8.00	18.00	M, M	B-16.9	A234GR.WPB(I:EPOXY,E:PE COATD)	BW	WVGCU4ZZ0	
REDE	REDUC.ECC	20.00	48.00	M, M	B-16.9	A234GR.WPB-W(I:EPOXY,E:PE CTD)	BW	WVGEG4ZZ0	
REDE	REDUC.ECC	50.00	52.00	M, M	MSS-SP75	A234GR.WPB-W(I:EPOXY,E:PE CTD)	BW	WVUEG4ZZ0	
CAP	CAP	4.00	6.00	STD	B-16.9	A234GR.WPB(I:EPOXY,E:PE COATD)	BW	WFGCU4ZZ0	
CAP	CAP	8.00	48.00	M	B-16.9	A234GR.WPB(I:EPOXY,E:PE COATD)	BW	WFGCU4ZZ0	
Valves Group									
GAV	VLV.GATE	4.00	24.00		API-600	BODY-ASTM A 216 GR.WCB (EPOXY COATED), TRIM-STELLITED,STEM-13% CR.STEEL	FLGD, 150, B-16.5, FF/125AARH, SHT NO.-513UD	513UDZZZ0	
GLV	VLV.GLOBE	4.00	16.00		API-623	ASTM A 216 GR.WCB (INTERNALLY EPOXY COATED), TRIM-STELLITED,STEM-13% CR.STEEL	FLGD, 150, B-16.5, FF/125AARH, SHT NO.-523UD	523UDZZZ0	
CHV	VLV.CHECK	4.00	24.00		API-594	ASTM A 216 GR.WCB (INTERNALLY EPOXY COATED), TRIM-STELLITED	FLGD, 150, B-16.5, FF/125AARH, SHT NO.-533UD	533UDZZZ0	
BFV	VLV.BTRFLY	4.00	24.00		API-609	ASTM A 216 GR.WCB (INTERNALLY EPOXY COATED), TRIM-13% CR.STEEL	WAFL, 150, B-16.5, FF/125AARH, SHT NO.-563UD	563UDZZZ0	
BFV	VLV.BTRFLY	26.00	48.00		API-609	ASTM A 216 GR.WCB (INTERNALLY EPOXY COATED), TRIM-13% CR.STEEL	FLGD, 150, B-16.47 B, FF/125AARH, SHT NO.-563VD	563VDZZZ0	
Bolt Group									

Package : IPMCS
Report No. : 50

A3ALU

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Client	**: NRL**	**Dept./Sect :**	**16\43**
Project	**: PPU**		
Location	**: NUMALIGARH, ASSAM**	**Pipe Class :**	**A3ALU** Sheet 6 of 6

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Bolt Group									
BOS	BOLT.STUD	4.00	52.00		B-18.2	BOLT:A193 GR.B7(GALV), NUT: A194 2H(GALV)		BS40513Z0	
Gasket Group									
GAS	GASKET	4.00	24.00		B-16.21-ANSI B16.5	EPDM	FULLFACE, 150, 3 MM	GKBEX22Z0	
GAS	GASKET	26.00	52.00		B-16.21-ANSI B16.47B	EPDM	FULLFACE, 150, 3 MM	GKAEX22Z0	
Trap/Strainer Group									
TSR	STRNR.TEMP	2.00	24.00		EIL'STD	B:A516GR.70 (NORM);INT:SS316L	CONETYPE , 150,FF/125AARH	ST1O831Z0	
PSR	STRNR.PERM	4.00	6.00	STD	EIL'STD	B:A234GR.WPB(CTD);INT:SS316L	BW, T-TYPE	SP1P644Z0	
PSR	STRNR.PERM	8.00	18.00	M	EIL'STD	B:A234GR.WPB(CTD);INT:SS316L	BW, T-TYPE	SP1P644Z0	
PSR	STRNR.PERM	20.00	24.00	M	EIL'STD	B:A234GR.WPB-W(CTD);INT:SS316L	BW, T-TYPE	SP1P744Z0	

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A6K** Sheet 1 of 4

PIPE CLASS : **A6K**
RATING : 150
BASE MATERIAL : SS 304L
CORROSION ALLOWANCE : 1.60 MM
SPECIAL REQUIREMENT :

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP	-29	38	93	149	204	260	316	343	371
PRESS	16.17	16.17	13.71	12.3	11.24	10.54	9.84	8.78	7.73

SERVICE

CORROSIVE PROCESS SERVICE - FLAMMABLE/NON FLAMMABLE, TOXIC/NON TOXIC BUT NON LETHAL - FLARE GAS, ACID GAS WITH CONDENSATE, REFLUX, CORROSIVE WATER, RICH AMINE, ETC.

NOTES

101 ALL MATERIAL IN THIS PIPING CLASS SHALL BE DUAL GRADE (SS304/SS304L) CERTIFIED. CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES OF BOTH GRADES SPECIFIED SHALL BE ENSURED.
150 THIS IS JOB SPECIFIC PIPING CLASS.
151 NDT REQUIREMENTS AS PER EIL JOB SPECIFICATION C050-6-44-0016.

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	ALL	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER JOB STD C050-7-44-0350, DF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER JOB STD. C050-7-44-0351, D4	
VENTS	ON LINES <= 1.5"	REFER JOB STD. C050-7-44-0350, VF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER JOB STD C050-7-44-0351, V4	
TEMP.CONN	1.5"	FLANGED. REFER JOB STD C050-7-44-0353	
PRESS.CONN	0.75"	SW NIPPLE WITH VALVE TO SPEC AS PER JOB STD C050-7-44-0354	

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Client	**: NRL**	**Dept./Sect :**	**16\43**
Project	**: PPU**		
Location	**: NUMALIGARH, ASSAM**	**Pipe Class :**	**A6K** Sheet 2 of 4

BRANCH PIPE (SIZE IN INCHES)

	0.50	0.75	1.00	1.25	1.50	2.00	2.50
84.00							
80.00							
76.00							
72.00							
70.00							
68.00							
66.00							
64.00							
62.00							
60.00							
58.00							
56.00							
54.00							
52.00							
50.00							
48.00							
46.00							
44.00							
42.00							
40.00							
38.00							
36.00							
34.00							
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16.00							
14.00							
12.00							
10.00							
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6.00							
5.00							
4.00							
3.50							
3.00							
2.50							
2.00						T	
1.50					T	T	
1.25							
1.00			T		T	W	
0.75		T	T		T	W	
0.50	T	T	T		T	W	

RUN PIPE (SIZE IN INCHES)

CODE	DESCRIPTION				
F	SADDLE FUSED JT	T	TEES	J	THREADOLET
H	H.COUPLING	W	WELDOLETS	N	NIPPOLET
P	PIPE TO PIPE	I	INSTRUMENT TEE	U	UNLISTED B31.3 COMP
R	REINFORCED	X	REFER NOTES		
S	SOCKOLETS	L	SWEEPOLET		

Package : IPMCS
Report No. : 50

A6K

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A6K** Sheet 3 of 4

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	0.75	80S	B-36.19	ASTM A 312 TP304L	BE, SEAMLESS	PI33717Z0	
PIP	PIPE	1.00	1.50	40S	B-36.19	ASTM A 312 TP304L	BE, SEAMLESS	PI33717Z0	
PIP	PIPE	2.00	2.00	40S	B-36.19	ASTM A 312 TP304L	BE, SEAMLESS	PI33717Z0	
NIP	NIPPLE	0.50	0.75	M	B-36.19	ASTM A 312 TP304L	PBE, SEAMLESS	PN33767Z0	
NIP	NIPPLE	1.00	1.50	M	B-36.19	ASTM A 312 TP304L	PBE, SEAMLESS	PN33767Z0	
Flange Group									
FLG	FLNG.WN	0.50	2.00	M	B-16.5	ASTM A 182 GR.F304L	150, RF/125AARH	FWC4327Z0	
FLB	FLNG.BLIND	0.50	2.00		B-16.5	ASTM A 182 GR.F304L	150, RF/125AARH	FBC4327Z0	
FEF	FLNG.FIG.8	0.50	2.00		ASME-B16.48	ASTM A 182 GR.F304L	150, RF/125AARH	FGK4327Z0	
Fitting Group									
ELB90	ELBOW.90	0.50	2.00	M	B-16.9	ASTM A 403 GR.WP304L-S	BW , 1.5D	WAG934Z10	
ELB45	ELBOW.45	0.50	2.00	M	B-16.9	ASTM A 403 GR.WP304L-S	BW , 1.5D	WBG934Z10	
TEQ	T.EQUAL	0.50	2.00	M	B-16.9	ASTM A 403 GR.WP304L-S	BW	WEG934ZZ0	
TRED	T.RED	0.50	2.00	M, M	B-16.9	ASTM A 403 GR.WP304L-S	BW	WRG934ZZ0	
REDC	REDUC.CONC	0.50	2.00	M, M	B-16.9	ASTM A 403 GR.WP304L-S	BW	WUG934ZZ0	
REDE	REDUC.ECC	0.50	2.00	M, M	B-16.9	ASTM A 403 GR.WP304L-S	BW	WVG934ZZ0	
CAP	CAP	0.50	2.00	M	B-16.9	ASTM A 403 GR.WP304L-S	BW	WFG934ZZ0	
Olet Group									
WLT	WELDOLET	0.50	2.00	M, M	MSS-SP97	ASTM A 182 GR.F304L	BW	YWS444ZZ0	
Valves Group									
GAV	VLV.GATE	0.50	1.50		API-602	BODY-ASTM A 182 GR.F304L, TRIM-STELLITED,STEM-SS 316L	BW, 150, B-16.25, SHT NO.-51922	51922ZZZ0	

Package : IPMCS
Report No. : 50

A6K

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A6K** Sheet 4 of 4

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Valves Group									
GAV	VLV.GATE	2.00	2.00		API-600	BODY-ASTM A 351 GR.CF3, TRIM-STELLITED,STEM-SS 316L	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-513GL	513GLZZZ0	
GLV	VLV.GLOBE	0.50	1.50		API-602	BODY-ASTM A 182 GR.F304L, TRIM-STELLITED,STEM-SS 316L	BW, 150, B-16.25, SHT NO.-52922	52922ZZZ0	
GLV	VLV.GLOBE	2.00	2.00		API-623	BODY-ASTM A 351 GR.CF3, TRIM-STELLITED,STEM-SS 316L	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-523GL	523GLZZZ0	
CHV	VLV.CHECK	0.50	1.50		API-602	BODY-ASTM A 182 GR.F304L, TRIM-STELLITED	BW, 150, B-16.25, SHT NO.-53922	53922ZZZ0	
CHV	VLV.CHECK	2.00	2.00		API-594	BODY-ASTM A 351 GR.CF3, TRIM-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-533GL	533GLZZZ0	
Bolt Group									
BOS	BOLT.STUD	0.50	2.00		B-18.2	BOLT:A193 GR.B7, NUT: A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	0.50	2.00		B-16.20-ANSI B16.5	SP.WND SS316L+GRAFIL+ I RING	SPIRAL, 150	GK66372Z0	
Trap/Strainer Group									
TSR	STRNR.TEMP	0.50	2.00		EIL'STD	B:A240TP304L;INT:SS316L	CONETYPE , 150,FF/125AARH	ST1N831Z0	
PSR	STRNR.PERM	0.50	1.50	M	MNF'STD	B:A182GR.F304L;INT:SS316L	BW, Y-TYPE	SP3B645Z0	
PSR	STRNR.PERM	2.00	2.00	M	EIL'STD	B:A403WP304L-S;INT:SS316L	BW, T-TYPE	SP1B744Z0	

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A8A** Sheet 1 of 5

PIPE CLASS : **A8A**
RATING : 150
BASE MATERIAL : CARBON STEEL
CORROSION ALLOWANCE : 3.20 MM
SPECIAL REQUIREMENT :

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP	0	38	65
PRESS	20.03	20.03	19.18

SERVICE

SULPHURIC ACID (80-98% CONC.) - TOXIC BUT NON LETHAL.

NOTES

7 FOR RESTRICTION ON USE OF BALL,PLUG & BUTTERFLY VALVES,REFER GENERAL NOTES.
150 THIS IS JOB SPECIFIC PIPING CLASS.
151 NDT REQUIREMENTS AS PER EIL JOB SPECIFICATION C050-6-44-0016.
152 VALVE SHALL BE PROVIDED WITH PUP PIECE.

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	1.5" & BELOW	SW COUPLING	
	2.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES <= 1.5"	REFER JOB STD C050-7-44-0350, DF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER JOB STD. C050-7-44-0351, D4	
VENTS	ON LINES <= 1.5"	REFER JOB STD. C050-7-44-0350, VF3	
	ON LINES >= 2.0"	AS PER P&ID OR 0.75". REFER JOB STD C050-7-44-0351, V4	
TEMP.CONN	1.5"	FLANGED. REFER JOB STD C050-7-44-0353	
PRESS.CONN	0.75"	SW NIPPLE WITH VALVE TO SPEC AS PER JOB STD C050-7-44-0354	

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Client	**NRL**	**Dept./Sect :**	**16\43**
Project	**PPU**		
Location	**NUMALIGARH, ASSAM**	**Pipe Class :**	**A8A** Sheet 2 of 5

BRANCH PIPE (SIZE IN INCHES)

	0.50	0.75	1.00	1.25	1.50	2.00	2.50
84.00							
80.00							
76.00							
72.00							
70.00							
68.00							
66.00							
64.00							
62.00							
60.00							
58.00							
56.00							
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3.50							
3.00							
2.50							
2.00						T	
1.50					T	T	
1.25							
1.00			T		T	S	
0.75		T	T		T	S	
0.50	T	T	T		T	H	

RUN PIPE (SIZE IN INCHES)

CODE	DESCRIPTION				
F	SADDLE FUSED JT	T	TEES	J	THREADOLET
H	H.COUPLING	W	WELDOLETS	N	NIPPOLET
P	PIPE TO PIPE	I	INSTRUMENT TEE	U	UNLISTED B31.3 COMP
R	REINFORCED	X	REFER NOTES		
S	SOCKOLETS	L	SWEEPOLET		

Package : IPMCS
Report No. : 50

A8A

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A8A** Sheet 3 of 5

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	0.75	XXS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z0	
PIP	PIPE	1.00	1.50	S160	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS	PI21977Z0	
PIP	PIPE	2.00	2.00	S160	B-36.10	ASTM A 106 GR.B	BE, SEAMLESS	PI21917Z0	
NIP	NIPPLE	0.50	0.75	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z0	
NIP	NIPPLE	1.00	1.50	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS	PN21967Z0	
Flange Group									
FLG	FLNG.WN	0.50	2.00	M	B-16.5	ASTM A 105 (NORMALISED)	150, RF/125AARH	FWC0427Z0	
FLB	FLNG.BLIND	0.50	2.00		B-16.5	ASTM A 105 (NORMALISED)	150, RF/125AARH	FBC0427Z0	
FEF	FLNG.FIG.8	0.50	2.00		ASME-B16.48	ASTM A 105 (NORMALISED)	150, RF/125AARH	FGK0427Z0	
Fitting Group									
ELB90	ELBOW.90	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 9000	WA605D4Z0	
ELB90	ELBOW.90	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WA605D3Z0	
ELB90	ELBOW.90	2.00	2.00	M	B-16.9	ASTM A 234 GR.WPB	BW , 1.5D	WAG684Z10	
ELB45	ELBOW.45	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 9000	WB605D4Z0	
ELB45	ELBOW.45	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WB605D3Z0	
ELB45	ELBOW.45	2.00	2.00	M	B-16.9	ASTM A 234 GR.WPB	BW , 1.5D	WBG684Z10	
TEQ	T.EQUAL	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 9000	WE605D4Z0	
TEQ	T.EQUAL	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WE605D3Z0	
TEQ	T.EQUAL	2.00	2.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WEG684ZZ0	
TRED	T.RED	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 9000	WR605D4Z0	
TRED	T.RED	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WR605D3Z0	

Package : IPMCS
Report No. : 50

A8A

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A8A** Sheet 4 of 5

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
TRED	T.RED	2.00	2.00	M, M	B-16.9	ASTM A 234 GR.WPB	BW	WRG684ZZ0	
SWGC	SWAGE.CONC	0.50	2.00	M, M	BS-3799	ASTM A 105 (NORMALISED)	PBE	WNH056ZZ0	
SWGE	SWAGE.ECC	0.50	2.00	M, M	BS-3799	ASTM A 105 (NORMALISED)	PBE	WPH056ZZ0	
CAP	CAP	2.00	2.00	M	B-16.9	ASTM A 234 GR.WPB	BW	WFG684ZZ0	
CPLF	CPLNG.FULL	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 9000	WJ605D4Z0	
CPLF	CPLNG.FULL	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WJ605D3Z0	
CPLH	CPLNG.HALF	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 9000	WK605D4Z0	
CPLH	CPLNG.HALF	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WK605D3Z0	
CPLL	CPLNG.LH	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 9000	WL605D4Z0	
CPLL	CPLNG.LH	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WL605D3Z0	
CPLR	CPLNG.RED	0.50	0.75		B-16.11	ASTM A 105 (NORMALISED)	SW, 9000	WM605D4Z0	
CPLR	CPLNG.RED	1.00	1.50		B-16.11	ASTM A 105 (NORMALISED)	SW, 6000	WM605D3Z0	
Olet Group									
SLT	SOCKOLET	0.50	0.75		MSS-SP97	ASTM A 105 (NORMALISED)	SW, 9000	YSS05D4Z0	
SLT	SOCKOLET	1.00	1.50		MSS-SP97	ASTM A 105 (NORMALISED)	SW, 6000	YSS05D3Z0	
Valves Group									
GAV	VLV.GATE	0.50	1.50		API-602	ASTM A105 (NORMALIZED), TRIM-STELLITED,STEM-SS 316	SW, 800, 3000, B-16.11, SHT NO. -510CA	510CAZZZ0	
GAV	VLV.GATE	2.00	2.00		API-600	BODY-ASTM A 216 GR.WCB, TRIM-SS 316	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-513CA	513CAZZZ0	

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Client :	**NRL**	**Dept./Sect :**	**16\43**
Project :	**PPU**		
Location :	**NUMALIGARH, ASSAM**	**Pipe Class :**	**A8A** Sheet 5 of 5

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Valves Group									
GLV	VLV.GLOBE	0.50	1.50		API-602	ASTM A105 (NORMALIZED), TRIM-STELLITED,STEM-SS 316	SW, 800, 3000, B-16.11, SHT NO. -520CA	520CAZZZ0	
GLV	VLV.GLOBE	2.00	2.00		API-623	BODY-ASTM A 216 GR.WCB, TRIM-SS 316	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-523CA	523CAZZZ0	
CHV	VLV.CHECK	0.50	1.50		API-602	ASTM A105 (NORMALIZED), TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO. -530CA	530CAZZZ0	
CHV	VLV.CHECK	2.00	2.00		API-594	BODY-ASTM A 216 GR.WCB, TRIM-SS 316	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-533CA	533CAZZZ0	
BLV	VLV.BALL	0.50	1.50		API-608	ASTM A105 (NORMALIZED), TRIM-SS 316 SEAT : RPTFE	SW, 800, 3000, B-16.11, SHT NO. -540CA	540CAZZZ0	152
BLV	VLV.BALL	2.00	2.00		API-608	BODY-ASTM A 216 GR.WCB/ ASTM A105-N, TRIM-SS 316 SEAT : RPTFE	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-543CA	543CAZZZ0	
Bolt Group									
BOS	BOLT.STUD	0.50	2.00		B-18.2	BOLT:A193 GR.B7, NUT: A194 GR.2H		BS40404Z0	
Gasket Group									
GAS	GASKET	0.50	2.00		B-16.20-ANSI B16.5	SP.WND SS316L+GRAFIL+ I RING	SPIRAL, 150	GK66372Z0	
Trap/Strainer Group									
PSR	STRNR.PERM	0.50	1.50		MNF'STD	B:A105(NORMALIZED);INT:SS316L	SW, Y-TYPE, 800	SP3E9D510	
PSR	STRNR.PERM	2.00	2.00	M	EIL'STD	B:A234GR.WPB;INT: SS316L	BW, T-TYPE	SP14044Z0	

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A93AU** Sheet 1 of 5

PIPE CLASS : **A93AU**
RATING : 150
BASE MATERIAL : CARBON STEEL
CORROSION ALLOWANCE : 1.60 MM
SPECIAL REQUIREMENT :

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP	65
PRESS	0

SERVICE

OWS - UNDER GROUND

NOTES

7 FOR RESTRICTION ON USE OF BALL,PLUG & BUTTERFLY VALVES,REFER GENERAL NOTES.

151 NDT REQUIREMENTS AS PER EIL JOB SPECIFICATION C050-6-44-0016.

175 ALL BURIED PIPING SHALL BE EXTERNALLY COATED.

177 PIPE WALL THICKNESS ARE BASED ON SOIL PARAMETERS AND BURIAL DEPTH OF 3000 MM. MINIMUM SOIL COVER FROM TOP OF PIPE FOR U/G PIPING SHALL BE 0.6M (0.5"-24.0" SIZE), 0.8M (26.0"-36.0" SIZE), 1.0M (40.0"-48.0" SIZE).

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTAINENCE JOINTS	ALL	FLANGED, TO BE KEPT MINIMUM	
PIPE JOINTS	4.0" & ABOVE	BUTTWELDED	
DRAINS	ON LINES >= 4.0"	AS PER P&ID OR 0.75". REFER JOB STD. C050-7-44-0351, D4	
VENTS	ON LINES >= 4.0"	AS PER P&ID OR 0.75". REFER JOB STD C050-7-44-0351, V4	
TEMP.CONN	1.5"	FLANGED. REFER JOB STD C050-7-44-0353	
PRESS.CONN	0.75"	SW NIPPLE WITH VALVE TO SPEC AS PER JOB STD C050-7-44-0354	

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A93AU** Sheet 2 of 5

BRANCH PIPE (SIZE IN INCHES)

	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.50	4.00	5.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	22.00	24.00
84.00																					
80.00																					
76.00																					
72.00																					
70.00																					
68.00																					
66.00																					
64.00																					
62.00																					
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26.00																					
24.00																					T
22.00																					
20.00																			T		R
18.00																		T	R		R
16.00																	T	R	R		R
14.00																T	R	R	R		R
12.00															T	R	R	R	R		R
10.00														T	R	R	R	R	R		R
8.00													T	R	R	R	R	R	R		R
6.00												T	R	R	R	R	R	R	R		R
5.00																					
4.00										T		R	R	R	R	R	R	R	R		R
3.50																					
3.00																					
2.50																					
2.00																					
1.50																					
1.25																					
1.00																					
0.75																					
0.50																					

RUN PIPE (SIZE IN INCHES)

CODE	DESCRIPTION				
F	SADDLE FUSED JT	T	TEES	J	THREADOLET
H	H.COUPLING	W	WELDOLETS	N	NIPPOLET
P	PIPE TO PIPE	I	INSTRUMENT TEE	U	UNLISTED B31.3 COMP
R	REINFORCED	X	REFER NOTES		
S	SOCKOLETS	L	SWEEPOLET		

Package : IPMCS
Report No. : 50

A93AU

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A93AU** Sheet 3 of 5

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	4.00	18.00	STD	B-36.10	ASTM A 106 GR.B (PE COATED)	BE, SEAMLESS	PI2R417Z0	
PIP	PIPE	20.00	24.00	STD	B-36.10	A672GR.B60 CL.12 (PE COATED)	BE, E.FS.W	PI2O313Z0	
Flange Group									
FLG	FLNG.WN	4.00	24.00	M	B-16.5	ASTM A 105 (NORMALISED)	150, RF/125AARH	FWC0427Z0	
FLB	FLNG.BLIND	4.00	24.00		B-16.5	ASTM A 105 (NORMALISED)	150, RF/125AARH	FBC0427Z0	
FEF	FLNG.FIG.8	4.00	8.00		ASME-B16.48	ASTM A 105 (NORMALISED)	150, RF/125AARH	FGK0427Z0	
FEF	SPCR&BLND	10.00	24.00		ASME-B16.48	ASTM A 105 (NORMALISED)	150, RF/125AARH	FCK0427Z0	
Fitting Group									
ELB90	ELBOW.90	4.00	18.00	M	B-16.9	ASTM A 234 GR.WPB (PE COATED)	BW , 1.5D	WAGY44Z10	
ELB90	ELBOW.90	20.00	24.00	M	B-16.9	ASTM A234 GR.WPB-W (PE COATED)	BW , 1.5D	WAGY54Z10	
ELB45	ELBOW.45	4.00	18.00	M	B-16.9	ASTM A 234 GR.WPB (PE COATED)	BW , 1.5D	WBGY44Z10	
ELB45	ELBOW.45	20.00	24.00	M	B-16.9	ASTM A234 GR.WPB-W (PE COATED)	BW , 1.5D	WBGY54Z10	
TEQ	T.EQUAL	4.00	18.00	M	B-16.9	ASTM A 234 GR.WPB (PE COATED)	BW	WEGY44ZZ0	
TEQ	T.EQUAL	20.00	24.00	M	B-16.9	ASTM A234 GR.WPB-W (PE COATED)	BW	WEGY54ZZ0	
TRED	T.RED	4.00	18.00	M, M	B-16.9	ASTM A 234 GR.WPB (PE COATED)	BW	WRGY44ZZ0	
TRED	T.RED	20.00	24.00	M, M	B-16.9	ASTM A234 GR.WPB-W (PE COATED)	BW	WRGY54ZZ0	

Package : IPMCS
Report No. : 50

A93AU

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A93AU** Sheet 4 of 5

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
REDC	REDUC.CONC	2.00	18.00	M, M	B-16.9	ASTM A 234 GR.WPB (PE COATED)	BW	WUGY44ZZ0	
REDC	REDUC.CONC	20.00	24.00	M, M	B-16.9	ASTM A234 GR.WPB-W (PE COATED)	BW	WUGY54ZZ0	
REDE	REDUC.ECC	2.00	18.00	M, M	B-16.9	ASTM A 234 GR.WPB (PE COATED)	BW	WVGY44ZZ0	
REDE	REDUC.ECC	20.00	24.00	M, M	B-16.9	ASTM A234 GR.WPB-W (PE COATED)	BW	WVGY54ZZ0	
CAP	CAP	4.00	24.00	M	B-16.9	ASTM A 234 GR.WPB (PE COATED)	BW	WFGY44ZZ0	
Valves Group									
GAV	VLV.GATE	0.50	1.50		API-602	ASTM A105 (NORMALIZED), TRIM-STELLITED,STEM-13% CR.STEEL	SW, 800, 3000, B-16.11, SHT NO. -510AA	510AAZZZ0	
GAV	VLV.GATE	2.00	24.00		API-600	BODY-ASTM A 216 GR.WCB, TRIM-STELLITED,STEM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-513AA	513AAZZZ0	
GLV	VLV.GLOBE	0.50	1.50		API-602	ASTM A105 (NORMALIZED), TRIM-STELLITED,STEM-13% CR.STEEL	SW, 800, 3000, B-16.11, SHT NO. -520AA	520AAZZZ0	
GLV	VLV.GLOBE	2.00	16.00		API-623	BODY-ASTM A 216 GR.WCB, TRIM-STELLITED,STEM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-523AA	523AAZZZ0	
CHV	VLV.CHECK	0.50	1.50		API-602	ASTM A105 (NORMALIZED), TRIM-STELLITED	SW, 800, 3000, B-16.11, SHT NO. -530AA	530AAZZZ0	
CHV	VLV.CHECK	2.00	24.00		API-594	BODY-ASTM A 216 GR.WCB, TRIM-STELLITED	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-533AA	533AAZZZ0	

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : A93AU** Sheet 5 of 5

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Valves Group									
BFV	VLV.BTRFLY	3.00	24.00		API-609	BODY-ASTM A 216 GR.WCB, TRIM-13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH, SHT NO.-563AA	563AAZZZ0	
Bolt Group									
BOS	BOLT.STUD	4.00	24.00		B-18.2	BOLT:A193 GR.B7(GALV), NUT: A194 2H(GALV)		BS40513Z0	
Gasket Group									
GAS	GASKET	4.00	24.00		B-16.20-ANSI B16.5	SP.WND SS316L+GRAFIL+ I RING	SPIRAL, 150	GK66372Z0	
Trap/Strainer Group									
TSR	STRNR.TEMP	4.00	24.00		EIL'STD	B:A516GR.70 (NORM);INT:SS316L	CONETYPE , 150,FF/125AARH	ST1O831Z0	
PSR	STRNR.PERM	4.00	18.00	M	EIL'STD	B:A234GR.WPB;INT: SS316L	BW, T-TYPE	SP14044Z0	
PSR	STRNR.PERM	20.00	24.00	M	EIL'STD	B:A234GR.WPBW;I NT:SS316L	BW, T-TYPE	SP13844Z0	

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : J2AL** Sheet 1 of 5

PIPE CLASS : **J2AL**
RATING : 150
BASE MATERIAL : CPVC
CORROSION ALLOWANCE : 0.00 MM
SPECIAL REQUIREMENT :

TEMPERATURE(Deg.C) AND PRESSURE(Kg/Sq.cm g) RATINGS

TEMP	23	49	60	71	82	93
PRESS	10.5	10.5	8.46	6.93	4.18	3.47

SERVICE

ABOVE GROUND PATABLE WATER

NOTES

151 NDT REQUIREMENTS AS PER EIL JOB SPECIFICATION C050-6-44-0016.
301 X= REDUCING TEE W/ ONE - MULTI REDUCER BUSHING.
302 PIPE SHALL BE TYPE IV, GR.1, CPVC 4120.
303 FLANGE SHALL BE DRILLED TO ASME B-16.5, 150#, CPVC 4120, ASTM F439, SOCKET END -TAPER TYPE.
304 FITTINGS SHALL BE CPVC 4120.
305 TRUE UNION BODY-UNION CONNECT.
306 EXTERNAL FASTENERS (BOLTS, STUDS AND NUTS) SHALL BE COATED WITH TAKECOAT-1000 OR EQUIVALENT.
307 THE CPVC PIPES AND ITS INSTALLATION SHALL CONFORM TO IS 15778.
308 SEALS, ELASTOMERS, POLYMERS IN CONTACT WITH POTABLE WATER SHALL NOT CONTAMINATE THE POTABLE WATER. NSF 61/ANSI 61-G CERTIFICATION OR EQUIVALENT IS/BIS CERTIFICATION FOR SUITABILITY OF THE SEAL MATERIAL IN POTABLE WATER SERVICE IS REQUIRED.
309 PIPE JOINTS WITH PRIMER (ASTM F656) AND SOLVENT (ASTM F493).
310 ALL JOINTS B/W THE NON METALLIC AND METALLIC PIPING SHALL BE FLANGED.

SPECIAL NOTES

ITEM	SIZE	DESCRIPTION	A.CODE
MAINTENANCE JOINTS	ALL	FLANGED TO BE KEPT MINIMUM	
PIPE JOINTS	UPTO 4"	SOCKET	
	6" & ABOVE	BUTT WELD	
DRAINS	ON LINES <= 1.5"	REFER JOB STD C050-7-44-0350	
	ON LINES >= 2.0"	AS PER P&ID. REFER JOB STD. C050-7-44-0351	
VENTS	ON LINES <= 1.5"	REFER JOB STD. C050-7-44-0350	
	ON LINES >= 2.0"	AS PER P&ID. REFER JOB STD C050-7-44-0351	
TEMP. CONN.	1.5"	FLANGED. REFER JOB STD C050-7-44-0353	
PRESS. CONN	0.75"	REFER JOB STD C050-7-44-0353	

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Client	**: NRL**	**Dept./Sect :**	**16\43**
Project	**: PPU**		
Location	**: NUMALIGARH, ASSAM**	**Pipe Class :**	**J2AL** Sheet 2 of 5

BRANCH PIPE (SIZE IN INCHES)

	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	3.50	4.00	5.00	6.00	8.00	10.00
84.00														
80.00														
76.00														
72.00														
70.00														
68.00														
66.00														
64.00														
62.00														
60.00														
58.00														
56.00														
54.00														
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30.00														
28.00														
26.00														
24.00														
22.00														
20.00														
18.00														
16.00														
14.00														
12.00														
10.00														T
8.00													T	T
6.00												T	T	R
5.00														
4.00										T		T	X	X
3.50														
3.00								T		T		X	X	X
2.50														
2.00						T		T		X		X	X	X
1.50					T	T		X		X		X	X	X
1.25														
1.00			T		T	T		X		X		X	X	X
0.75		T	T		T	X		X		X		X	X	X
0.50	T	T	T		T	X		X		X		X	X	X

RUN PIPE (SIZE IN INCHES)

CODE	DESCRIPTION				
F	SADDLE FUSED JT	T	TEES	J	THREADOLET
H	H.COUPLING	W	WELDOLETS	N	NIPPOLET
P	PIPE TO PIPE	I	INSTRUMENT TEE	U	UNLISTED B31.3 COMP
R	REINFORCED	X	REFER NOTES		
S	SOCKOLETS	L	SWEEPOLET		

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J2AL

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Client	**: NRL**	**Dept./Sect :**	**16\43**
Project	**: PPU**		
Location	**: NUMALIGARH, ASSAM**	**Pipe Class :**	**J2AL** Sheet 3 of 5

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Pipe Group									
PIP	PIPE	0.50	4.00	S80	ASTM F441	ASTM D1784 CL 23448	PE, SEAMLESS	PICBU77Z0	302
PIP	PIPE	6.00	6.00	HVY	IS-1239-I	IS-1239 (BLACK) (EPOXY COATED)	BE, C.WELDED	PI6S511Z0	
PIP	PIPE	8.00	10.00	6.0	IS-3589	IS-3589 GR.330(EPOXY COATED)	BE, WELDED	PI7BP19Z0	
Flange Group									
FLG	FLNG.SW	0.50	4.00	M	MNF'STD	ASTM D1784 CL 23448	150, FF/125AARH	FSGO521Z0	303
FLG	FLNG.WN	6.00	6.00	STD	B-16.5	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FWCL821Z0	
FLG	FLNG.WN	8.00	10.00	M	B-16.5	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FWCL821Z0	
FLB	FLNG.BLIND	0.50	4.00		MNF'STD	ASTM D1784 CL 23448	150, FF/125AARH	FBGO521Z0	303
FLB	FLNG.BLIND	6.00	10.00		B-16.5	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FBCL821Z0	
FEF	FLNG.FIG.8	0.50	8.00		ASME-B16.48	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FGKL821Z0	
FEF	SPCR&BLND	10.00	10.00		ASME-B16.48	ASTM A105 N (EPOXY COATED)	150, FF/125AARH	FCKL821Z0	
Fitting Group									
ELB90	ELBOW.90	0.50	4.00		ASTM F439	ASTM D1784 CL 23448	SW, NA	WAXEHDZZ0	304
ELB90	ELBOW.90	6.00	6.00	STD	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW , 1.5D	WAGBL4Z10	
ELB90	ELBOW.90	8.00	10.00	M	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW , 1.5D	WAGBL4Z10	
ELB45	ELBOW.45	0.50	4.00		ASTM F439	ASTM D1784 CL 23448	SW, NA	WBXEHDZZ0	304
ELB45	ELBOW.45	6.00	6.00	STD	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW , 1.5D	WBGBL4Z10	

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : J2AL** Sheet 4 of 5

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
ELB45	ELBOW.45	8.00	10.00	M	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW , 1.5D	WBGBL4Z10	
TEQ	T.EQUAL	0.50	4.00		ASTM F439	ASTM D1784 CL 23448	SW, NA	WEXEHDZZ 0	304
TEQ	T.EQUAL	6.00	6.00	STD	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WEGBL4ZZ0	
TEQ	T.EQUAL	8.00	10.00	M	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WEGBL4ZZ0	
TRED	T.RED	0.50	4.00		ASTM F439	ASTM D1784 CL 23448	SW, NA	WRXEHDZZ 0	304
TRED	T.RED	6.00	6.00	STD, M	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WRGBL4ZZ0	
TRED	T.RED	8.00	10.00	M, M	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WRGBL4ZZ0	
REDC	REDUC.CONC	6.00	6.00	STD, STD	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WUGBL4ZZ 0	
REDC	REDUC.CONC	8.00	10.00	M, M	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WUGBL4ZZ 0	
REDE	REDUC.ECC	6.00	6.00	STD, STD	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WVGBL4ZZ0	
REDE	REDUC.ECC	8.00	10.00	M, M	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WVGBL4ZZ0	
SWGC	SWAGE.CONC	0.50	4.00	M, M	ASTM F439	ASTM D1784 CL 23448	PBE	WNXEH6ZZ 0	304
SWGE	SWAGE.ECC	0.50	4.00	M, M	ASTM F439	ASTM D1784 CL 23448	PBE	WPXEH6ZZ 0	304
CAP	CAP	6.00	6.00	STD	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WFGBL4ZZ0	
CAP	CAP	8.00	10.00	M	B-16.9	A 234 GR WPB(INT:EPOXY CTD)	BW	WFGBL4ZZ0	

Package : IPMCS
Report No. : 50

J2AL

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Client : NRL	**Dept./Sect : 16\43**
Project : PPU	
Location : NUMALIGARH, ASSAM	**Pipe Class : J2AL** Sheet 5 of 5

Note :(The shaded portion of PMS body shows Field Fabricated Items)

Input Id.	Item Type	Lower Size (Inch)	Upper Size (Inch)	Sch/ Thk (mm)	Dmn.STD	Material	Description	Commodity Code	Note No
Fitting Group									
CPLF	CPLNG.FULL	0.50	4.00		ASTM F439	ASTM D1784 CL 23448	SW, NA	WJXEHDZZ0	304
CPLH	CPLNG.HALF	0.50	4.00		ASTM F439	ASTM D1784 CL 23448	SW, NA	WKXEHDZZ0	304
CPLL	CPLNG.LH	0.50	4.00		ASTM F439	ASTM D1784 CL 23448	SW, NA	WLXEHDZZ0	304
CPLR	CPLNG.RED	0.50	4.00		ASTM F439	ASTM D1784 CL 23448	SW, NA	WMXEHDZZ0	304
Valves Group									
GAV	VLV.GATE	0.50	4.00		MNF'STD	BODY-CPVC ASTM D1784 CL 23448, TRIM-CPVC	SW, 150, 3000, MNF'STD, SHT NO.-51923	51923ZZZ0	305
CHV	VLV.CHECK	0.50	4.00		MNF'STD	BODY-CPVC ASTM D1784 CL 23448, TRIM-CPVC	SW, 150, 3000, MNF'STD, SHT NO.-53923	53923ZZZ0	305
CHV	VLV.CHECK	6.00	10.00		API-594	ASTM A 216 GR.WCB (INTERNALLY EPOXY COATED), TRIM-STELLITED	FLGD, 150, B-16.5, FF/125AARH, SHT NO.-533YA	533YAZZZ0	
BLV	VLV.BALL	0.50	4.00		MNF'STD	BODY-CPVC ASTM D1784 CL 23448, TRIM-CPVC	SW, 150, 3000, MNF'STD, SHT NO.-54923	54923ZZZ0	305
BFV	VLV.BTRFLY	6.00	10.00		API-609	ASTM A 216 GR.WCB (INTERNALLY EPOXY COATED), TRIM-13% CR.STEEL	WAFL, 150, B-16.5, FF/125AARH, SHT NO.-563YA	563YAZZZ0	
Bolt Group									
BOS	BOLT.STUD	0.50	10.00		B-18.2	BOLT:A193 GR.B7, NUT: A194 GR.2H		BS40404Z0	306
Gasket Group									
GAS	GASKET	0.50	10.00		B-16.21-ANSI B16.5	EPDM	FULLFACE, 150, 3 MM	GKBEX22Z0	

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ANNEXURE – I (TO PMS)

PIPING MATERIAL SPECIFICATION GENERAL NOTES

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	18.04.2025	ISSUED AS JOB SPECIFICATION	VD	VD	LJ

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Abbreviations:

AARH	: Arithmetic Average Roughness Height
ANSI	: American National Standards Institute
API	: American Petroleum Institute
ASME	: American Society of Mechanical Engineers
ASTM	: American Society for Testing and Materials
AWWA	: American Water Works Association
BIS	: Bureau of Indian Standards
BSI	: British Standards Institute
BW	: Butt Weld
CA	: Corrosion Allowance
DIN	: Deutsches Institut für Normung
FRP	: Fiber Reinforced Plastic
GOST	: Russian Standard (Gosudarstvennyy Stan dart)
HDPE	: High Density Poly Ethylene
IBR	: Indian Boiler Regulations
JIS	: Japanese Industrial Standards
LTCS	: Low Temperature Carbon Steel
MSS	: Manufacturers Standardization Society
NACE	: National Association of Corrosion Engineers
NDT	: Non Destructive Testing
PMS	: Piping Material Specification
PP	: Poly Propylene
PTFE	: Poly Tetra Flouro Ethylene
PVC	: Poly Vinyl Chloride
PVDF	: Poly Vinylidene Flouride
RTJ	: Ring Type Joint
SW	: Socket Weld

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1.0 SCOPE

1.1 This specification (PMS) covers the various piping classes for Process and utility Piping.

1.2 Deviations from this specification may be necessary to conform to specific job requirements.

2.0 REFERRED CODES & STANDARDS

2.1 All Piping shall be designed in accordance with the Process Piping Code, ASME B31.3. A particular edition (indicated in Design Basis), once selected shall be followed throughout the job.

2.2 Editions and addenda (if any) of referred Codes and Standards shall be as per the Job Engineering Design Basis (Piping).

2.3 For the sake of brevity, the initials of the society to which the codes are referred to may be omitted in the specification. For example; B16.5 is a code referring to ASME; A106 is a standard referring to ASTM.

2.4 For Job PMS, 'ASME B31.3' & 'ASME B16.5' have been followed.

3.0 MATERIAL SPECIFICATIONS

3.1 Individual piping Class has been generally designed to cover a set of services operating within pressure-temperature combination as per ASME B16.5 / B16.34 or part of it.

3.2 The PMS shall be strictly adhered to in the design, requisitioning, purchasing, fabrication and testing of the piping system. However, deviations of material may occur due to design conditions and/or availability. All substitutions must be duly approved.

3.3 Unless mentioned otherwise, pipe thicknesses in the specs are for above ground piping.

4.0 CLASS DESIGNATION CODE

The class designation shall consist of not more than three components made up of a letter, number & letter; e.g.B1A.

4.1 The first letter indicates pressure rating.

A	150 Class	D	600 Class	G	2500 Class
B	300 Class	E	900 Class	J	125/150 Class
C	400 Class	F	1500 Class	K	UNCLASSIFIED

4.2 The middle number indicates difference in the specifications within the same rating and material as enlisted in the Table attached.

4.3 The third letter indicates type of material.

A	Carbon
B	Carbon Moly. (This material is not recommended)
C	1.0 % Cr., 0.5 % Moly. (This material is not recommended)
D	1.25 % Cr., 0.5 % Moly.
E	2.25 % Cr., 1.0 % Moly.
F	5.0 % Cr., 0.5 % Moly.
G	9.0 % Cr., 1.0 % Moly.
H	3.5 % Ni.

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I	
J	Nickel / Titanum
K	Stainless steel type 304, 304H, 304L.
L	Aluminium
M	Stabilised stainless steel type 321, 347 and Stainless steel type 316, 316H.
N	316L
P	Monel / Alloy 20
Q	Hastalloy / Inconel / Incoloy
R	Lead
S	PVC & FRP, PP / FRP, PVDF / FRP
T	Cast Iron / Silicon Iron
U	
V	Duplex Stainless Steel
W	Cupro-Nickel
Y	Lined steel (Rubber Lined, Teflon Lined, Cement lined etc).
Z	HDPE / PDVF / Teflon / PVC

5.0 PIPES

5.1 Pipe dimension shall be in accordance with ASME B36.10, IS:1239 & IS:3589 for wrought steel and wrought iron pipe; to B36.10 / B36.19 for stainless steel pipe and respective ASTM Standard for non-ferrous and non- metallic pipes.

5.2 Pipe made by acid-bessemer process shall not be acceptable, steel pipe shall be made by open hearth, electric furnace or basic Oxygen process.

5.3 All pipe threads shall conform to ASME B1.20.1 except where otherwise noted.

5.4 Pipe thicknesses not covered in different classes of this specification shall be calculated to meet specific job requirement based on actual max. design condition to economise on thickness. However, in such cases the thickness shall be calculated at not less than 80% of class rating unless defined otherwise in the Job Engineering Design Basis (Piping).

5.5 Maximum of 10% of Corrosion Allowance may be adjusted to optimize on pipe schedule. However, if CA is suffixed by 'minimum', this downward adjustment shall not be used.

5.6 Non-standard pipe sizes 1¼", 2½", 3½", 5" and 22" shall not be treated as a part of this specification unless these sizes are separately called out.

6.0 FLANGES

6.1 Flanges shall be in accordance with the following codes, except where otherwise noted:

Upto 24" (150# -1500#)	ASME B16.5
Upto 12" , 2500#	ASME B16.5
Above 24"	ASME B16.47 SERIES 'B' / AWWA / EIL' STD.

Flanges to ASME B16.47 SERIES 'A' or any other standard (e.g. DIN, GOST, JIS etc.) may be specified to mate with equipment or valve flanges with the corresponding bolting.

6.2 Finish of steel flange faces shall be as follows:

Stock Finish	:	1000 µin AARH max.
Serrated Finish / 125 AARH / Smooth finish	:	Serrations with 125-250µin AARH
63 AARH	:	32 TO 63 µin AARH

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6.3 Brinnel hardness for RTJ groove shall be atleast 20 BHN more than that of corresponding gasket as specified.

6.4 Fig.8 Fl and SPCR & BLN shall be as per B16.48 upto 24" (150-1500#) & upto 12" for 2500#. For other sizes, refer EIL Std 7-44-0162.

7.0 FITTINGS

7.1 Forged steel SW and threaded fittings shall be in accordance with ASME B16.11, unless otherwise specified. For items not covered under B16.11, reference may be made to BS 3799 or appropriate MSS-SP-Std.

7.2 BW Fittings shall be in accordance with ASME B16.9, unless otherwise specified.

7.3 Dimensions of steel BW fittings for sizes not covered in ASME B16.9 shall conform to MSS-SP-48.

7.4 Usage of unions shall be restricted to utilities only.

8.0 BENDS, MITRES AND REDUCERS FABRICATED FROM PIPE

8.1 Mitres and Reducers fabricated from Pipe may be used if specified in particular Piping Class. Mitres require higher thickness than corresponding Pipe / Elbow to hold the same pressure (Refer ASME B31.3).

9.0 GASKETS

9.1 Non-metallic gaskets shall conform to B16.21 (corresponding to B16.5) upto 24", and B16.21 (corresponding to B16.47B) beyond 24", unless otherwise specified.

9.2 Spiral wound gaskets (SP.WND or SPWD) and Ring Joint gaskets shall conform to B16.20.

10.0 BOLTING

10.1 All bolts shall conform to B18.2.1, nuts to be B18.2.2. Reference shall also be made to B16.5 for studs.

10.2 Threads shall be to coarse Thread Series, B1.1, having Class 2A allowances for bolts and studs, and Class 2B tolerance for nuts.

10.3 Nuts for Bolts and Studs shall be the American Standard Hexagon Heavy Series.

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11.0 THREADS

11.1 Threads for threaded Pipes, Fittings, Flanges and Valves shall be in accordance with B1.20.1 taper threads, unless otherwise specified.

11.2 Upto 204 deg.C, threaded joints shall be made with 1" width PTFE joining tape.

11.3 Above 204 deg.C, threaded joints shall be seal welded with a full strength fillet weld.

11.4 All threaded joints irrespective of pressure and temperature on lines carrying toxic fluid shall be seal welded with a full strength fillet weld.

12.0 VALVES

12.1 Face to Face / End to End dimension of valves shall conform to B16.10 to the extent covered. For valves not covered in B16.10, reference shall be made to BS EN 558-1 for PN Designated Flanged valves, BS EN 558-2 for Class designated Flanged valves and BS EN 12627 for Butt Welding end valves and / or the manufacturer's drawings.

12.2 Flange / weld ends of the valve shall be as per the corresponding Flange / Fitting ends of the piping class, unless otherwise specified.

12.3 Pressure-temperature rating for flanged and butt welding end valves shall be as per ASME B16.34 except for ball, plug & butterfly valves. For these valves refer TABLE FOR PRESSURE-TEMP RATING FOR BALL, PLUG AND BUTTERFLY VALVES. Wall thickness of valve body at different locations should not be less than as calculated as per B16.34.

12.4 Unless called-out specifically, valves shall be as per the following Standards:

Valve	Size	Rating	Des. Std.	Testing Std.
Gate	1/2"- 1-1/2"	800 / 1500	'API 602/ ISO 15761'	API-598
Globe / Check	-do-	800 / 1500	'API 602/ ISO 15761'	API-598
Gate	2"-24"	150 / 300 / 600	'API 600/ ISO 10434'	API-598
Gate	26"-42"	150 / 300	B-16.34	'API 598'/ 'BS EN 12266-1'
Globe	2"-16"	150	BS-1873	'BS EN 12266-1'
Globe	2"-12"	300/600	BS-1873	-do-
Check	2"-24"	-do-	BS-1868	-do-
Gate/ Globe/Check	2"-8"	900 / 1500 / 2500	B-16.34 (Refer 12.6 also)	'API 598' / 'BS EN 12266-1'
Ball	1/2"-16"	150 / 300 / 600	'BS EN ISO 17292' / 'API 6D'	'BS EN 12266-1' / 'API-598'
Ball	1/2"-8"	900/ 1500	API 6D	API-598
Plug	1/2"-12"	All	'API-599' /'BS 5353'	'API-598' / 'BS EN 12266-1'
Btrfly	3" & above	All	'API-609' / 'BS EN 593' / 'AWWA C504'	'API-598' /' BS EN 12266-1'/ 'AWWA'

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Diaphragm	ALL	-	BS-5156	'BS EN 12266-1'
Bronze			RELEVANT IS STD.	RELEVANT IS STD.
Cast Iron			RELEVANT IS STD.	RELEVANT IS STD.

12.5 If not covered in 12.3, the valve shall be as per B16.34 / relevant MSS-SP Standard.

12.6 For details of the valves specifications, refer specifications C050-6-44-0006. Features not covered by C050-6-44-0006 and the relevant code shall be to the manufacturer's standard.

12.7 Unless otherwise specifically called for, upto 600# rating, 2" and larger size steel Gate, Globe & Check valves in Hydrocarbon and utility service shall have bolted bonnets. Pressure-seal bonnets or covers shall be used for Classes 900# and above to minimize bonnet leakage. However, valves with Pr-seal Bonnet shall have wall thickness & stem diameter as per API-600, (if required). Welded bonnets or screwed & seal welded bonnets are acceptable for sizes lower than 2" for Classes 900# & above.

13.0 For Non-Destructive Testing (NDT) specification, refer Job Specification C050-6-44-0016.

14.0 For Welding specifications, refer EIL specs. 'Welding Specification for fabrication of piping (6-77-0001)' & 'Job Welding Specification charts for piping classes (C050-000-06-41-WSC-0001)'.

15.0 For 'Caustic Soda service graph' refer sheet 14 of 14.

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TABLE FOR MIDDLE NUMBER

Middle Number	Carbon Steel A	AlloySteel B, C, D, E, F, G, H	SS304 / SS304H / SS304L K	SS 316 / 316H / 321 / 321H / 347 M
1	CA=1.5	CA=1.5	CA=NIL (SS304)	CA=NIL (SS316)
2	CA=1.5 (IBR)	CA=1.5 (IBR)	CA=NIL (SS304-CRYO)	CA=NIL (SS321-CRYO)
3	CA=1.5 (CAT'D)	CA=6.0	CA=NIL (CAT 'D' SS304)	CA=1.5 (SS321)
4	CA=1.5 (LTCS)	CA=3.0	CA=1.5 (SS304H)	CA=NIL (SS321)
5	CA=1.5 (Hydrogen)	CA=1.5 (Hydrogen)>230^{O}C	CA=3.0 (SS304H)	CA=NIL (SS316H) – H_2
6	CA=4.5	CA=4.5	CA=1.5 (SS304L)	CA=NIL (SS316H)
7	CA=1.5 (Vacuum)		CA=NIL (SS304L-Vacuum)	CA=NIL (SS347)
8	CA=1.5 (Conc.Sulphuric Acid)		CA=1.5 (SS304L-CRYO)	CA=1.5 (SS347)
9	CA=3.0		CA=1.5 (SS304)	CA=1.5 (SS316)
10	CA=1.5 (Offsites)			
11	CA=3.0 (Hardness controlled)		CA=NIL (SS304L)	
12			CA=NIL (SS304-IBR)	
13	CA=6.0			
15	CA=3.0 (Liquid Sulphur)		CA=1.5 (SS304 H_2 & CO_2)	CA=1.5 (SS321H - H_2)
16	CA=4.5 (NACE)	CA=4.5 (NACE)	CA=1.5 (SS304L - NACE)	CA=1.5 (SS321 - NACE)
17	CA=3.0 (dry Chlorine)			
18	CA=1.5 (Oxygen)		CA=NIL (SS304L-Oxygen)	
19	CA=3.0 (Caustic / Amine, Stress relieved)			
20	CA=1.5 (Jacket for A15A)			
24		CA=4.5 (1.25Cr + 0.5Mo)		
32	CA=1.5 (Tracing)		CA=NIL (Tracing)	
33	CA=1.5 (Fire Water)			
39	CA=1.5 (10Kg/cm2g) (Cooling Water)			
91	CA=1.5 (Fire Water A/G)			

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Middle Number	Carbon Steel A	AlloySteel B, C, D, E, F, G, H	SS304 / SS304H / SS304L K	SS 316 / 316H / 321 / 321H / 347 M
92	CA=1.5 (Fire Water U/G, 3LPE)			
93	CA=1.5 (CAT'D)			CA=0 (CAT'D)
96	CA=1.5 (CAT'D U/G)			

NOTE: USE MIDDLE NUMBERS 21 TO 30, 91 TO 99 OR TWO ALPHABETS (EXCEPT THAT SECOND ALPHABET SHALL NOT BE “S” OR “X”) FOR PROJECT DEPENDENT CLASSES.

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TABLE FOR MIDDLE NUMBER

Middle Number	SS316L N	NICKEL /TITANUM J	ALLUMINIUM L	MONEL / ALLOY 20 P
1	CA=NIL	CA=NIL (NICKEL)		CA=NIL (MONEL)
2	CA=1.5 (CRYO)	CA=1.5 (NICKEL)		CA=1.5 (MONEL)
3		CA=NIL (TITANUM)		CA=NIL(ALLOY 20)
4		CA=1.5 (TITANUM)		CA=1.5 (ALLOY 20)
5	CA=1.5 H_2			
6	CA=NIL (Vacuum)			
7				
8				
9				
10				
11			CA=NIL	
12				
13				
14				
15				
16	CA=1.5(NACE)			
17				
18				CA=NIL (MONEL) OXYGEN
19				
20				
32				
33				

NOTE: USE MIDDLE NUMBERS 21 TO 30, 91 TO 99 OR TWO ALPHABETS (EXCEPT THAT SECOND ALPHABET SHALL NOT BE “S” OR “X”) FOR PROJECT DEPENDENT CLASSES.

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TABLE FOR MIDDLE NUMBER

Middle Number	Hastelloy / Inconel / Incoloy Q	PVC / FRP S	LINED STEEL Y	HDPE / PVDF / TEFLON Z
1	CA=NIL (INCONEL 600)	CA=NIL (PVC)	CA = NIL (TEF LINED)	CA=NIL (HDPE) H_2SO_4
2		CA=1.5 (PVC / FRP)		
3	CA = NIL (INCOLOY 800)	CA=NIL (FRP)	CA = NIL (RUBBER LINED - SOFT)	
4	CA = 1.5 (INCOLOY 800)		CA = NIL (RUBBER LINED – SEMI HARD) 30% HCL	CA = NIL (HDPE) 30% HCL
5			CA = 3.0 (<= 2”) & NIL (>= 3”) (CEMENT LINED) CAT ‘D’ SEA WATER	CA = NIL (HDPE) 50% HF
6	CA = 1.5 (INCOLOY 800H)			
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
32				
33			CA = 3.0 (<= 2”) & NIL (>= 3”) (CEMENT LINED) FIRE WATER (SEA)	

NOTE: USE MIDDLE NUMBERS 21 TO 30, 91 TO 99 OR TWO ALPHABETS (EXCEPT THAT SECOND ALPHABET SHALL NOT BE “S” OR “X”) FOR PROJECT DEPENDENT CLASSES.

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TABLE FOR PRESSURE TEMPERATURE RATING FOR BALL, PLUG & BUTTERFLY VALVES

ITEM	PRESSURE RATING (PIPING CLASS)	SIZE RANGE (NB INCHES)	PRESSURE IN kg / cm^2								
			TEMPERATURE IN ^{O}C								
			-29 TO 38	50	65	100	120	150	175	204	>204
BALL (RPTFE/PTFE Seated)	150# (AS PER PMS)	Upto 16”	19.99	19.58	19.2	17.93	17.2	16.12	15.22	7.03	DO NOT USE
	300# (AS PER PMS)		52.00	51.02	49.8	41.85	37.3	27.4	19.15	7.03	
	600# (AS PER PMS)		104.1	98.46	91.4	64.61	49.3	38.6	29.68	17.6	
PLUG (RPTFE/PTFE Seated)	150# (AS PER PMS)	Upto 8”	19.33	19.3	18.63	17.6	16.89	15.82	14.93	14.06	
	300# (AS PER PMS)		52.02	50.35	48.26	43.4	40.0	37.4	35.23	28.1	
PLUG (Lubricated)	150# (AS PER PMS)	Upto 12”	19.99	19.58	19.12	18.05	17.28	16.12	15.15	14.28	
	300# (AS PER PMS)		52.0	51.1	49.96	47.3	46.82	46.1	45.5	44.6	
	600# (AS PER PMS)		104.1	102.2	99.95	94.7	93.74	92.3	91.1	89.4	
Butterfly (Soft Seat)	150# (A3A, A5Y)	Upto 48”	10.55	10.55	10.55	DON’T USE					DO NOT USE
	150# (A33A, A33Y)		16	16	16						
	150# (RPTFE/PTFE Seat)		19.99	19.58	19.2	17.93	17.20	16.12	15.22	7.03	

NOTE: IF THE CLASS PRESSURE / TEMPERATURE IS LOWER THAN THIS TABLE, CLASS PRESSURE / TEMPERATURE TO BE FOLLOWED.

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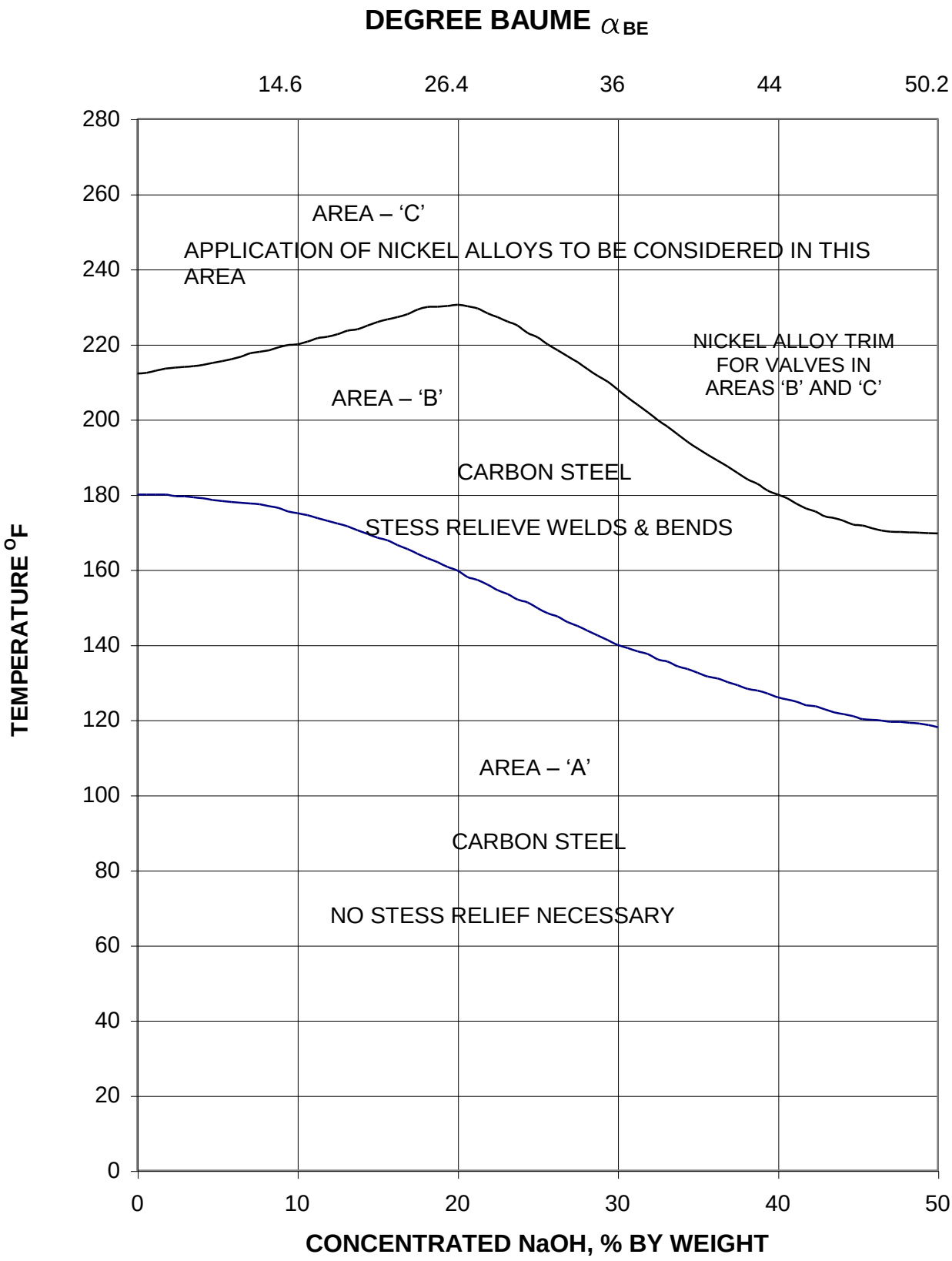
CAUSTIC SODA SERVICE GRAPH



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WELDING SPECIFICATION CHARTS FOR PIPING CLASSES

PROJECT: PPU

CLIENT: NRL

JOB NO. : C050

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
2	14-08-2025	REISSUED FOR TENDER	U KUMAR	P CHOWDHARY	R CHITARA
1	16-06-2025	REISSUED FOR TENDER	U KUMAR	P CHOWDHARY	R CHITARA
0	30-04-2025	ISSUED FOR IMPLEMENTATION	U KUMAR	P CHOWDHARY	R CHITARA

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Revision History :

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
1	16.06.2025	A60Y, A61K, A62K, A9A, B64I, D1K, D2A Piping Classes Added and Reissued For Tender	U KUMAR	P CHOWDHARY	R CHITARA
2	14.08.2025	A8A, A2A, A3A, A3ALU, A6K, A1N Piping Classes Added	U KUMAR	P CHOWDHARY	R CHITARA

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WSC FOR PIPING CLASSES: A64I, B64I, D64I 8
WSC FOR PIPING CLASSES: A1K, A3K, D1K 9
WSC FOR PIPING CLASSES: A61K, A62K, A6K 10
WSC FOR PIPING CLASSES: A1N 11

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GENERAL NOTES

1.1 Scope :
This document covers the Welding Specification for the piping classes covered in the Piping Material Specification (Specification No. C050-1P39A-6-44-0005-5020_Rev-A). WPS and PQR for the field fabrication and erection of piping system shall be made in conformity with this document. In case of any conflict between this document and Piping Material Specification for any piping class, the most stringent requirement shall be followed.

1.2 This document shall be read in conjunction with the latest revisions/editions of the following documents:

a) ASME Boiler and Pressure Vessel Codes

Section II Part C – Specification for Welding Rods, Electrodes, and Filler Metals
Section V – Nondestructive Examination
Section IX - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators

b) ASME B31.3, Process Piping

c) ASTM E10, Standard Test Method for Brinell Hardness of Metallic Materials

d) Job Specification No. C050-6-44-0016, Specification for Non Destructive Examination Requirements of Piping

e) Welding Specification for Fabrication of Piping, 6-77-0001 Rev.5.

1.3 GTAW process can be applied in place of SMAW process with a corresponding suitable filler metal for the application.

1.4 Abbreviations:

GTAW : Gas Tungsten Arc Welding

PMS : Piping Material Specification

PQR : Procedure Qualification Record

SMAW : Shielded Metal Arc Welding

WSC : Welding Specification Chart

WPS : Welding Procedure Specification

1.6 ASME B31.3 PWHT thickness exemption for P no. 1 materials is not permitted for material thickness greater than 1.5 inch (38mm).

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WSC FOR PIPING CLASSES: **A1A, A8A, A9A, A60Y, B1A**					
MATERIAL SPECIFICATIONS	PIPES	**ASTM A 106 GR.B, A672GR.B60 CL.12**			
	FITTINGS	**ASTM A 105, ASTM A234 GR.WPB, ASTM A234 GR.WPB-W, ASTM A 106 GR.B**			
	FLANGES	**ASTM A 105**			
	OTHERS	-			
BASE METAL `P' NO	**1**				
WELDING PROCESS	GROOVE JOINTS				
	BUTT		OTHER THAN BUTT		
	ROOT PASS: **GTAW / SMAW (NOTE-1, 2)**	FILLER PASS: **GTAW / SMAW (NOTE-1, 2)**	ROOT PASS: **GTAW / SMAW (NOTE-1, 2)**	FILLER PASS: **GTAW / SMAW (NOTE-1, 2)**	
	FILLET JOINTS/ SOCKET JOINTS: **SMAW/GTAW**				
WELDING MATERIALS	GROOVE JOINTS				
	BUTT		OTHER THAN BUTT		
	ROOT PASS: **ER70S-2 / E6010**	FILLER PASS: **ER70S-2 / E7016 / E7018**	ROOT PASS: **ER70S-2 / E6010**	FILLER PASS: **ER70S-2 / E7016 / E7018**	
	FILLET JOINT/SOCKET JOINT: **E7016 / E7018/ ER70S-2**				
	BACKING RING: -		CONSUMABLE INSERT: -		
JOINT PREPARATION	**ASME B31.3**				
GASES	PURGING: -		SHIELDING: **ARGON**		
GAS COMPOSITION	PURGING: -		SHIELDING: **99.995%**		
PREHEATING **(NOTE-3)**	PREHEAT TEMP: **10°C MIN/ 100°C FOR THK >25 mm**		INTERPASS TEMP.: **----**		
POST HEATING: --					
POST WELD HEAT TREATMENT **(NOTE-4)**	HOLDING TEMP---		HOLDING TIME: **----**		
	RATE OF HEATING: **---**		MIN. HOLDING TIME: **---**		
	METHOD OF COOLING: **---**		RATE OF COOLING: **---**		
MECHANICAL PROPERTY REQUIREMENTS	CHARPY `V' NOTCH VALUE:		MIN: -	AVERAGE: -	
	AT TEMPERATURE:		-		
	HARDNESS: **200 BHN MAX. (NOTE-4)**				
CODE OF FABRICATION	**ASME B31.3**				

TECHNICAL NOTES:

1 THE ROOT PASS FOR SINGLE SIDE WELDING SHALL BE DONE BY GTAW PROCESS

2 GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL BORE PIPING, DIAMETER 2" AND SMALLER.

3 PRE-HEAT TEMPERATURE OF ATLEAST 50°C SHALL BE PROVIDED FOR THE FIRST TWO PASSES FOR THK>=12.5 mm & ≤ 25 mm.

4 FOR PIPING CLASS A1A, IF THE PIPING CONTAINS ANHYDROUS AMMONIA (WITH < 0.2 % WATER), THEN PIPING WELDS SHALL BE PWHT IRRESPECTIVE OF THICKNESSES AND PWHT SHALL BE DONE AS PER LATEST EDITION OF ASME B31.3. HARDNESS SHALL BE MEASURED AFTER PWHT.

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WSC FOR PIPING CLASSES: **A2A, D2A**				
MATERIAL SPECIFICATIONS	PIPES	ASTM A106 GR. B, ASTM A672 Gr.B60 Cl.22		
	FITTINGS	ASTM A 105, ASTM A234 GR.WPB, ASTM A234 GR.WPB-W		
	FLANGES	ASTM A 105		
	OTHERS	-		
BASE METAL `P' NO	**1**			
WELDING PROCESS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: **GTAW / SMAW (NOTE 1)**	FILLER PASS: **GTAW / SMAW (NOTE 1)**	ROOT PASS: **GTAW / SMAW (NOTE 1)**	FILLER PASS: **GTAW/ / SMAW (NOTE 1)**
	FILLET JOINTS/ SOCKET JOINTS: **SMAW/GTAW**			
WELDING MATERIALS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: **ER70S-2 / E6010**	FILLER PASS: **ER70S-2 / E7016/E7018**	ROOT PASS: **ER70S-2/ E6010**	FILLER PASS: **ER70S-2 / E7016/ 7018**
	FILLET JOINT/SOCKET JOINT: **E7016/E7018/ER70S-2**			
	BACKING RING: -		CONSUMABLE INSERT: -	
JOINT PREPARATION	**ASME B31.3 & IBR**			
GASES	PURGING: -		SHIELDING: **ARGON**	
GAS COMPOSITION	PURGING: -		SHIELDING: **99.995%**	
PREHEATING **(NOTE-2)**	PREHEAT TEMP: **10°C MIN/ 100°C FOR THK >25 mm**		INTERPASS TEMP: ---: -	
POST HEATING: ---				
POST WELD HEAT TREATMENT **(NOTE-3)**	HOLDING TEMP: **-**		HOLDING TIME**: -**	
	RATE OF HEATING: **-**		MIN. HOLDING TIME: **-**	
	METHOD OF COOLING: **-**		RATE OF COOLING: **-**	
MECHANICAL PROPERTY REQUIREMENTS	CHARPY `V' NOTCH VALUE:		MIN: -	AVERAGE: -
	AT TEMPERATURE:		-	
	HARDNESS:			
CODE OF FABRICATION	**ASME B31.3& IBR**			

TECHNICAL NOTES:

1. **GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL-BORE PIPING, DIAMETER 2" AND SMALLER. THE ROOT PASS FOR SINGLE SIDE WELDING SHALL BE DONE BY GTAW PROCESS.**

2. **PRE-HEAT TEMPERATURE OF ATLEAST 50°C SHALL BE PROVIDED FOR THE FIRST TWO PASSES FOR THK>= 12.5MM & ≤ 25 MM.**

3. **PWHT SHALL BE DONE AS PER IBR FOR WALL THICKNESS EXCEEDING 20MM.**

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WSC FOR PIPING CLASSES: **A3AL, A3A, A3ALU**					
MATERIAL SPECIFICATIONS	PIPES	ASTM A 106 GR.B, IS-1239, IS-3589 Gr.330			
	FITTINGS	ASTM A 105, ASTM A234 GR.WPB			
	FLANGES	ASTM A 105			
	OTHERS	-			
BASE METAL `P' NO	**1, Unlisted (IS-1239, IS-3589)**				
WELDING PROCESS	GROOVE JOINTS				
	BUTT		OTHER THAN BUTT		
	ROOT PASS: **GTAW /SMAW (NOTE-1)**	FILLER PASS: **SMAW (NOTE-1)**	ROOT PASS **GTAW /SMAW (NOTE-1)**	FILLER PASS: **SMAW (NOTE-1)**	
	FILLET JOINTS/ SOCKET JOINTS: **SMAW/GTAW**				
WELDING MATERIALS	GROOVE JOINTS				
	BUTT		OTHER THAN BUTT		
	ROOT PASS: **ER70S-2/E6010**	FILLER PASS: **E6013/E7016/E7018**	ROOT PASS: **ER70S-2/ E6010**	FILLER PASS: **E6013/E7016/E7018**	
	FILLET JOINT/SOCKET JOINT: **E6013/ E7016/E7018/ ER70S-2**				
	BACKING RING: -		CONSUMABLE INSERT: -		
JOINT PREPARATION	**ASME B31.3**				
GASES	PURGING: -		SHIELDING: **ARGON**		
GAS COMPOSITION	PURGING: -		SHIELDING: **99.995%**		
PREHEATING **(NOTE-2)**	PREHEAT TEMP: **10°C MIN/100°C FOR THK >25 mm**		INTERPASS TEMP.: ---		
POST HEATING: ---					
POST WELD HEAT TREATMENT	HOLDING TEMP: --		HOLDING TIME: **---**		
	RATE OF HEATING: **---**		MIN. HOLDING TIME: **---**		
	METHOD OF COOLING: **---**		RATE OF COOLING: **---**		
MECHANICAL PROPERTY REQUIREMENTS	CHARPY `V' NOTCH VALUE:		MIN: -	AVERAGE: -	
	AT TEMPERATURE:		-		
	HARDNESS:				
CODE OF FABRICATION	ASME B31.3				

TECHNICAL NOTES:

1. **GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL BORE PIPING, DIAMETER 2" AND SMALLER.**

2. **PRE-HEAT TEMPERATURE OF ATLEAST 50°C SHALL BE PROVIDED FOR THE FIRST TWO PASSES FOR THK >=12.5 MM & <=25MM.**

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WSC FOR PIPING CLASSES: **A64I**, **B64I, D64I**				
MATERIAL SPECIFICATIONS	PIPES	ASTM A 333 GR.6, ASTM A 671 GR.CC60 CL.32		
	FITTINGS	ASTM A 350 GR.LF2 CL.1, ASTM A 420 GR.WPL6, ASTM A 420 GR.WPL6-W		
	FLANGES	ASTM A 350 GR.LF2 CL.1		
	OTHERS	-		
BASE METAL `P' NO	**1**			
WELDING PROCESS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: **GTAW**	FILLERPASS: **GTAW / SMAW (NOTE-2)**	ROOTPASS: **GTAW**	FILLER PASS: **GTAW / SMAW (NOTE-2)**
	FILLET JOINTS/ SOCKET JOINTS: **SMAW/GTAW**			
WELDING MATERIALS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: **ER 80SNi 1 (NOTE-1)**	FILLER PASS: **ER 80SNi 1 /E7018-1 (NOTE-1)**	ROOT PASS: **ER80S-Ni1 (NOTE-1)**	FILLER PASS: **ER 80SNi 1 /E7018-1 (NOTE-1)**
	FILLET JOINT/SOCKET JOINT: **E7018 -1/ ER 80SNi 1 (NOTE-1)**			
	BACKING RING: -		CONSUMABLE INSERT: -	
JOINT PREPARATION	**ASME B31.3**			
GASES	PURGING: -		SHIELDING: **ARGON**	
GAS COMPOSITION	PURGING: -		SHIELDING: **99.995%**	
PREHEATING **(NOTE-3)**	PREHEAT TEMP: **10°C MIN/ 100°C FOR THK >25 mm**		INTERPASS TEMP.: **315°C MAX.**	
POST HEATING: -				
POST WELD HEAT TREATMENT	HOLDING TEMP: **-**		HOLDING TIME: **-**	
	RATE OF HEATING: **-**		MIN. HOLDING TIME: **-**	
	METHOD OF COOLING: **-**		RATE OF COOLING: **-**	
MECHANICAL PROPERTY REQUIREMENTS **(NOTE-4)**	CHARPY `V' NOTCH VALUE:		MIN: **20 J**	AVERAGE: **27 J**
	AT TEMPERATURE:		**-48 DEG C**	
	HARDNESS:			
CODE OF FABRICATION	**ASME B31.3**			

TECHNICAL NOTES:

1. **ALL BATCHES OF WELDING CONSUMABLES SHALL BE IMPACT TESTED AT - 48°C.**
2. **GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL-BORE PIPING, DIAMTER 2" AND SMALLER.**
3. **PRE-HEAT TEMPERATURE OF ATLEAST 50°C SHALL BE PROVIDED FOR THE FIRST TWO PASSES FOR THK >=12.5 MM & <= 25 MM.**
4. **DURING PQR, IMPACT TESTING SHALL BE CARRIED OUT AT – (MINUS) 48°C.**

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WSC FOR PIPING CLASSES: **A1K, A3K, D1K**

MATERIAL SPECIFICATIONS	PIPES	ASTM A 312 TP304, ASTM A 358 TP304 CL.1		
	FITTINGS	ASTM A 182 GR.F304, ASTM A 403 GR.WP304-S, ASTM A 403 GR.WP304-WX		
	FLANGES	ASTM A 182 GR.F304		
	OTHERS	-		
BASE METAL `P' NO	8			
WELDING PROCESS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: GTAW	FILLERPASS: GTAW/SMAW (NOTE-1)	ROOTPASS: GTAW/SMAW (NOTE-1)	FILLER PASS: GTAW/ SMAW (NOTE-1)
	FILLET JOINTS/ SOCKET JOINTS: SMAW/GTAW			
WELDING MATERIALS	GROOVE JOINTS			
	BUTT		OTHER THAN BUTT	
	ROOT PASS: ER308/ ER308/ER308L	FILLER PASS: ER308/ ER308L/E308-15/16/ E308L-15/16	ROOT PASS: ER308/ ER308L/ E308-15/16/ E308L-15/16	FILLER PASS: ER308/ ER308L/ E308-15/16/ E308L-15/16
	FILLET JOINT/SOCKET JOINT: E308-15/16/ E308L-15/16 /ER308 / ER 308L			
	BACKING RING: -		CONSUMABLE INSERT: -	
JOINT PREPARATION	ASME B31.3			
GASES	PURGING: - ARGON		SHIELDING: ARGON	
GAS COMPOSITION	PURGING: - 99.995 %		SHIELDING: 99.995 %	
PREHEATING	PREHEAT TEMP: 10 °C		INTERPASS TEMP.: 175°C MAX.	
POST HEATING: -				
POST WELD HEAT TREATMENT	HOLDING TEMP: -		HOLDING TIME: -	
	RATE OF HEATING: -		MIN. HOLDING TIME: -	
	METHOD OF COOLING: -		RATE OF COOLING: -	
MECHANICAL PROPERTY REQUIREMENTS	CHARPY `V' NOTCH VALUE:		MIN: -	AVERAGE: -
	AT TEMPERATURE:		-	
	HARDNESS: -			
CODE OF FABRICATION	ASME B31.3			

TECHNICAL NOTES:

1. GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL BORE PIPING, DIAMETER 2" AND SMALLER.

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WSC FOR PIPING CLASSES: **A61K, A62K, A6K**				
MATERIAL SPECIFICATIONS	**PIPES**	**ASTM A 312 TP304/304L**		
	FITTINGS	**ASTM A240 GRADE F304/304L , ASTM A 403 GR.WP304/304L-S, ASTM A 403 GR.WP304/304L-WX**		
	FLANGES	**ASTM A240 GRADE F304/304L**		
	OTHERS	**-**		
BASE METAL `P' NO	**8**			
WELDING PROCESS	**GROOVE JOINTS**			
	BUTT		**OTHER THAN BUTT**	
	ROOT PASS: GTAW	**FILLERPASS: GTAW/SMAW (NOTE-1)**	**ROOTPASS: GTAW/SMAW (NOTE-1)**	**FILLER PASS: GTAW/ SMAW (NOTE-1)**
	FILLET JOINTS/ SOCKET JOINTS: SMAW/GTAW			
WELDING MATERIALS	**GROOVE JOINTS**			
	BUTT		**OTHER THAN BUTT**	
	ROOT PASS: ER308L	**FILLER PASS: ER308L / E308L-15/16**	**ROOT PASS: ER308L / E308L-15/16**	**FILLER PASS : ER308L/ E308L-15/16**
	FILLET JOINT/SOCKET JOINT: E308L-15/16 /ER308L			
	BACKING RING: -		**CONSUMABLE INSERT: -**	
JOINT PREPARATION	**ASME B31.3**			
GASES	**PURGING: - ARGON**		**SHIELDING: ARGON**	
GAS COMPOSITION	**PURGING: - 99.995 %**		**SHIELDING: 99.995 %**	
PREHEATING	**PREHEAT TEMP: 10 °C**		**INTERPASS TEMP.: 175°C MAX.**	
POST HEATING: -				
POST WELD HEAT TREATMENT	**HOLDING TEMP: -**		**HOLDING TIME: -**	
	RATE OF HEATING: -		**MIN. HOLDING TIME: -**	
	METHOD OF COOLING: -		**RATE OF COOLING: -**	
MECHANICAL PROPERTY REQUIREMENTS	**CHARPY `V' NOTCH VALUE:**		**MIN:**	**AVERAGE:**
	AT TEMPERATURE:		**-**	
	HARDNESS: -			
CODE OF FABRICATION	**ASME B31.3**			

TECHNICAL NOTES:

1. **GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL BORE PIPING, DIAMETER 2" AND SMALLER.**

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WSC FOR PIPING CLASSES: **A1N**				
MATERIAL SPECIFICATIONS	**PIPES**	**ASTM A 312 TP316/316L, ASTM A 358 TP316/316L CL.1**		
	FITTINGS	**ASTM A 182 GR.F316/316L, ASTM A 403 GR.WP316/316L-S, ASTM A 403 GR.WP316/316L-WX**		
	FLANGES	**ASTM A 182 GR.F316/316L**		
	OTHERS	**-**		
BASE METAL `P' NO	**8**			
WELDING PROCESS	**GROOVE JOINTS**			
	BUTT		**OTHER THAN BUTT**	
	ROOT PASS: GTAW	**FILLERPASS: GTAW/SMAW (NOTE-1)**	**ROOTPASS: GTAW/SMAW**	**FILLER PASS: GTAW/ SMAW (NOTE-1)**
	FILLET JOINTS/ SOCKET JOINTS: SMAW/GTAW			
WELDING MATERIALS	**GROOVE JOINTS**			
	BUTT		**OTHER THAN BUTT**	
	ROOT PASS: ER316L (NOTE-2)	**FILLER PASS: : ER316L/ E316L-15/16 (NOTE-2)**	**ROOT PASS: ER316L/ E316L-15/16 (NOTE-2)**	**FILLER PASS : ER316L/ E316L-15/16 (NOTE-2)**
	FILLET JOINT/SOCKET JOINT: E316L-15/16/ER316L (NOTE-2)			
	BACKING RING: -		**CONSUMABLE INSERT: -**	
JOINT PREPARATION	**ASME B31.3**			
GASES	PURGING: **- ARGON**		**SHIELDING: ARGON**	
GAS COMPOSITION	**PURGING: 99.995 %**		**SHIELDING: 99.995 %**	
PREHEATING	**PREHEAT TEMP: 10 °C**		**INTERPASS TEMP.: 175°C MAX.**	
POST HEATING: -				
POST WELD HEAT TREATMENT	**HOLDING TEMP: -**		**HOLDING TIME: -**	
	RATE OF HEATING: -		**MIN. HOLDING TIME: -**	
	METHOD OF COOLING: -		**RATE OF COOLING: -**	
MECHANICAL PROPERTY REQUIREMENTS	**CHARPY `V' NOTCH VALUE:**		**MIN:**	**AVERAGE:**
	AT TEMPERATURE:		**-**	
	HARDNESS: -			
CODE OF FABRICATION	**ASME B31.3**			

TECHNICAL NOTES:

1. **GTAW SHALL BE EMPLOYED FOR ENTIRE WELDING OF SMALL BORE PIPING, DIAMETER 2" AND SMALLER.**

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JOB SPECIFICATION

(ELECTRICAL)

FOR

COOLING TOWER PACKAGE

(TENDER NO.: C050-1U68-81-45-PB-T-8010)

PROJECT : EPCM SERVICES FOR SETTING UP POLYPROPYLENE UNIT AT NRL

CLIENT : M/s NRL, NUMALIGARH

PMC : ENGINEERS INDIA LIMITED

JOB NO : C050

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	12.08.2025	ISSUED WITH TENDER	MS	AKG	VK

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1 GENERAL

1.1 INTRODUCTION

1.1.1 This specification along with the scope of work, design philosophy, equipment specifications, data sheets, drawings and documents attached or referred, shall form the basis for developing detailed design and engineering for electrical facilities including electrical distribution system, electrical equipment and electrical installation etc. for the Cooling tower packages for PP Unit Project of M/s NRL - Numaligarh, Assam.

1.1.2 The work shall be carried out to the best workmanship, in conformity with the specifications, approved drawings/ construction drawings and the instructions of the OWNER or Engineer-in-Charge from time to time.

1.1.3 The contract shall include clearing of temporary constructions, waste materials and loose earth, which might get collected in and nearby the work site during execution of work and after final completion.

1.2 STANDARDS

1.2.1 The designed system shall comply with the requirement of relevant standards and statutory regulations as defined in relevant documents. Design, engineering, detailed engineering, preparation of drawings/ documents, supply, erection, testing and commissioning of the electrical system shall be performed as per enclosed design philosophy, other specifications, data sheets and drawings enclosed with tender

1.2.2 In case of conflict between requirements specified in various documents, the more stringent one shall be followed. OWNER / PMC's decision shall be binding. The same shall be complied without any time / cost implication to OWNER.

1.2.3 It is responsibility of the CONTRACTOR to highlight any contradiction amongst various documents at the bid stage itself & get required clarification from OWNER / PMC.

1.2.4 Codes and standards as prevailing in the country of origin may be followed for equipment purchased abroad provided that the equivalent standards are more stringent than Indian / International standards and meet the statutory regulations of the approving Indian statutory authorities.

1.2.5 In addition, the work shall also conform to the requirements of latest editions/ amendments of the following:

- The CEA guidelines and rules framed there under.
- The fire insurance Regulations.
- Indian Petroleum Rules.
- The regulations laid down by Electrical Inspectorate (CEA).
- The regulations laid down by the Chief Controller of Explosives.
- Any other regulations laid down by the Central, State or Local Authorities from time to time during the execution of this contract.

2 AREA CLASSIFICATION & EQUIPMENT SELECTION

2.1 The detailed area classification drawing for the complete package shall be prepared by the CONTRACTOR. However, following minimum consideration shall be made while selecting the equipments.

2.2 Area classification and the equipment selection for the area handling flammable gases and vapours shall be based on relevant standards. However all electrical equipment in/on FRP cooling tower shall be suitable for minimum Zone-2 area classification. Following as a minimum shall be followed for Zone-2 equipments:

Equipment	Type of enclosure protection
MV Motors	Ex-de
Electrical Heater	Ex-d
Local control station / Push Button Station	Ex-d
Lighting fitting	Ex-d

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Equipment	Type of enclosure protection
Control Gear Box / Junction Box	Ex-d
Lighting Panel / Power Panel	Ex-d
Plug & Socket	Ex-d
Welding Receptacle	Ex-d

* - For all Ex-de equipment, main enclosure of the equipment shall be Ex-d certified and terminal box shall be Ex-e certified.

2.3 Fan motors, light fittings and any other electrical equipment installed on process cooling tower shall be suitable for Zone-2. Other electrical equipment coming in safe area i.e. Cooling water pumps, lighting in cooling water pump house, etc., shall be weather proof industrial type.

2.4 Flameproof Equipment shall be Ex–d type suitable for Zone-2, Gas group IIA/IIB, Temp. Cl. T3. Flameproof (Ex-d) motors shall meet the requirements of IS/IEC/ 60079-0/1.

2.5 All equipments shall have type test certificates as required in the above mentioned standards for conforming compliance to relevant standards.

2.6 All accessories like nuts, bolts, washers, earthing studs etc. shall be made of stainless steel SS-304.

2.7 Cable glands shall be supplied as per IEC-60079-0. For Zone-2 equipments, FLP cable glands shall be provided.

2.8 Plastic cable glands are not acceptable (neither for Zone-2 nor for safe area equipments).

2.9 A nameplate indicating Tag Number shall be provided on each FLP equipment. Separate nameplate shall also be provided to indicate the details of testing agency, test certificate no. with date, statutory approval no. with date and agency, applicable gas group etc.

2.10 All electrical equipment for use in hazardous areas shall be certified by CIMFR, ATEX, BASEEFA or equivalent independent testing agency for the service and the area in which it can be used and shall be approved by PESO/CCOE.

2.11 All indigenous flameproof equipment (Type Ex-d) shall be manufactured under valid BIS license.

3 SITE CONDITIONS

The equipment and the installation shall be suitable for continuous operation under the following site conditions :

Maximum Temperature	:	38 °C
Minimum Temperature	:	10 °C
Equipment Design Temperature	:	40 °C
Relative Humidity	:	85% at 40 DEG C
Altitude above MSL	:	< 1000m
Environment	:	Dusty, Tropical & Corrosive as in Hydrocarbon Industry

4 UTILIZATION VOLTAGES

Various equipment and items being supplied as part of the package shall be suitable for voltage supplies as listed below :

a.)	For motors rating less than 0.18kW	:	240V ± 10%, 50Hz ±3%, SP AC
b.)	Motors rated above 160kW (DOL)	:	6.6kV ± 10%, 50Hz ±3%, TP AC
c.)	Motors rated above 0.18kW & up to 160kW (DOL)	:	415V ± 10%, 50Hz ±3%, TP AC
d.)	Anti-condensation heaters (for motors rated 30kW and above)	:	240V ± 10%, 50Hz ±3%, SP AC

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e.)	PDB/ Power Panel/Welding receptacles	:	415V ± 6% AC; 50 Hz ± 3% TPN
f.)	Lighting Panel / Lighting High Mast	:	415V ± 6% AC; 50 Hz ± 3% TPN
g.)	Normal Lighting/Emergency Lighting	:	240V ± 10% AC; 50 Hz ± 3% SPN
h.)	DC Critical Lighting	:	110V ± 10% DC
i.)	UPS Power Supply	:	110V ± 10% AC; 50 Hz ± 3% SPN

Notes:

1. 415V system is solidly grounded.
2. 6.6 kV system is resistance earthed/grounded.
3. LV - Low Voltage. The voltage which does not normally exceed 250 V.
4. MV - Medium Voltage. The voltage which normally exceeds 250 V and does not exceed 650 V.
5. HV - High Voltage. The voltage which normally exceeds 650 V but does not exceed 66 kV.

5 ENGINEERING AND JOB SPECIFIC REQUIREMENTS

5.1 The drawings / documents supplied by the OWNER / EIL define the basic system design and distribution philosophy for the package. CONTRACTOR shall develop and update the power system design during detailed engineering and define this design by means of various deliverables as required but not limited to those defined in document no. C050-1U68-16-50-VR-8010.

5.2 All the above items shall be updated to reflect any changes and modifications to “AS BUILT” status. Modified equipment shall be highlighted.

5.3 Various equipments covered in the bid package to be supplied by the CONTRACTOR shall in general be, in accordance with the requirements defined in design basis document, standard specifications, respective equipment datasheet and hardware datasheet. Besides these, the requirements as detailed out in respective clauses for the equipments shall also be considered.

5.4 CONTRACTOR shall ensure that all electrical equipment comply to site and system conditions, rating and other technical requirement as specified in the engineering design basis and shown in the single line diagram.

5.5 CONTRACTOR shall use this specification, datasheet, design basis document and OWNER/ EIL’s standard specifications for various equipments. However for equipment where OWNER/ EIL’s standard specifications have not been attached, the CONTRACTOR shall use their own specification developed based on current Indian Standard/IEC/Specification, project specific requirement and good engineering practices prevalent in petroleum industry so as to ensure satisfactory operational and maintenance requirements.

5.6 CONTRACTOR shall note that data sheets for some of the equipment are not enclosed separately. Equipment data sheets for all equipment shall be prepared by the CONTRACTOR based on relevant codes and specifications and data sheet shall contain all technical data and information which are essential for review and technical acceptability, detailed engineering, installation, testing, repair and maintenance, replacement etc.

5.7 The CONTRACTOR shall prepare data sheets referred in OWNER/ EIL standard specifications, but not enclosed with the package.

5.8 The equipment shall in general conform to latest revision of statutory regulations, Indian Standards, IEC / Other international standards applicable for the country of origin of the equipment.

5.9 All equipment shall be subjected to routine and acceptance tests as per applicable specifications. In addition, equipment shall be subjected to type tests if specified elsewhere.

5.10 CONTRACTOR shall clearly specify in their purchase specifications, the requirement of conducting other special tests / type tests, which are envisaged for various electrical equipment, which shall have no impact on cost and time.

6 EQUIPMENT & SYSTEM SPECIFICATIONS

6.1 EQUIPMENT SIZING

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6.1.1 Sizing of various items in CONTRACTOR's scope of supply such as motors, cables trays, single phase PDB, etc. is included in CONTRACTOR's scope of work.

6.1.2 All equipments shall conform to attached standard specification. In addition additional requirements as mentioned below, for each equipment shall be followed.

6.2 **MOTORS**

6.2.1 HV Motors (6.6 kV, Induction) shall be as per EIL specification 6-51-0031 and datasheet for HV Motor, C050-999-16-50-DS-0300 (DOL Start).

6.2.2 MV motors (<1100V) shall be as per EIL specification 6-51-0064 and datasheet for MV Motor, C050-999-16-50-DS-0307 (DOL Start).

6.2.3 Variation / Clarifications against the standard specification of HV motor 6-51-0031, and MV Motor 6-51-0064, shall be as per the MOU agreed with EIL by respective motor manufacturer. No further deviations shall be entertained

6.2.4 All MV motors for hazardous area shall be IE3 type and all MV motors for safe area shall be IE4 type conforming to requirements of EIL specification 6-51-0064 and all operating parameters such as starting current, efficiency for all IE3 and IE4 MV motors shall be in line with latest IS 12615.

6.2.5 The rated efficiency and the IE code shall be durably marked on the rating plate, for example "IE4– 95.4 %".

6.2.6 All MV motors shall be provided with spreader box for smooth termination of power cables in the motor.

6.2.7 Recommended range for the starting power factor of the DOL start motors shall be in range of 0.2 to 0.3.

6.2.8 Space heater shall be provided for motors rated 30 kW and above.

6.2.9 CONTRACTOR to provide adequate size of motor terminal box to accommodate & terminate OWNER's cable sizes (refer below table) and avoid additional intermediate JB for motor termination.

Cl. 6.2.5 of EIL specification 6-51-0064 Rev.2 is superseded by following clause.

"The terminals, cable lugs, terminal box, cable entries and cable glands shall be suitable for the minimum cables sizes as specified below for 2 pole, 4 pole or 6 pole motors. Motor terminal box shall be provided for the given cable size. However, the actual cable sizes shall be provided post order during detail engineering.

Sr. No	Motor rating (in kW) up to and including	Cable Size (mm^2)
1	0.12	1R X 3C X 4 Cu
2	0.18	1R X 3C X 4 Cu
3	0.25	1R X 3C X 4 Cu
4	0.37	1R X 3C X 4 Cu
5	0.55	1R X 3C X 4 Cu
6	0.75	1R X 3C X 4 Cu
7	1.1	1R X 3C X 4 Cu
8	1.5	1R X 3C X 4 Cu
9	2.2	1R X 3C X 4 Cu
10	3.7	1R X 3C X 10 Cu
11	5.5	1R X 3C X 16 Cu
12	7.5	1R X 3C X 16 Cu
13	11	1R X 3C X 50 Al

Sr. No	Motor rating (in kW) up to and including	Cable Size (mm^2)
14	15	1R X 3C X 70 Al
15	18.5	1R X 3C X 70 Al
16	22	1R X 3C X 95 Al
17	30	1R X 3C X 150 Al
18	37	1R X 3C X 240 Al
19	45	2R X 3C X 95 Al
20	55	2R X 3C X 120 Al
21	75	3R X 3C X 120 Al
22	90	3R X 3C X 150 Al
23	110	3R X 3C X 185 Al
24	132	4R X 3C X 240 Al
25	160	4R X 3C X 240 Al

(R: Nos. of cable run, C: Nos. of cable core)

In case it is not feasible to provide motor terminal box suitable to accommodate OWNER's cables (indicated above), then separate motor junction box shall be provided by CONTRACTOR to accommodate OWNER's cable(s) without any time and cost implication to OWNER. The Motor junction

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box shall be Flameproof type (Ex-d) suitable for the specified gas group and temperature classification. FLP JB shall be supplied with FLP cable glands & lugs and shall meet all the requirement of IS/IEC-60079-0/1. Thread shall be Metric type.

The enclosures of the junction boxes shall be of cast light metal alloy. The Junction Box shall be suitable for outdoor location and shall have minimum IP-55 degree of protection. All accessories like nuts, bolts, washers etc. shall be made of stainless-steel SS-304.

6.2.10 All opening in the motor terminal boxes shall be supplied with weatherproof (min. IP 55) blanking plugs so that the motor is transported with sealed terminal boxes. The cable entries of all terminal boxes of motors, before dispatch from motor manufacturer works, shall be fitted with suitably sized weatherproof (IP 55 minimum) Metallic Sealing Plugs to prevent water entry/ingress in motor windings through openings meant for cable entry in terminal boxes at construction site till the time motors are erected and cable terminations are carried out. However, same shall be replaced by associated flameproof cable glands and lugs to be also supplied by CONTRACTOR along with motors as specified in MR.

6.2.11 If any HV Motor is provided with elastimold terminal box, then vendor to furnish detailed drawings of elastimold cable termination kits & ensure that cable termination kit shall be made available during FAT of Motor. Short circuit test report shall be furnished for elastimold terminations.

6.2.12 CONTRACTOR to note that, if there is any requirement of emergency electrical power for the auxiliary equipment supplied with the main motor/pump, same shall be highlighted at the bid stage only.

6.2.13 RTD/BTD shall be provided for HV motors as per Cl. 7.1 and Cl. 7.2 respectively of EIL specification 6-51-0031.

6.2.14 All motors shall have provision for double earthing.

6.2.15 External fan cooled/water cooled motors are not acceptable.

6.2.16 Bearings for all motors shall be provided with capability of grease injection from outside. Pre-lubricated sealed bearings shall not be considered.

6.2.17 In addition to packing requirements specified in EIL standard specification of motors, Vendor to do plastic wrapping of all electrical equipment for shipping from works to site.

6.2.18 Non VFD HV Motors (if applicable), having rating greater than or equal to 1500 kW, 3 numbers class PS CTs for motor differential protection shall be provided in the neutral terminal box. The exact specification of CTs (CT ratio, Knee point voltage, Imag, etc.) shall be given during detailed engineering so that it matches with the corresponding CTs provided on switchgear side.

6.3 **SINGLE PHASE POWER DISTRIBUTION BOARD**

6.3.1 For single phase motor loads being supplied as part of the package, fixed type Power Distribution Board (PDB) shall be provided by CONTRACTOR.

6.3.2 Requirements as indicated in the switchboard datasheet C050-999-16-50-DS-0070 and specification for Fixed type switchboard (6-51-0012) shall be taken care of while designing the PDB and filled in datasheet shall be furnished for review.

6.3.3 Hardware requirement in the Incomer & outgoing feeders shall be as per that attached datasheet C050-999-16-50-DS-0071.

6.3.4 All necessary motor starter feeders & contactor controlled power feeders shall be provided in the PDB based on the load requirement.

6.3.5 Minimum 20% of each type of outgoing feeders or 1 no. each type (whichever is maximum) shall be provided as spare in the PDB.

6.3.6 PDB shall be with two incomers without buscoupler with mechanical interlock between the incomers. Incoming 3 Phase 415V AC, TPN, supply for the incomers shall be provided by OWNER.

6.3.7 This PDB shall be installed in the CWTP building and all cabling from this PDB to the various loads shall be by CONTRACTOR.

6.3.8 All interface requirement for loads shall be covered in the PDB. Cabling for same from PDB to PLC/Control Room shall by CONTRACTOR.

6.3.9 Control supply for the switchboard shall be derived from the incoming power supply.

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6.4 **LOCAL CONTROL STATION**

6.4.1 The Local Control Stations (LCS) shall conform to EIL spec no. 6-51-0006 & 6-51-0014 based on the applicable area classification.

6.4.2 Flameproof and weatherproof control stations (IP-65) for all motors and heaters, emergency stop push buttons for motors, as required for plant operation and safety shall be supplied by the CONTRACTOR.

6.4.3 Each motor shall have a separate push button station for motor. LCS shall be provided with separate push button for start, stop, emergency stop, local/ remote selector switch, auto/manual selector switch as per operation requirement. Analogue ammeter shall be provided for all motors rated greater than 3.7 kW. All the STOP Push buttons, Emergency STOP push buttons shall be shrouded type only. Stop Push button shall have provision of putting LOTO locks and padlocks.

6.4.4 For DOL fed motors, OWNER shall provide 1A CT signal from OWNER's motor feeders for wiring ammeter in LCS.

6.4.5 One number emergency stop push button station shall be provided near each motor having control not in the vicinity. This push button shall be installed at an accessible place and clearly marked with suitable warning instructions.

6.4.6 For cooling fan motors mounted on the top of cooling tower, grade level emergency stop pushbutton shall be provided.

6.4.7 All push button stations shall be provided with 2 nos. earthing lugs/studs.

6.5 **CABLE TRAYS/ TRENCHES**

6.5.1 Interface with client's cable system shall be through trays at package battery limit. Further distribution inside package battery limit shall be through trays.

6.5.2 Engineering for sizing, deciding the number and routing of cable trench/cable trays within CONTRACTOR's battery limits shall be carried out by the CONTRACTOR based on number and sizes of cables. These details shall be finalized during detail engineering, which shall be taken care of by the CONTRACTOR without any impact on cost and time to OWNER/ EIL.

6.5.3 All power cables in racks / trays shall be laid in single layer only.

6.5.4 Minimum 20% spare space in each cable tray shall be kept for future use.

6.5.5 All cable trays as required for the package shall be GI type with SS hardware and shall be provided by CONTRACTOR. Cable trays shall be Hot dip Galvanized with 100 micron thickness

6.5.6 GI pipes for cable protection above ground, floor sleeves, supports wherever necessary, cable markers, identification tags, GI saddles, saddle bars and associated accessories, all other galvanized hardware like nuts, bolts, washers, grouting bolts as necessary, shall also be provided.

6.5.7 GI Sheet covers shall be provided for vertical extent of cable trays & top most trays. GI Sheet covers shall be provided at the bottom of the bottom most cable trays, if trays are laid on pipe rack with hydrocarbon piping below the cable trays.

6.5.8 It shall be CONTRACTOR's responsibility to co-ordinate the cable trench/ tray routing from the package battery limit area, control room and substation building etc. with other agencies involved. Trenches and trays shall be provided up to the battery limits as per the final approved layouts without any impact on cost and time to OWNER.

6.6 **MV POWER AND CONTROL CABLES**

6.6.1 All power and control cables shall be XLPE insulated, flame retardant, armoured type and shall comply with the requirements indicated below and datasheet for MV Power Cable (C050-999-16-50-DS-0220) and MV Control Cables (C050-999-16-50-DS-0221).

6.6.2 Power cables used for incoming to lighting/power panels shall be 3.5 core. The conductor size shall be minimum 4mm^2 for power cables.

6.6.3 For outdoor lighting, armoured power cable of minimum size 3Cx2.5mm^2 shall be used for individual circuit and for lighting inside the building, minimum 1.5 sqmm copper conductor, PVC insulated wire shall be used in conduit system (for circuit and point wiring), with proper colour coding.

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6.6.4 Cables for lighting shall be sized to maximum voltage drops of 10% for outdoor lighting and 5% for DC Critical lighting.

6.6.5 The conductor material for MV power cables shall be copper up to 16 mm^2 & Aluminum above 16 mm^2.

6.6.6 Control cable shall be with copper conductors of size 2.5mm^2, XLPE insulated, stranded, twisted pair individual pair shielded and overall shielded type.

6.6.7 Outside substation, cabling shall be done above ground on GI cable trays.

6.6.8 All power cables in racks / trays shall be laid in single layer only.

6.7 LIGHTING SYSTEM

6.7.1 All lighting fixtures shall be suitable for the area in which they are installed viz safe or hazardous area.

6.7.2 All lighting fixtures shall be LED type (for normal, emergency & DC lighting).

6.7.3 Lighting & Power panels shall be standardized to have 6, 12 or 18 single phase outgoing feeders.

6.7.4 Lighting & Power Panel shall have 63 A Four Pole MCB (Incomer), 20 A Double Pole MCBs + RCCB as Outgoings.

6.7.5 All Lighting & power panels shall have separate compartments for incoming & outgoing cables – apart from the MCB enclosure. The incomer (line) side shall have R–Y–B LED indications. The lighting panels shall be structure mounted or free standing type.

6.7.6 The requirement of lux level at various places has been specified elsewhere. Package CONTRACTOR shall demonstrate that the actual lux achieved at various locations, in his scope, are in line with specified lux values and augment the lighting, if found to be inadequate.

6.7.7 Type of fixture shall be selected out of the Lighting Fixture Schedule (C050-999-16-50-DS-0702) attached with the bid document.

6.7.8 Normal, emergency & critical lighting shall be provided as per Electrical Design Philosophy and Design Data.

6.7.9 DC critical lighting shall be provided to enable operation in the event of power failure.

6.7.10 DC lighting fittings suitable for operation at 110 V DC shall be provided at exit, escape route & any other strategic location inside the process units.

6.7.11 All outdoor lighting fixtures shall be provided with external reflectors.

6.7.12 Control gear box shall be separate/integral, as applicable as per lighting fixture schedule. If separate, it shall be located at accessible level.

6.7.13 The control gear boxes shall be provided with 3 nos. entries and 3 nos. double compression nickel plated brass cable glands. The glands shall be suitable for the specified cable size. 20%of the control gear boxes shall be supplied with 1 no. nickel plated brass plug for sealing the unused entry.

6.8 EARTHING & LIGHTNING PROTECTION SYSTEM

6.8.1 Earthing system of the entire package shall be designed to meet the statutory requirements and shall be included in package CONTRACTOR's scope.

6.8.2 All earthing material (like earthing cable, GI earth strip, earth plates, lugs etc.) shall be provided & installed by package CONTRACTOR for all equipment within package battery limits.

6.8.3 Minimum size of the main earth grid around the cooling tower shall be 50 X 6 mm GI strip.

6.8.4 Earth electrodes with test pits shall be provided around the cooling towers.

6.8.5 Adequate number of earth plates for taking branch connections shall be provided.

6.8.6 Earth connections from GI earth grid to individual equipment located outdoor shall be done by using green coloured PVC insulated Aluminium cable from earth plate onwards as per EIL standard 7-51-0116.

6.8.7 Package CONTRACTOR's scope shall include lightning protection of tall structures (no. of connections of the equipment to the earthing system for lightning protection shall be as per relevant standards).

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However, minimum two nos. independent earth electrodes shall be provided for tall structures for connection to earth and to the main earth grid. Earth electrode shall be of GI pipe as per 7-51-0101.

6.8.8 All earthing hardware (i.e. nut, bolts, etc.) for earth pits, earth plates connection cable trays earthing, etc. shall be of stainless steel grade SS 304.

6.8.9 Package CONTRACTOR shall provide earth grid up to battery limit of the package including provision of earth plate near the battery limit for interconnection of the unit earth grid with the Employer's main plant grid.

6.9 ELECTRICAL DESIGN

Standard design philosophy for electrical facilities 6-51-0099 along with the detailed/requirements indicated here and other specifications attached with the tender shall form the basis for basic design and developing detailed design and engineering for electrical facilities including electrical power system, electrical equipment and electrical installation etc.

6.10 MISCELLANEOUS REQUIREMENTS

6.10.1 Numbering scheme for various equipment shall be decided during detail engineering and tag number/ service/ other details of all equipment shall be marked accordingly on the tag plate.

6.10.2 All outdoor equipments shall be provided with FRP canopy for additional weather protection.

6.10.3 All equipment shall be tested and certified by an independent testing authority for use in the specified area. The following statutory approval certificates shall be submitted for all equipment to be installed in hazardous areas :

a.) Type Test Certificate from independent testing authorities such as CIMFR / BASEEFA / ATEX / equivalent test house

b.) Applicable CCoE/ PESO approval certificates.

c.) Valid BIS license for all Ex-d equipment (equipment procured from India)

6.10.4 All equipment shall be subjected to routine and acceptance tests as per applicable specifications. In addition, equipment shall be subjected to type tests if specified elsewhere.

6.10.5 All the instruments, meters, etc., used for testing shall be duly calibrated at NABL laboratory and necessary calibration certificate shall be made available during inspection.

6.10.6 CONTRACTOR to furnish filled in load data along with nos. of feeders required (of all voltage level, as applicable) as per Doc No. C050-999-16-50-DS-0700 attached with the TENDER.

6.10.7 OWNER will provide 415V AC feeders from the PCC/ MCC/ ASB/ LDB/ ELDB for MV loads, 415V AC feeders from the EPMCC for emergency MV loads (if required). 110V AC UPS feeders and 110V DC supply feeders from OWNER's AC UPS/ DC system shall be provided by OWNER. Utilization voltages other than those mentioned above, if required specifically by CONTRACTOR for any equipment shall be arranged by the CONTRACTOR.

6.10.8 CONTRACTOR to note that, if there is any requirement of emergency electrical power for the auxiliary equipments supplied with the main motor/pump, same shall be highlighted at the initial stage only.

6.10.9 CONTRACTOR shall comply to various requirements as per Ministry of Power (GoI) various orders regarding testing of all equipment, components & parts imported for use in the power supply system to check any kind of embedded malware/Trojans/cyber threat and for adherence to Indian Standards.

6.10.10 All external hardware shall be of stainless steel in view of the corrosive atmosphere.

6.10.11 Paint shade for indoor electrical equipment shall be RAL 7032, & for outdoor electrical equipment shall be RAL 7031. Paint shade for Emergency & DC lighting fixtures shall be informed during detailed engineering.

6.10.12 Suitability of cable terminal boxes/ chambers for the respective cables sizes / runs as per the final cable schedule shall be ensured by the CONTRACTOR. Incoming cable sizes for equipment shall be provided by OWNER, as per voltage drop calculations. Terminal box for motors and other equipments shall be suitable for the cable sizes, to be finalized during detail engineering.

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6.10.13 All electrical components and equipment shall be sized to suit the maximum load under the most severe operating conditions. Rated voltage and frequency for the equipment shall be as indicated in enclosed data sheets.

6.10.14 All spares required for testing and commissioning the package shall be included along with any special tools and tackles required for operation and maintenance.

6.10.15 All equipment shall be supplied along with Cable glands & lugs.

6.10.16 Cable glands shall be of FLP type (minimum IP-55) suitable for use in Zone-2, Gas group IIA/IIB, Temp class T3 and shall meet all the requirement of IS/IEC-60079-0/1/15. Cable glands shall be single compression type for indoor equipment and double compression type for outdoor equipment. Glands shall be double compression type Nickel plated brass FLP cable glands. Thread shall be Metric type.

6.10.17 Cable lugs shall be crimping type. All cable lugs shall be long barrel type. Lugs having sector shaped or circular barrel shall be used for making connections for cables having sector shaped or circular geometry of conductor respectively. Lugs shall be as per the following:

a.) Aluminum conductor cable termination on Aluminum bus bar/ terminals in switchboards - Aluminum lugs

b.) Aluminum conductor cable termination on Copper bus bar/ terminals in switchboards - Bimetallic lugs having Al barrel & tinned Cu palm

c.) Copper conductor cable termination on Aluminum bus bar in switchboards - Bimetallic lugs having tinned Cu barrel and Al palm

d.) Copper conductor cable termination on copper bus bar/ terminals in switchboards- Tinned copper lugs

7 MAKES OF EQUIPMENT/COMPONENTS

7.1 List of approved vendors for Electrical equipment/components shall be as indicated in the Vendor List-Electrical (Doc. No. C050-1U68-16-50-VL-8010) attached with the TENDER.

7.2 CONTRACTOR may procure material from any of the listed vendors. However current validity and range of approval as per EIL enlistment letter, workload, stability and solvency need to be verified by the CONTRACTOR before placement of order.

7.3 For equipment/ components, other than those specified in vendor list, CONTRACTOR can propose makes of equipment/ components during order execution. The alternate make of equipment/ components will be evaluated post order, based on the satisfactory track record and test certificates to be furnished by the vendor/ Sub vendor. CONTRACTOR to take approval from OWNER/ EIL before finalization of vendor.

7.4 CONTRACTOR shall ensure the availability of spare parts and maintenance support services for the offered equipment at least for 10 years from the date of supply. Vendor/ sub-vendor shall give a notice of at least one year to the end user of equipment and EIL before phasing out the products/spares to enable the end user for placement of order for spares and services.

8 LIST OF ATTACHMENTS

Sr. No.	Document Title	Document No.	Rev.
1.	Scope of work/Supply - Electrical	C050-1U68-16-50-SOW-8010	A
2.	Job Specification - Electrical	C050-1U68-16-50-SP-8010	A
3.	Electrical Block Diagram – Cooling Tower Package	C050-1U68-16-50-SK-8010	A
4.	Mandatory Spares list – Electrical	C050-1U68-16-50-SL-8010	A
5.	Vendor Data Requirement – Electrical	C050-1U68-16-50-VR-8010	A
6.	Vendor List – Electrical	C050-1U68-16-50-VL-8010	A
7.	Datasheet for MV Switchboard (Fixed Type)	C050-999-16-50-DS-0070	A

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Sr. No.	Document Title	Document No.	Rev.
8.	Hardware Datasheet for MV Switchboard (Fixed Type) Incomer / Motor Feeder / MCCB Contactor Feeder	C050-999-16-50-DS-0071	A
9.	Datasheet for MV Power Cables	C050-999-16-50-DS-0220	A
10.	Datasheet for MV Control Cables	C050-999-16-50-DS-0221	A
11.	Data Sheet - HV Induction Motor - DOL Start	C050-999-16-50-DS-0300	A
12.	Data Sheet - MV Induction Motor - DOL Start, IE3	C050-999-16-50-DS-0307	A
13.	Electrical Load Data Format	C050-999-16-50-DS-0700	A
14.	Utility Consumption Data	C050-999-16-50-DS-0701	A
15.	Lighting Fixture Schedule	C050-999-16-50-DS-0702	A
16.	Specification for quality management system requirements from bidders	6-78-0001	2
17.	Specification for documentation requirements from CONTRACTORs	6-78-0002	2
18.	Specification for flameproof control stations.	6-51-0006	6
19.	Specification for flameproof lighting and power panels	6-51-0008	6
20.	Specification for LV switchboards fixed type for package equipment.	6-51-0012	6
21.	Specification for industrial type control stations.	6-51-0014	6
22.	Specification for flameproof plugs, sockets and hand lamps	6-51-0021	6
23.	Specification for high voltage induction motors	6-51-0031	6
24.	Specification for medium and high voltage cables and accessories.	6-51-0051	9
25.	Specification for communication, fire alarm and control paired cables.	6-51-0052	7
26.	Specification for hazardous area light fixtures and junctions boxes	6-51-0061	6
27.	Specification for energy efficient medium voltage induction motors	6-51-0064	2
28.	Specification for electrical equipment installation	6-51-0081	5
29.	Specification for cable installation	6-51-0082	6
30.	Specification for lighting installation	6-51-0083	6
31.	Specification for earthing installation	6-51-0084	5
32.	Specification for field inspection, testing and commissioning of electrical installations	6-51-0087	4
33.	Specification for electrics of offsite package units	6-51-0092	6
34.	Design philosophy for electrical facilities	6-51-0099	7
35.	Typical earth electrode for earthing system.	7-51-0101	6
36.	Typical earth electrode in test PIT	7-51-0102	8
37.	Typical earth plate and fixing details.	7-51-0103	7
38.	Typical arrangement for earthing of motor.	7-51-0104	6
39.	Typical earth connection for push button station.	7-51-0106	6
40.	Typical earth connection for lighting pole.	7-51-0107	6
41.	Typical earthing of tanks, vessels and spheres.	7-51-0108	7
42.	Equipment earthing schedule	7-51-0116	9
43.	Typical installation of lighting fixture at ground level	7-51-0201	6
44.	Typical installation of lighting fixture on platform	7-51-0202	6

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Sr. No.	Document Title	Document No.	Rev.
45.	Typical installation of open area flood light fixture mounted on wall or column	7-51-0203	6
46.	Typical installation of flood light fixtures (two) mounted on pole.	7-51-0205	6
47.	Typical installation of aviation obstruction light	7-51-0220	6
48.	Typical installation of hazardous area well glass / dome glass / flat glass lighting fixture	7-51-0221	6
49.	Typical installation of hazardous area bulk - head fixture	7-51-0222	6
50.	Typical installation of flood light fixture	7-51-0223	6
51.	Typical installation of weather proof light fixture.	7-51-0224	6
52.	Typical installation of flame proof lighting / power panel	7-51-0225	6
53.	Typical installation of lighting / power panel wall (surface) mounted.	7-51-0226	6
54.	Typical installation of ground level lighting fixture with precast foundation	7-51-0233	1
55.	Typical installation of street lighting fixture with precast foundation	7-51-0234	1
56.	Typical installation of two no. flood light fixtures on pole with precast foundation	7-51-0235	1
57.	Installation details for control station on structural channel in paved area	7-51-0306	6
58.	Installation details for control station on concrete / steel column in paved area	7-51-0307	6
59.	Connection details for motor and control station (cable in tray)	7-51-0314	6
60.	Installation details for socket / receptacle mounted on column (cable in tray)	7-51-0316	6
61.	Installation details for socket / receptacle / control station mounted on hand rail	7-51-0317	6
62.	Safety measures for electrical installations during construction	7-51-0332	4
63.	Details for hot dip galvanized ladder type cable trays	7-51-0333	4
64.	Inspection and test plan for flameproof control stations	6-81-1006	5
65.	Inspection and test plan for flameproof lighting and power panels	6-81-1008	4
66.	Inspection and test plan for MV fixed type switch board for package equipment	6-81-1012	3
67.	Inspection and test plan for industrial type control stations	6-81-1014	4
68.	Inspection and test plan for flameproof plugs, sockets and hand lamps	6-81-1021	3
69.	Inspection and test plan for high voltage induction motors	6-81-1031	5
70.	Inspection and Test Plan for MV and HV cables and accessories	6-81-1051	4
71.	Inspection and Test Plan for communication and fire alarm cables	6-81-1052	4

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Sr. No.	Document Title	Document No.	Rev.
72.	Inspection and test plan for hazardous area lighting fixture and junction boxes	6-81-1061	4
73.	Inspection and test plan for energy efficient medium voltage motors	6-81-1064	1

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JOB SPECIFICATIONS
(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	SS	RK	NK

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Sr No.	Description	Properties	Scope by Contractor
1.0	**General**		
1.1	Location	Safe Area	
		Hazardous area	√
1.2	Hazardous Area Classification of instruments (to be considered for selection of all electronics/electrical instruments & accessories)	As per Hazardous Area Classification	
		Zone 1 Gas Group IIA/IIB/IIC	
		Zone 2 Gas Group II A, B	
		Zone 2 Gas Group II A, B, C Temp Class T3 (considering dust classification as per licensor documents)	√ (Refer Electrical specifications for the same)
		Any other	
1.3	Type of Instrumentation	Electronic	√
		Pneumatic	
1.4	Type of Instruments	Conventional	
		Smart with HART protocol	√
		Foundation Field-bus	Not applicable
1.5	Type of Control Valve Actuators		
		Pneumatic	√ (Note-1.2)
		Electrical	
		Electro – Hydraulic	
		Any other	
1.6	Type of hazardous area protection		
	Instruments	Intrinsically safe (Exia)	√
		Flame proof (Ex'd)	√
		Any Other	
	Analyzers	Flame Proof if Intrinsically safe not available	√
		Purged	
		Any other	
	Solenoid Valves (with class H minimum insulation)	Intrinsically safe	√
		Flame Proof (if distance limitations exists for signal transfer)	√
		Any Other	
	For solenoid valves with Field Manual Reset, separate push button shall be provided as per P&IDs for reset (i.e. not integral reset with solenoid valve) as per P&IDs. Vent port of all solenoid valves shall be provided with SS/ Brass bug screens, to prevent blockage of port because of bugs and to save the port from dust.		
	Process Switches	Limit Switches-Proximity Type	√
		Flame Proof (Others)	
		Any other	NA (Note-3)
1.7	Operational Requirements		
	Main operational Interface Location	Polypropylene Control Room (PCR)	√
		ClO2 Dosing Room	√

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		Local Control Panel (LCP) with redundant IS Display Units (HMIs)	√
	Control and Monitoring		
	a) Type	Purchasers Main Plant PLC	
		Dedicated PLC based Control System	
		Purchaser's DCS Control System	√
	b) Location of Main DCS/ PLC control system	Polypropylene Control Room (PCR)	√
		Main control room	
		Local Control Panel	
	c) Location of Dedicated Package PLC based Control System	Polypropylene Control Room (PCR)	
		ClO2 Dosing Room	√
		Local Control Panel	
	d) Sequence/ Interlock & Shutdown System	Dedicated PLC based control system (SIL 3 /TMR/ Quad)	
		Purchasers Main Plant ESD PLC	√
		Chemical Dosing Package PLC	√
1.8	Cable Distances		
		Between Package battery limit and ClO2 Dosing room	By Contractor
		Between Package battery limits and Polypropylene Control Room (PCR)	Approx 1200 meters
		Between Chemical Dosing room and Polypropylene Control Room (PCR)	Approx 1200 meters
	Note: Actual distances shall be confirmed during detailed engineering.		
1.9	Signal Routing Philosophy		
		Junction boxes within battery limit	√
		Local Control Panel with IS Display Units (Redundant HMI units)	√
		Any Other	
1.10	Logic Representation	ISA - Binary logic	√
		Any Other	
	Contractor shall provide the Logic diagram as per ISA 5.2 for cooling tower package and associated facilities for the applicable signals to be incorporated in the Owner's DCS/PLC by DCS vendor. Logic write-up / Cause & Effect including Sequence of start-up, shutdown & normal operation, graphics, logic diagrams shall be furnished by the contractor for clarity and implementation in Owner's DCS/ PLC system. However, for chemical dosing system, the logics shall be implemented in Package PLC by the contractor.		
2.0	**Control and Monitoring System**		
2.1	Type of System	Distributed Control System - Only Monitoring through serial link	√
		Purchasers Main Plant ESD PLC	√

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		Package PLC	√ (for chemical dosing)
2.2	Location	Polypropylene Control Room (PCR)	√
		ClO2 Dosing Room for package PLC	√
2.3	Functional Requirements	Control algorithm	√
		Data Acquisition	√
		Interlock logics	√
		Alarm Management	√
		Historisation	√
		Dynamic Graphics	√
		Logging & Report Generation	√
		Any other	-
		Configuration - Single - Dual redundant - Quadruplicate or TMR - Any other	√ DMR/TMR /Quad Package PLC
		Configuration Type	
		Response time - **250 msec** - 500 msec - 1000 msec	√ (250 msec)
		Control processor loading – Less than 60% per controller – Any other	√ -
		Power supply - Dual Redundant - Single	√ -
		Console requirements	
	Console requirements	- Desk Console type	√
		- Table Top	
		- Any other	
		One Number of Operator cum Engineering workstation Console for Package PLC	√
		Number of LED operating screens per Console	
		- 1 nos.	√
		- 2 nos.	
		- Any other	
	Type of video screen	Flat CRT	
		TFT LCD with backlit LED	√
		Any other	
		Screen Size - 22"	√
		- Any other	
		Hardwired console	

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		- Required	√ (as per P&IDs)
		- Not required	
		Printer (Color LaserJet printer A3) – one number	√
		Hard copier	
3.0	**Sequence, Interlock and Shutdown System**		
	Philosophy	Common with control and monitoring system	√ (Chemical dosing package only)
		Separate from control and monitoring system	√ (Main Plant ESD PLC)
	Type of System	Electromechanical relays	
		Programmable Logic Controller	√
	Location	Main Control Room	
		Polypropylene Control Room (PCR) (for main Plant ESD PLC)	√
		ClO2 Dosing Room (for Package PLC)	√
	PLC Response Time	100msec 250msec 500msec	- √ 250msec -
	Processor Loading	Less than 60% per controller	√
	Screen type	Flat CRT TFT LCD with backlit LED	- √
	Sequence of event resolution	1msec 100msec 250msec	(Same as PLC scan time)
	Functional requirements	Control algorithm	√
		Data Acquisition	√
		Interlock logics	√
		Alarm Management	√
		Historisation	√
		Dynamic Graphics	√
		Logging & Report Generation	√
		Any other	
	Configuration	Simplex	
		Dual Processor Single I/O	
		Dual Processor dual I/O	
		Dual Processor dual tested I/O	
		DMR or Triple Modular Redundant (TMR) or Quadruplicate	√ (Package PLC)
	Power Supply	Redundant	√
		Separate for each processor	
	Safety level	SIL – 2	
		SIL – 3 and TMR/Quad	√ (Main Plant ESD PLC)
		TUV AK 6	

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		TUV AK 5	
		Any other	
	Package PLC Interface with Purchaser's control system	Serial	
		Redundant Mod Bus TCP/IP or RTU	√ (Redundant Modbus TCP/IP)
		Hardwired	√
		Any other	
4.0	**Local Panel Requirement (Note-12)**		
4.1	Panel Type	Purged (Type - Z)	
		Weather proof	√
		Explosion proof type	
4.2	Constructional Details		
	a) Type	Free Standing	√
		Wall mounted	
	b) Enclosure Type	Flameproof, IP 55	
		Purged type	
		Weatherproof, IP-55	√
	c) Door	Front	
		Rear	√
	d) Cable Entry	Bottom	√
		Side	
4.3	Power supply distribution		
	a) Incoming switch & Fuse	Required	√
		Not required	
	b) Switch fuse for each consumer	Required	√
		Not required	
	c) Power indication on panel front	Required	√
		Not Required	
4.4	Controllers		
	a) Type	µP based	
		Single Loop	
	b) Scan Time	250msec	
		Any other	
4.5	Indication		
	a) Type	µP based	
		Single Loop	
		Loop powered Indicators	√ As per P&IDs
4.6	Alarm Annunciators		
	a) Type	Solid State	
		µP based	√
		Vendor standard	
	b) Hazardous	Intrinsically safe	√

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	Protection	Safe area	
		Flame proof type	
		Any other	
	c) Indicators	Flame proof Lamps	√
		WP Lamp assembly	
		High intensity LED	√
		LED Cluster	√
		Any other	
	d) Switches and Push Button	Flame proof	√
	e) Emergency Button	Push type with Mushroom head along with protective cover	√
		Pull type with Mushroom head	
		Any other	
		Current / Voltage indication	
		Current Transducer	√
		Voltage transducers.	√
4.7	Panel Cooling	Required	√ (if required)
		Not Required	
	a) Type	Dedicated AC (Ex-proof)	
		Vortex Cooler	√
5.0	**Field Instrumentation**		
	a) Type of Transmitters	Conventional	
		Smart with HART Protocol	√ (Note-2)
		Foundation Fieldbus (FF)	
	Transmitter accuracy	Smart transmitters when specified shall be used in analog mode with an accuracy of ± 0.065% of span with a rangeability of 100:1 unless specified otherwise.	
	b) Type of Positioners	Pneumatic	
		Smart with HART Protocol	√ (Note-2)
	c) Flow instrument type	Orifice	√
		Meter run	√ (for 1 1/2" lines and below)
		Electromagnetic type flowmeter for water service (cooling water (main supply & return, Unit Supply& return), Drinking water, Raw water etc.) upto and including line size of 8”	√
		Ultrasonic Type flowmeter for cooling water line size > 8" (clamp on type)	√
		Flow nozzle (for VHP/HP/MP steam service) as per P&IDs	√
		Vortex flowmeter as per P&IDs	√
		Variable Area Flowmeter (Rotameter) as per P&ID	√

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		Others-as per P&IDs	√
	Sizing	ISO 5167 for orifice	√
	Flange rating	Minimum flange rating shall be 300# for all flow meters.	√
	d) Level Instruments		
	Type – Other than Tanks	Displacer Type LT upto 1524 mm (C-C length)	√ (Note-2)
		Guided Wave radar LT (if mandated by licensor as per licensor P&IDs)	√ (Note-2)
		Remote diaphragm seal LT (Differential pressure type) above 1524 mm (C-C length)	√ (Note-2)
		Others	√ (Note-2) (As per P&IDs)
	Tanks	Radar Type	√
		Servo Type	-
		Displacer Type	-
		Others	-
	Level Gauges	Transparent	-
		Reflex	-
		Magnetic	√
	e) Temp. Instruments	Duplex Type	√
	Element Type	Thermocouple, ungrounded type-(above 400°C operating temp)	√
		Skin Thermocouple, grounded type	√
		RTD (upto 400°C operating temp)	√
	Thermowell	Minimum rating 300#	√
		MOC- minimum SS316	√
		U length	√ (as per 6-52-0052)
	f) Temperature transmitter	Remote field mounted dual compartment type (Remote on yoke)	√ (for all temp loops)
	g) Sensors for Shutdown	Process switches	-
		Transmitters - For all - For low DP /Low pressure - Flow - Temperature	√

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	Ultrasonic Flow meter	Ultrasonic flow meters, External clamp on type shall be provided on cooling water lines of > 8 inch size. UFT in buried lines shall be provided with remote mounted transmitters. Probe/sensor shall be suitable for continuous immersion in water. Minimum material: SS316. Superior material meeting the process condition is also acceptable. Output: 4-20mA HART, Flameproof. Refer Standard spec 6-52-0011 attached with tender. Upstream and downstream straight length requirements of ultrasonic flowmeters shall be provided by the contractor for proper installation.	√
	Electromagnetic Flowmeter	Electromagnetic type flowmeter for water service (cooling water (main supply & return, Unit Supply & return), Drinking water, Raw water etc.) shall be provided upto and including line size of 8 inch. Minimum material: SS316 for electrode, SS for tube and PTFE for Liner. Superior material meeting the process condition is also acceptable. 2 nos. of SS316 Grounding Ring with one side neck type shall be provided with each flowmeter. Output: 4-20mA HART, Flameproof. Refer Standard spec 6-52-0002 attached	√
	Analyzers	Contractor shall provide CLO2 analyzers, HC analyzer , pH Analyser and conductivity analyzers, other analysers as shown in P&IDs. Analyzer type, make, model number shall be of proven design for Cooling water systems/ plant applications. Sample tubing shall be minimum SS316L and fittings shall be SS316	√
	HC analyzer	Principle of operation: Oxidation (using reagent/ UV & persulphate / catalytic combustion/ High temp combustion) using CO2 detection with NDIR. Output: 4-20mA HART, Flameproof.	√

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	CLO2 Analyzer	Chlorine di-oxide analyzer shall be a continuous measurement type analyzer without any requirement for reagent. The complete analyzer system shall be mounted on the free-standing enclosure. The complete analyzer shall be sourced from Original Equipment Manufacturer. Output: 4-20mA HART, Flameproof. Refer Standard spec 6-52-0035 attached	√
	pH and Conductivity analyzer	Minimum material: SS316 for wetted parts. pH/ Conductivity Analyser (as applicable) shall be On line, In-situ type. Measuring electrode shall be of glass or metallic as governed by the process conditions indicated in the purchaser's data sheets. Reference electrode shall be 'non-flowing type'. The electrode with electrolyte replenishment or external pressurization type shall not be used. The pre-amplifier and transmitter shall be solid-state type with automatic temperature compensation. Refer standard Spec 6-52-0029 attached with tender.	√
	CLO2 Detectors	This type of detectors for Toxic gases shall be of electrochemical cell type. The field life of electrochemical type of sensor shall be 2 years as a minimum. The cell shall be able to be replaced in-situ. Range of detectors shall be 0-10 ppm and Repeatability: ±2 % of full scale. Refer standard Spec 6-52-0080 attached	√
	TOC/ Water quality analyzer	UV Persulphate oxidation with acid sparging for TIC removal / Combustion Catalytic oxidation/ CO2 detection. Output: 4-20mA HART, Flameproof.	√
	Corrosion transmitter	Intrinsically safe instrument with 4-20mA output with proven design.	√
	Instruments located in buried line	Instruments shown in buried line shall be located in a pit and shall be suitable for continuous immersion in water.	√
6.0	**Anti Surge Controller (Not applicable)**		
	a) Type	Dedicated	

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		With Control System	
		µP based	
		Conventional	
	b) Scan time	≤ 40msec.	
		Any other	
	c) Configuration	Single loop/ Dedicated multi-loop controller	
		Dedicated HMI	
		Duplex redundancy	
	d) Programming / Program modification	From Engineering cum operator Console 24" LED with keyboard console mounted type	
		Laptop	
	e) Serial interface with DCS.	Serial	
		Mod Bus (TCP/IP)	
	f) Control Module Location	Main Control room	
7.0	**Vibration Monitoring (For Cooling Tower Fans)**		
	Type of Sensors	Vibration transmitters	✓
		Any other	
	Note: Vibration transmitters signals shall be connected directly to PLC for tripping of fans. 2oo2/ 2oo3 shall be considered for voting configuration in case of tripping.		
	Control system	Local Control Panel	
		Polypropylene Control Room (PCR)	✓
		Main Control Room	
	Indicators	Local Control Panel	
		Satellite Rack Room	
		Main Control Room	
	Serial Interface with Purchaser's control system	MODBUS TCP/IP	
	Output	4-20 mA output	√
		Contact for shutdown	
8.0	**Installation and Installation material**		
	Prefabricated Hook Ups	Not applicable	-
	Close coupled	For pressure Gauges and for other instruments where mandatorily recommended by Licensor.	√

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	Remote	(i) For DP Type Level and PDT (ii) For PT & DP Type FT - Services above ASME 600 class. - Services with maximum operating temp. above 325 Deg. C - Steam - Hydrogen (iii) For DP type FT pertaining to venturi, Flow Nozzle, D- D/2 Tapping, Meter Run. (iv) For Congealing services and corrosive services where diaphragm seal is used as per P&ID. (v) For Pressure Gauges: - Services with maximum operating temp. above 100 Deg C. - Reciprocating Pump discharge line where vibration is expected.	✓ ✓ ✓ ✓ ✓
	Installation Impulse Line for close coupled and remote installations	Piping Impulse Lines: For Hydrogen service, Diaphragm seal, line rating above 600 class and as mandatorily recommended by Licensor.	✓
		Tubing Impulse Lines	✓ (For Line rating up to 600#)
	Type of Instrument First Isolation Valves for close coupled and remote installations	Quarter turn Ball	-
		Globe	-
		Gate (First isolation valve shall be Gate type near the main process tap-off and all other isolation/ equalization valve shall be Globe type. For hydrogen service (irrespective of rating) and for other services (600# line rating and above), double isolation piping root isolation valves and double vent & drain valves shall be considered)	√
	Vent/ Drain Valves for close coupled and remote installations	Globe	-
		Gate	√
		Ball	-
	Instrument Valve Manifolds for close coupled and remote installations	For DP type FT - 3 Valves (Integral Manifold) - 5 Valves (Integral Manifold) - Prefabricated (integral)	√ (for Steam) √ (For Others) -
		For PG and PT - 2 Valves (Integral Manifold) - Prefabricated (integral)	√-

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	Cable Routing	Main Duct (GI) with SS bolts & nuts – From PCR to package battery limits – Within the package Battery Limits	By Purchaser √
		Cable Trays (within package Battery Limits)	√
		Branch Cable Trays	√
	Type of cable trays	FRP (Perforated)	-
		Anodized Aluminum Cable Trays	√
	Canopy	**Pre-fabricated FRP canopy:** Required for all Transmitters/ Electronic field sensors, temperature elements, Junction Boxes, Local Control Panel, Positioner, SOV, position transmitter with Instrument tag numbers painted on the canopy. Canopy for transmitters shall cover Top and all 3 sides (Back & two sides) with a window of transparent material at the center to view local indication without lifting canopy; canopy for JB, LCP & Push button shall cover top side only.	√
		Canopy colour shall be RED for ESD tags	√
9.0	**Instrumentation Spares Philosophy**		
	Mandatory spares	Required	√(Note-4)
	Consumable Spares	Required	√(Note-4)
	Commissioning Spares	Required	√(Note-4)
	Two Years spares for operation and maintenance	Required	√(Note-4)
10.0	**Other Requirements**		
	Pressure gauges	Shall be supplied with Pressure Limit valve (Gauge Saver) wherever applicable	√
	IS Barriers		√
	Solenoid Valves	Minimum Requirement of body material: 316 SS. Solenoid valve shall be 24V DC Intrinsically Safe type in general. However, 110V AC flameproof type solenoid valves shall be provided where distance limitation exists for signal transfer.	√

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	Limit Switches	Limit switches shall be intrinsically safe proximity type as per NAMUR (DIN 19234) except for MOVs for which mechanical snap acting type is acceptable.	√
	Signal Cables	Armoured, Paired, 1.5 mm^2	√ (Note-5)
	Alarm Cables	Armoured, Paired, 1.5 mm^2	√ (Note-5)
	Control Cables	Armoured, Paired, 1.5 mm^2	√ (Note-5)
	Power supply cables and Fire & Gas detector cables	Armoured, Triad, 2.5 mm^2	√ (Note-5)
	Fiber Optic Cable	All Fiber optic cables shall be double Armoured, single mode type.	√
	Special Cables / Serial Link Cables	Armored	√
	Junction Boxes	JBs MOC shall be Die Cast Aluminium (LM-06) type for IS and NIS Instruments.	√
		Flameproof + Weatherproof to IP65	√ (for IS & NIS signals)
		JB Color: Blue for IS signals, Grey for Non-IS signals. As a standard suitable for 12 pair cables with two 1-1/2" NPT (bottom cable entries). 8 Triad JB for Gas Detectors	√ (Note-7, 9)
	Ferruling JB	Heat shrinkable printed sleeve type	√
	Cable Glands	Material: SS 304 Double Compression	√ (Note-10)
	Terminals	Push-in Screwless type in Cabinets, Junction Box and Local Control Panel	√

General Notes:

a) Scope of work (Instrumentation) for the complete Package shall be followed as defined in Scope of work document attached elsewhere in the tender.
b) Refer Standard specification for Package units (6-52-0052)
c) Refer Standard specification for PLC (6-52-0040)

Notes:

1) Utility Supply

1.1 Power supply for operation shall be as follows:

Control System / Package PLC, Analyser, 4 wire instruments, LCP etc.:	110 VAC (UPS) ± 10%, 50Hz ± 3Hz
Solenoid valve (Instrinsically safe)	24 VDC
Solenoid valve (Flameproof type)	110 VAC (UPS) ± 10%, 50Hz ± 3Hz
Utility/ Illuminators for panel/cabinet	240 VAC (NON-UPS) ± 10%, 50Hz ±

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	3Hz
Interrogation Voltage for interlocks & Supply for transmitters	24 VDC

Owner shall provide redundant feeders of 5 KVA rating of 110 VAC UPS (power supply grounded) and Single feeder for 240V AC non-UPS near Contractor supplied package PLC cabinets in CLO2 dosing room. Further supply and distribution of power to various instruments, panels, LCP and its derivation to any other voltage level as required in CLO2 dosing room and in field, shall be carried out by contractor. Power Distribution Cabinet with glanding termination of cables shall be provided in dosing room by the contractor.

Contractor shall provide power consumption details along with Bid proposal. In case Contractor requirement is higher, Contractor shall provide the justification with detailed power consumption details. If Contractor doesn't provide any power consumption detail along with bid proposal, then it is confirmed that the given power is sufficient for the entire package.

1.2 Instrument air pressure at normal condition is 4.5 kg/cm2g. The (Min/ Nor/ Max/ Design Pressure of Inst. air 4.0/4.5/5.5/10.5 Kg/cm2 (g) shall be available in the unit. Instrument air shall be given at one place in the field by Purchaser; further distribution shall be by Contractor.

1.3 Actuator sizing shall be done considering the instrument air pressure of 3.5 kg/cm2g and valves shall be suitable for design condition. Contractor shall select the valve actuator accordingly and shall indicate the instrument air consumption for the package.

1.4 Instrument air supply tubing: 6 mm OD with 1 mm wall thickness and 12 mm OD with 1.2 mm wall thickness (for any higher size valve as per Process requirement), SS316L tube for instrument air supply tubing shall be used. 3/8" OD with 0.049" wall thickness Copper tube for steam tracing shall be used.

2) All open loops, close loops signals and interlock analog signals shall be SMART (HART) type.

3) Process switches shall not be provided for any application. i.e. Flow, Pressure, Diff Pressure, Level, Temperature. Only transmitters shall be provided. Process switches, shall be realised through field transmitters. This shall override any requirement specified elsewhere including process package.

4) Refer List of all types of Instrumentation spares requirements as attached elsewhere in the tender. Contractor shall separately quote accordingly.

5) Blue cable shall be used for IS and Black cable shall be used for Non-IS/ Power signals. All signal and control cables shall be Flame retardant low smoke type and shall have XLPE as primary insulation. Instrument electronic signal & alarm

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cables, single pair as well as multi pair shall be 1.5 mm2 twisted in pair overall shielded with aluminum Mylar tape with drain wire and Armoured.
For Control wiring for solenoid valves of the interlock and shutdown system, single pair & multipair shall be 1.5 mm² (min.) twisted in pair individually and overall shielded with aluminum Mylar tape with drain wire and Armoured. Contractor shall carry out voltage drop calculation based on cable distance. In case 2.5 mm2 cable is required for longer distances, same shall be considered. Power supply cables to field instruments and fire and gas detectors cables shall be minimum 2.5 mm² armoured.

Cable routing shall be preferably above ground through cable trays/ duct. Wherever Cable trays are required to be used, same shall be perforated type, of standard widths 60/ 150/ 300 mm only and of anodized aluminium material of sheet thickness 2.5 mm (min). Contractor shall select the cable tray vendor based on the Proven Track Record. EIL drawing No. 7-52-0107 attached with the MR is for dimensional reference only. Contractor shall develop detailed drawing for tray routing.

All branch cables pertaining to ESD application for fire safe valves and for fire and gas detectors shall be Flame Retardant plus Fire-resistant type. All Flame Retardant Plus Fire-resistant cables shall have outer sheath colour as red.

6) Slipper type PVC sleeves (cable shrouds) shall be used over cable glands (both single pair & multipair) for all cable entries in junction boxes.

7) Flameproof type Junction boxes shall be provided for IS and Non-IS signals. All Junction boxes shall be Flameproof Ex'd, as per IS/IEC 60079. JBs MOC shall be Die Cast Aluminium (LM-06) for IS and NIS Instruments.

8) Cable routing shall be preferably above ground through cable trays/ duct.

9) All Junction boxes shall be Flameproof & Weatherproof IP 65 as per IS/IEC 60079 and IS/IEC 60529 respectively. Allen screws (made of SS316) type fasteners shall be used for fixing covers and shall be self-locking type to ensure that they do not fall off when cover is opened. Junction boxes shall have tag numbers engraved on front cover with PESO certificate number.

Following shall be taken care for the junction boxes:

Sizing shall be done with due consideration for accessibility and maintenance in accordance with the following guidelines:

(a) Junction boxes shall be suitable for 6 pair or 12 pair/ 8 Triad signal cables.
(b) Cable entries for single pair and multipair shall be from bottom only.
(c) 50 to 60 mm gap between terminals and sides of box parallel to terminal strip for up to 50 terminals and additional 25 mm for each additional 25 terminals.
(d) 100 to 120 mm between two terminal strips for up to 50 terminals and additional 25 mm for each additional 25 terminals.

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(e) Bottom/ top of terminal shall not be less than 100 mm from bottom/ top of the junction box.

Separate JBs for different type of signals as given below:

a) 4-20 mA DC signals (IS)
b) 4-20 mA DC signals (non-IS)
c) Thermocouples, wherever used
d) RTDs, wherever used
e) Contact signals (Field switches, push buttons etc.)
f) Interlock and shutdown signals (Solenoid valves)
g) Power supply to various instruments
h) Signals from probes for vibration monitoring
i) Limit switches (IS)
j) Gas Detectors

In addition, separate junction boxes shall be used for package signals going to Main plant DCS, Main Plant ESD PLC, package PLC and/ or any other systems.

10) All cable glands shall be of double compression type, certified flameproof + Weatherproof IP 65 as per IS/IEC 60079 (both JB and Instrument side) irrespective of the area classification and contractor to provide cable glands for all instrumentation items supplied by contractor including cable glands for Junction Boxes for single pair and multi-cables.

11) Plugging of all extra/ unused entries of Junction Boxes, transmitters, thermocouples heads shall be ensured with flameproof metallic plugs (double compression) by contractor.

12) Weatherproof local control panel with all components and accessories weatherproof to IP65 shall be provided by contractor for classified area, wherein the local panel mounted IS Display Units (Redundant HMI units) shall be intrinsically safe. Alarm Annunciator shall be intrinsically safe or Flameproof and all other items like push button, lamps, selector switches etc. mounted on the local panel shall be flame-proof “Ex’d” type. Barriers for Power Supply of IS Alarm annunciator and Barriers for all the alarm contacts shall be supplied by contractor and purchaser will provide potential free contact for the same. Further, all the spare channels in the alarm annunciators shall be provided with barriers in pre-wired/ configured condition for purchaser’s use.

Local Control panels shall be used only for start-up and normal critical operations. Unless otherwise indicated in MR, the following points shall be kept in mind while engineering the local control panels:

a) The IS power supply module for alarm annunciator shall be installed in a flameproof box in local panel. For Lamps, wet contact from the PLC shall be provided.

b) The Power supply distribution box inside the Local Panel shall also be flame-proof Ex’d.

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c) Explosion proof (Ex'd) Local control panel is also acceptable. In case any current and voltage transducer is located in local panel, the same shall be mounted in Ex proof & weatherproof enclosure.

d) Local Panel shall house switches/ pushbuttons, status lamps, important alarms and critical indications only. No electronics/ electronic devices or Instruments except intrinsically safe indicators/ Local Panel HMI shall be located on the local panel.

e) All cable entries in the local control panel shall be from bottom. Cable entry to Local Control Panel shall preferably be through MCT, however, double compression type Ex'd SS 304 cable glands along with PVC sleeves are also acceptable. All spare cable entries shall be sealed using double compression type SS Ex'd plugs.

f) Local panels shall be protected from direct sunlight using overhung Canopy.

g) Local Panel lamps shall be cluster LEDs type and ESD button shall be provided with protective cover.

h) Barriers for IS alarm annunciator shall be supplied by Contractor along with IS annunciator and Contractor to consider potential free contact for the same. The IS power supply module for alarm annunciator shall be installed in a flameproof box in local panel. Further, all the spare channels in the alarm annunciators shall be provided with barriers in pre-wired/ configured condition for purchaser's use.

i) Local Control Panel HMI (Touch screen enabled HMI suitable for the hazardous area)

j) Local control panel mounted IS display units (Redundant HMI units, touch screen enabled) for local monitoring and control of package shall be provided. Local HMI shall meet the weather protection of IP65. The HMI screen size shall be approximately 15" diagonal (if applicable) and shall be equipped with necessary accessories for operation and monitoring suitable for specified hazardous outdoor installation. Both the HMIs of each LCP shall be identical having same sets of graphics (Process etc.) so that redundancy can be achieved. Also, both the HMIs of LCP should be hooked up with the DCS via MODBUS TCP/ IP.

k) Local IS (intrinsically safe) display unit shall be installed with required driver software and configured as MODBUS SLAVE instead of MODBUS MASTER. Since the DCS always acts as MODBUS MASTER, configuring the IS display unit as MODBUS slave only will ensure proper serial communication between DCS and IS display unit. Any hardware/ software required for establishing the communication with purchaser's DCS shall be in contractor scope.

13) The electronic components which are installed outdoor shall be suitable to continuously operate at ambient temperature and humidity specified under ambient conditions. The heat generation effect of current carrying for the electronic modules

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shall also be considered. For this purpose, the system shall be rated for minimum 5 deg C more than the maximum ambient temperature specified. In case the system is not suitable for the above conditions, necessary cooling arrangement (vortex cooler) shall be provided by contractor

14) Contractor to note the following points regarding Instrument Installation:

(a) For process handling hydrogen, toxic and services above 600# class, double isolation root valves, double vent / drain valve shall be used. No unions shall be used. Only break flanges shall be used.

(b) Separate Vent/Drain valves are not required when valve manifolds are used for PT and DP type flow transmitters.

(c) Contractor shall follow typical EIL installation standard for instrument hook-ups, attached with the MR.

(d) Instrument installation standards shall be provided as per Engineering design basis (Instrumentation), Doc No. C050-999-16-51-EDB-1001 attached with MR. The material of construction & specification for piping installation material shall be as per the approved PMS as part of detailed engineering.

(e) All instruments mounted on steam traced lines shall also have their installation steam traced. Steam tracing tubing shall be bare copper tube of 3/8” OD with 0.049” wall thickness; ¼” OD with 0.04” wall thickness shall be used for gauge glasses only.

(f) Consider 6 mm OD with 1 mm wall thickness, SS316L tube with SS316 fittings for Instrument Air Supply. Instrument air manifold shall be SS316 with X-mas tree distribution.

(g) All instrument Impulse piping should be shot blasted prior to use. All instrument impulse lines shall be painted.

(h) Manifolds shall be fabricated out of piping material as per approved Hook-up drawing.

15) Statutory certificates from the country of origin as well as PESO certificates shall be provided by contractor for all electrical/ electronic items being supplied by contractor in the field. A copy of approval for intrinsically safe/flameproof enclosure, whenever specified, shall be provided as per following:

a) For all electrical items manufactured in India, the testing shall be carried out & test report issued by Indian test laboratory recognized by the Chief Controller of Explosives and valid copy of BIS license (only for Ex Electric Apparatus having flameproof type protection) or IECEx Certificate of Conformity, valid copy of IECEx Quality Assessment Report (summary) and IECEx Test Report.

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b) For all electrical items manufactured outside India, Test report issued by Indian test laboratory recognized by the Chief Controller of Explosives and valid copy of BIS license or IECEx Certificate of Conformity, valid copy of IECEx Quality Assessment Report (summary) and IECEx Test Report or EU Type Examination Certificate (Applicable for manufacturers having manufacturing locations in countries covered under the European Union), valid copy of Production Quality Assessment / Assurance Notification.

c) For installations in India, additionally a copy of approval for intrinsically safe/flameproof enclosure from local statutory authority i.e., 'Petroleum and Explosives Safety Organization (PESO), Nagpur in India' shall also be provided based on above.

16) Dedicated Transmitters shall be used for BPC (DCS control) and ESD interlocks for the same service. Any Transmitter used for DCS Control should not be used/ shared for any trip/safety interlocks of ESD System and vice versa.

17) Each transmitter (PT/DPT/LT/FT) linked with closed loop control shall have redundant DCS indication for the same service with additional/ alternate transmitter.

18) Electromagnetic flow meter shall be used for water service (cooling water (main supply & return, Unit Supply & return), Drinking water, Raw water etc.) upto and including line size of 8-inch, mass balancing (for line size below 8" subject to suitability as per pressure, temperature etc.), Above, 8-inch line, clamp on Ultrasonic flowmeter should be used subject to suitability as per pressure, temperature etc.

19) For any interlocks linked with trip and safety, the input Instruments/ transmitters should be configured as 2oo3 (except where installation limitations exist).

20) The vibration and temperature monitoring signals for cooling water pumps shall be connected to purchaser's DCS / PLC (located in PCR) as per the P&IDs. Suitable transmitters for vibration and temperature monitoring signals shall be provided by the contractor and wired upto the junction boxes by the contractor.

21) Refer to the specific job requirements as per below Annexure-I of this document.

ANNEXURE-I

SPECIFIC JOB REQUIREMENT FOR COOLING TOWER PACKAGE

1.0 General:

1.1 The purpose of this specification is to define the job requirements & philosophy of Instrumentation & control for Cooling Tower Package and associated facilities as per P&IDs and other documents attached in the Tender.

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1.2 This specific job requirements shall be read in conjunction with specification mentioned above, and other instrument standard specifications, design basis, scope of works etc. attached with the tender for applicable instruments items/systems.

1.3 Instruments shall be supplied from approved vendor list, attached elsewhere in tender, meeting the Proven Track Record (PTR) requirement as below:

Offered Make and model of all instruments, valves, analysers, flowmeters, transmitters, package PLC etc should have been operating satisfactorily in any hydrocarbon industry like Refinery, Petrochemical and Gas processing plant under similar process conditions for at least 6 months as on bid due date. Items with prototype designs or items not meeting provenness criteria specified above shall not be offered by contractor.

1.4 Instrument connection on vessels, standpipes and tanks shall be as per 7-52-0001 and Instrument connection on pipes shall be as per 7-52-0002. The minimum rating of all instrument nozzles on the vessels shall be 300#.

Level standpipe philosophy: Level transmitters in open loop and level gauge shall be mounted on the standpipe. Also, multiple level gauges shall be mounted on standpipe. Multiple level gauges shall be used for visible lengths more than 2500 mm.

Level Transmitters in close loop and trip/ safety interlock shall be directly connected to Vessel/ column. Maximum number of nozzles on standpipe shall be 6. Not more than 2 level transmitters (in open loop) shall be considered in one standpipe. Standpipe shall not have instruments other than for level.

1.5 Pressure rating of control valves, on-off valves and self-actuated pressure control valves body and flanges, orifice plates with flanges, special flowmeters, thermowell flange shall be minimum 300# rating or as per respective piping specification whichever is higher.

1.6 All instruments shown in package battery limits in the P&IDs shall be in the scope of Contractor.

1.7 Control Panels including local panels, junction boxes terminals shall be push in screw less type. Ferrules used shall be single sleeve with source destination type. Cross ferruling philosophy shall be followed for wiring. Only push in type screwless terminal blocks (TB) shall be used. TBs shall have lever indicating termination of wire.

1.8 All cables including spare pair / core shall be terminated inside control panels/ junction boxes and no loose cables shall be allowed. All cables shall be glanded in control panels / junction boxes.

1.9 Any Instrument loose supplied items are to be packed separately instead of packing the same with other mechanical items while shipping to site. Markings shall be provided for such packing's as "Instrument Items – Loose Supply".

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1.10 IBR service requirements:

a) All Desuperheater/Control Valves/Strainers/ Instruments in IBR application shall be tested as per IBR requirements and test certificates in Form III C shall be required duly countersigned by IBR authority or its approved representative.

b) Carbon contents shall not exceed 0.25% for flanges fittings, valves etc. that may require welding. Moreover, for flanges, Sulphur and phosphorous shall also be limited to 0.05% each.

1.11 Radiography requirement:

a) For all Desuperheater/PRDS/Control valves/ Strainers castings/ flanges with ratings ANSI 600# and above or as Specified in respective data sheets, shall undergo 100% radiography testing. The radiography procedure and area to be radiographed shall be as per ANSI B16.34 and acceptance criteria shall be as per ANSI B16.34 Annexure-B in general. For areas of castings to be radiographed for valves not covered as per ANSI B16.34, Contractor shall furnish details of the areas to be radiographed.

(b) Post weld heat treatment (PWHT) shall be provided for welds, if any. Radiography shall be carried out after completion of the PWHT/ Stress relieving operation for the welds if any.

2.0 Design Requirements:

a) ClO2 Dosing Package PLC:

i. Contractor shall supply Dedicated DMR or TMR or Quad PLC based control system for ClO2 Dosing package which shall be located in a separate room within ClO2 Dosing room.

ii. **DMR/TMR** or **Quad** PLC based control system with all the following modules (cards) and network components **as being dual-redundant**:

a. PLC Processor (CPU) and Communication Processor
b. Processor power supply, IO rack power supply & IOs Bulk Power Supply (BPS),
c. Serial communication (Modbus) module.
d. IO cards / modules (all closed loops, open loops, controls, logics, interlocks, safety, shutdown signals).
e. PLC network and its components (switches).

iii. For maintenance of SMART HART devices, IO cards shall be either HART Pass Through card or HART Interface Modules to interface with Purchaser's HART Maintenance System / Asset Management system shall be provided by contractor.

iv. This Package PLC shall be serially interfaced to Purchaser's DCS in the PCR.

v. Fiber Optic cable shall be considered for serial link between CLO2 package PLC and Purchaser's DCS in PCR. The double armoured fiber optic cable along with FO connector, FO convertor, LIU at both ends shall be supplied by contractor.

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Contractor shall provide the serial interface Modbus mapping details in the format, which shall be given to the Contractor during detailed engineering.

vi. Contractor shall meet the following minimum requirements for package PLC:

a. The package PLC redundancy shall be provided in such a way that in case of failure of the main processor, the standby processor shall take over automatically. This changeover shall be bump less. The system shall be failsafe. Redundancy shall be provided for complete processor sub system including CPU, memory, power supply, communication, I/O cards.

b. Package PLC shall be complete with all pre-loaded basic and application software. Vendor shall provide the configuration application software, operating system etc. in soft format. It shall be possible to do all configurations, modifications in the programs, set point changes, I/O assignments etc. and debug/analyze any malfunction in the software/program.

vii. Package PLC cabinet shall be freestanding type of size 2100(H) x 800 (D) x 1200/800 (W) mm. Cable entry in Package PLC cabinets shall be provided through cabinet MCT

viii. Console workstation for operation, engineering & programming with 22" LED Monitor shall be supplied with keyboard, hard disk, USB port etc. Dynamic Graphic displays, Group displays, alarm summary, Trend etc. shall be provided for operator interface. All the engineering/ modification/ software download/Updation must be possible on line through menu driven function. Anti- virus software shall be provided to avoid software corruption. The configuration data shall be protected against power failure. All necessary Licenses for carrying out Engineering, operation, configuration/ programming, troubleshooting etc. shall be provided by Contractor.

ix. All electrical interfaces (MCC Signals) for interlock / shutdown to programmable logic controller shall be hardwired through potential free contact. Interposing relays shall be provided for all electrical contact signals to package PLC. Location of MCC shall be as specified elsewhere in the tender.

x. <u>System software / License</u>

All Control & Interlock system (package PLC) software shall include the operating system and application program. The application program shall include software for performing functions like interlock and shutdown logic, programming/ program modification, documentation etc. Two copies of application program and two set of licensed system software shall be supplied. The program language shall be English.

The licenses and application program shall allow:

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a) Monitoring of system program for troubleshooting purpose.
b) Carrying out any modifications to the package PLC program; if need arises (engineering license with proper validity)
c) Troubleshooting of any system related failures.
d) Monitoring of the package PLC healthiness.

The system shall be supplied with programming tools and related accessories.

xi. ClO2 Package PLC shall be located in separate room in ClO2 dosing room. Cable Entry to CLO2 PLC room shall be through MCT Blocks (by Contractor).

xii. Drawings/ documents which are required for engineering of package PLC and other systems pertaining to complete package shall be developed by contractor. The engineering of control systems shall be carried out based on general philosophy. The completeness and correctness of control system engineering documents shall be vendor's responsibility. These shall include, but not limited to following:

a) Functional schematics and I/O count duly segregated with respect to its origination (field/ MCC/ Local panel), type, functionality (monitoring / interlock/ shutdown), location of functionality
b) Functional schematics for complex loops with write up
c) Dynamic graphic display
d) Logging and report requirements with formats and tag no.
e) Instrument details (database)
f) Operator guide messages
g) Alarm assignments
h) Logic diagram
i) PLC display requirements
j) Any other requirements/ inputs as found necessary.

xiii. Contractor shall be responsible for the total system configuration as per the requirements including the following:

a) System design
b) System engineering.
c) Functional design.
d) System testing & FAT
e) System testing at site including loop testing etc.
f) System commissioning and SAT

xiv. Contractor shall be totally responsible for system engineering, testing and field integration of package PLC system pertaining to ClO2 package. These include participation in kick-off meetings, generation of all engineering documents, review of package PLC vendor generated drawings and documents, participation in FAT at package PLC vendor's shop, participation in field testing and any other activity

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needed for successful commissioning of ClO2 package and other associated utilities with field and control systems fully integrated.

b) ANALYSERS

i) Analysers as per P&ID shall be supplied and installed in cabinet with suitable Hazardous area protection. Contractor to refer attached standard specification 6-52-0035. Analyzer type, make, model number shall be proven for similar application. Necessary sample handling system shall be provided by Contractor.

ii) Calibration gases shall be supplied by Contractor for minimum 6 months operation. Valid PESO certificate must be provided along with calibration gas cylinders. PESO certificates as applicable for both basic gas and mixture gas must be provided for calibration gas cylinder and the certificates should be in the name of NRL.

iii) All utilities required by analyser such as service water, Nitrogen, cooling water, steam, instrument air, plant air distribution is in contractor's scope.

iv) Analyser shall be supplied as pre-calibrated from OEM vendor's works.

c) CONTROL VALVES AND ON-OFF VALVES

1. For Control valves and On-off valve's accessories like Air Filter Regulators, Positioners, SOVs, Limit switches, Hand wheel etc. (Wherever applicable) shall be supplied in fully assembled conditions. Accessories like AFR shall be selected to match the air tubing requirements by contractor.

2. Control valves and On-off valves body and flange rating: 300# (minimum).

3. Tube fittings (male connectors) shall be of SS316 MOC, flare less double compression type. Tubing MOC shall be SS316L.

4. Contractor shall offer standard CV as per their catalogue. However, in case it is unavoidable, Contractor to ensure that capacity test certificate from independent test like FCRI, clearly indicating the capacity in terms of CV values (as per ISA 75-01) for the valves which are not indicated in standard product catalogue.

5. The Software necessary for advance control valve diagnostics like seat ring condition, gland packing condition, actuator leakage, device checks, maintenance etc. shall be supplied by contractor. Any such diagnostic software related to Smart positioner shall be of "plug-in" type and the software shall be easily integrated with Owner's Asset Management System. This advance diagnostic software (full version) shall be of latest release/version with advanced features. Vendor shall ensure software seamless integration with the available reputed make of DCS. Control valve diagnostic software shall be able to do online performance

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diagnostics of control valve (without taking offline) like valve friction trending, signature recording etc. Control valve shall be supplied with original signature of valve from OEM to measure/compare drift in future.

6. Pneumatic diaphragm Actuator shall be provided. Actuator sizing is actuator vendor's responsibility. Instrument air pressure shall be considered as stated above in Notes. SS Lifting hook shall be provided on the actuator top.

7. Control valve sizing:

   i. In case valve vendor's calculation indicates cavitation for any valve, vendor must offer hardened/stellited trim irrespective of whether hardened trim has been specified or not.

   ii. In case valve vendor's calculation indicates noise more than 85 dB for any valve, vendor must offer low noise trim or noise treatment solution.

   iii. Valve vendor shall examine each control valve for noise generation possibilities. The noise level shall be calculated as per ISA 75.17 or any other equivalent standard.

   iv. Noise generated by control valve during operation shall be limited to OSHA specified levels i.e. the maximum allowable noise shall be less than 85 dBA, when measured at a distance governed by ISA 75.17.

   v. If the predicted noise level is found to exceed 85 dBA, control valve shall be treated for noise. Source treatment for noise shall be resorted to. When source treatment for noise is not sufficient to reduce the noise level below 85 dBA, vendor shall provide path treatment like diffuser plate / silencer etc. in addition to source treatment so as to reduce the level below 85 dBA. Whenever additional path treatment is recommended, the maximum differential pressure across the silencer / diffuser plate shall not exceed 40% of the specified differential pressure.

   Contractor shall also furnish noise calculations with and without the use of these devices and the noise abatement achieved in individual components.

8. All control valve packing shall comply with fugitive emission requirement as per leakage class-C of ISO-15848-1.

9. Vendor shall also ensure that all electric & pneumatic entries (actuator, positioners etc.) to be suitably plugged before dispatch to site and metallic plug shall be provided.

d) FIELD INSTRUMENTS

1. Instruments in general shall be intrinsically safe type. Instruments, which are not available as per their standard design from any reputed manufacturer as intrinsic

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safe, can be supplied in flameproof design. All such instruments shall be certified for the hazardous area classification.

2. All field transmitters including temperature transmitters shall be provided with dual compartment housing. Dual input capability with automatic transfer to back-up sensor shall be considered for all temperature transmitters. Accordingly, both the elements shall be wired to transmitters.

3. All temperature elements shall be provided with thermowells fabricated out of bar stock of minimum SS 316 or better material to suit the service condition as per EIL Standard 7-52-0035. The base of the thermowells shall be chosen to fit the instrument without air gap for minimizing measurement lag. Thermowell and flanges shall be SS 316 or better with Pressure rating of flanges shall be minimum 300# rating.

4. Thermocouples shall be considered for all process services with operating temperature above 400 deg C. RTD shall only be used for operating temperature upto 400 deg C and for motor bearing & winding temperatures and for process temperature below 200 deg C.

5. The thermocouple shall be K-type, un-grounded and duplex type. The element shall be 20 AWG for Duplex thermocouples. All temperature signals shall be provided with field remote mounted (not head mounted type) Temperature Transmitters.

6. Dedicated orifice-tapings shall be used for each transmitter, for the installation of multiple transmitters from a common orifice. All the Orifice flanges shall have 4 sets of tappings Unused tapings shall remain capped. For hydrocarbon and high-pressure steam service, unused holes in orifice flange should be plugged and seal welded, used holes from where the tappings are taken should also be welded.

7. All Instruments, Junction boxes in field, local gauge board etc. shall be provided with SS tag plates.

8. As per project philosophy only 6 pair/ 12 pair / 8 Triad multi cables shall be used, contractor to consider Junction box accordingly.

9. For Digital Outputs going to MCC for starting/ stopping of motors, high rating fuse shall be used to eliminate chance of fuse failure leading to unreliability in pump auto start / stop operations.

10. All line or equipment mounted instruments like control valves, pressure relief valves, thermowells, orifice flanges, level instruments etc., installed on pipes and vessels under IBR shall be certified by IBR or their authorized representative.

11. The square root extraction for the differential pressure type flow measurement shall be carried out in the flow transmitter. The flow transmitters integral display unit shall be configured for the engineering unit.

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12. In case of special instrument items, analysers, flowmeters, control valves, package PLC etc. the installation shall be done under the supervision of that system/ instrument vendor's personnel. It is the responsibility of Contractor to co-ordinate and to make available the OEM specialist's services at the time of installation, testing and commissioning of the package at their own cost.
13. Plugging of all extra/ unused entries of Junction Boxes, transmitters, thermocouples heads shall be ensured.

14. Contractor scope of work includes vibration analysis of thermowells as per ASME PTC 19.3 TW latest edition. Thermowell shall be suitable for stresses due to steam velocity condition. Any design change necessary as a consequence to this vibration analysis shall be included and provided by contractor and shall be according to the following order of precedence:

    i) The thickness of the thermowell shall be increased.

    ii) U length shall be reduced maximum by 50mm.

    iii) Combination of both above points (i) & (ii).

    iv) If none of the above options are meeting the requirements, in that case thermowell size can be increased.

    For all such changes, vendor must obtain prior approval from purchaser before proceeding with the fabrication of temperature element.

    In case, wake frequency analysis fails for all the above conditions, the contractor shall provide helical / helicoidal / Scruton thermowell. Contractor to note that the helical design of Thermowell shall be directly from the Metal Bar Stock. Any external welded helix is not acceptable. Vendor to furnish calculation for the pitch height of helix for helical thermowells. Vendor to furnish the CFD calculations/ stress analysis for the helical design thermowells.

15. Any instrument such as Ultrasonic flowmeter, transmitters etc. if installed in Pit, shall be weatherproof to IP68 or higher. Contractor shall make suitable arrangement to protect instrument.

3.0 Cable Philosophy

a) Supply of all cables including cable trays within the specified package battery limits shall be in contractor's scope as per Scope of work (Instrumentation) attached elsewhere in the Tender.
   All cables upto contractor supplied junction boxes, local control panel, package PLC within the package battery limits shall be provided by the Contractor. All System cables between Contractor supplied Package PLC, workstation consoles, printer etc. shall be provided by the Contractor.

b) Each individual cable routed through cable trays must be clamped or tied using SS wires. The overall clamping shall be with aluminum clamp instead of tying with cable

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armour. Nuts/Bolts for cable tray fixing & for fixing for the instrument items shall be SS.

c) Perforation in the cable trays shall be provided at regular intervals for clamping of cables from cable trays.

d) Cable trays including its structural supports shall be provided by the Contractor within the package battery limits and interfacing of cable trays upto Owner's cable duct shall be provided by the contractor.

e) System cables routed outside the control rooms (between PCR and CLO2 dosing room) shall be fibre optic cables and the same shall be double Armoured and rodent resistant type also. Each fibre optic cable shall have spare fibres.

f) System cables shall be Armoured. Separate cable shall be considered for each serial link i.e. the cores of one serial link shall be separate from the cores of other serial link in case of redundant link and shall not be combined in the same cable.

4.0 Drawings and Documents

4.1. Contractor shall thoroughly review and approve vendor drawings for all instruments and accessories before forwarding to EIL/Purchaser. Only the approved drawings duly stamped and signed by a competent engineer of the Contractor shall be sent to EIL/Purchaser.

4.2. Contractor shall submit all instrument specifications and data sheets as per ISA format.

4.3. Contractor shall submit drawing / documents required for DCS and ESD PLC engineering such as Point database (I/O list), cable schedule, logic diagram, graphics etc. Native files shall also be submitted by the contractor.

4.4. Softcopy of all instrumentation documentation shall be submitted by contractor in editable format for loading into Purchaser's documentation node. Contractor to ensure that all final as-built instrumentation documentation are submitted as separate volume/section.

4.5. Contractor shall review totality of sub-package vendor drawings including P&ID's, DCS engineering documents and ensure that the same are in line with process philosophy followed in process units. These drawings shall be submitted for Purchaser's review

4.6. Contractor shall generate and submit all instrument datasheets, Cable Schedule, Instrument Index and Instrument loop Diagram including JB wiring in Intergraph Smart Instrumentation SPI version 13.1 and oracle version 19c client as per VDR. All necessary SEED files shall be provided by the purchaser.

4.7. Contractor to note that data sheets of special instruments, Package PLC, analysers, flowmeters etc. shall be reviewed by Purchaser.

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5.0 Hart Maintenance System (HMS) :

5.1 Dedicated Hart Maintenance System (HMS) system shall be provided by Purchaser located in Polypropylene control room (PCR) which shall facilitate maintenance management of all smart / conventional instruments connected to the Package PLC. In case HART Pass Through IO cards are not available in package PLC, HART Interface Modules to interface with Purchaser's HART Maintenance System shall be considered by Contractor as per **C050-1U68-16-51-SK-8010** attached with tender.

5.2 HMS shall have connectivity to all I/Os, however for shutdown loops, smart transmitters configuration facility shall be kept inhibited by default. This system shall interact with all Smart Transmitters and Smart Positioners to provide:

a) Monitoring of device (Smart Transmitters and Smart Positioners/Control Valves) status on-line.
b) All maintenance related data like diagnostics alarms, transmitter range, settings etc.
c) Trend Data for all devices.
d) Facility to re-range, configure and calibrate field transmitters and smart positioners remotely.
e) An audit trail for a complete historical record of all configuration, calibration and device alerts.
f) Data on predictive maintenance such as list of transmitters experiencing drift, control valves loosing as shipped characteristics etc.
g) Advanced diagnostic features like device step response, device signature, dynamic error band etc.
h) Documentation like various trend reports, Diagnostic reports, predictive maintenance reports, audit reports, historical data and device specification sheets in addition to those available with selected software as stand-alone.

5.3 The Advance diagnostic for Smart Valve Positioners shall include as a minimum Step Response, Dynamic Error Band, Valve Signature, Travel deviation Alert, Valve Seat Load, Bench set, Friction calculation, Cycle alert, Travel accumulation. In case valve advance diagnostics software cannot be snap-on to HMS, separate hardware/software shall be provided by Contractor to fulfill the functional requirement.

5.4 For all I/Os connected to package PLC, Contractor shall provide suitable barriers and multiply the signals in package PLC for connecting to Purchaser's HMS system. All the signals to be connected to Purchaser's HMS system shall be terminated on separate Terminal blocks in package PLC for further connection to the HMS system by Purchaser.

5.5 Laser printers for alarm and event printing, log reports, Graphics and Group displays, programming printouts, reports etc. for the package PLC system shall be considered by Contractor.

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5.6 System diagnostics shall be provided which shall include sensor out of range, open or shorted loops, checking the compatibility and availability of I/O hardware and software, memory diagnostics, availability and fault of power supplies etc.

5.7 All power supply modules shall have reverse current protection and short circuit protection.

5.8 Contractor shall provide a configuration laptop (latest version) for cooling tower package for configuration of Package PLC based systems with engineering license. It shall be possible to do all configurations, modification in the programs, set point changes, I/O assignments etc. from package plc laptop. It shall be possible to debug/analyze any malfunction in the software/program through laptop. All necessary Licenses for carrying out Engineering, operation, configuration/ programming, troubleshooting etc. for package PLC shall be provided by Contractor.

5.9 The control system shall also meet the total functional requirements, specifications and plant operational requirements as per process scheme, process description and any other requirements as defined in this bid package. If at any point of time of execution of the job, the package PLC system supplied is found inadequate to meet the above requirements, any addition, modification required in software's/ hardware's shall be carried out by the Contractor without any time/ cost implications.

5.10 The drawing and documentation which are required for complete engineering of package PLC shall be prepared by the Contractor, not limited to the documents indicated in vendor data requirement, enclosed elsewhere in this bid document. The correctness and completeness of these documents shall be the responsibility of the Contractor. The formats for these documents shall be supplied after order.

5.11 The schedule for the preparation and submission of drawings and documents for package PLC engineering shall be as agreed mutually between successful Bidder and Purchaser, after the award of contract. The Contractor shall review the vendor drawings/ documents before submission to Purchaser.

5.12 Purchaser shall participate in the following activities of Package PLC engineering along with the contractor and control system vendor:

a) Kick-off Meeting, System Definition Meeting, and Software Definition Meeting at PLC Sub-vendor's works/ Purchaser/ Vendor's office (at the discretion of Purchaser).
b) Review of Package PLC/ Sub-Vendor drawings/ documents.
c) Factory Acceptance Test of Package PLC at Sub-Vendor's works.
d) Loop checking, Inspection, testing and commissioning.

6.0 Electrical-Control & Instrumentation Interface:

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6.1 Electrical-Instrumentation interface is the connectivity with respect to substation with the package and field. The interface required is in the following areas:

6.2 Control signals between Substation and package PLC based control system.

6.3 The input and output contacts shall be in separate multi-cables.

6.4 Contractor shall provide details of Interlock, operation & shutdown signals to / from MCC & control system for the entire package as per format given in std spec. 6-52-0052 attached elsewhere in the tender.

6.5 All electrical interfaces (MCC Signals) for interlock / shutdown to programmable logic controller shall be hardwired through potential free contact. Interposing relays shall be provided for all electrical contact signals to package PLC. The monitoring signals to DCS shall be connected through serial interface from MCC. Start / Stop, Local / Remote commands for all electrical drives shall be located in Local Control Station in field (A/M switch shall be in the control room/ Local control panel) and shall be directly wired to MCC.

6.6 Start command & stop command shall be separate contacts from package PLC. Start/stop single contact shall not be used.

7.0 Inspection and testing

a) All instruments, analyzer and Package PLC etc. shall undergo factory testing and inspection by Contractor's authorized representatives, Purchaser and EIL, unless specified otherwise.

b) The inspection and testing shall be carried out as per related specifications, international codes and practices/ standards, approved documents and/ or any other document attached elsewhere in this document.

c) No system-oriented item shall be dispatched without integrated factory testing. The testing procedures shall be detailed out by Contractor based on testing requirements indicated in individual system specifications and shall be approved by Purchaser/ EIL. Contractor must certify that the system is actually ready before calling the Purchaser / EIL for FAT. Also, all the necessary approved documents and literature are to be submitted before calling for Factory Acceptance

d) For package PLC system the inspection and testing shall confirm to testing requirements given in standard specification in addition to testing requirement as per ITP Testing of PLC based Control System, and any other critical System shall be witnessed by Purchaser/ EIL at their discretion.

e) The Contractor shall attend the Factory Acceptance Test (FAT) and/or Site Acceptance Test (SAT) of the Package PLC systems to check and approve the implemented controls, logics and the complete interface to vendor's package

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PLC. Therefore, Contractor has to provide relevant hardware/software tools, manpower and services.

f) Contractor to ensure all special testing requirements like Radiography and other NDT requirements for all the instruments/ instrument castings shall be carried out as per the PMS requirements.

g) IBR Certifications, wherever applicable, shall be provided by Contractor in the appropriate format duly signed by IBR authority or their authorized agency if applicable.

8.0 Vendor List

a) Vendor List for Instrumentation items (Annexure-3) is provided elsewhere in the Tender. Contractor shall consider the instrument supplier as identified in the Vendor List.

b) Vendor list provided in the Tender is for the Make only, and not for any specific Model. For any instrumentation item, the offered model for the same must meet the specification and proven track record (PTR) requirements specified in tender.

c) For Instruments/ items not covered in the vendor list, contractor shall furnish proposed sub-vendor list for Purchaser's approval.

9.0 Training:

Contractor shall arrange training for Purchaser's personnel at site. Different type of courses shall be offered for Operation / Process/System Engineers and Operators and Instrument Maintenance Engineers/Technician. Contractor shall indicate a detailed proposal for training in the offer. The site training course shall be for control systems (Package PLC) and their bought out items also. Contractor shall offer operation training basically meant for operating personnel. The various facilities available in the control systems for operation, actions required during emergencies and identifying the various diagnostic messages shall be the main contents of the operation training. The other general requirements & duration of this training shall be as defined elsewhere part of this tender.

Contractor shall quote per diem rate of training in the offer. For evaluation purpose following to be considered.

5 Mandays for Package PLC

10.0 Site conditions & climate:

All field instruments, valves covered in this Tender shall be suitable for unprotected installation in Hot, humid environment having ambient conditions mentioned elsewhere in the Tender.

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11.0 Logistic support

a) Contractor shall ensure and provide the following information/ details during detail engineering as part of purchase requisition for critical instrumentation items like Package PLC, Analysers:

i) Local service facilities in India is available or not from the manufacturer?
ii) If not available, where in the manufacturer's approved service facility presently located nearest to India?
iii) Instruments/ System shall be user serviceable.
iv) User reference list.

b) Logistic support certificate shall be provided from the supplier of package PLC, analyzers as part of purchase specification/ requisition. The logistic support certificate shall be signed by a corporate level person of the vendor/ vendor's principal.

c) **Certificate for Logistics Support (by Vendor's Principal)**

(To be signed by Vendor's/ Principal's corporate level signatory on company's letterhead)

I, on behalf of M/s _____ confirm that the * quoted by M/s _____ for Analyser / Package PLC of NRL PP Project against Tender No C050-1U68-81-45-PB-T-8010 for Cooling Tower Package, shall continue to be supported by us. The quoted item shall not be withdrawn from Indian market in next five (5) years from the date of placement of order as a matter of our corporate policy as supported by attached certificate from our principal(s) M/s_____.

I further confirm that in case of placement of order by M/s _____on us, we shall continue to support NRL PP Project at NRL, Assam in providing back-up engineering, maintenance support and spare part for a period of 10 years from the date of expiry of warranty.

SIGNATURE WITH SEAL

AUTHORIZED, SENIOR MANAGEMENT LEVEL

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* Package PLC Control System, Analyser provided by Vendor.

12.0 Post warranty annual maintenance contract (PWAMC):

Post commissioning onsite support for system-oriented items for Package PLC, Analyzer System (except density analyzer, moisture analyzer (non-GC based), PH/conductivity analyzer), FA System, special control system etc. Non comprehensive, 2 Periodic visits of expert for each system (at least @5 days at site per visit) on mutually agreed interval/schedule with Owner shall be provided by the contractor. The validity of the contractual period shall be 3 years from the expiry of the warranty. Also, its shall be non-comprehensive. PWAMC will be separately ordered by owner.

The bid shall be made year wise upto 3 years and the price validity shall be available for the entire period of contract. Contractor shall PROPOSE 3 year's post warranty annual maintenance contract (non-comprehensive) & shall exclusively mention the services to be provided, methodology, scope of works, and contractor's responsibility with year wise break up.

In the event of any malfunction of the system hardware / system software, experienced service engineer shall be made available at site within 24 hours on the receipt of such information from OWNER.

The contract shall include travel, boarding & lodging of service engineer. The services under Post Warranty Annual Maintenance Contract (Non-comprehensive) including services shall broadly encompass:
- Preventive maintenance
- Periodic maintenance
- Emergency service
- Software support

Preventive maintenance:

Site Visit for inspection of hardware and software, fault prediction, inspection of power supply quality, environmental and operating condition checks, cleaning, calibration checks and detailed reporting.

Periodic maintenance:

Site visit for inspection of general healthiness of the system, study and advice on daily maintenance, inspection of H/W & S/W. if any problem is reported, running of test programs, diagnostics, on-line servicing and solving reported problems. Checks shall be conducted on running system i.e.

(a) On-line sub-systems
(b) Power supply checks
(c) Others contractor to mention.

Software maintenance:

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Maintain existing system softwares to improve and utilize existing applications and improve performance of the system. Minor modifications of the softwares shall also be covered under this scope.

Emergency service:
Provide remote or on-site support to address urgent issues and minimize downtime. Troubleshooting problems and identifying the root cause of malfunction and doing minor repairs or adjustments.

Note:

a) Contractor to note that while carrying out the Post Warranty Annual Maintenance Contract activities (non-comprehensive), the Owner's (NRL) engineers may associate with system engineers. On-Job training of these associated engineers shall be covered under this scope.

b) All financial aspects of the Post Warranty Annual Maintenance Contract (Non-comprehensive) must be listed clearly by the Contractor.

LIST OF DOCUMENTS

S No.	Description	Document No.	No. of sheets
1.	Instrumentation Scope of Work	C050-1U68-16-51-SOW-8010	11
2.	Vendor Data requirement (Instrumentation)	C050-1U68-16-51-VDR-8010	5
3.	Mandatory Spares List (Instrumentation)	C050-1U68-16-51-SL-8010	4
4.	Vendor List-Instrumentation	Annexure-3	158
5.	Technical Confirmation List (Instrumentation)	C050-1U68-16-51-CF-8010	2
6.	List of Engineering / Installation Standards (Instrumentation)	C050-1U68-16-51-MD01	82
7.	Standard Specifications List	C050-1U68-16-51-SP-1002	442
8.	List of Drawings	C050-1U68-16-51-SP-1003	58
9.	Engineering Design Basis (Instrumentation)	C050-999-16-51-EDB-1001	57
10.	SPI Blank Datasheets Formats	Annexure-4	68
11.	Inspection and Test Plan List (Instrumentation)	(Attached elsewhere in tender)	-

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	NUMALIGARH REFINERY LIMITED	Total pages: 10

NRL EXPANSION PROJECT

SITE SPECIFIC SEISMIC SPECTRA

			Written By	Checked by	Approved By			
D1	17/02/2021	Approved For Design	TMB	PKB	KC			
A1	09/10/2020	Issued for Review	TMB	PKB	KC			
Rev.	Date	Reason for Issue	Prepared	Checked	Approved	Prepared	Review	Review
			Discipline Engineer	Discipline Lead	Contractor Representative	Discipline Engineer	Project Engineer	Department Head

TECHNIP INDIA LIMITED			**TPIL**			**NRL**	
			Category		Code	Description	
			Facility Area Code		1Z	Common Document	
NRL's PO NO: 4300062833-AMA/16.06.2020			Document Type		BOD	Basis of Design	
TP DOC REF: 082176C-ZZZ-JSD-1700-0002_D1			System Number		00	General	
			Life Cycle		02	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**	**CV**	**BOD**	**0002**	**D1**

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1 INTRODUCTION:

NUMALIGARH REFINERY LIMITED (NRL) has awarded a contract to M/s. Technip India Limited (TPIL) to provide Managing Project Management Consultancy services (MPMC) for the capacity expansion of their refinery from 3 to 9 MMTPA as part of Numaligarh Refinery Expansion Project (NREP) in Numaligarh, Golaghat District, Assam, India.

2 DEFINITIONS & ABBREVIATIONS

Wherever used in this procedure, the following words shall have the meaning as given hereunder:

Abbreviation	Definition /Expanded form
NRL / OWNER / CLIENT	shall mean Numaligarh Refinery Limited
MPMC	Managing PMC (shall mean Technip India Limited)
CONSULTANT	Shall mean EPCM/ EPCM 1/ EPCM 2/ BOO
LICENSOR	Party responsible for process technology ownership for any UNIT
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / EPC packages.
LSTK	Lump Sum Turn Key execution of EPC package by the CONTRACTOR
EPC	Engineering Procurement & Construction execution on Lumpsum basis by the CONTRACTOR
SUB-CONTRACTOR	Party whose services are obtained by CONTRACTOR for performing the works specified as part of LSTK / EPC packages
VENDOR	Any third party supplying the equipment/materials for setting up the Plant
EPCM-1	A portion of NREP for which NRL is engaging another Consultant to perform Engineering, Procurement, Construction management services as required within the battery limits of UNITs assigned to it
EPCM-2	A portion of NREP for which NRL is engaging another Consultant to perform Engineering, Procurement, Construction management services as required within the battery limits of UNITs assigned to it
BOO	Build Own Operate – A portion of NREP for which NRL is engaging a CONTRACTOR on “Build Own Operate “mode to supply the output to be consumed in rest of the UNITs
UNIT	Indicates any particular portion of the NREP to be built which can be Process related or Utilities/Offsites related

3 PURPOSE:

The purpose of this document is to lay down the basic requirements for Site Specific Seismic Spectra including the philosophy, schematic, functional requirement for each structure / foundation/ equipment / component of the system to be taken into consideration in design, manufacture, testing, supply, construction and installation. This shall be applicable for all CONSULTANTS/ CONTRACTOR / Sub-CONTRACTOR working in Numaligarh Refinery Expansion Project to meet the overall requirements of the CLIENT.

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4 CONFLICTS & DEVIATIONS

If conflicting statements exist within this document or between this document and other applicable specifications, Standard Drawings, Industry standards, codes, etc., it shall be brought to CLIENT / MPMC notice for clarification and proper approval shall be obtained before implementation. Decision of CLIENT / MPMC shall be final.

In case of contradiction between licensor specification, design basis and Job Supply Specifications / data Sheets, it has to be brought to the notice of CLIENT / MPMC and Decision of CLIENT / MPMC shall be binding on CONTRACTOR / VENDOR.

In general, order of priority of the documents shall be as follows,

- Local regulatory and statutory requirement.
- Licensor Requirements (as applicable)
- Project specification and datasheets, wherever applicable.
- This specification and relevant equipment/system specification.
- Codes and standard

5 GENERAL SCOPE

Site specific seismic spectrum is generated separately for Design Basis Earthquake (DBE) & Maximum Considered Earthquake (MCE) for different damping values. The spectral accelerations presented here shall be used along with Clause no. 7.3.1 of IS 1893 (Part 4). This specification provide certain guidelines for site specific seismic spectra used for seismic analysis of structures and equipment. However, detailed mathematical formulations of seismic analysis are outside its scope.

6 UNIT

The International System of Units (SI) shall be used.

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7 REFERENCED STANDARDS & PUBLICATIONS

(All codes & Standards including all parts shall be latest revision with all amendments issued thereto)

Si No.	Description	Code
1.	Criteria for earthquake resistant design of structures (Part 1) - General provisions and buildings	IS:1893
2.	Criteria for earthquake resistant design of structures (Part 2) - Liquid Retaining Tanks	IS:1893
3.	Criteria for earthquake resistant design of structures (Part 3) -	IS:1893
4.	Criteria for earthquake resistant design of structures (Part 4)- Industrial structures including stack-like structures	IS:1893

Note:

Apart from above, refer to 082176C-ZZZ-JSD-1700-0001 – Engineering Design Basis for Civil, Structural, Architectural and U/G network for applicable list of references and codes.

8 SITE SPECIFIC SEISMIC SPECTRA

8.1 GENERAL

It is the design force specified in this specification shall be considered in each of the two principal horizontal directions and vertical direction. The specified standard design spectra by IS code 1893, is to be taken as minimum strength of design structures. The effects of site-spectra used in design shall not be less than standard design spectrum specified as specified in the code IS 1893. curve representing the peak acceleration w.r.t time period of single degree of freedom system for the Numaligarh Site. This is different from the spectra given in IS1893. It depends on the location of Numaligarh site.

The design force specified in this specification shall be considered in each of the two principal horizontal directions and vertical direction. The specified standard design spectra by IS code 1893, is to be taken as minimum strength of design structures. The effects of site-spectra used in design shall not be less than standard design spectrum specified as specified in the code IS 1893.

8.2 DESIGN HORIZONTAL SEISMIC COEFFICIENT

The horizontal seismic coefficient Ah shall be obtained using the period T, described as under

8.2.1 SITE SPECIFIC SPECTRA:

When using the site specific spectra, the seismic coefficient shall be calculated from the expression:

$$Ah = \frac{Sa}{g}\frac{I}{R}$$

Where $\frac{Sa}{g}$ = Spectral acceleration coefficient corresponding to time period T of the structure.

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8.3 SPECTRAL ACCELERATION COEFFICIENTS (SA/G) FOR DESIGN BASIS EARTH QUAKE (DBE)

Spectral Acceleration coefficients (Sag) for 5% damping for Design Basis Earth Quake (DBE) in the horizontal direction shall be based on the following equations. The spectral acceleration values for different damping ratios are given in Figure 1 and Table 1

$\frac{Sa}{g}$ (damping : 5%) = 0.24 +3.6T for 0.00 < T < 0.10 sec

= 0.60 for 0.10 < T < 0.55 sec

= $\frac{0.33}{T}$ for 0.55 < T < 10.0 sec

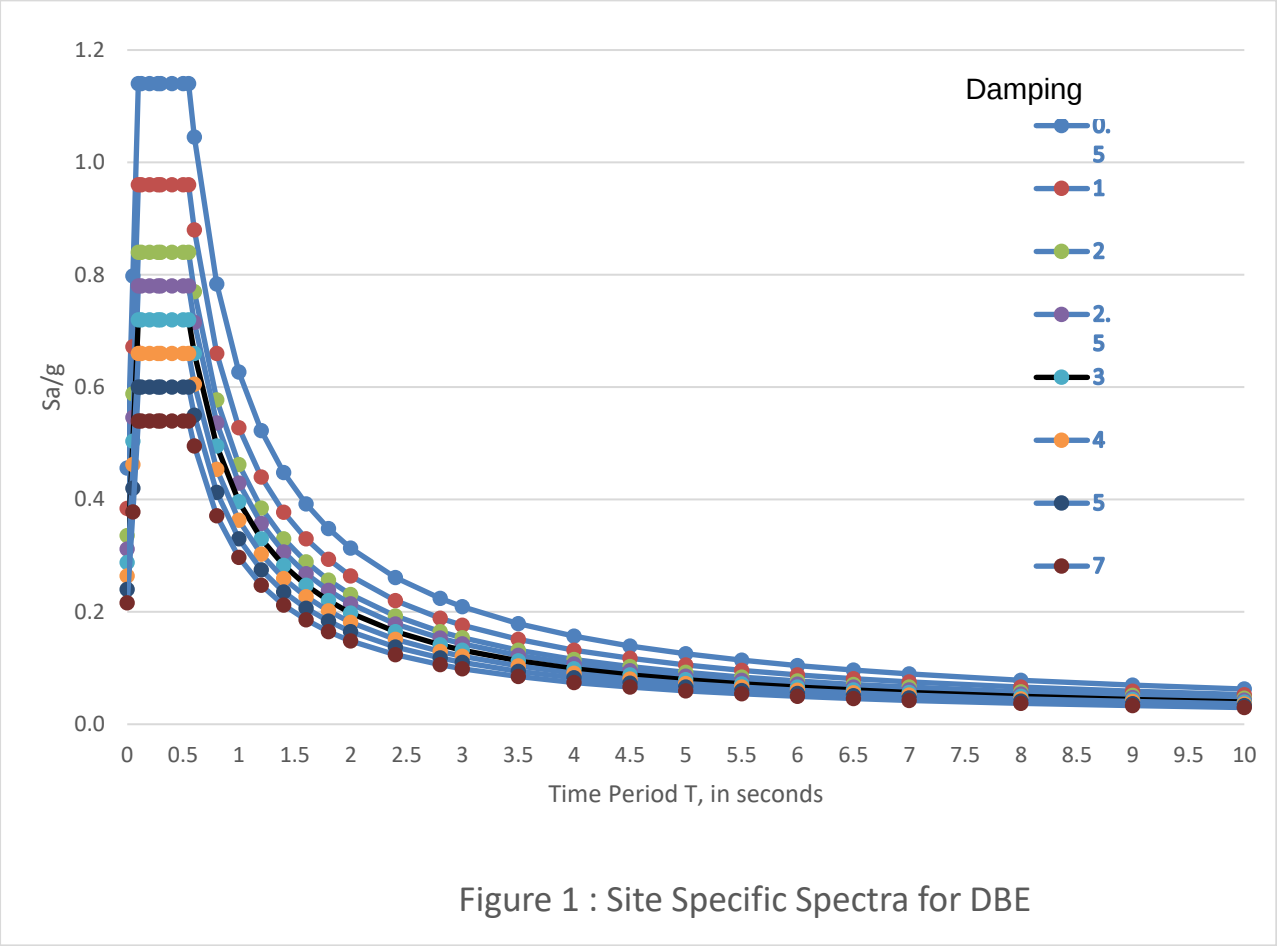

Figure 1 : Site Specific Spectra for DBE

Table 1 Spectral Acceleration Coefficients (Sa/g) for Design Basis Earthquake(DBE)

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Time Period (sec)	Percentage of Critical Damping							
	0.5	1	2	2.5	3	4	5	7
0	0.240	0.240	0.240	0.240	0.240	0.240	0.240	0.240
0.05	0.798	0.672	0.588	0.546	0.504	0.462	0.420	0.378
0.1	1.140	0.960	0.840	0.780	0.720	0.660	0.600	0.540
0.125	1.140	0.960	0.840	0.780	0.720	0.660	0.600	0.540
0.2	1.140	0.960	0.840	0.780	0.720	0.660	0.600	0.540
0.275	1.140	0.960	0.840	0.780	0.720	0.660	0.600	0.540
0.3	1.140	0.960	0.840	0.780	0.720	0.660	0.600	0.540
0.4	1.140	0.960	0.840	0.780	0.720	0.660	0.600	0.540
0.5	1.140	0.960	0.840	0.780	0.720	0.660	0.600	0.540
0.55	1.140	0.960	0.840	0.780	0.720	0.660	0.600	0.540
0.6	1.045	0.880	0.770	0.715	0.660	0.605	0.550	0.495
0.8	0.784	0.660	0.578	0.536	0.495	0.454	0.413	0.371
1	0.627	0.528	0.462	0.429	0.396	0.363	0.330	0.297
1.2	0.523	0.440	0.385	0.358	0.330	0.303	0.275	0.248
1.4	0.448	0.377	0.330	0.306	0.283	0.259	0.236	0.212
1.6	0.392	0.330	0.289	0.268	0.248	0.227	0.206	0.186
1.8	0.348	0.293	0.257	0.238	0.220	0.202	0.183	0.165
2	0.314	0.264	0.231	0.215	0.198	0.182	0.165	0.149
2.4	0.261	0.220	0.193	0.179	0.165	0.151	0.138	0.124
2.8	0.224	0.189	0.165	0.153	0.141	0.130	0.118	0.106
3	0.209	0.176	0.154	0.143	0.132	0.121	0.110	0.099
3.5	0.179	0.151	0.132	0.123	0.113	0.104	0.094	0.085
4	0.157	0.132	0.116	0.107	0.099	0.091	0.083	0.074
4.5	0.139	0.117	0.103	0.095	0.088	0.081	0.073	0.066
5	0.125	0.106	0.092	0.086	0.079	0.073	0.066	0.059
5.5	0.114	0.096	0.084	0.078	0.072	0.066	0.060	0.054
6	0.105	0.088	0.077	0.072	0.066	0.061	0.055	0.050
6.5	0.096	0.081	0.071	0.066	0.061	0.056	0.051	0.046
7	0.090	0.075	0.066	0.061	0.057	0.052	0.047	0.042
8	0.078	0.066	0.058	0.054	0.050	0.045	0.041	0.037
9	0.070	0.059	0.051	0.048	0.044	0.040	0.037	0.033
10	0.063	0.053	0.046	0.043	0.040	0.036	0.033	0.030

8.4 SPECTRAL ACCELERATION COEFFICIENTS (SA/G) FOR MAXIMUM CONSIDERED EARTHQUAKE (MCE)

Spectral Acceleration coefficients (Sag) for 5% damping for Maximum Considered Earthquake (MCE) in the horizontal direction shall be based on the following equations. The spectral acceleration values for different damping ratios are given in Figure 2 and Table 2

$\frac{Sa}{g}$ (damping : 5%) = 0.36 +5.4T for 0.00 < T < 0.10 sec

= 0.90 for 0.10 < T < 0.55 sec

= $\frac{0.495}{T}$ for 0.55 < T < 10.0 sec

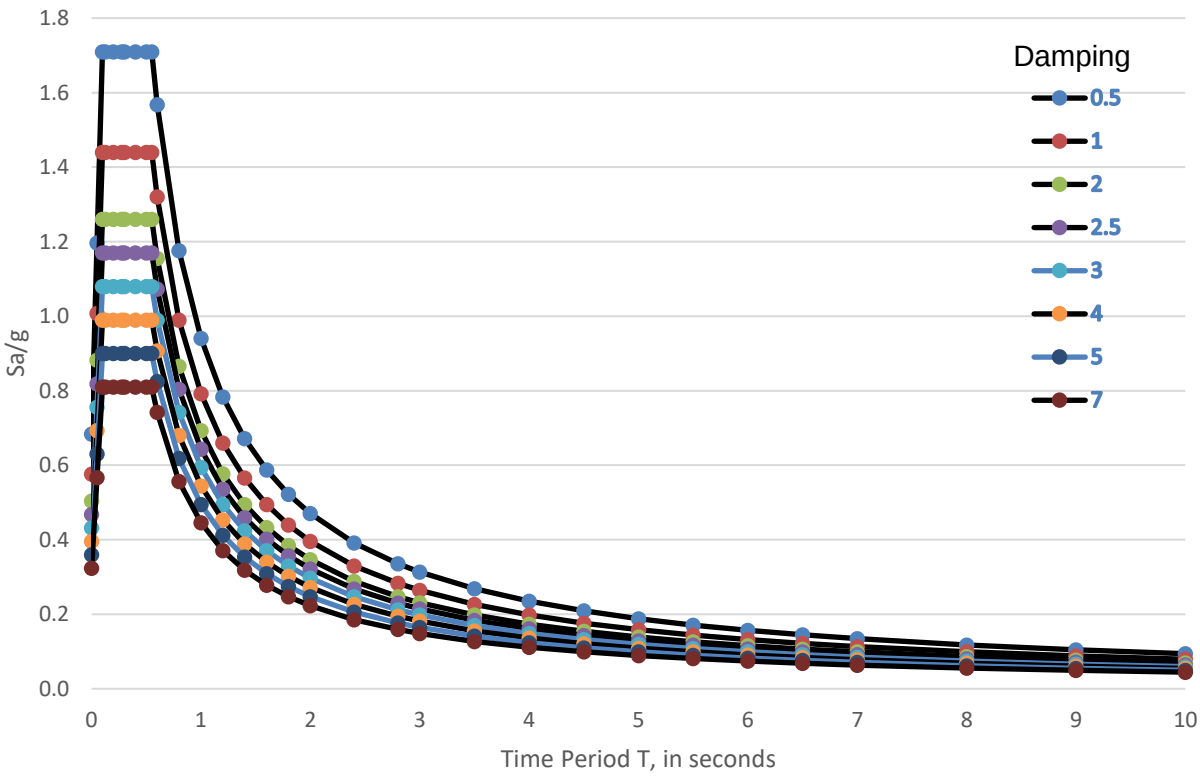

Figure 2 : Site Specific Spectra for MCE

Table 2 Spectral Acceleration Coefficients (Sa/g) for Design Basis Earthquake(MCE)

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Time Period (sec)	Percentage of Critical Damping							
	0.5	1	2	2.5	3	4	5	7
0	0.360	0.360	0.360	0.360	0.360	0.360	0.360	0.360
0.05	1.197	1.008	0.882	0.819	0.756	0.693	0.630	0.567
0.1	1.710	1.440	1.260	1.170	1.080	0.990	0.900	0.810
0.125	1.710	1.440	1.260	1.170	1.080	0.990	0.900	0.810
0.2	1.710	1.440	1.260	1.170	1.080	0.990	0.900	0.810
0.275	1.710	1.440	1.260	1.170	1.080	0.990	0.900	0.810
0.3	1.710	1.440	1.260	1.170	1.080	0.990	0.900	0.810
0.4	1.710	1.440	1.260	1.170	1.080	0.990	0.900	0.810
0.5	1.710	1.440	1.260	1.170	1.080	0.990	0.900	0.810
0.55	1.710	1.440	1.260	1.170	1.080	0.990	0.900	0.810
0.6	1.568	1.320	1.155	1.073	0.990	0.908	0.825	0.743
0.8	1.176	0.990	0.866	0.804	0.743	0.681	0.619	0.557
1	0.941	0.792	0.693	0.644	0.594	0.545	0.495	0.446
1.2	0.784	0.660	0.578	0.536	0.495	0.454	0.413	0.371
1.4	0.672	0.566	0.495	0.460	0.424	0.389	0.354	0.318
1.6	0.588	0.495	0.433	0.402	0.371	0.340	0.309	0.278
1.8	0.523	0.440	0.385	0.358	0.330	0.303	0.275	0.248
2	0.470	0.396	0.347	0.322	0.297	0.272	0.248	0.223
2.4	0.392	0.330	0.289	0.268	0.248	0.227	0.206	0.186
2.8	0.336	0.283	0.248	0.230	0.212	0.194	0.177	0.159
3	0.314	0.264	0.231	0.215	0.198	0.182	0.165	0.149
3.5	0.269	0.226	0.198	0.184	0.170	0.156	0.141	0.127
4	0.235	0.198	0.173	0.161	0.149	0.136	0.124	0.111
4.5	0.209	0.176	0.154	0.143	0.132	0.121	0.110	0.099
5	0.188	0.158	0.139	0.129	0.119	0.109	0.099	0.089
5.5	0.171	0.144	0.126	0.117	0.108	0.099	0.090	0.081
6	0.157	0.132	0.116	0.107	0.099	0.091	0.083	0.074
6.5	0.145	0.122	0.107	0.099	0.091	0.084	0.076	0.069
7	0.134	0.113	0.099	0.092	0.085	0.078	0.071	0.064
8	0.118	0.099	0.087	0.080	0.074	0.068	0.062	0.056
9	0.105	0.088	0.077	0.072	0.066	0.061	0.055	0.050
10	0.094	0.079	0.069	0.064	0.059	0.054	0.050	0.045

8.5 SPECIAL NOTES

a) Detailed mathematical formulations of seismic analysis is outside of this document scope.

b) This document shall be read in conjunction with document 082176C-000-JSD-1700-001 : Engineering Design Basis for Civil, Structural and Architectural and U/G works.

c) All design parameters shall be in accordance with the reference codes mentioned in cl. 7.

d) Structure/Equipment defined as Category 1 as per Cl. 8.1 of IS 1893 part 4 and Process Safety recommendations shall also be designed for Maximum Considered Earthquake (MCE).

e) For ductile design and detailing requirements as per design codes IS 13920, IS 800, IS 456, etc., the site location shall be considered as Zone V. Response reduction factors for design of structures with Structural steel shall be considered as per provisions of Section 12 of IS 800(2007).

f) Cylindrical Storage Tanks designed as per API 620/650 using site specific design method, the critical damping percentage and Response reduction (R) factor shall be considered as per respective design codes.

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Annexure-B

JOB SPECIFICATION
(SMED - PACKAGED EQUIPMENT)

COOLING TOWER PACKAGE

TENDER No. C050-1U68-81-45-PB-T-8010

PROJECT	**:**	**EPCM SERVICES FOR SETTING UP POLYPROPYLENE UNIT AT NRL**
OWNER	**:**	**NUMALIGARH REFINERY LIMITED (NRL)**
EPCM	**:**	**ENGINEERS INDIA LIMITED**
EIL JOB No.	**:**	**C050**

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
0	26.08.2025	ISSUED WITH TENDER	AS	VMG	PD

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1.0 GENERAL

1.1 Specific requirements and guidelines pertaining to individual equipment and system are listed in subsequent sections. However, following general considerations have to be kept in view for all items while formulating their specifications and procurement engineering activities:

1.1.1 Reliability in service (assessed from Contractors' relevant track record and improved by incorporating certain minimum design features or requirements in the specifications).

1.1.2 All equipment/packages shall be sourced from Owner / PMC approved vendor list attached elsewhere in the tender document. For the items not covered in above vendor list, Contractor shall submit the credentials (past experience/ reference list, technical/ manufacturing capability etc.) of the selected vendor in support of his proven track record and the same shall be subject to acceptance of Owner/PMC during detail engineering. Non-acceptance of a particular proposed vendor due to any reasons whatsoever shall not be a cause of schedule and cost implication.

1.1.3 All equipment shall be of proven design. Prototypes, new designs, or extensive modifications of standard designs are unacceptable.

1.1.4 Compliance with applicable national or international codes and standards as well as any statutory regulation in existence for a specific item.

1.1.5 Service reliability, ease of operation and maintenance including any necessary measures for ensuring safety of personnel and equipment as well as a conducive working environment.

1.1.6 Standardization of components, wherever feasible.

1.1.7 Adherence to any limitations of space available for the equipment and its operation / maintenance.

1.1.8 The size and weight of equipment / package shall preferably be kept minimum.

1.1.9 Facility for any known future expansion of plant capacity with a minimum of modifications or shutdown.

1.1.10 Equipment shall be designed for the given site condition. Extreme climatic/ environment conditions shall be taken into consideration while selection of equipment, materials and arrangement/ provisions.

1.2 Specifications forming a part of the Bid Document indicate a minimum standard of quality for materials, fabrication and/or erection of the proposed equipment. Responsibility for complete compliance to these specifications shall rest with the Contractor. It will be Contractor's responsibility to obtain clarification from Owner's representative, wherever necessary, which in all cases shall be final and binding.

1.3 All equipment and materials supplied or installed under these specifications shall be installed in accordance with sound engineering principles and good fabrication and construction practice (no omission from these specifications shall relieve the Contractor from his responsibility).

1.4 All equipment and materials fabricated and installed under these specifications shall conform to the latest editions of the applicable codes and standards cited in the bid documents. No omission in the project instructions shall be construed as relieving the Contractor of his responsibility to ascertain these requirements, to perform work and furnish material in accordance with the codes specified.

1.5 Design life referred in the process design basis / design criteria shall be considered.

1.6 Contractor shall develop technical specification of equipment taking into consideration the requirements defined job specifications, data sheets and standard specifications

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etc. pertaining to equipment and other disciplines such as electrical, structural etc. (as applicable) attached with the tender.

1.7 All equipment to be supplied shall be designed for optimum utility consumption requirements.

1.8 Equipment/ packages shall be complete in all respects and any item or feature not covered in the specification but essential for proper operation shall be included by the Contractor. Also, the plant shall conform in all respects to high standards of engineering design, state of art technology, and reliability in continuous operation.

1.9 **MATERIAL OF CONSTRUCTION AND METALLURGY**

1.9.1 All materials and equipment shall be new and unused.

1.9.2 All materials supplied under these specifications shall be adequate for the proposed service.

1.9.3 Corrosion allowance and safety factor shall be within good engineering practice subject to the minimum as stated in the relevant specifications/ data sheets.

1.9.4 Selection of material for each component of equipment shall be based on the design pressure, temperature and other conditions of operation and in no case shall be inferior to the material indicated in Process Basic Design Engineering Package (BDEP).

1.10 **SAFETY**

1.10.1 It is the intent of the Owner that operational hazards be reduced to a minimum. Contractor shall use sound engineering judgment to complete an installation that will perform the required function without compromising this aim.

1.10.2 Noise limits and vibration limits shall be minimized. Noise limit shall be limited to 85 dBA at 1 m distance from the source unless otherwise specified. In general, OSHA requirements shall be complied with.

1.10.3 All electrical devices shall meet the requirements for the area classification in which they are installed.

1.10.4 Painting shall comply to the requirement as per specification attached with the bid package.

2.0 CODES AND STANDARDS

2.1 The main codes and standards applicable for equipment or system are indicated in the respective standard specification.

2.2 The list of applicable EIL standard specifications/ITPs is as given below. Contractor shall refer the applicable standard specifications and codes (latest version) referred therein for the item or system and make part of respective equipment specification in compliance with all such standard specifications.

Sl. No.	Doc. No.	Title Description of Standard Specification/ ITP
1.	6-48-0003	Standard Specification for Standard specification for H.O.T. Crane
2.	6-61-0014	Standard Specification for Electric Wire Rope Hoist
3.	6-61-0015	Standard Specification for Chain Pulley Block
4.	6-78-0001	Quality management system requirements from Bidders

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5.	6-78-0002	Documentation requirement from Contractors
6.	6-78-0003	Documentation requirement from Suppliers
7.	6-81-0136	Inspection and test plan for H.O.T. crane
7.	6-81-0035	Inspection & Test Plan for Chain Pulley Block/ Winch
8	6-81-0142	Inspection & Test Plan for Electric Hoist
9.	7-76-0103	Instructions to Vendor for Site Performance Guarantee Requirements for Package Units

3.0 TECHNICAL REQUIREMENTS

3.1 Material Handling Equipment/ Facility (Tag No. to be assigned by Contractor)

3.1.1 Requirements of Material Handling Equipment/ Facility, if found necessary in 3D model reviews over and above the ones already considered by the contractor, the same shall be provided by the contractor without any cost and time implication to Owner.

3.1.2 For site testing of material handling equipment, Contractor shall arrange the test load. The contractor shall make his own arrangements for shifting of test loads available at various locations inside the plant, to the erection place where load testing will be carried out for the material handling equipment.

3.1.3 Suitable monorail shall be provided for accommodating Chain pulley Blocks and Electric Wire Rope Hoist.

3.1.4 Chain Pulley Block/Electric Hoist shall be of compact design. Ease of installation & maintenance of the same shall be ensured by Contractor.

3.1.5 **HAND OPERATED TRAVELLING (HOT) CRANE**

a) HOT Cranes shall be designed for minimum head-room above the highest hook position and for closest approach of the hooks to each end stop.

b) For other technical requirements refer to Standard specification for H.O.T. crane (Doc. No. 6-48-0003) attached with the enquiry.

3.1.6 **CHAIN PULLEY BLOCK**

a) Chain Pulley Block shall be provided for handling equipment / component weighing 10 MT or less and / or lift less than 10 m or where frequency of maintenance/operation is very less. However, in cases with lifting weighing is more than 10 MT and/or lift is more than 10 m but frequency of operation is very less, Chain Pulley Blocks may also be considered.

b) All Chain Pulley Blocks shall be spark-resistant construction irrespective of hazardous area classifications.

c) Chain Pulley Blocks shall be complete with geared trolleys, adequate length of hand chain & load chain, trough for collecting load chain etc.

d) The minimum capacity of chain pulley blocks with monorail shall be weight of the largest components to be handled plus design margin of 10% as a minimum, rounded off to nearest standard capacity. Wherever two chain pulley blocks are required, each of 75% capacity of the total weight shall be provided.

e) Chain pulley blocks of standard capacities shall be provided.

f) Trolley mounted CP Blocks shall be of detachable type suitable for mounting on geared trolleys of same rating/capacities.

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g) Required manual effort for Chain Pulley Block shall be as per the stipulations of IS 3832.

h) The duty class of Chain Pulley Block shall be minimum M2 class as per IS 3832.

i) Self-braking system for holding the load in any position shall be provided.

j) For other technical requirements, refer EIL Standard Specification for Chain Pulley Block (Doc. No. 6-61-0015).

3.1.7 **ELECTRIC WIRE ROPE HOIST**

a) Electrically Operated Wire Rope Hoist with trolley shall be provided for handling equipment / component weighing 10 MT or above and / or lift more than 10 m or where frequency of maintenance/operation is relatively high. However, in cases where lifting weight is less than 10 MT and/ or lift is less than 10 m but frequency of operation is high or required for continuous operation, Electric Hoist shall be considered.

b) For electric hoists, festoon type cable trolleys shall be considered.

c) Electric hoist shall be operated from floor using a push button type pendent.

d) The capacity of the Electric Hoist shall be decided based on heaviest equipment to be handled during maintenance with 10% margin.

e) Up to 16 MT capacity Electric Wire Rope Hoist shall be as per IS 3938. For capacity above 16 MT, Electric hoist shall be manufacturer's standard based on satisfactory Proven Track Record.

f) Class designation for Electric hoist intended for maintenance shall be considered as 2 as per IS 3938. Class designation of electric hoist for process and continuous operation shall be considered as 4 as per IS 3938.

g) For other technical requirements, refer EIL Standard Specification for Electric Wire Rope Hoist (Doc. No. 6-61-0014).

3.2 **INVERTER CONTROLLED SPLIT A.C.**

3.2.1 Inverter controlled split air conditioners (wherever required as per Scope of Work, Doc. No. C050-1U68-80-42-SOW-8010, Annexure-B) shall be complete with all accessories, fittings, remote controller and electronic voltage stabilizer (copper winding) with time delay relay. Split unit shall be provided with wall mounted indoor (evaporating) unit and remotely located air cooled outdoor (condensing) unit with insulated refrigerant piping, controls and line accessories, initial charge of refrigerant. Associated electrical and civil works (e.g. civil work related to concealing of refrigerant piping, condensate piping to the nearest drain, cabling in AC space and outside upto the outdoor unit) as required including the structural steel framework, pedestal to mount the indoor/outdoor units, supports for indoor/outdoor units, supports & clamps for refrigerant piping/cables, hold down nuts & bolts shall also be in Contractor's scope.

3.2.2 All Split air conditioning units shall be 5 star rated and suitable for stabilizer free operation (though stabilizer is to be supplied with each air conditioner) is to be and supplied with factory charged Non-CFC & Non-ODP environmentally friendly refrigerants (i.e. R-32/R-134a/ R-407a/ R-407c /R-410a etc.).

3.2.3 Spares for commissioning and start up.

3.2.4 Make of Split ACs shall be selected from the vendor list attached with the tender.

4.0 INSPECTION AND TESTING

4.1 General

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4.1.1 Equipment shall be subjected to stage-wise expediting, inspection and testing at manufacturer's works by approved third party inspection agency (TPIA). Contractor shall submit Quality Assurance (QA) procedure before commencement of fabrication. Approved QA procedure shall form the basis for equipment inspection.

4.1.2 For Inspection and Testing at Works and at Site, Contractor shall comply with the Approved Quality Assurance Plan.

4.1.3 Any or all the tests, at Owner's option, shall be witnessed by PMC / Owner apart from TPIA. However, such inspection shall be regarded as check-up and in no way absolve the vendor of his responsibility.

4.1.4 Contractor shall comply with the inspection & test requirements as mentioned in respective EIL Standard Specifications/ ITP attached with the bid package.

5.0 PERFORMANCE GUARANTEE

5.1 General

5.1.1 Contractor shall be fully responsible for design and manufacturing work as well as the smooth functioning of the equipment covered under this specification as a minimum.

5.1.2 The system shall be performance tested at site after commissioning. The guaranteed parameters shall be checked during the performance test. The performance testing procedures shall be mutually decided after finalization of order.

5.1.3 Necessary Instruments for performance testing shall be arranged by the contractor, and calibrated before undertaking the performance test.

5.1.4 All equipment and component parts shall be guaranteed by the Contractor against faulty design, defective material or poor workmanship for a period stipulated in the bid package.

5.1.5 If any equipment or component(s) fail to perform the stipulated duty or malfunction, contractor shall rectify, modify, replace or make good the defective equipment/component(s) free of cost on notification by the purchaser within a reasonable time period mutually agreed upon.

5.1.6 Performance guarantee of "Electric Hoist" shall be demonstrated at site as per Cl. No. 4.3 of Standard Specification for Electric Hoist (Doc. No.6-61-0014) attached with Tender.

6.0 PROTECTION AND PAINTING

Surface preparation and painting for all equipment shall be as per painting specification attached with the bid package.

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Annexure-A

JOB SPECIFICATION

COOLING TOWER PACKAGE

(SMED - STATIC EQUIPMENT)

TENDER No. C050-1U68-81-45-PB-T-8010

PROJECT	**:**	**EPCM SERVICES FOR SETTING UP POLYPROPYLENE UNIT AT NRL**
OWNER	**:**	**NUMALIGARH REFINERY LIMITED (NRL)**
EPCM	**:**	**ENGINEERS INDIA LIMITED**
EIL JOB No.	**:**	**C050**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
0	22.08.2025	ISSUED WITH TENDER	CK	PKP	TK

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1.0 SCOPE

1.1 This specification covers the supply of Static Equipment (Pressure vessels, Storage Tanks, Mixer/Agitator etc.) for Cooling Tower Package for NRL Expansion Project (360 KTA PP Unit) of **NUMALIGARH REFINERY LIMITED (NRL)**, in accordance with this job specification, specifications, standards and codes etc. listed in the bid document.

This specification provides the additional technical requirements along with the requirements of standard specification 6-12-0030 (Pressure Vessels), 6-13-0053 (Storage Tanks) and 6-26-0001 (Mechanical agitators) (as applicable), and is intended to supplement the main scope of work and supply defined elsewhere in the bid package.

2.0 GENERAL

2.1 Definitions

- Contractor means the successful bidder on whom the order is placed.
- Vendor means the designer and/or supplier of static equipment.

2.2 Codes

All Codes referred to in various general specifications form a part of this specification; latest editions apply.

2.3 Deviations

2.3.1 Deviations are not acceptable in general. However, deviation with intent to improve upon the equipment life or performance may be quoted separately and it shall be EIL/Owner's prerogative to accept them or not. Such deviation shall be highlighted in the bid or raised in the 'Deviation Schedule' format.

2.3.2 Any deviation, which dilutes the specifications or brings down the quality, is not acceptable at all. Such deviation, if taken, may lead to technical rejection.

2.3.3 For successful Contractor any deviation at the execution stage, which becomes unavoidable, shall be submitted for EIL/Owner approval and Contractor shall not proceed with such deviation till acceptance of deviation by EIL/Owner. Time taken/delay, if any, in processing of deviation permit or its rejection shall be solely to Contractor's account.

2.4 Conflict

In case of conflict between this specification and other specifications, Codes and data sheets, it shall be referred to EIL/Owner for clarification and the decision of EIL/ Owner shall be final & binding on Contractor, without any cost & delivery implications.

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However, in the event of conflict, most stringent requirements shall be followed in the order of precedence as mentioned in clause 2 “conflict” of document no. C050-IU68-80-42-SOW-8010- Annexure-A.

2.5 Safety

It is the intent of Owner that operational hazards are reduced to a minimum. Vendor shall use sound engineering judgment to complete an installation that will perform the required process function without compromising this aspect.

2.6 Vendor Pre-Qualification

2.6.1 The Vendor shall be approved as per Vendor list enclosed elsewhere in the Tender or Contractor must take prior approval before placement of order for items not covered in the vendor list based on Proven Track record/past experiences. All necessary documentation for approval of vendor shall be provided by contractor before proceeding ahead with ordering.

2.7 Vendor Documentation

2.7.1 Master document index

Master document index with submission date must be submitted within 15 days after award of contract. Following order of submission of document must be adhered to:

i) Pre-qualification details of the Vendor which are not approved as per Vendor list.
ii) Master document index with schedule of submissions.
iii) Purchase Requisition
iv) Mechanical design calculations
v) Mechanical Engineering Data sheets
vi) Detailed drawings/documents.

2.7.2 Mechanical Engineering Data sheets

Vendor must perform design and prepare Mechanical Engineering Data sheets, which includes the following basic features as a minimum:

i) Design Data
ii) Complete dimensions; size, location & orientation of nozzles & saddles etc.
iii) Material of construction of all components along with their sizes and thickness
iv) Any specific feature, requirements relating to the equipment.

EIL/Owner shall review these data sheets. Comments, if any, shall be complied with. EIL’s review of Vendor’s design calculations, drawings and documents shall

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not relieve the Contractor of his responsibilities to supply equipment as per bid package.

All the Vendor drawings/documents must be reviewed and approved by Contractor before submission to EIL. Unchecked drawings and documents without revisions no. clearly marked shall not be reviewed. Successive reviews of the same drawings shall apply only with respect to EIL's comments on the previous submission.

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

Any drawings/documents once reviewed by EIL in Code-1 shall not be submitted again (incorporating some other changes) for EIL review. However, if some change is really necessary the same shall be brought to EIL notice separately through design change note for review/information and shall be incorporated in as built drawings.

2.7.3 Documents Required with Bid

- Pressure Vessel data sheet as per Annexure II of specification 6-12-0030.
- Storage Tank data sheet as per Annexure I of specification 6-12-0031.
- Preliminary datasheet for heat exchanger
- Deviations to enquiry documents & its attachments
- List of References
- Compliance statement

2.7.4 Fabrication drawings

Based on reviewed Mechanical Engineering Data sheets, Contractor/Vendor must prepare fabrication drawings and other documents. Fabrication drawings submitted shall only be for information and Vendor to fabricate and supply the equipment based on his responsibility of ensuring compliance to Mechanical Engineering Data sheets, Codes, EIL specifications & standards etc.

2.7.5 It is contractor's responsibility to obtain approval of calculations / drawings / documents from CIB. Copies of all IBR approved documents have to be submitted to the OWNER/CONSULTANT as and when IBR approval is received by CONTRACTOR.

3.0 SPECIFIC JOB REQUIREMENTS

3.1 Pressure Vessels and Storage Tanks

3.1.1 General

3.1.1.1 Mechanical design of pressure vessels, (i.e. design of shell, heads, supports, Anchor bolts, wt. calculation, wind and seismic analysis, RF pad etc.) shall be performed by vendor, approved for design, as per relevant code as defined in specification shall be carried out by the vendor approved for design. Type of supports shall be selected based on Equipment layout.

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3.1.1.2 Complete design (i.e. design of shell, bottom, roof, floating roof, roof structure, curb angle, spiral stairway, ladder, top & intermediate platform, RF pads, wind girders, compression area checking, counter balancing weight, anchorage requirement, gauge hatch, still well for instrument connections etc.) as per specifications / standards and codes shall be carried out by the CONTRACTOR.

3.1.1.3 Fabrication, erection of tanks, hydrotesting and other testing etc., installation of accessories at site, as per codes, specifications and standards. CONTRACTOR shall ensure that the Design of floating roof is carried out by a back up consultant with a proven track record. Prior approval for selection of such consultant shall be obtained from OWNER / CONSULTANT.

3.1.1.4 Carrying out calibration of tanks including getting approval from competent authorities. Calculations for calibration to be submitted to OWNER/CONSULTANT for prior approval shall be as per standard no. IS: 2007 and IS: 2008. All instruments and tools such as strapping tapes, pre-calibrated water meters and other accessories, as required for calibration, shall be arranged by the CONTRACTOR at his own cost.

3.1.1.5 Inside/outside painting of tanks shall be carried out based on product stored and as per specifications enclosed elsewhere in bid package.

3.1.1.6 All nozzles of pressure vessels shall be **set-in** type. Set-on type nozzles are not permitted.

3.1.2 Design

3.1.2.1 All vessels shall be designed by CONTRACTOR as per ASME Sec. VIII Div. 1 (latest edition including latest addenda) and as per IBR (latest edition) as applicable in accordance with design data enclosed with the package. All tanks shall be designed by CONTRACTOR as per API 650 (latest edition). All design calculations shall be made considering all loads for erection, operating and hydrotest condition.

3.1.2.2 Items not covered under IBR shall be designed as per ASME SEC. VIII DIV.1. (LATEST).

3.1.2.3 Manhole for IBR vessels shall be designed by contractor meeting the IBR requirements.

3.1.2.4 FLAT heads (top or Bottom) if any shall be adequately stiffened to limit the deflection to t/2, where t is the thickness of the flat head.

3.1.2.5 Wind and Seismic requirements are as follows:

I. Design of equipment including anchor chair shall be carried out considering Wind Load as per IS 875 (latest edition). A contingency factor of 1.1 shall be applied to wind pressure.

a) Drag coefficient for cylindrical vessels shall be 0.7 minimum.
b) Drag coefficient for spherical vessel shall be 0.6 minimum.
c) Basic wind speed of 50 m/s shall be considered
d) Other factors shall be as below
K1 = 1.0
K2 shall be based on Category 3 for units and 2 for offsite

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K3 = 1.0
K4 = 1.0

II. Seismic loads shall be calculated in accordance with seismic design basis enclosed with the package.

3.1.2.6 Buried vessels shall be designed for external pressure arising from soil load in addition to the design external pressure if any. It shall also be checked for buoyancy in case of pit flooding with water.

3.1.2.7 Flat Covers may be used for atmospheric vessels.

3.1.2.8 Flanged Covers (consisting of standard forged WN flanges and blind flange as per ASME B16.5/16.47) shall be used for Vessels/Columns of Diameter <= 900mm having internals.

3.1.2.9 All columns having diameter 900 mm and below shall be provided with intermediate body flanges. Numbers of intermediate flanges shall be decided based on column height and type of internals.

3.1.2.10 Vessels with diameter from 900 mm up to 1200 mm shall be provided with min. 500 NB manholes. For vessels with diameter greater than 1200 mm manhole size shall be 600 NB min. Manhole size shall be increased (if required) to facilitate easy passage of removable internals.

3.1.2.11 For storage tanks minimum number of manholes (Size 600mm) shall be as follows:

Tank Diameter	**Shell Manhole**	**Roof * Manhole**
Diameter <= 12 m	1	1

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

3.1.2.12 Vertical Vessel having safety valve size 80 NB and above and or having internals, shall be provided with pipe davit.

3.1.2.13 All vessels shall be capable of withstanding water full condition during system testing in corroded condition.

3.1.2.14 In addition, all vertical vessels, columns and horizontal vessels shall be designed so as to permit site testing of the equipment with water at the test pressure on the top of the equipment considering 33% of design wind load. The design shall be based on fully corroded condition.

3.1.2.15 All nozzle necks, all nozzle flanges and blind flanges shall be of weld deposit construction for clad equipment. Loose liners are not permitted.

3.1.2.16 No flanged connection shall be provided inside support skirt or other confined areas

3.1.2.17 All vertical equipment shall be provided with two lifting lugs. Lifting lugs shall be designed with minimum impact factor of 1.5.

3.1.2.18 Permanent sloping monkey ladder should be provided inside the skirt of the column and vertical vessels to approach the bottom head for inspection purposes.

3.1.3 Material of construction

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3.1.3.1 Material of construction of the equipment shall be as per Process Data Sheet if enclosed elsewhere in the package. However, for all material selection of vessels including non pressure part shall be strictly in accordance with Annexure-III of Spec. 6-12-0030. (It shall not be considered as "General Guideline". It is mandatory to follow this table.)

3.1.3.2 For IBR vessels all materials used shall meet the IBR requirements in addition to ASME / EIL specification.

3.1.3.3 SA 516 Gr. 60 shall be used for CS vessel/tanks under hydrogen, amine, caustic, sulphur and wet H_2S or lethal service.

3.1.3.4 Unless otherwise specified elsewhere, minimum external corrosion allowance for carbon steel buried vessel shall be of 1.5 mm.

3.2 AGITATOR (As Applicable)

Complete design, supply, inspection and testing based upon Licensor specifications and standard spec for mechanical agitators (6-26-0001) shall be carried out by contractor. Contractor to furnish filled in data sheet as per attached format for each agitator.

Mixer / agitator's with shaft length more than 1.6 meter has to be supported and clamped at different heights or shaft has to be provided with end bearing support so that there is no wobbling at the impeller end. Bidder shall also provide necessary access for maintenance of mixer / equipment.

4.0 SPARES

Refer Spare list document no. C050-IU68-80-42-SL-8010- Annexure-A.

5.0 EQUIPMENT LAYOUT

It shall be the responsibility of Contractor to co-ordinate with piping & structure with respect to piping loads, nozzle orientation etc. Contractor shall do the piping layout such that the minimum loads are transmitted to the nozzles and which shall be clearly specified. All loading imposed on nozzles shall be fully analysed to examine its acceptability within permissible code limits.

6.0 INSPECTION

Stage wise and final inspection shall be done by a reputed third-party inspection agency. Inspection must be carried out only after drawings are approved by EIL.

Ensure that all materials are properly identified and finally check tested as per Tender requirement. Inspection test plan of Contractor shall comply with all requirements specified or enclosed in bid document. It must specify various stages of inspection. Any comments by EIL/Owner shall be complied with without time & cost implication.

For Equipment's falling under PESO, Inspection & Document approval shall be carried out by PESO & the same shall be the responsibility of the Contractor.

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6.1 Specific requirements

When spot radiography is specified, the following requirements shall supplement the requirements specified in ASME Section-VIII Division-I:

i) All T joints shall be radiographed.
ii) Minimum 5% of total weld length excluding T joints shall be radiographed.

The same shall be replaced as follows in both vessels and exchanger specifications, which shall be in line with code requirements and as per the practices followed by other international licensors.

Each category A or B pressure containing weld shall be spot radiographed in accordance with ASME Section-VIII Division-I, paragraph UW-52 as a minimum requirement. Each spot radiograph shall be a minimum of six inches (150 mm) in length and minimum one spot shall be selected in each circumferential & longitudinal seam. Additionally, at least one T joint in each circumferential seam shall also be selected. Weld from each welding procedure, welder/welding operator shall be examined.

7.0 KICK-OFF MEETING

After award of contract, Contractor shall arrange a kick off meeting with the following agenda:

(i) Selection of Vendor for design and fabrication of exchangers along with details required to be furnished as per Vendor's pre-qualification Criteria.
(ii) Review & finalization of master document schedule.
(iii) Any clarification on the data sheets & specifications enclosed in bid package.
(iv) Identification of critical documents, which need to be reviewed on priority, preferably across the table.

8.0 GUARANTEE

8.1 Contractor shall have final & total responsibility for the design & supply of all equipment supplied under this specification. Contractor shall repair/replace the damaged part during guarantee period at his own cost. The Contractor shall be completely responsible for the compliance to Datasheet, specifications requirement, Code requirements, Mechanical design, detailing, fabrication, materials and workmanship of the Equipment as per the stipulations of the tender and its attachments. In this regard, it may be noted that review by Owner / Consultant shall not relieve the Contractor of his responsibility of meeting all requirements and ensuring satisfactory guarantee of the equipment.

8.2 Contractor shall agree to repair/replace any part of equipment/components free of cost and with no loss of time if:

a) Equipment designed by vendor does not meet process/ performance requirements during performance test.
b) Selected metallurgy wherever in vendor scope is not suitable for intended service.

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c) There is defect in material or workmanship and/or it does not comply with this specification's requirements.
d) It does not comply with various requirements of the bid document agreed to by vendor at the time of order.

8.3 Owner or his authorized representative's inspection or approval of vendor's drawings / documents or deviations shall in no way absolve the vendor or reduce his responsibility towards this guarantee.

8.4 The guarantee period and financial liabilities of the vendor shall be as per Owner's commercial terms and conditions.

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DESIGN RECIRCULATING COOLING WATER QUALITY AND TREATMENT SCHEME

Rev. No	Date	Purpose	Prepared by	Reviewed by	Approved by
0	11/08/2025	Revised and Issued for BDEP	JATIN	SAHIL	S. SRIDHAR
0	03/04/2025	Issued for BDEP	JATIN	SAHIL	S. SRIDHAR

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1.0	General
2.0	Cooling Water Quality
3.0	Monitoring

ABBREVIATIONS

COC	:	Cycle of Concentration
HEDP	:	Hydroxy Ethylidene Di phosphonic Acid.
SRB	:	Sulphur reducing bacteria
TSS	:	Total Suspended Solids
TDS	:	Total Dissolved solids
BZT	:	Benzotriazole
CW	:	Cooling water
SHMP	:	Sodium Hexametaphosphate

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1.0 GENERAL

This document covers the minimum guidelines to be followed for the chemical treatment of recirculating Cooling Water system. The Document outlines the quality of makeup water available, cooling water treatment scheme and control limits of re-circulating cooling water parameters at the design Cycles of Concentration (COC).

2.0 COOLING WATER QUALITY

Envisaged cooling water system is fresh water re-circulating type. The system will cater to all end users of the complex/Project.

2.1 Make up water quality

Make-up water quality for the cooling tower is as per the following table:

Parameters	Unit	Value
pH	-	7.24
Total suspended solids	mg/l	5
Turbidity	NTU	<2
Conductivity	µS/cm	346
TDS	mg/l	223
Total hardness $CaCO_3$	mg/l	146.38
Calcium as Ca	mg/l	21.5
Magnesium as Mg	mg/l	22.54
Total Alkalinity	mg/l	123
Chlorides as Cl	mg/l	28.6
Sulphates as SO_4	mg/l	12.8
Total Iron as Fe	mg/l	0.13
Total Silica	mg/l	13-18

2.2 Cycle of Concentration (COC)

Considering the quality of available make up water and efficiency of the inhibitor treatment scheme, it is recommended that the cooling water system shall be operated at 5 COC.

2.3 Design Quality and Control limits of Re-circulating Cooling Water

Parameters	Unit	Normal	Design
pH	-	7.5-7.8	7.8
Total suspended solids	mg/l	<5	10(2)
Turbidity	NTU	<5	10(2)
TDS	mg/l	1115	1120
Conductivity	µS/cm	1730	1750
Total hardness $CaCO_3$	mg/l	732	740

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Calcium as Ca	mg/l	107.5	110
Total Alkalinity (1)	mg/l	100	120
Chlorides as Cl	mg/l	143	145
Sulphates as SO_4	mg/l	559	579
Total Iron as Fe	mg/l	<0.5	0.5
Total Silica	mg/l	65-90	95
Corrosion rate	Mils/year	<3	3

(1) Total alkalinity will find its own level depending upon maintained pH. Total alkalinity as CaCO3 will be about 100-120 ppm.
(2) 10 ppm is at the outlet of cooling tower sump. SS filter shall be designed for the inlet value of 60 ppm.

2.4 Corrosion and Scale control

The purpose of chemical treatment is effective corrosion & scale inhibition in cooling water system. Treatment with chemical formulations containing corrosion, scale inhibitors and polymeric dispersant is recommended. The following general guidelines shall be followed for developing chemical formulation

a) The formulation shall be single and based on Zinc, Organo Phosphonate, SHMP and polymeric dispersant. The formulation containing Inorganic poly phosphate should have neutral pH (around 7.0). The formulation shall be blended in such a way that maintenance of 100 mg/l of the formulation in the cooling water will maintain the following level of inhibitors:

Zn	1-2 mg/l
Hydroxy Ethylidene Di phosphonic Acid (HEDP)	10- 15 mg/l
SHMP	8-10 mg/l
Polymeric dispersant	20-30 mg/l
BZT*	0.5 ppm

* In case of copper or copper alloys are present in the cooling system then 0.5ppm of BZT needs to be incorporated in to the formulation.

b) Polymeric Dispersant details
A low mol. wt. (<5000) preferably, PA-SA (Poly Acrylic Sulphonic Acid Co-polymer) or AAHAPS (Acrylic Acid hydroxy Allyloxy Propane Sulphonate) based dispersant formulation shall be dosed to maintain a level of 20-30 mg/l in cooling water. Stabilisers may be added, if required, as per cooling water treatment contractors' recommendation.

The chemical formulation shall have sufficient proven performance data both in the laboratory and in the field.

c) The pH /alkalinity of cooling water shall be controlled by the addition of Sulphuric acid. Acid Dosing system shall be provided for re-circulating water. The acid dosing rate shall be adjusted to correct the pH variation in recirculating cooling water.

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2.5 Microbiological control

a) Chlorine Dioxide shall be used as biocide. ClO2 dosing with in-situ non-hypochlorite-based generator shall be considered. Initial dosing rate of ClO2 shall be 2 mg/l based on holdup volume. Subsequent dosing rate is adjusted to maintain 0.2 to 0.4 mg/l of ClO_2 in the return header.

b) In addition to Chlorine dioxide, shock dosing of following two biocides @50 mg/l, based on hold-up shall be given alternately once in a fortnight:

- Quaternary Ammonium compound-based biocide formulation containing a minimum of 25% of active ingredients.

- Carbamate/Isothiazolene/Bisphane based biocide formulation containing a minimum of 25% of active ingredients.

During non-oxidizing biocide dosing, ClO_2 shall be stopped for 6 hrs. Thereafter ClO_2 needs to be given at maximum possible rate.

c) Microbiological control shall ensure:

- Total bacterial count $<10^5$/ml
- SRB count <100/100ml
- Minimum slime in coolers/condensers

Algae growth shall not be visible on cooling tower external structures sweated by cooling water.

2.6 Contingency due to oil ingress

To nullify the effect of oil ingress (up to 10 mg/l) in process cooling water system as and when it takes place, suitable oil dispersant @ 1ppm per 5 ppm oil based on hold up volume shall be dosed. Heavy blow-down shall be given during that period to control oil level in circulating water within tolerable limit till leaky equipment is isolated. After this, blow-down shall be brought down to normal rate. The oil dispersant may be a Non-ionic Ethylene Oxide based surfactant.

2.7 Feeding of chemicals

Chemical formulations shall be dosed continuously in the CT sump from HDPE dosing tanks by electronic metering dosing pumps. Dosing tanks shall be sized for 7 days requirement. Transfer system for transferring formulation into the dosing tank needs to be provided.

2.8 Side stream filters

To control suspended solids (TSS) within stipulated limits in the recirculating water, pressure side stream filters shall be provided to filter 1-2% of re-circulation rate. The filter shall be designed to reduce TSS from 60mg/l to 10mg/l.

3.0 MONITORING

Cooling water treatment programme should envisage a sound and balanced monitoring scheme.

3.1 Water Analysis shall be carried out for the following parameters:

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- pH shall be tested once in 4 hrs.

- TDS, Oil, Alkalinity, Ca, TH, Cl, ClO2, SiO2, Fe, Inorganic and organic phosphates shall be analysed once in a day.

- Zinc once in a week.

- Turbidity of the recirculating cooling water shall be monitored by a turbidity meter installed on the Cooling Water Supply Header.

- Bacterial count should be monitored once in every week and specific bacterial counts like SRB, Iron bacteria, sessile bacteria to be specified by the Contractor.

Detailed analysis of cooling tower make-up, and circulating water would be in Contractor's scope.

3.2 Corrosion monitoring

Coupons

Corrosion rate is measured by permanently installing standard solid plug CS test coupons in coupon testing rigs or corrosion racks. The coupon needs to be mounted on rigid holder using a method that galvanically isolates the coupon from its mounting. Coupons shall be mounted in pair. Coupons shall be strip type and suitable for middle of line mounting. Coupon holder shall be on line retractable suitable up to 1500 Psi.

LPR Probe

Corrosion rate shall also be measured with corrosion meter connected with the LPR probes. Two sets of coupon and probes shall be installed, one on hot return line and one at the outlet of any Heat Exchanger with maximum CW outlet temperature.

3.3 Special monitoring during oil ingress and other contingencies.

3.4 Joint physical inspection of coolers, condensers and portions of pipeline opened/dismantled for cleaning/replacement in any short shutdown of a unit.

3.5 Pre-treatment cum passivation of entire cooling water system shall be carried out prior to the start of regular treatment as per OWNER/PMC approved procedure. Regular treatment shall be started by the CT contractor when TSS is less than 30 mg/l and HEDP is less than 10mg/l as PO_4 after passivation.

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JOB SPECIFICATION FOR SURFACE PREPARATION AND PROTECTIVE COATING (SMMS)

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
1	24/07/2025	Issued as Job Specification	JATIN	SAHIL	S. SRIDHAR
0	14/05/2025	Issued as Job Specification	JATIN	SAHIL	S. SRIDHAR

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Abbreviations:

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

REVISION HISTORY:

1. Typing error is rectified in Table-10

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1.0 GENERAL

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

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

2.0 SCOPE

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

This specification defines the requirements for surface preparation, selection and application of primers and coatings on external surfaces of items mentioned in clause 2.2 of this specification and quality control, inspection & testing of the coating systems. The items listed in clause 2.2 and the heading of tables of paint systems are non-exhaustive. However, the CONTRACTOR is fully responsible for carrying out all the necessary painting, coating and lining job on external and internal surfaces as per the contract requirement, technical data sheets and drawings etc.

2.2 Extent of work covered in this specification

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

a. All Carbon Steel structures.

b. All Carbon Steel and Alloy steel piping, equipment, valves, fittings & stacks.

c. All Carbon Steel and Alloy steel tanks.

d. Tanks internal as per applicable datasheets, drawings & contract requirements.

e. All insulated CS, LAS, & alloy steel pipes, equipment, vessels, reactors, valves, fittings & stacks.

f. All insulated SS, DSS & SDSS pipes, equipment, vessels, reactors valves, fittings, vessels & stacks.

g. All structural steel supports, walkways, handrails, ladders, platforms etc.

h. Flare lines, external surfaces of steel chimney with or without refractory lining and internal surfaces of steel chimney without refractory lining.

i. RCC structures as per applicable drawings/relevant documents.

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2.2.2 Marking and Identification of painted items:

2.2.3 Supply and prequalification testing of all primers, paints and all other materials required for painting (other than OWNER supplied materials)

2.2.4 Application of pre-erection/fabrication and shop primer.

2.2.5 Repair work of damaged pre-erection/ fabrication and shop primer and weld joints in the field/site before and after erection.

2.2.6 Quality control, testing and inspection during all stages of work (surface preparation, application of coating and testing of applied coating).

2.2.7 Exclusions:

(a). All metallic surfaces do require painting except for following materials. These materials are not painted unless specified by the contractual provisions and the same shall be painted as per the relevant specifications:

- Un-insulated stainless steel.
- Plastic and/or plastic-coated materials.
- Galvanized Iron.
- Aluminum.
- Ni-Alloys.
- Glass.
- Ceramics.
- Machined surfaces.
- Label and names plates.

Note: Galvanized steel doesn't require painting for corrosion protection. However, if painting is mandated due to OWNERs instructions/contractual provision/ for colour coding requirement mentioned in this specification or by OWNER, then the coating system in Table 4.0 shall be followed.

3.0 REFERENCE CODES & STANDARDS

3.1 Latest editions of the following codes and standards are applicable for the work covered by this specification:

American Society for Testing and Materials (ASTM):

ASTM Volume 6.01	Paint - Tests for Chemical, Physical, and Optical Properties; Appearance
ASTM Volume 6.03	Paint -- Pigments, Polymers, Resins, Naval Stores, Cellulosic Esters, and Ink Vehicles
ASTM D6677	Standard Test Method for Evaluating Adhesion by Knife

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ASTM D5894	Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM D870	Standard Practice for Testing Water Resistance of Coatings Using Water Immersion
ASTM D2485	Standard Test Methods for Evaluating Coatings for High Temperature Service
ASTM D2247	Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D4060	Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D4752	Standard Practice for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D4940	Standard Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blast Cleaning Abrasives
ASTM D4285	Standard Test Method for Indicating Oil or Water in Compressed Air
ASTM D543	Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
ASTM C868	Standard Test Method for Chemical Resistance of Protective Linings
ASTM G42	Standard Test Method for Cathodic Disbonding of Pipeline Coatings Subjected to Elevated Temperatures
ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D1475	Standard Test Method for Density of Liquid Coatings, Inks, and Related Products
ASTM D823	Standard Practices for Producing Films of Uniform Thickness of Paint, Coatings and Related Products on Test Panel
ASTM D2369	Standard Test Method for Volatile Content of Coatings
ASTM D1640/D1640M-14	Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings
ASTM D522/D522M	Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings
ASTM D968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1044	Standard Test Method for Resistance of Transparent Plastics to Surface Abrasion
ASTM D1849	Standard Test Method for Package Stability of Paint

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ASTM D2247	Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity
ASTM D5146	Standard Guide to Testing Solvent-Borne Architectural Coatings
ASTM D4258	Standard Practice for Surface Cleaning Concrete for Coating
ASTM D4259	Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application

Steel Structures Painting Council (SSPC)

SSPC SP-1	Solvent cleaning
SSPC Painting manual Vol.1	Good Painting practices
SSPC Painting manual Vol.2	Systems & specification
SSPC VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC AB1	Mineral and Slag Abrasives
SSPC PA 2	Measurement of Dry Paint Thickness with Magnetic Gauges
SSPC-PA-9	Measurement of Dry Coating Thickness Using Ultrasonic Gages

Association for Materials Protection and Performance (AMPP)

NACE RP 0287	Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape
NACE SP 0198	Control of Corrosion under Thermal Insulation and Fireproofing Materials
NACE SP 0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

International Organization for Standardization (ISO):

ISO 12944	Corrosion Protection of steel Structures by Protective Paint System
ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles-Specifications and test methods.
ISO 8501-1/ SIS-05 59 00	Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness— Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
ISO 8502-3	Preparation of steel substrates before application of paints and related products -Tests for the assessment of surface cleanliness - Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)
ISO 8502-9	Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness—Part 9: Field method for the conductometric determination of water-soluble salts

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ISO 2808	Paints and varnishes - Determination of film thickness
ISO 2811	Paints and varnishes — Determination of density

Other Standards

IS 5	Colors for ready mix paints and enamel
NORSOK M-501	Surface preparation and protective coating

4.0 SURFACE PREPARATION

4.1 General

Adhesion of the paint film to the surface depends largely on the degree of cleanliness of the metal surface and proper surface preparation have large contribution to the success of the paint protective system. Following method shall be employed for surface preparation:

a. Abrasive blast cleaning: Applicable in all cases.
b. Mechanical or power tool cleaning: Shall be used for repair & touch up, and any other area due to practical constraints with prior permission from EIL Engineer-in charge.

4.2 Applicable Standards:

Latest editions of the following codes and standards are applicable for the surface preparation work:

TABLE-1: SURFACE PREPARATION STANDARDS

Sl. No.	GRADE OF SURFACE CLEANLINESS	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)		
		ISO 8501-1/ SIS-05 59 00	SSPC, USA	NACE, USA
1.	Solvent cleaning	-	SSPC-SP-1	-
2.	Manual or hand tool cleaning	St 2	SSPC-SP-2	-
3.	Mechanical or power tool cleaning	St 3	SSPC-SP-3	-
4.	White metal	Sa 3	SSPC-SP-5	NACE No.1
5.	Near white metal	Sa 2½	SSPC-SP-10	NACE No.2
6.	Commercial Blast	Sa 2	SSPC-SP-6	NACE No.3
7.	Brush-off Blast for SS, galvanized steel and non-ferrous metals	-	SSPC-SP-16	-
8.	Surface Preparation of Concrete	-	SSPC-SP-13	NACE No.6

4.3 Sequence of surface preparation:

4.3.1 Solvent Cleaning

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Mill scale, rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained. Unless otherwise specified, surface preparation shall be done as per provisions of relevant tables given elsewhere in this specification. Before surface preparation by blast cleaning, the surface shall be cleaned to remove all grease, oil etc. as per SSPC-SP-1.

4.3.2 Blast cleaning with abrasives

The surfaces shall be blast cleaned using one of the abrasives listed below and at an appropriate distance & angle depending on nozzle size maintaining constant velocity and pressure.

a. The quality of abrasives shall be free from contaminants and impurities and shall meet the requirements of SSPC AB1.

b. The compressed air shall be free from moisture and oil.

c. On completion of blasting operation, the blasted surface shall be clean and free from any scale or rust. Blast cleaning shall not be done outdoors in bad weather without adequate protection. If there is dew on the metal surface, it shall be cleaned. If possible, a vacuum collector shall be installed to collect and recycle the abrasives.

d. Surface roughness profile: The surface roughness profile for carbon steel and low alloy steels to be coated shall be in accordance with the written recommendations of the paint Manufacturer and shall be measured as per ASTM D4417, method B. When roughness profile is not specified by the paint Manufacturer, then surface roughness profile as specified below in this specification shall be followed.

   - The surface roughness profile shall be between 40 µm and 70 µm for coatings up to thickness 500 µm and between 70 µm and 125 µm for coating systems over 500 µm thickness. In all cases, the surface roughness shall have a sharp angular profile.

   - If stainless steel, hot dip galvanised or non-ferrous metal surfaces are to be painted then blast cleaning shall be carried out as per SSPC-SP-16, using a fine non-iron containing abrasive.

   - On galvanised surfaces, the zinc layer shall not be damaged; a smooth uniform surface roughness shall be achieved. No defects such as break through or crisping of the zinc layer shall occur. The surface roughness shall be in the range of 20 µm to 30 µm or as agreed with the paint Manufacturer.

e. Abrasives: Abrasive for use in blast cleaning steels shall be in accordance with ISO 8504-2. Steel or iron grit is commonly used as recyclable abrasives. When steel shot is used, it shall be used together with steel grit. The shot content of such a mix shall not exceed 67 %. For blasting stainless steel, non-(free) iron containing abrasive shall be used, e.g. Garnet or aluminium oxide. Abrasives used for blast cleaning shall be free from oil, grease, moisture, chloride contamination etc. and shall have crystalline silica not more than 1%.

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Test methods for abrasives shall be in accordance with the tests specified in the ISO 11125 and ISO 11127 series for metallic and non-metallic abrasives respectively. Each batch of abrasive should be tested to check that the abrasive meets the requirements as specified in the relevant ISO standard. The conductivity of non-metallic abrasives to be used for stainless steels shall be maximum 15 mS/m. For all other non-metallic abrasives, the conductivity shall not exceed 25 mS/m. OWNER/PMC shall approve the use of alternative abrasive materials. Abrasive used shall be as per following specification:

Type	Generic Name	Standard
Metallic	Iron grit	ISO 11124-2
	Steel grit	ISO 11124-3
Natural mineral	Staurolite	ISO 11126-9
	Garnet	ISO 11126-10
Synthetic material	Aluminium oxide	ISO 11126-7
	Cu Slag	ISO 11126-3

Note:

Aluminum oxide or other abrasive (free from any chloride or iron/steel contamination) shall be used for blasting stainless steel. Copper slag and sand shall not be used.

4.3.3 Mechanical or power tool cleaning

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

4.4 General Notes for surface preparation/blasting and paint application:

a. Surface shall not be coated in rain, wind or in an environment where injurious airborne elements exist.

b. Surface shall not be coated when the steel surface temperature is less than 3°C above dew point.

c. Surface shall not be coated, when the relative humidity is greater than 85%.

d. Surface shall not be coated when the temperature is below 10°C and the ambient/substrate temperature is below the paint manufacturers recommended temperature of application and curing.

e. Surface shall not be coated when surface temperature is greater than 40°C (unless a higher temperature is agreed by the paint manufacturer)

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f. The paint application shall not be done when the wind speed exceeds 20 km per hour.
g. The illuminance during coating and inspection shall be at least 500 Lux.

4.5 Use of Dehumidifier

In case of internal coating of storage tanks, dehumidifier shall be used to control humidity level below 60%. Dehumidifier should depress the dew point of air in the enclosed space, sufficient enough so as to maintain it more than 3ºC below the metal substrate temperature during entire period of blasting and coating application. During the interval time between application of primer coat and subsequent intermediate and top coats or between blast cleaning completion and start of application of primer coat, dehumidifier unit should be in continuous operation to ensure that no condensation occurs on the substrate.

The Engineer in-Charge shall have the right to disallow usage of dehumidifier if the performance is not meeting the specified requirements. Under such circumstances, the CONTRACTOR shall remove the equipment and replace the same with another equipment to provide satisfactory results without any additional cost to the OWNER.

4.6 Surface preparation of concrete:

The external surface of RCC to be painted shall be dry and clean. Any loose particle of sand, cement, aggregate etc. shall be removed and surface shall be prepared as per SSPC-SP-13.

5.0 COATING APPLICATION

5.1 Blast cleaned surface shall be coated with complete application of primer as soon as practicable but in no case later than 4 hours the same day. However, at times of unfavorable weather conditions, the Engineer-In-Charge shall have the liberty to control the time period, at his sole discretion and/or to insist on re-cleaning before primer application is taken up. In general, during unfavorable weather conditions, blasting and painting shall be avoided as far as practicable.

5.2 To the maximum extent practicable, each coat of paint shall be applied as a continuous film with uniform thickness and free of probes. Any spots or areas missed in application shall be re-coated and permitted to dry before the next coat is applied.

5.3 Each coat shall be in proper state of cure or dryness before the application of succeeding coat. Material shall be considered dry for re-coating when an additional coat can be applied without the development of any detrimental film irregularities such as lifting or loss of adhesion of the under coat. Manufacturer's instructions shall be followed for inter-coat interval.

5.4 When the successive coat of the same colour have been specified, alternate coat shall be tinted, when practical, sufficiently to produce enough contrast to indicate the complete coverage of the surface. The tinting material shall be compatible with the material underneath and shall not be detrimental to its service life and shall be recommended by the original paint manufacturer.

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5.5 Airless spray application shall be in accordance with steel structure paint manual Vol.1 & Vol.2 by SSPC, USA

5.6 Brush application of paint shall be in accordance with the following:

a. Brushes shall be of a style and quality that will enable proper application of paint.

b. Round or oval brushes are most suitable for rivets, bolts, irregular surfaces, and rough/ pitted steel. Wide flat brushes are suitable for large flat areas but they shall not have width over 5 inches.

c. Paint shall be applied into all corners.

d. Any runs or sags shall be brushed out.

e. There shall be a minimum of brush marks left in the applied paint.

f. Surfaces not accessible to brushes shall be painted by spray, daubers, or sheepskin.

5.7 Applied paint should have the desired wet film thickness specified by manufacturer. For each coat, the painter should know the WFT corresponding to the specified DFT and standardize the paint application technique to achieve the desired WFT. This has to be ensured in the qualification trial.

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

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

5.10 Drying of coated surfaces

a. No coat shall be applied until the preceding coat has dried. The material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion of undercoats. Drying time of the applied coat should not exceed maximum specified for it as a first coat. If this exceeds, the paint material has possibly deteriorated or mixing is faulty.

b. No paint shall be force dried under conditions which will cause chalking, wrinkling, blistering formation of pores, or detrimentally affect the conditions of the paint.

c. No drier shall be added to paint on the job unless specifically called for in the manufacturers' specification for the paint.

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

5.11 Spot repair of damaged primer

a. Where pre-erection/shop primer has been damaged at isolated localized spots during handling and transportation or after erection / welding, its repair shall be done as given below and as per the Table-3 of this specification.

b. Surface preparation: Quickly remove the primer from damaged area by mechanical scraping and emery paper conforming to SSPC-SP-3 to expose the white metal. Blast clean the surface, if possible. Feather the primed surface, over the intact adjacent surface surrounding the damaged area, by emery paper.

Primer shall be applied (as per the applicable design temperature and in conjunction with Table-3) wherever damage was observed on pre-erection / pre fabrication or shop primer.

c. If damaged areas are found to be extensive and spread over large areas (as required by Engineer-in charge), then entire pre-erection/pre-fabrication/shop primer shall be removed by blasting to achieve SSPC-SP-10 and entire blasted surface shall be primed again with F-8/ F-9 or F-16, as applicable, for the intended design temperature. (See note of Table-3). If the prepared surface lies adjacent to a sound coated surface, the surface preparation shall overlap the coated surface by at least 50mm. The remainder of existing coated surface shall be properly protected with shields or screens to prevent any possible damage to the coating.

5.12 Equipment:

a. All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning, all equipment, scaffolding materials, shot & grit blasting equipment, air compressors etc. required shall be suitable for the work and shall be arranged by the CONTRACTOR in sufficient quantity at the site. The manufacturers test certificates / data sheets for all the above-mentioned items shall be reviewed by Engineer-In-Charge at site before start of the work.

b. All paint spraying equipment, including mixers, shall be thoroughly cleaned before mixing of new materials. All coating materials shall be mixed and thoroughly stirred in accordance with the instructions of the paint Manufacturer. Sufficient agitation to maintain good mixing shall be applied until the product is used. If air is entrapped in the product during mixing/stirring, sufficient time should be allowed for the air bubbles to escape before application. Only thinners specified by the paint Manufacturer shall be used.

5.13 Shop coating

a. Shop coated equipment (coated with primer & finishing coat) should not be repainted unless paint is damaged. Repair of primer shall be carried out as per Table-3 of paint systems depending upon the compatibility of paint. Intermediate and final coats over repaired primer shall be as per applicable

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tables mentioned in this specification. The recommendations of paint manufacturer's datasheets including maximum overcoat interval shall be followed and recorded in the coating inspection logbook.

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

d. For package units/Items/ OEM equipment, shop primer & coating system should be as per the paint system given in this specification. However, manufacturers' standard may be followed after review by EIL but shall adhere to the minimum DFT specified in ISO-12944-5; C5 (Very high durability). For system under insulation, minimum guidelines as per NACE RP 0198 shall be followed.

In this case, guarantee of the coating system lies with package supplier/OEM. EIL's decision in this regard is final and binding on Supplier/Contractor/manufacturer.

5.14 Guidelines for Documentation / records

a. A written quality plan with procedure for qualification trials and for the actual work including test and inspection plan & procedure for approval before start of work.

b. Daily progress report with details of weather conditions, particular of applications, no. of coats, overcoating intervals, pot life and type of materials applied, anomalies, progress of work versus program.

c. Results of measurement of temperatures, relative humidity, surface profile, film thickness, holiday detection, adhesion tests with signature of appropriate authority.

d. Particulars of surface preparation and paint application during trials and during the work.

e. Details of non-compliance, rejects and repairs.

f. Type of testing equipment and calibration.

g. Code and batch numbers of paint materials used.

Note: The coating applicator must maintain a job record consisting of all the information as per 5.12.b. to 5.12.g above as well as the approved procedure of work (5.12.a. above). The job record consisting of information in accordance to 5.12.b. to 5.12.g shall be entered on daily basis and should be daily signed by Engineer-in-charge.

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6.0 PAINT MATERIALS

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

TABLE-2: PAINT MATERIALS

(Refer to general notes at the end of this table)

DESCRIPTION	P-6	P-7	P-4	F9
Technical name	Epoxy Zinc Phosphate Primer	Cold Galvanizing product	Etch Primer/Wash Primer	Inorganic zinc silicate coating
Type and composition	Two component polyamide cured epoxy resin medium, pigmented with zinc phosphate.	One pack synthetic resin-based zinc galvanizing containing min 92% of electrolytic zinc dust of 99.95% purity.	Two pack polyvinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate.	Inorganic zinc silicate Coating containing zinc content min. 80%. Shall pass MEK rub test as per ASTM D4752 with resistance rating >4
Volume solids % Minimum	49	37	9	57
DFT per coat, µ	40-50	40-50	8-10	65-75
Theoretical covering capacity in m^2/coat/ litre	9.8-12.2	3.4-4.4 m²/kg	9.0-11.2	7.6-8.8
Weight per liter in Kg/litre (min.)	1.4±0.05	2.67 kg at 15°C	1.2±0.05	2.3
Touch dry at 30°C (max.)	30 min.	10 min.	2 hrs.	0.5 hrs.
Hard dry at 30°C (max.), Hrs.	8	24	24	12 hrs.
Over-coating interval, hrs. *Note 11	Min. 8	Min. 4	Min. 4-6	Min. 12 hrs. at 20°C & 50% RH
Pot life at 30°C for two Component paints, hrs.	6 - 8	NA	NA	4-6
Adhesion (ASTM D 4541)	>7	NA	NA	>5

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Temperature resistance (min) °C (ASTM D 2485) *Note 8	80 (Method A)	50 (Method A)	NA	400 (Method B)

TABLE- 2: PAINT MATERIALS (Contd.)

DESCRIPTION	F-2	F-3	F-6A/B	F-6C
Technical name	Acrylic Polyurethane finish paint	Chlorinated rubber-based finish paint	Epoxy-High Build coating	Solvent less epoxy coating
Type and composition	Two-pack aliphatic isocynate cured acrylic finish paint (free of alkyd/polyester resins).	Single pack Plasticized chlorinated rubber based medium with chemical and weather resistant pigments.	F-6A Two-Pack Aromatic polyamine cured epoxy resin medium suitably pigmented. F-6B: polyamide cured epoxy resin medium suitably pigmented.	Two pack, cured with Amine Adduct; catalyzed epoxy resin suitably pigmented
Volume Solids % (min.)	40	36	57	98
DFT per coat, µ	30-40	30-40	100-125	300-450
Theoretical covering capacity in m^2/coat/litre	10-13.3	9-12	4.6-5.7	2-3.9
Weight per liter in Kg/litre (min.)	1.15	1.15	1.42	1.40
Touch dry at 30°C (max)	30 min.	30 min.	3 hrs.	3 hrs.
Hard dry at 30°C (max.).	8 hrs.	8 hrs.	16 hrs.	16 hrs.
Full cure at 30°C (for immersion/ high temperature service)	NA	NA	5 days	5 days
Over-coating Interval, hrs. *Note 11	Min.12.	Min. Overnight	Min. Overnight Max. 5 days	Min. 8. Max. 48
Pot life (approx.) at 30°C for two component paints, hrs.	5-8	NA	3-6	0.5
Adhesion (ASTM D 4541)	>5	>4	>7	>8

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Abrasion Resistance (ASTM D4060) For 1000 g load	<300 mg /1000 cycles/CS17 or <100 mg /1000 cycles/CS10	NA	NA	NA
Temperature resistance (min.) °C (ASTM D 2485) *Note 8	80 (Method A)	60 (Method A)	80 (Method A)	120 (Method A)

TABLE- 2: PAINT MATERIALS (Contd.)

DESCRIPTION	F-7	F-8	F-11	F-12
Technical name	High build coal tar epoxy coating.	Self-priming type surface tolerant high build epoxy coating (complete rust control Coating)	Heat resistant synthetic medium based two pack Aluminum Paint suitable up to 250°C dry temp. *Note: 10	Heat resistant silicone Aluminum Paint suitable up to 540°C dry temp.
Volume Solids % Minimum.	62	75	35	18
DFT per coat in µm	100-125	100-125	15-20	15-20
Theoretical covering capacity in m^2/coat/ litre	5-6.2	6-7.5	17.5-23.3	9-12
Weight per liter in Kg/litre (min.)	1.40	1.41	0.95	1.00
Touch dry at 30°C (maximum)	4 hrs.	3 hrs.	3 hrs.	0.5 hrs.
Hard dry at 30°C (maximum),	48 hrs.	24 hrs.	12 hrs	24 hrs.
Full cure 30^{o}C (for immersion /high Temperature service.)	5 days	5 days	NA	NA

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Over-coating interval, hrs. *Note 11	Min. 24 hrs Max.5days	Min. 10	Min. 24	Min. 24
Pot life at 30°C for two components Paints, hrs.	4-6	1.5	NA	NA
Adhesion MPa (ASTM D 4541)	>5	>5	NA	NA
Temperature resistance (min.) °C (ASTM D 2485) *Note 8	80 (Method A)	80 (Method A)	250 (Method A)	540 (Method B)

TABLE- 2: PAINT MATERIALS (Contd.)

DESCRIPTION	F-14	F-15	F-16	F-17	F-20
Technical name	Polyamine cured coal tar epoxy	Two-component Epoxy phenolic coating cured with Polyamine adduct hardener	Inert polymeric matrix coating suitable for under insulation for CS and SS.	Novolac epoxy phenolic coating cured with Polyamine adduct hardener	Glass flake reinforced vinyl ester coating.
Type & composition	Specially formulated polyamine cured coal tar epoxy suitable for application under insulation	Two pack ambient temperature curing epoxy phenolic coating system suitable for application under insulation CS/SS piping	Suitable for high temperature service and under insulation coating for CS, alloy steel and SS	Novolac epoxy phenolic coating cured with Polyamine adduct hardener	Two component glass flake filled vinyl ester lining for under immersion services up to 90 deg. C.
Volume Solids % Minimum.	67	67	50	98	98
DFT per coat in microns	100-125	75-100	100-125	300-450	500-600

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Theoretical covering capacity in m^2/coat/ litre	5.4-6.7	6.7-8.9	4-5	2.2-3.3	1.6-2
Weight per liter in Kg/litre (min.)	1.45	1.65	>1.3	1.7	>1.2
Touch dry at 30°C (max)	4 hrs.	3 hrs.	1 hrs.	2 hrs.	2 hrs.
Hard dry at 30°C (max).	24 hrs.	24 hrs.	16 hrs.	24 hrs.	4 hrs.
Full cure 30°C (for immersion / high temp service)	168 hrs (7 days)	168 hrs (7 days)	NA	168 hrs (7 days)	96 hrs (4 days)
Over-coating Interval *Note 11	Min. 6 hrs Max.5 days	Min. 36 hrs Max.21 days	Min.6 hrs Max. Not applicable	Min. 16 hrs Max.21 days	Min. 4 hrs Max.3 days
Pot life at 30°C, hrs (for two component paints)	4	4-6	\ 1	1	50 min-1 hr.
Adhesion, MPa (ASTM D 4541)	>6	>7	NA	>8	>7, Tensile strength >20N/mm2 (ASTM D 638)
Temperature resistance (min.) °C (ASTM D 2485) *Note 8	125 (Method A)	150 (Method A)	650 (Method B)	200 (Method A)	90 (Method A)

General notes for TABLE-2:

1. Covering capacity and DFT achieved per coat depends on method of application. Covering capacity specified above is theoretical. For estimation of actual quantity of paints required, include the losses during application. Minimum specified DFT should be maintained in any case.

2. All primers and finish coats should be ambient temperature curing and air drying unless otherwise specified.

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3. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. Wherever a deviation is noticed from the specification in manufacturer data sheet, more stringent one between the data sheet and the specification shall prevail e.g. if this specification recommends Sa 2 ½ and the manufacturer data sheet requires Sa3, the surface preparation shall be done as per Sa 3. However, in another case if this specification requires the surface preparation of Sa 2 ½ and the manufacturer data sheet recommends only Sa 2 as minimum, the surface preparation shall be done as per Sa 2 ½.

4. Technical data sheets for all paints shall be supplied at the time of submission of quotations.

5. Internationally recognized & acceptable testing method shall be used for lab testing wherever testing standards are not mentioned.

6. Touch dry, hard dry, pot life, full cure period, & over coating interval shall be as per manufacturer's data sheets and no testing is required. Slight variation in the values of these parameters along with weight per liter may be permissible with the discretion of engineer-in-charge in consultation with EIL-SMMS.

7. Temperature resistance tests (ASTM D2485) shall be carried out for minimum required temperature resistance indicated.

8. Wherever ASTM D 2485 method B is applicable, test results of the panels subjected to salt spray (ASTM B 117) after muffle furnace exposure shall be submitted for pre-qualification purpose.

9. F6-C shall be suitable for drinking water service and should have certification from competent authority.

10. Alkyd type paint system has potential flaking problems and therefore, F11 shall not be alkyd type.

11. Maximum overcoat interval shall be as per Paint manufacturer's datasheet.

7.0 SELECTION OF COATING SYSTEMS

The external coating system for EIL projects should be selected based on the C5 environment (very high durability) as per ISO12944-2, design temperature, involved services of the steel substrate and plant location.

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

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

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7.1 Classification based on plant location:

a) Plant located in inland area (more than 50 km from coast).

- For offsite areas and utilities: Table-5 to be followed.
- For process units, DM plant, CPP and Cooling towers, ETP, RWTP: Table-6/7 as applicable to be followed.

b) Plant located on sea coast or within 50 km from sea coast.

- For process units, DM plant, CPP, Cooling tower, ETP, RWTP, offsite & utilities etc.: Table-6/7 as applicable to be followed.

c) For external surface of above ground tanks, Table-8 to be followed for all locations (inland or coastal)

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

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

Sl. No.	Design Temp. in ºC	Surface Preparation	Coating System	Total DFT in Microns (min.)	Remarks
3.1	-45 to 80	SSPC-SP-3	1 coat of F-8 @ 125 µ DFT/coat+ 1 coat of P-6 @ 40 µ DFT/coat	165	See Note-1 below and clause 5.11
3.2	251 to 400	SSPC-SP-11	1 coat of F-9 @ 65-75 µ DFT/coat + 1 coat of F-12 @ 20 µ DFT/coat	85-95	
3.3	401 to 550	SSPC-SP-3	1 coat of F-16 @ 125 µ DFT/coat	125	

Note for Table-3:

1. The application and repair of pre-erection/pre-fabrication and shop primer given in above tables shall be done for all the items to be painted. In case the damages of primer are severe and spread over large area as per Engineer In charge discretion, entire primer shall be removed by blasting to achieve SSPC-SP-10 and surfaces shall be suitably primer coated as mentioned in Table 5.0 to Table 12.0. After the repairs of the primer, suitable intermediate and final coats shall be applied as per applicable coating systems mentioned in Table 5.0 to Table 12.0.

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TABLE-4: COATING SYSTEM FOR GALVANIZED ITEMS (Refer clause 2.2.7)

Sl. No.	Design Temp. in °C	Coating System	Total DFT in Microns (min.)	Remarks
4.1	Up to 60	Hot Dip Galvanizing with thickness as per ISO 1461, Surface preparation over galvanization as per SSPC SP 16 & ISO 12944-4; 1 coat of F-6B @ 100µ DFT/coat + 1 coat of F-2 @ 40 microns DFT/coat	140µ of finish coat (excluding the thickness of galvanizing)	Special primers like etch primer (surface preparation) may also be considered for coating on galvanized surfaces

Notes for Table-4:

1. F-6B shall be modified type and suitable for coating over galvanization. Paint suppliers' confirmation is mandatory.

2. Repair of the damaged areas of galvanized coatings due to welding during erection shall be carried out as per recommended practice ISO 1461, using cold galvanizing spray process. Organic paint systems are not acceptable for the repair.

3. After repair of damaged galvanized coating by cold galvanization (P-7), the repaired area shall be top coated with paint system as given in table-4 above (i.e. 1 coat of F-6B @ 100µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat).

4. Galvanized gratings don't require painting in general until otherwise specified elsewhere or as per the requirement of the OWNER. Galvanized items may require painting to meet the colour coding requirement of the OWNER. Contractor has to ensure the applicable colour coding prior to application of coating as per this clause.

TABLE-5: COATING SYSTEMS FOR INLAND PLANTS (OFFSITES & UTLITIES)

(For all new un-insulated above ground CS, LTCS & Alloy steel piping, equipment, structures, valves, Vessels & columns, stacks etc.)

Sl. No.	Design Temp. in °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total Final DFT in Microns (min.)	Remarks
			Intermediate Coat	Finish Coat		
5.1	-45 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat	-	-	65-75	a. No over-coating shall be done on

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5.2	-14 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat + 1 coat of P-6 @ 40 µ DFT/ coat	1 coat of F-6B @ 100 µ DFT/coat	1 coat of F-2 @ 40µ DFT/coat	245-255	F-9. b. Surface profile for F-9 shall be 30-40 µm c. F-12 shall be ambient temperature curing type
5.3	81 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/coat + 1 coats of F-12 @ 20µ DFT/coat	-	1 coats of F-12 @ 20µ DFT/coat	105-115	
5.4	401-650	SSPC-SP-10; 1 coat of F-16 @ 125 µ	-	1 coat of F-16 @ 125 µ	250-300	-

TABLE-6: COATING SYSTEMS FOR CORROSIVE AREAS (PROCESS UNITS, COOLING TOWER, DM, CPP, ETP, RWTP etc.)

(For all new un-insulated above ground CS, LTCS & Alloy steel piping, equipment, structures, valves, vessels & columns, furnace stacks etc.)

Sl. No.	Design Temp. °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total DFT in Microns (min.)	Remarks
			Intermediate coat	Finish Coat		
6.1	-45 to -15	SSPC-SP-10; 1coat of F-9 @ 65-75µ	-	-	65-75	a)No over coating on F-9 is allowed b) F-12 shall be ambient temperature curing type c) Surface profile for F-9
6.2	-14 to 80	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/ coat + 1 coat of P-6 @ 40 µ DFT/ coat	2 coats of F-6B @ 100 µ DFT/coat	1 coat of F-2 @ 40µ DFT/coat	345-355	

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6.3	81 to 400	SSPC-SP-10; 1coat of F-9 @ 65-75µ DFT/ coat + 1 coats of F-12 @ 20µ DFT/coat	-	1 coat of F-12 @ 20µ DFT/coat	105-115	shall be 30-40 µm
6.4	401-650	SSPC-SP-10; 1 coat of F-16 @ 125 µ	-	1 coat of F-16 @ 125 µ	250-300	-

NOTES for TABLE-5 & TABLE-6:

1. The list of items given in the heading of the above table is not exhaustive. There may be more items for a particular contract where these specifications are used. The CONTRACTOR is fully responsible for completing painting including prefabrication primer for all the items supplied and fabricated as per contract document and scope of work.

2. If the application of pre-erection/pre-fabrication/shop primer has already been completed, the same shall not be repeated in the field. In case the damages to the primer coat are severe and spread over large areas, the Engineer-In-Charge may decide & advise re-blasting and re-application of the primer coat. Repair of pre-fabrication/pre-erection primer, if required, shall be done as per Table-3.

3. Flare line within unit or offsite areas shall be coated as per clause 6.4 of Table-6.

4. For external surface of RCC Chimney, 2 coats of F-6 B@ 100µ DFT/coat to obtain a total DFT of 200 µ shall be applied after proper surface preparation as per guidelines in clause 4.6. Suitable PU top coat shall also be considered.

5. At the site, shop primer coated prefabricated items/structures/equipment/vessels shall be stored in the shed area and contractor shall brush off any chalking observed with emery paper, prior to application of subsequent coats.

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

Sl. No.	Design Temp. in °C	Surface Preparation	Coating system		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
7.1	For external surfaces of steel items: screens, walk way bridges, clarifier/thickener scrapping mechanism, baffles, Media filters/vessels (PSF, DMF, MMF, & ACF etc.), vertical pumps, CS/MS tanks/ vessels and structures.					
	-14 to 80	SSPS-SP-10	1 coat of F-9 @ 65-75µ DFT/coat + 1 coat of P-6 @ 40 µ DFT/ coat	2 coats of F-6B @100µ DFT/coat + 1 coat of F-2 @ 40µ DFT/coat (2x100+40= 240)	345-355	Note 1
7.2	For internal surfaces of steel items: all effluent handling units such as TPI, DAF, tube settlers, clarifiers, tanks, sludge tanks and sewage tank, wet slop oil tanks etc., scrapping mechanism in clarifier etc.					
	-14 to 80	SSPS-SP-10	1 coat of F-15 @ 75µ DFT/coat.	2 coats of F-15 @75µ DFT/coat (2x75=150)	225	-
7.3	All R.C.C./concrete surfaces exposed to effluent water / liquid such as tanks, structures, drains etc., all effluent handling units such as API, TPI, DAF, tube settlers, clarifiers, tanks, sumps, sludge sumps/tanks and sewage sumps/tank, wet slop oil sump/tanks etc.					
	-14 to 80	As per clause 4.6 of this specification	Epoxy screed lining		3000	Note 1
7.4	Internal surface of equipment like Media filters/vessels (PSF, DMF, MMF, & ACF etc.), activated carbon filters, alkaline, acids & other high corrosive service					
	Up to 90	SSPC-SP-10	1 coat of clear two component solvent free vinyl ester primer @ 100µ DFT/ Coat + 2 coats of F-20 @ 500µ DFT/ Coat		1100	Note-2

NOTES for TABLE-7:

1. Contractor shall follow manufacturer recommendations to develop epoxy screed lining procedure for EIL review and approval.

2. This coating system is applicable in conjunction with relevant PDS of the equipment.

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

Sl. No.	Design Temp. in °C	Surface Preparation	Coating system (Note-1)		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
8.1	All external surfaces of shell, wind girders, appurtenances, roof tops of all above ground tank including top side of external and internal floating roof and associated external structural works.					
8.1.1	-14 to 80	SSPC-SP-10	1coat of F-9 @ 65-75µ DFT/coat + 1coat of P-6 @ 40µ DFT/ coat	2 coats of F-6B @ 100µ DFT /coat + 1 coat of F-2 @ 40µ DFT/ coat	345-355	
8.1.2	81 to 450	SSPC-SP-10	1coat of F-9 @ 65-75µ DFT/coat	1 coat of F-16 @ 125 µ DFT / coat	190-200	
8.2	External surfaces of bottom plate (in contact with soil) for all storage tanks.					
8.2.1	-14 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75µ DFT/ coat	3 coats of F-7@ 150µ DFT/coat (3x150=450)	515-525	-
8.2.2	81 to 200	SSPC-SP-10	1 coat of F-17 primer @ 400µ DFT/ coat	1 coat of F-17 finish coat @ 400µ DFT/ coat	800-825	Note-4
8.3	For underside of the bottom plate (not in contact with soil) (in case tank is not lifted during PWHT) (Note- 2)					
8.3.1	-29 to 400	SSPC SP-10	1 coat of F-16 @ 125 µ	2 coat of F-16 @ 125 µ/coat	375	Note-3

Notes for TABLE-8:

1. All paint coating application including primer for tanks shall be carried out at field after erection and completion of entire welding.

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2. For underside of bottom plate as per clause no.8.3.1:

a) Painting shall be carried out before laying the bottom plate for tanks with non-Post Weld Heat Treatment (PWHT).

b) For tanks with PWHT, painting shall be carried out after PWHT.

c) In case tank is not lifted during PWHT then painting shall be applied before laying the bottom plate.

3. This coating system is also applicable for temperature ranges not covered in 8.2 above.

4. This coating system is also applicable for bottom plates having MOC as Stainless Steel.

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

Sl. No.	Design Temp. in oC	Surface Preparation	Coating system		Total DFT in Microns (min.)	Remarks
			Primer	Finish Coat		
9.1	All internal surfaces of hydrocarbon, slops, amine solutions, sour water and other hydrocarbon-water solutions tanks but not limited to: Underside of floating roofs, internal surface of cone roof, inside of bottom plate, internal surfaces of shell for full height, underside of floating roof, oil side surfaces of deck plates, oil side surfaces of pontoons, support structures, roof legs, drain pipes and ladders etc.					
9.1.1	-14 to 45	SSPC-SP-10	1 coat of F-9 @ 65-75 µ DFT/coat	-	65-75	-
9.1.2	46 to 90	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat	240	-
9.1.3	91 to 200	SSPC-SP-10	-	1 coat of F-17 @ 400µ DFT/coat	400	-
9.2	Potable, Raw & Fire water, De-mineralized (DM) water & Condensates etc. All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.2.1	-14 to 60	SSPC-SP-10	1 Coat of F-6A @ 100µ DFT/coat	1 coat of F-6C @ 300-350 µ DFT/ coat	400-450	-

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9.2.2	61 to150	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat (80+80=160)	240	-
9.3	Hydrochloric acid (HCl) 10 %: All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.3.1	-14 to 60	SSPC-SP-10	1 Coat of clear two component solvent free vinyl ester primer @ 100µ DFT/ Coat	2 Coats of F-20 @ 500µ DFT/ Coat	1100	-
9.4	Aggressive solvents like hexane, hexene, benzene, xylene and toluene etc.: All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.4.1	-14 to 65	SSPC-SP-10	1 coat of F-9 @ 65-75µ DFT/ coat	-	65-75	-
9.5	Ethylene glycol tanks: All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.5.1	All	SSPC-SP-10	-	3 coats of vinyl chloride co-polymer @ 75µ /Coat; (3x75=225)	225	-
9.6	Inside pontoon and inside of double deck of all floating roofs					
9.6.1	-14 to 80	SSPC-SP-3	1 coat of F-8 @ 100µ DFT/coat	1 coat of F-8 @ 100µ DFT/coat	200	-
9.6.2	81 to150	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	1 coat of F-15 intermediate coat @ 80µ DFT/coat + 1 coat of F-15 finish coat @ 80µ DFT/ coat (80+80=160)	240	-
9.6.3	151 to 200	SSPC-SP-10	-	1 coat of F-17 @ 400µ DFT/coat	400	-
9.7	Alkalis up to 50 % concentration: All internal surfaces but not limited to internal surfaces of shell for full height, bottom plate, accessories, roof and roof structures of cone and dome roof tanks etc.					
9.7.1	Up to 60°C	SSPC-SP-10	1 coat of F-15 primer @ 80µ DFT/ coat	2 Coats of F-6 A @ 100µ DFT/coat (2x100=200)	280	-

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General Note for Table-9: The list of surfaces to be painted are not exhaustive. All internal surfaces of all type of tanks including structural items shall be coated as per the above table. No CS surface shall be kept un-painted.

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

Sl. No.	Design Temp. in °C	Surface Preparation & Shop Primer	Coating system		Total DFT in Microns (min.)	Remarks
			Surface Preparation & Primer	Finish Coat		
10.1	Underground carbon steel plant piping.					
10.1.1	25 to 80	-	As per document C050-000-06-42-PLS-04	3layer polyethylene (3LPE) coating as per document C050-000-06-42- PLS-04	3.5 mm	--
10.1.2	81 to 200	-	SSPC-SP-10; 1 coat of F-17 primer @400 µ DFT/ coat	1 coat of F-17 @ 400 DFT/coat	800	-
10.2	External side of underground vessels					
10.2.1	-45 to 80	SSPC-SP -10; 1 coat of F-9 @ 65-75µ DFT/ coat + 1 coat of F-7 @ 100µ DFT/coat	-	2 coats of F-7 @ 100µ DFT/coat	365-375	-

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10.2.2	81 to 200	SSPC-SP -10	1 coat of F-17 primer @400 µ DFT/ coat	1 coat of F-17 @400µ DFT/ coat	800	-

TABLE-11: COATING SYSTEMS FOR UNDER INSULATION (ALL UNIT AREAS & OFFSITES)
(For insulated piping, equipment, storage vessels, tanks, columns etc. of CS, LTCS, Alloy steel, SS, DSS and SDSS in all environments.)

Sl. No.	Design Temp. °C	Surface Preparation & Pre-erection/Shop Primer	Coating system		Total DFT Microns (min.)	Remarks
			Primer	Finish paint		
11.1	Carbon steel, LTCS and Alloy steel Piping, Storage tanks, Vessels, Equipment etc.					
11.1.1	-45 to 125	SSPC-SP-10; 1coat of F-15 @ 75µ DFT/coat	None	2 coats of F-15 @75µ DFT/coat	225	Note 1
11.1.2	126 to 560	SSPC-SP-10; 1 coat of F-16 @ 125µ DFT/coat	None	1 coat F-16 @ 125µ DFT/coat	250	
11.2	Stainless Steel, Duplex Stainless steel, Super Duplex stainless steel & Piping, Tanks, Vessels & Equipment etc.					
11.2.1	-45 to 125	SSPC-SP-16; (15-25µ surface profile) 1 coat of F-15 @ 75 µ DFT/coat	None	2 coats of F-15 @75µ DFT/coat	225	Note 1
11.2.2	126 to 650	SSPC-SP-16; (15-25µ surface profile) 1 coat of F-16 @125µ DFT/coat	None	1 coat of F-16 @125µ DFT/coat	250	
11.3	Cyclic service of CS, LTCS, SS, DSS, SDSS & Alloy Steels (Note-1)					

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11.3.1	-45 to 150 (Note-1)	SSPC-SP-10 For CS, LTCS & Alloy steel. SSPC-SP-16 for SS; (15-25µ surface profile) 1 coat of F-15 @75 µ DFT/coat	None	2 coats of F-15 @75µ DFT/coat	225	Note-2&3
11.3.2	-180 to 650	SSPC-SP-10 for CS, LTCS & Alloy steel. SSPC-SP-16 for SS (15-25µ surface profile) 1 coat of F-16 @ 125µ DFT/coat	None	1 coat of F-16 @ 125µ DFT/coat	250	

Notes for TABLE 11

1. Coating system for any other design temperature range not covered in Sr. No. 11.1 & Sr. No. 11.2 shall be as per Sr. No. 11.3.2.

2. In case of overlapping of cyclic temperature ranges as mentioned in 11.3.1 and 11.3.2 then clause 11.3.1 shall be followed.

3. Alternatively, for this temperature range, 1 coat of F-17 @ 400 µ is also acceptable.

General notes for TABLE-11:

1. “Cyclic Service” is characterized by rapid or periodical temperature fluctuation or temperature cycles or as defined in the process datasheet.

2. The blasting abrasives for SS and alloy steels shall be aluminum oxide or garnet only.

3. The coating system applicable for any other temperature range shall be reviewed if it is encountered.

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TABLE-12: INTERNAL COATING SYSTEMS FOR WATER SIDE COMPONENTS OF CS, SS, DSS & NON-FERROUS HEAT EXCHANGERS

Sl. No.	Design Temp. in °C	Surface Preparation & Pre-erection/Shop Primer	Coating System		Total Final DFT in Microns (min.)	Remarks
			Primer	Finish paint		
12.1	Up to 80	SSPC-SP-10 for CS and SSPC-SP-16 for SS	1 coat of F-15 @ 80 µ DFT/coat	2 coats of F-15 @ 80 µ DFT/coat	240	-
12.2	81 to 200	SSPC-SP-10 for CS and SSPC-SP-16 for SS	-	2 coats of F-17@ 400µ/coat	800	-

Note for Table-12:

1. Coating systems are applicable as per requirement specified in the data sheets of the respective exchangers or equipment.

GENERAL NOTES FOR TABLE: 5 TO 12

1. For uninsulated or insulated items, scope of surface preparation, application of primers to finish coat including repair shall be as per applicable contractual documents like SOR, MR, and PR etc. The list of items is not exhaustive.

2. At the site, shop primer coated prefabricated items/structures/equipment/vessels shall be stored in the shed area and contractor shall brush off any chalking observed with emery paper, prior to application of subsequent coats.

8.0 GUIDELINES FOR STORAGE & HANDLING

8.1 All paints and painting materials shall be stored in rooms only which are to be arranged by CONTRACTOR and approved by Engineer-In-Charge for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent building. A signboard bearing the word “PAINT STORAGE- NO NAKED LIGHT-HIGHLY INFLAMMABLE” shall be clearly displayed outside. Manufacturers’ recommendation /Materials safety datasheet shall be followed for storage and handling of paint materials.

Note: This standard doesn’t address all the safety concerns if any, associated with its use. It is responsibility of the user of this specification to establish appropriate safety and health practice and determine the applicability of regulatory limitations prior to use.

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9.0 COLOUR CODE, IDENTIFICATION AND MARKING

Color Coding, Identification and marking shall be as per Annexure-I

10.0 QUALITY CONTROL, INSPECTION AND TESTING

10.1 All painting materials including primers and thinners brought to site by CONTRACTOR for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturers' test certificates. Paint formulations without certificates are not acceptable (see section 12.0 & 13.0).

10.2 The CONTRACTOR must produce test certificate from pre-qualified paint manufacturer for various tests as detailed out in section 15.0 of this document. The Engineer-In-Charge, in consultation with SMMS, shall have the right to test wet samples of paint at random for verifying quality of paint supplied. CONTRACTOR shall arrange to have such tests, as instructed, performed at his cost at any one of the NABL accredited laboratories under a TPI agency.

Samples for the test will be drawn at random in presence Engineer-In-Charge or his representations. Following tests to be carried out if called:

a. Specific Gravity
b. % solids by weight (% zinc content in case of inorganic or organic zinc primer)
c. Drying time (touch dry & full curing)
d. Adhesion test on a test panel prepared at the site (ASTM D 6677).

Test methods for above tests shall be as per relevant ASTM or ISO Standard.

10.3 The painting work shall be subject to inspection by Engineer-In-Charge at all times. In particular, following stage-wise inspection will be performed and CONTRACTOR shall offer the work for inspection and approval of every stage before proceeding with the next stage. The record of inspection shall be maintained in the registers. Stages of inspection are as follows:

a. Surface preparation
b. Primer application
c. Each coat of paint

10.3.1 Following tests are to be carried out during surface preparation:

a. Test for presence of oil/grease and contamination

The steel substrate after degreasing as per SSPC-SP-1 shall be tested as per following procedure to validate absence of oil and grease contamination:

- Visual inspection - continue degreasing until all visible signs of contamination are removed.

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- Conduct a solvent evaporation test by applying several drops or a small splash of residue-free tri-chloromethane on the suspect area especially pitting, crevice corrosion areas or depressed areas. An evaporation ring formation is indicative of oil and grease contamination. Continue degreasing and inspection till test is passed.

b. **Tests for surface finish of blasted surface** shall be done by visual inspection using SSPC-VIS1. Clear cellophane tape test as per ISO 8502-3 shall be used to confirm absence of dust on blasted surface. Checks shall be done on each component at least once per 200 m^2 of blasted surface and a minimum of 3 checks per shift.

c. **Test for presence of soluble salt** as per method ISO 8502-9. Maximum allowable salt content shall be considered 20 mg/m^2.Checks shall be done on each component at least once per 200 m^2 of blasted surface and minimum of 3 checks per shift. In case salt exceeds specified limit, the contaminated surface shall be cleaned by method as per Annexure-C of ISO 12944-4 (water cleaning). After cleaning, surface shall be retested for salt after drying.

d. **Blast Profile Measurement**: (In-Process testing during actual production before application coating). The angular profile depth measurement shall be done by profile tape as per method ASTM D 4417 method B (Profile depth gauge micrometer)/ calibrated Digital gauge meter. Spot measurement shall be carried out every 15m^2 of blasted surface. At each spot three measurements shall be taken over an area of 10 m^2 and average of measurements to be recorded and reported. If profile is less than specified range, blasting shall continue till greater specified depth profile is achieved.

e. **Tests for blasting media:** Blasting Media (For every fresh batch of media and one random test during blasting)**.** Blasting Media shall be visually inspected for absence of contamination and debris using 10 X magnification.

- Inspection for the absence of oil contamination shall be conducted using following procedure:
  - Fill a small clean 200 ml bottle half full of abrasive.
  - Fill the bottle with potable water, cap and shake the bottle.
  - Inspect water for oil film/slick. If present, the blasting media is not to be used.

- Soluble salt contamination if suspected shall be verified by method ASTM D 4940. If present, media to be replaced.

- Clean blasting equipment, especially pot and hoses, and then replace blasting media and retest.

f. **Test for Blasting Air** (Once Daily before start of blasting and once at random during Blasting). The air for blasting shall be free from moisture and oil. The compressor air shall be checked for oil and water contamination per ASTM D 4285.

In addition to above, record should include type of shop primer already applied on equipment e.g. zinc silicate or zinc rich epoxy or zinc phosphate. Any defect noticed during the various stages of

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inspection shall be rectified by the CONTRACTOR to the entire satisfaction of Engineer-In-Charge before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work, CONTRACTOR shall be responsible for rectifying any defects found during final inspection/guarantee period/defect liability period as defined in general conditions of the contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the DFT specified without any extra cost to OWNER, the extra coat should have prior approval of Engineer-in-charge.

10.4 Final inspection of finished coating shall consist of the following:

a. **Coating DFT & WFT check:** DFT measurement shall be as per ISO 2808. Type-II electronic gauge shall be used as described in ASTM D7091. DFT gauge calibration, adjustment of gauge coating thickness, frequency and number of coating thickness measurement shall be as per ASTM D7091 and SSPC-PA2. Measured DFT shall have a tolerance as per SSPC-PA-2 level-3 of the dry film thickness, specified in this specification. Once in every layer of coating application, spot checks of WFT shall be carried out during the coating application according to ISO 2808, Method No. 1A- comb gauge. This is to ensure that film thickness is being achieved as per the specification. The frequency of WFT check shall be one per 10 m^2.

b. **Adhesion testing:** Adhesion of the primer to the steel substrate and inter-coat adhesion of the subsequent coat(s) after curing for at least a week after application of the topcoat shall be examined by a knife test in accordance with ASTM D6677. For the knife test, if the rating is better than 8, the adhesion is considered acceptable. The adhesion is destructive and tested areas shall be repaired afterward using the spot repair procedure. Alternatively, the applicator may perform the adhesion test on a steel panel coated using the same surface preparation and coating application procedure as the work piece. Adhesion testing shall be carried out for each component at least once per 200 m^2 of coated surface.

c. **Holiday detection check:** Holiday testing of non-conductive coatings shall be carried out in accordance with NACE SP0188. For immersion, buried & under insulation services, 100% of coated area shall be inspected for holidays. For atmospheric exposure, 10% of coated area which must include weld seams, corners and edges to be holiday tested. Voltage at which test is to be carried out will depend upon DFT of coating being tested and shall be as per NACE SP0188. Any holiday is unacceptable and should be marked and repaired immediately.

The CONTRACTOR shall arrange for spot checking of paint materials for specific gravity, glow time (ford cup) and spreading rate.

11.0 PAINT MATERIAL GUARANTEE CERTIFICATE

The CONTRACTOR shall guarantee that the chemical and physical properties of paint materials used are in accordance with the specifications contained herein/to be provided during execution of work and shall submit necessary certificate of the paint material.

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12.0 QUALIFICATION CRITERIA OF PAINTING CONTRACTOR/SUB-CONTRACTOR

Painting CONTRACTOR who is awarded any job for EIL, Projects under this standard must have necessary equipment, machinery, tools and tackles for surface preparation, paint application and inspection. The CONTRACTOR must have qualified, trained and experienced surface preparator, paint applicator, inspector and supervisors. The CONTRACTOR supervisor, inspector, surface preparator and paint applicator must be conversant with the standards referred in this specification.

13.0 PRE-QUALIFICATION/ACCEPTANCE CRITERIA FOR PAINT COATING SYSTEM

13.1 Pre-qualification of paint coating manufacturer and their products

Paint manufacturer meeting the following requirements shall be considered by the CONTRACTOR for supply of the paint products.

a) Manufacturer should have been in continuous business of paint coating formulation and manufacturer for at least past 5 years.
b) Manufacturer should possess past experience of supplying products to hydrocarbon, petrochemical, fertilizer, chemical processing, offshore or heavy industry in the past 5 years.

c) Coating manufacturer should have supplied at least 10000 litre of an individual product to hydrocarbon, petrochemical, fertilizer, chemical processing, offshore or heavy industry.

d) The manufacturer's manufacturing procedure & QA/QC system shall meet ISO 9001 requirements and preferably should possess ISO 14000 certificate.

e) The Quality control set up should be manned by qualified paint technologists whose biodata should be sent along with quality control organization chart.

The Past Track record of the manufacturers as mentioned above shall be substantiated by providing relevant documents to EIL-SMMS for their review and acceptance. This shall include Work Orders, Purchase orders and ISO 9001 certification covering all the requirements mentioned from bullets a) to e) above.

CONTRACTOR shall procure the paint materials from the qualified manufacturer meeting above requirements and after obtaining prequalification testing approval as per requirements mentioned in clause 15.2 below.

13.2 Pre-Qualification Testing procedure:

The paint manufacturer engaged by the mechanical contractor shall carry out the tests in NABL accredited government laboratories or in suggested list of laboratories below, as a part of qualification. Paint manufacturer shall provide the paint samples to laboratory for testing of the parameters mentioned in Table-2 (typical characteristics) and Table-20 (tests on coating systems)

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of this specification. The testing laboratory will confirm the compliance of the paint material with respect to the acceptance criteria mentioned in the respective tables.

Colored photographs of coated test panels should be taken before and after the test and should be enclosed along with test report. Contractor shall furnish these test certificates along with all necessary supporting documents/information to EIL-SMMS for approval/ acceptance. The paint manufacturer will be qualified and approved by EIL-SMMS for supply of paints after review/assessment of the submissions made by the contractor. Test certificates which are more than 3 years old will not be considered. Paint manufacturers are advised to carryout pre-qualification testing accordingly for paints supply to EIL projects.

List of suggested laboratories:

1. National Test house – Kolkata
2. National Test house-Mumbai
3. HBTU- Kanpur
4. GIRDA (Gujarat Industrial Research & Development Agency)- Vadodara
5. Indian institute of chemical technology – Hyderabad
6. RITES – Kolkata
7. ICT- Mumbai

TABLE-13: PRE-QUALIFICATION TESTING

SYSTEM No.	COATING SYSTEM	REFERENCE CLAUSE (from table-3 to 12)	TOTAL DFT µ (min)
1.	F-9+P6+F6B+F2	6.2	345
2.	F9+F12+F12	6.3	105
3.	F15+F15+F15	9.1.2	240
4.	F16+F16	11.1.2	250
5.	F17	9.6.3	400
6.	F8	3.1	125
7.	F20+F20	9.3.1	1100
8.	F6A+F6C	9.2.1	500
9.	F9+F7+F7+F7	10.2.1	365
10.	F15+F6A+F6A	9.7.1	280

S. No.	TEST	FOR SYSTEM NUMBER	DURATION	ACCEPTANCE CRITERIA
1.	Cyclic Test Salt Spray : 72 hrs. Drying in air: 16 hrs. UV-A340 nm weather meter: 80 hrs. One cycle: 168 hrs.	1	4200 hrs.	Shall pass. No chalking, cracking, flaking, blistering or peeling shall be observed.

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	(25 cycles at 168 hrs. each cycle) (ASTM D5894)			
2.	Chemical Resistance Test **(**ASTM D543)			
2a.	10% & 40% NaOH	3, 5, 7, 9 & 10	1000 hrs.	Shall pass. No cracking, discoloration, blistering, peeling or softening of film shall be observed.
2b.	5% H2SO4		168 hrs.	
2c.	Xylene		4 weeks	
2d.	Acetone		4 weeks	
2e.	Ethanol		4 weeks	
2f.	Kerosene		4 weeks	
2g.	Sea water		2000 hrs.	
3.	Immersion in DM/DI water @90^0 (ASTM C868)	3, 5, 7, 9 & 10	30 days	No softening, blistering or film damage.
4.	Resistance to DM water using water immersion. (ASTM D870)	8	2000 hrs.	Shall pass. No chalking, cracking, flaking, blistering or peeling.
5.	100% Humidity Test (ASTM D2247)	1 to 10 (except system-2)	1440 hrs.	Shall pass
6.	Thermal Shock Resistance Test; 5 cycles @ 30 minutes in furnace at 120 º C and 15 minutes in water after quenching in water for each cycle. (ASTM D2485 method A)	2, 3, 4, & 10 (For system-2, testing to be done after heating the panels at 400°C for 2 hrs.)	-	Shall pass
7.	Cathodic Disbondment Test (ASTM G42 @80°C)	3, 5, 9, & 10	-	Diameter of cathodic Disbondment < 10 mm with 6 mm diameter artificial holiday.
8.	Assessment of Adhesion and artificial ageing as per ISO 19277	3, 4, 5, 9 & 10	-	Shall Pass

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Each coating product to be qualified shall be identified by the Specific gravity of base and curing agent (ISO 2811). The identification shall be carried out on the batch, which is used for the pre-qualification testing.

13.3 Information to be furnished during delivery of paint materials:

CONTRACTOR along with delivery of paint material has to furnish following information from paint manufacturer to EIL for acceptance/approval of products:

a) Batch test certificates:

Along with paint products delivery to site from the pre-qualified coating manufacturer, CONTRACTOR has to produce test certificate (from paint manufacturer) for each category of product for the following test items. All test results must mention clearly the batch no. and category of product tested. Tests to be conducted for following properties:

- Specific Gravity
- % solids by weight (% zinc content in case of inorganic or organic zinc primer) ~ ASTM D521.

b) Product information sheet/ technical data sheet for each category of product.
The contractor shall be fully responsible for the quality of the paints products as per prequalification testing. After the paint materials are supplied to site, the supplier shall organize random sampling and testing in a NABL laboratory as per discretion of the Engineer-in-charge in consultation with SMMS. Failing to meet the specified quality requirements may cause rejection of the paint products.

c) Remaining Shelf life shall be at least 50% of the total duration at the time of above application of procured material by contractor / owner. However, it is preferred to have the materials from the fresh stock for better performance of coatings.

14.0 METHOD OF SAMPLING & DISPATCH FOR LABORATORY TESTING

(Pre-Qualification tests (sec. 13.2), Batch testing (sec. 13.3) and Inspection testing (sec. 10.0))

14.1 Samples of coating materials should be submitted to the laboratory in sealed containers with batch no. and test certificate on regular format of manufacturer's testing laboratory.

14.2 All test panels should be prepared by testing laboratory. Surface preparation for a system shall be done in accordance with this specification. For individual products testing, minimum shall be Sa 2.5. Colour photographs of test panels should be taken before and after the test and should be enclosed along with test report. Sample batch no. and manufacturer's test certificate should be enclosed along with the report. Test report must contain details of observation and rusting if any, as per the testing code.

14.3 Manufacturers should intimate EIL, details of sample submitted for testing, name of testing agency, date, and contact personnel of the testing agency.

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ANNEXURE-I

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TECHNICAL DOCUMENTATION FRONT SHEET

Total Pages: **16**

NUMALIGARH REFINERY LIMITED

NRL EXPANSION PROJECT

SPECIFICATION FOR
IDENTIFICATION OF PIPING & EQUIPMENT

Rev.	Date	Reason for Issue	Prepared by	Checked by	Approved by	Prepared by	Reviewed by	Reviewed by
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			Discipline Engineer	Discipline Lead	Contractor Representative	Discipline Engineer	Project Engineer	Department Head

Numaligarh Refinery Limited

NRL		
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FOREWORD

This document covers the specifications for the identification of the facilities and off-sites piping and equipment for (i) New grass-root projects, (ii) In-house Revamping Projects, (iii) Management of changes (MOCs) and, (iv) Maintenance painting.

This document serves dual purpose (i) It specifies the basic colour-codes requirements of NRL, which all external consultants are required to adhere to, (ii) It serves as a guideline for NRL's In-house projects. Therefore, some of the details furnished hereinunder, may be or may not be relevant to the external Consultants. These details are meant for the guidance of the NRL personnel. If external consultants are in doubt about the validity and/or the applicability of a particular detail, they should consult NRL for the clarifications.

Attempts have been made to align the requirements with the Indian statutory regulations and national and international codes and standards, minimising the Owner's preferences over the established norms. The consultants and the contractors shall ensure this spirit is maintained throughout the execution of the projects.

Although, it is recognized the engineering consultants may desire to modify, delete, or amplify sections of the national and international codes and standard, it is strongly recommended such modifications, deletions, and amplifications are initiated by supplementing the relevant national and international norms rather than by rewriting the revised clauses into consultants' documents. Any modification(s) to the national and international codes and standards and to NRL specifications shall not be acceptable, unless approved by the concerned code authorities or NRL, as the case may be.

Throughout the document, if the term "NRL" is used, it represents NRL Engineer(s) and the external parties, such as the Process Licensors, Consultants in various roles, Engineering Contractors, Suppliers, Sub-suppliers, Site Contractors and the third-party Inspectors engaged by NRL to act on behalf of NRL in a context-sensitive manner.

Compliance with this Specification does not in itself confer immunity from the mandatory legal and statutory requirements. In the event of a conflict of requirements, the order of precedence shall be as follows: (a) Indian Statutory Regulations like PNGRB, OISD, CPCB, IBR, (b) Project Specifications, (c) NRL Specifications, (d) Applicable Codes and Standards, (e) Process Licensor's specific requirements. In case, the process licensor(s) requirements have a conflict with the documents higher in the hierarchy, they shall submit a list of deviations, detailing how their requirements differ and why these requirements need to be implemented.

NRL documents are drafted for viewing on a computer-screen as few diagrams may use colours to enhance clarity and viewing experience. If printed on a black-and-white printer, few diagrams may not reflect correctly.

NRL engineers will continue to enrich this document based on their in-house experience and the feed-back received from the consultants and contractors. Feedback, comments or suggestions derived from the application of this document at any stage of the project design, purchase, construction, field installation, commissioning, operation and maintenance are welcome and should be directed to NRL.

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1.0 SCOPE

This specification covers the requirement of colour scheme for the identification of the contents of the pipelines carrying fluids, storage tanks and equipment in refineries and petrochemical installations. The following colour coding system has been made based on international standards like ASME/ ANSI, and Indian Standard.

The colour-strips shown under "Approx. Appearance" column are indicative only and picked up from https://www.ralcolor.com/ using an un-calibrated monitor. All colours, paints and stickers colours shall confirm to specified RAL numbers.

2.0 REFERENCE DOCUMENTS

Several codes are listed below as reference documents only. The colour-schemes as described in this document shall only be followed in order to maintain the uniformity with the NRL's existing refinery. The referred codes cover the overall subject and are a useful reading. If in doubt about the applicability, please refer to NRL for a resolution.

IS 2379 : Pipelines Identification Colour Code,

ASME A13.1: Scheme for the Identification of Piping Systems,

BS 1710 : Specification for identification of pipelines Services

ANSI/NEMA Z535 : Safety Colours

OSHA : A Guide to OSHA Safety Signs

NFPA 99 : Health Care Facilities Code

TP-1ZZZA-PI-SPE-0003, Job Specification for Painting.

3.0 COLOUR IDENTIFICATION

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

b) Secondary colours: The narrow bands presenting the secondary colour which identifies the specific service, may be applied by painting or preferably by use of adhesive plastic tapes of the specific colour.

c) The colour bars shown in the paragraph 6 and 7 are indicative only. The appearance will depend on the colour calibration of the monitors. RAL numbers are to be taken as true reference.

4.0 LABELING MATERIAL OPTIONS

It is recommended to use colour-band tapes made of synthetic materials in lieu of traditional painting. This is an economic and long-lasting option. Synthetic tapes are also easier to apply around the pipes in congested areas, which are difficult to access all around the circumference (360°).

The following options shall be considered:

4.1 Standard Vinyl Label – The majority of pipe labels will be made on standard vinyl label stock. This stock is very durable, available in a variety of colors, and can have any text or symbols easily printed onto them.

4.2 High Performance Vinyl – Outdoor pipes, or pipes that are exposed to harsh conditions will use high-performance vinyl labels. These labels are thicker, have stronger adhesive, and have long life, lasting more than 10 years.

4.3 Reflective Vinyl – Specially made vinyl labels that are reflective shall be used in low-light facilities, such as off-sites. The vinyl itself is the same as standard label stock so it is durable and long-lasting.

4.4 Brushed Metal Label – Brushed metal labels are very durable, can come in aluminum or gold colors, and are desirable for many industrial-grade applications.

4.5 Magnetic Label – Magnetic labels aren't commonly used for pipe markings, but they can be in some situations. These labels are magnetic and can be used on the items requiring temporary markings.

4.6 Low Halide Label – Halogens such as fluorine, chlorine, bromine, and iodine are commonly found in label adhesives. These can be corrosive to stainless steel. Choosing the low-halide stock is often necessary when applied to stainless steel pipes.

4.7 Heat Shrink Label - One option is to use heat shrink labels. These labels are printed-off with the desired data, wrapped around the pipes themselves, and then heated up using warm-air gun. As the labels are heated, it shrinks down and fit snugly around the pipe. Heat shrink labels are good for places where it is difficult to get normal labels to stick securely to the pipe. Rather than using adhesive to get the label to stay, it is kept in place by getting the label to become tight around the pipe.

4.8 All uninsulated pipes having temperatures above 100ºC shall be identified using Teflon Tape.

5.0 PIPE MARKING TAGS

While not technically a label, pipe marking tags are a good alternative in certain situations. The tags usually have a piece of string with a paper, plastic, or vinyl tag hanging off of it. The string can be tied securely onto the pipe with the tag hanging down. One downside about this option is that the tags are harder to read and usually will not contain as much information. These shall be used right at the end of a pipe, where the contents come out so that the plant operators and the technicians accessing the pipe get a quick confirmation of what is in the pipe.

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6.0 COLOUR CODING FOR PIPING (UN-INSULATED)

Sr.	Service	Ground Colour	RAL No.	Approx. Appearance	1st Band	RAL No.	Approx. Appearance	2nd Band	RAL No.	Approx. Appearance
1	Drinking Water	Sea Green	6028		French Blue	5024		Signal Red	3001	
2	DM Water	Sea Green	6028		Orange Pure	2004		---	---	---
3	Cooling Water	Sea Green	6028		French Blue	5024		---	---	---
4	Boiler Feed Water	Sea Green	6028		Gulf Red	3003		---	---	---
5	Fire Water	Flame Red	3000		--	---	---	---	---	---
6	Raw Water/ CRWS	Sea Green	6028		Jet Black	9005		---	---	---
7	Industrial Water	Sea Green	6028		Signal Red	3001		---	---	---
8	Treated Water/PW	Sea Green	6028		Oxide Red	3009		---	---	---
9	Service Water	Sea Green	6028		Signal Red	3001		---	---	---
10	Tempered Water	Sea Green	6028		Grass Green	6010		---	---	---
11	DM Water	Sea Green	6028		White Aluminium	9006		---	---	---
12	DM Water> 150°C	Sea Green	6028		Jet Black	9005		---	---	---
13	Sour Water	Sea Green	6028		Pearl white	1013		---	---	---
14	Stripped Water	Sea Green	6028		Cobalt Blue	5013		---	---	---
15	ETP Treated Water	Sea Green	6028		Sky Blue	5015		---	---	---
16	Steam Condensate	Grey Aluminum	9007		Light Brown	1011		---	---	---
17	HP Steam	Grey Aluminium	9007		Signal Red	3001		---	---	---
18	MP Steam	Grey Aluminium	9007		French Blue	5024		---	---	---
19	LP Steam	Grey Aluminum	9007		Canary Yellow	1016		---	---	---
20	Plant Air	Sky Blue	5015		French Blue	5024		---	---	---

Sr.	Service	Ground Colour	RAL No.	Approx. Appearance	1st Band	RAL No.	Approx. Appearance	2nd Band	RAL No.	Approx. Appearance
21	Instrument Air	Sky Blue	5015		Gulf Red	3003		---	---	---
22	Hydrogen	Canary Yellow	1016		Signal Red	3001		French Blue	5024	
23	Nitrogen/LN/Inert Gas	Canary Yellow	1016		Signal Black	9004		---	---	---
24	Flare Gas/OHD/ OFG/ PV/ PE	White Aluminium	9006		Signal Red	3001		---	---	---
25	ATF	White Aluminium	9006		Signal Black	9004		---	---	---
26	SKO/KO	White Aluminium	9006		Golden Yellow	1004		---	---	---
27	HSD	White Aluminium	9006		French Blue	5024		---	---	---
28	Naphtha/MS	White Aluminium	9006		Dark Brown	8002		---	---	---
29	Reformer Naphtha/ ISO	White Aluminium	9006		Dark Brown	8002		French Blue	5024	
30	VGO	White Aluminium	9006		Golden Yellow	1004		Signal Red	3001	
31	Liquid LPG	White Aluminium	9006		Signal Red	3001		Pure Green	6037	
32	Vapour LPG	White Aluminium	9006		Signal Red	3001		Signal Black	9004	
33	Crude Oil	White Aluminium	9006		Signal Black	9004		French Blue	5024	
34	RCO/CD/RF	White Aluminium	9006		Signal Black	9004		Clay Brown	8003	
35	Fuel Gas/Sweet Gas/NG	Canary yellow	1016		Silver Grey	7001		---	---	---
36	Sour Gas/Acid Gas/VOC	Canary yellow	1016		Graphite Grey	7024		Signal Violet	4008	
37	Amine/ABD/CS	Admiral Grey	7012		Signal Red	3001		Light Brown	1011	
38	Acid	Signal Violet	4008		Canary Yellow	1016		---	---	---
39	Other Chemicals/ Catalyst	Signal White	9003		Signal Violet	4008		Signal Red	3001	
40	Caustic	Signal White	9003		Signal Violet	4008		---	---	---

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Sr.	Service	Ground Colour	RAL No.	Approx. Appearance	1st Band	RAL No.	Approx. Appearance	2nd Band	RAL No.	Approx. Appearance
41	Phosphate	Signal Violet	4008		Red Orange	2001		Signal White	9003	
42	Vacuum Residue	White Aluminium	9006		Signal Black	9004		---	---	---
43	Fuel Oil	White Aluminium	9006		---	---	---	---	---	---
44	Gas Oil/LCO/ UCO/ CLO/ HCO	White Aluminium	9006		---	---	---	---	---	---
45	Flushing Oil/HO	White Aluminium	9006		---	---	---	---	---	---
46	Slop/CBD/OWS	White Aluminium	9006		---	---	---	---	---	---
47	Service Air/Process Air	Sky Blue	5015		---	---	---	---	---	---
48	Instrument Air	Sky Blue	5015		---	---	---	---	---	---
49	Freon	Yellow Green	6018		---	---	---	---	---	---
50	Chlorine	White Aluminum	9006		---	---	---	---	---	---
51	Hydrogen Sulphide (H_2S)	Canary Yellow	1016		Silver Grey	7001		Signal Violet	4008	
52	Sulphur Dioxide (SO_2)/SUL	Lemon Yellow	1012		---	---	---	---	---	---
53	Drains & Vents	Main Line Colour	---	---	---	---	---	---	---	---
54	Lube Oil	Light brown	1011		Light grey	7035		---	---	---
55	Methanol/ Ethanol	Admiral Grey	7012		Deep buff	8001		---	---	---
56	Propylene/ Polypropylene	Admiral Grey	7012		Brilliant green	120 70 75		---	---	---
57	Ethylene	Canary yellow	1016		Dark violet	4001		Signal red	3001	
58	Raw sewage	Dark Brown	8002		---	---	---	---	---	---

Note: 1. Red texts have been added/modified.

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7.0 COLOUR CODING FOR PIPING (INSULATED)

Sr.	Service	Recommended Colour	Ground RAL #	Approx. Appearance	Band RAL #	Approx. Appearance
1	IFO Supply	Jet Black ground colour with 1 Traffic Yellow band in centre	9005		1023	
2	IFO Return	Jet Black ground colour with 1 Grass green band in centre	9005		6010	
3	HPS	Jet Black ground colour with 1 Signal Red band in centre	9005		3001	
4	Bitumen	Jet Black ground colour with 2 Signal Red bands in centre	9005		3001	
5	CLO	Jet Black ground colour with 1 copper brown band in centre	9005		8004	
6	VB Tar	Jet Black ground colour with 2 Copper brown bands in centre	9005		8004	
7	Bitumen & VBU Feed	Jet Black ground colour with 1 Cobalt blue band in centre	9005		5013	
8	VR BH	Jet Black ground colour with 2 Cobalt blue bands in centre	9005		5013	
9	Vacuum Slop	Jet Black ground colour with 1 pure white band in centre	9005		9010	
10	Slop	Black ground colour with 1 deep orange band in centre	9005		2011	
11	Crude - Sweet	Basalt Grey ground colour with 1 signal red band in centre	7012		3001	
12	Crude - Sour	Basalt Grey ground colour with 1 deep orange band in centre	7012		2011	
13	VGO / HCU	Oxide red ground colour with 2 iron grey bands in centre	3009		7011	
14	OHCU Bottom/ FCCU Feed	Oxide red ground colour with 2 iron grey bands in centre	3009		7011	
15						
16						
17						
18						
19						
20						

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8.0 COLOUR CODING FOR EQUIPMENT AND STRUCTURES (UN-INSULATED)

Sr.	Service	Recommended Colour	RAL No.	Approx. Appearance
1	Heater Structure	Iron Grey	7011	
2	Heater Casing	Heat-Resistant White Aluminium	9006	
3	Vessels & Columns	Heat-Resistant White Aluminium	9006	
4	Hydrogen Bullets	Antique Pink	3014	
5	LPG Vessels	Oxide Red	3009	
6	Sulphur Dioxide (SO_2) Vessels	Lemon Yellow	1012	
7	Heat Exchangers	Heat-Resistant White Aluminium	9006	
8	Furnace Oil & Hot Tanks	Jet Black	9005	
9	All other Tanks	Heat-Resistant White Aluminium	9006	
10	Caustic / Amine / Acid Tanks	Golden Yellow	1004	
11	Sour Water	Sky Blue	5015	
12	Outer Surfaces in Boiler House	Heat-Resistant White Aluminium	9006	
13	Compressors & Blowers	Basalt Grey	7012	
14	Pumps	Pigeon Blue	5014	
15	Turbines and Generators	Pebble Grey	7032	
16	All Electrical Equipment including Motors (Indoors & Outdoors)	Light Grey	7035	
17	Hand Railings, support post & Toe guard.	Canary Yellow	1016	
18	Staircase, Ladders & Walkways	Jet Black	9005	
19	Lifting Equipment & Accessories	Clay Brown	8003	
20	General Structure	Smoke grey (BS381C-692)	-----	

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9.0 COLOUR CODING FOR PIPES & FITTINGS ALLOY STEELS & STAINLESS STEELS - MATERIAL IN STORES

Sr.	Service	Recommended Colour	RAL No.	Approx. Appearance
1	IBR Pipes	Signal Red	3001	
2	1¼Cr - ½Mo (Gr. 1.9 Materials)*	Traffic Yellow	1023	
3	2¼Cr - 1Mo (Gr. 1.10 Materials)*	Luminous Yellow	1026	
4	5Cr - ½Mo (Gr. 1.17 Materials)*	Light Blue	5012	
5	9Cr - 1Mo (Gr. 1.14 Materials)*	Pale Green	6021	
6	SS 304 (Gr. 2.1 Materials)*	Grey Blue	5008	
7	SS 316/316L (Gr. 2.2 Materials)*	Blue Lilac	4005	
8	SS 304L (Gr. 2.3 Materials)*	Distant Blue	5023	
9	SS 321 (Gr. 2.4 Materials)*	Pigeon Blue	5014	
10	SS 347/347H (Gr. 2.5 Materials)*	Ocean Blue	5020	
11	Monel 400 (Gr. 3.4 Materials)*	Water Blue	5021	
12	Inconel 625 (Gr. 3.8 Materials)*	Pastel Blue	5024	
13				
14				
15				
16				
17				
18				
19				
20				

* Represents material group of ASME B16.5 Table 1A, “List of Material Specifications”.

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10.0 COLOUR CODING FOR HAZARDS & SAFETY

Sr.	Service	Recommended Colour	RAL No.	Approx. Appearance
1	Dangerous Obstructions	Jet Black/ Carmine Red	9005 & 3002	
2	Exposed Parts of Machinery	Carmine Red	3002	
3	Fire Water Foam & Extinguishers	Carmine Red	3002	
4	Hazard Marking	Luminous Yellow/ Jet Black	5012 / 9005	
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

11.0 COLOUR CODING DETAILS

11.1 Ground Colour.

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

11.2 Colour Bands:

Location of colour bands: At Battery Limits
Intersection points & change of direction points in piping
Midway of piping section, near valves, across culverts
At 50 M interval on long stretch pipes
At the starting and termination points

Minimum width:

DN (NPS)	Width	Remark
80 mm (3") and below	75 mm	For insulated pipes, DN indicates Insulation Outer Diameter.
Above 80 mm (3") to 150 mm (6")	DN x 25 mm	
Above 150 mm (6") to 300 mm (12")	DN x 18 mm	
Above 300 mm (12")	DN x 15 mm	

Sequence :

Colour bands shall be arranged in sequence showing Table above and the sequence follows the direction of flow. The width of the 1st band to 2nd band is 4:1.

Note : Wherever deemed required by Process Department of Safety, pipes handling hazardous substances will be given hazard marking of 30 mm wide diagonal stripes of Signal Black and Golden Yellow per IS: 23710.

11.3 Identification Markings on Equipment / Piping

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

Operations Group shall specify location:

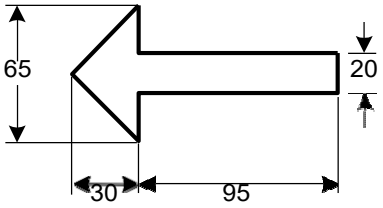
Sizes shall be:

a. Columns, Vessels, Heaters 150 mm
b. Pumps and other M/c 50 mm
c. Piping Outer Diameter / 2 with Maximum 100 mm
d. Storage Tanks Per Drawings

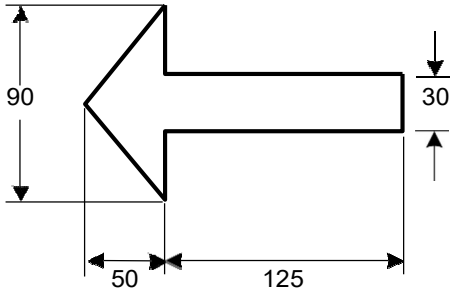
11.4 Identification of Direction of Flow

In addition, the contents of the pipe, the direction of flow may be further indicated by arrows and legend. If a hazard is involved it must be identified clearly by hazard marking legend # 37.

a. Where fluids predominately flow in a single direction, a "single direction of flow arrow" shall be used. Where fluids are able to flow in either direction (e.g., in a ring-main), a double headed arrow shall be used.
b. The direction of flow of the fluid shall be indicated by an arrow or arrows situated in the banding or immediately adjacent to it. The arrow shall be coloured white or black in order to contrast clearly with the basic identification colour or the background of the pipe or its covering.



For Pipes DN 200 (NPS 8") & below



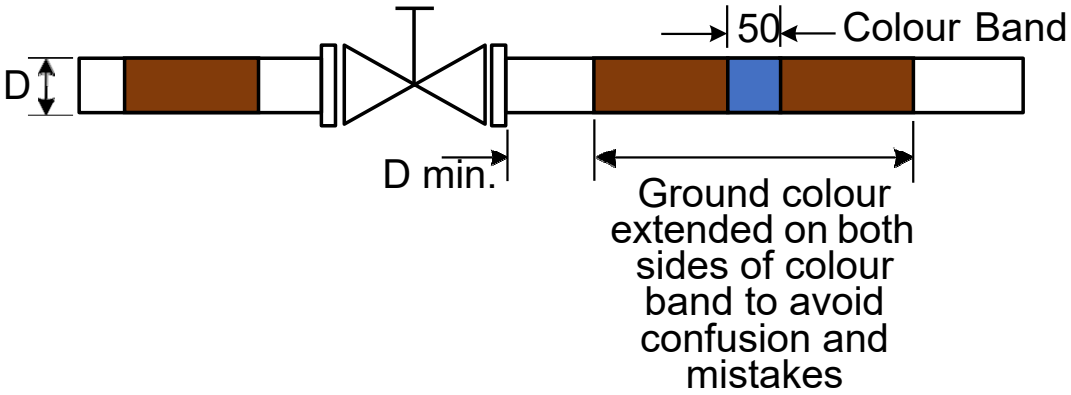
For Pipes DN 250 (NPS 10") & above

11.5 Colour Band

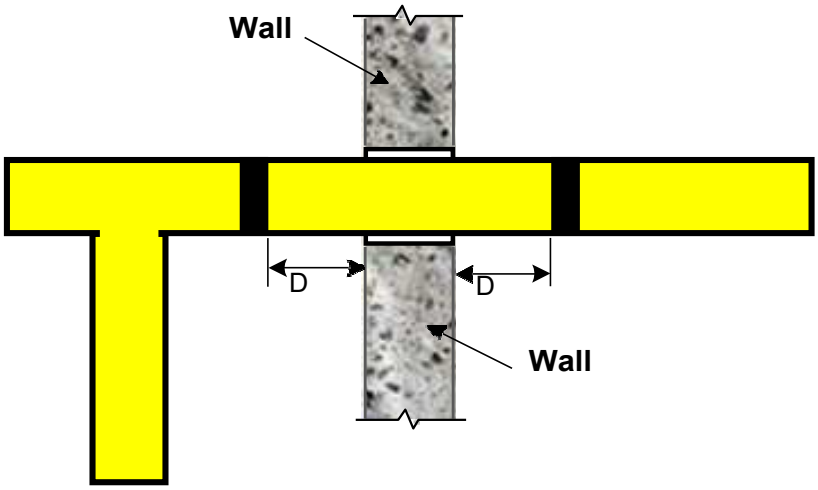
Colour Band: The location and size of bands, as recommended, when used, shall be applied to

i. Pipes

ii. On both sides of the valves, strainers, quills, sampling connections, tees, elbows, corrosion coupons and access fittings.



iii. Where the pipe enters and emerges from walls and where it emerges from road & walkway overpasses, unit battery limits.



iv. At uniform intervals along long sections of the pipe.

v. Adjacent to tanks, vessels, pumps, compressors, heat exchangers and any other equipment.

11.6 Miscellaneous Details

A. For piping, writing of name of service and direction of flow for all the lines shall be done as follows

i. The letters will be in black on pipes painted with light shade colours and white on pipes painted with dark shade colours to give good contrast.

ii. Only writing of service name shall be done on stainless steel lines.

iii. Precautions should be taken while painting on Stainless-Steel by using low chloride content painting to avoid any damage to the stainless-steel pipes. It is preferable to use adhesive plastic tapes to protect stainless steel pipes.

B. Colour band specification:

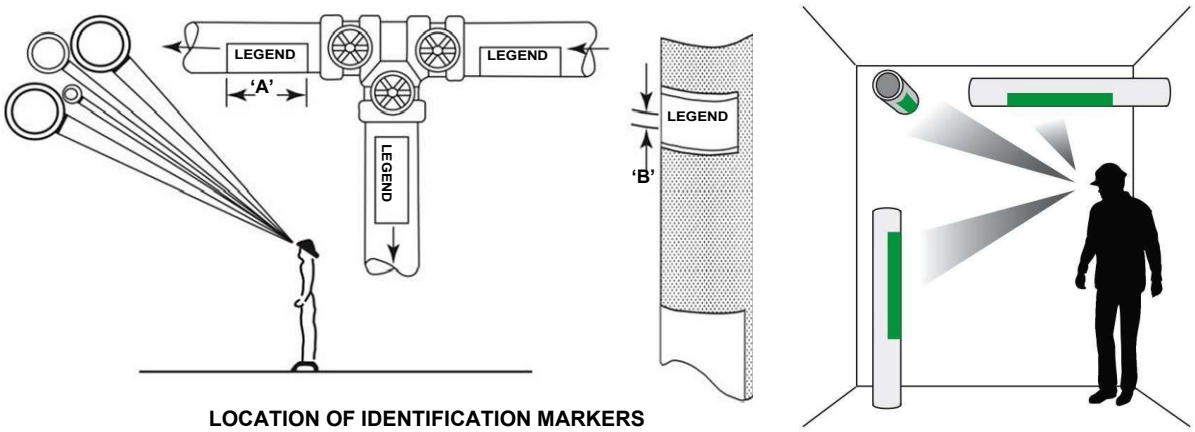
i. Unit Area: Bands at intervals of 6.0 meters.

ii. Offsite Area: Bands at intervals of 10.0 meters.

iii. Each pipe segment will have minimum one band indication, irrespective of length.

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

v. The color coding and bands shall be included in the piping at the locations such that the operator is able to see the colour coding. For example, for pipes in the pipe rack the banding and coding shall be located between 3 O Clock and 6 O clock position so that the operator is able to see the marking



LOCATION OF IDENTIFICATION MARKERS

vi. For alloy steel/ stainless steel pipes and fittings in stores/ fabrication yard, colour band the complete length of pipe, bends/ tees, side-curved surface (on thickness) of flanges as well as valves as per the metallurgy.

vii. The specification for application of the complete Piping identification colour code, including base and bands colours, are presented in the enclosed tables 2 &3

viii. The colour embedded in the table 3 is only indicative (for sake of Convenience) and not to be used for acceptance or rejection of colour.

ix. Sequence: Colour bands shall be arranged in sequence shown in Tables 2 & 3 and the sequence follows the direction of flow.

x. Wherever deemed required by Process Department or Safety, pipes handling hazardous substances will be given hazard marking of 30 mm wide diagonal stripes of Black and Golden Yellow as per IS: 23710.

****

Clause no-12 deleted.

JOB SPECIFICATION FOR EXTERNAL COATING OF BURIED PIPING, VALVES, FLANGES AND FITTINGS

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
0	01-09-2025	ISSUED FOR JOB SPECIFICATION	JATIN	SAHIL	SRIDHAR

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ABBREVIATIONS:

API: American Petroleum Institute
DIN: Deutsches Institut für Normung
3LPE: 3 Layer Polyethylene
FJC: Field Joint Coating
HSS: Heat Shrinkable Sleeves

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1.0 SCOPE

This specification specifies the minimum technical requirements for pipes externally coated with extruded / sintered 3-layer polyethylene (3LPE) in shop or field and the fittings / flanges / valves / strainer body externally coated with liquid epoxy in the shop or field. These externally coated pipes and fittings are intended for the usage in the buried conditions. The list of items to be coated given in this specification is not exhaustive. This specification is applicable for all items which are in buried condition.

This specification does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this specification to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.0 REFERENCES

BS EN ISO 21809-1: External coatings for buried or submerged pipelines –Polyolefin coatings
DIN 30670: Polyethylene coatings on steel pipes and fittings – Requirements and testing
DIN EN 10289: Steel tubes and fittings for onshore and offshore pipelines
BS EN ISO 21809-3: External coatings for buried or submerged pipelines -Field joint coatings

3.0 MATERIALS

3.1 Coating materials shall be suitable for the service conditions and the pipe sizes involved in the project. The 3LPE coating system for pipes shall comprise of a powder epoxy primer, polymeric adhesive and a medium or high-density polyethylene top coat. The coating materials i.e. epoxy powder; adhesive and polyethylene compound shall have proven compatibility. The compatibility of all the three components shall be ensured by manufacturer / applicator.

3.2 Fittings shall be coated with liquid applied epoxy coating material

3.3 Buried field joints of 3LPE pipe shall be coated with heat shrinkable sleeves / Cold applied tapes defined as per clause 4.3 of this specification.

4.0 FUNCTIONAL REQUIREMENTS AND PROPERTIES OF COATING

4.1 3LPE coated pipes

4.1.1 General requirements

The 3LPE coating shall preferably be applied by side extrusion method as per BS EN ISO 21809-1 for piping which are having a design temperature up to 80°C. However, for design temperature up to 70°C, 3LPE coating by sintering method is also acceptable and shall conform to DIN 30670 (Type S) and table-1 of this specification. Total thickness of the coating shall conform to thickness class ‘n’ as per table-3 of DIN 30670.

Cut back provision for pipes and fittings shall be as follows:

For pipes smaller than DN 600 the length of the cutback shall be no greater than 150 mm, for larger pipes the cutback shall be (150 ± 20) mm. For three-layer coatings, the epoxy resin and adhesive layers at the pipe ends shall be removed to at least 80 mm

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from the welding bevel. A not less than 20 mm strip of epoxy resin or epoxy resin and adhesive should extend from the cutback of the polyethylene coating. For coating thicknesses up to 2.2 mm the bevel angle shall be no greater than 45°, for greater coating thicknesses the bevel angle shall be no greater than 30°.

Table-1: Properties of 3 LPE Coatings

PROPERTY	REQUIREMENT	TESTING AS PER DIN 30670	NOTES
Cathodic disbondment (CD test)	23 °C/28 d or 60 °C/2 d max. 7 mm	Annex C	-
Peel strength	70 N/cm (23 °C) 30 N/cm (70 °C)	Annex D	For system testing single values shall beno more than 25 % lower than the required average value.
Continuity (holiday detection)	No discharges	Annex E	25 kV test
Elongation at break(23 °C ± 2 °C)	min. 300 %	Annex F	-
Impact resistance(23 °C ± 2 °C)	≥ 7 J/mm	Annex H	25 kV test No discharges
Low temperature impact resistance	≥ 7 J/mm (−40 °C ± 2 °C)	Annex H	25 kV test No discharges
Indentation resistance	max. 0,2 mm (23 °C) max. 0,4 mm (70 °C)	Annex I	-
Specific electrical coating resistance (23 °C ± 2 °C)	≥ 10^8 Ωm²	Annex J	-
UV resistance	⊿MFR ± 35 %	Annex K	-
Thermal ageing resistance	⊿MFR ± 35 %	Annex L	-

4.2 Epoxy coated fittings, flanges and valves

Fittings shall be coated with liquid epoxy conforming to DIN EN 10289 (Class C and type 3) and table-2 of this specification. Thickness of the coating shall be minimum 1500 microns. Wherever epoxy coated fittings are to be welded with 3LPE coated pipes or fittings, it is the responsibility of the supplier/coating applicator to ensure a proper cut

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back in such a way that the coating is not damaged during welding. Specific written approval of EIL to be obtained in case there is difficulty in complying with this requirement, supplier to submit justification for the same. The joints between two epoxy coated fittings shall be coated with liquid epoxy as per DIN EN 10289, Class C and type 3.

Table-2: Properties of Liquid Epoxy Coatings

PROPERTIES	REQUIREMENTS		TESTING AS PER DIN EN 10289
Hardness Shore "D"	Specified by the manufacturer		Clause 7.3
Appearance and continuity	Uniform colour, smooth appearance and free from defects		Clause 7.4
Cut back	(150 ± 20) mm		Clause 7.5
Holiday detection	Free from holiday		Clause 7.6
Impact resistance	(23 ± 2) °C	(- 5 ± 3) °C	Clause 7.7
	5 J X k X mm (mm of coating thickness)	3 J X k X mm (mm of coating thickness)	
Adhesion test Resistance to removal	(23 ± 2) °C	maximum service temperature ± 2 °C	Clause 7.8
	min. rating 2	Results for information	
Cathodic disbondment	Average	Maximum	Clause 7.10
	<=6 mm	<= 8 mm	
Specific electrical insulation resistance	Minimum Rs after set number of days at constant temperature		Clause 7.11
Indentation resistance	(23 ± 2) °C	maximum service temperature ± 2 °C	Clause 7.13
	max 0.2 mm	<=30 % of initial measured thickness	

4.3 Field joint coating

The joint between 3LPE coated pipe and epoxy coated fitting shall be protected by heat shrinkable sleeves / cold applied tapes conforming to codes 14-B / 19-E respectively as per BS EN ISO 21809-3.The FJC shall meet the requirements as mentioned in table-3 & 4 of this specification.

Note: Liquid epoxy coating conforming to DIN EN 10289, Class C and type 3 can also be applied as field joint coating where there is practical difficulty in applying HSS / Cold applied tapes subject to approval by the OWNER / PMC. A certificate for compatibility of liquid epoxy with 3LPE coated pipes shall be obtained from liquid epoxy coating manufacturer and submitted to OWNER / PMC for approval. Epoxy coating shall comply to the Table-2 of this specification.

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Table-3: Properties of Heat Shrinkable sleeves

PROPERTY	TEST TEMP.	UNIT	REQUIREMENTS	TEST METHOD AS PER BS EN ISO 21809-3
Thickness – Sleeve Layers	-	-	>= specified min. value	Annex B
Holiday detection at 5 kV/ mm + 5 kV	-	-	No holiday	Annex C
Impact resistance (holiday detection at 5 kV/mm + 5 kV)	23 °C	J/mm	≥7	Annex D
Indentation resistance: Pressure	T_{max}	N/mm2	10,0	Annex E
Residual thickness		mm	≥0,6	
Amount of penetration		mm	—	
Cathodic disbondment at 28 days	23 °C	mm	≤5,0	Annex G
	T_{max} limited to 95 °C	mm	≤10	
Peel strength at 10 mm/min to pipe surface and to poly- olefin plant coating	23 °C	N/mm	≥5,0	H.1
	T_{max}	N/mm	≥0,30	
Peel strength at 10 mm/min to pipe surface and to poly- olefin plant coating after 100- day hot-water immersion test at T max limited as per Annex I	23 °C	P100/P0	≥0,75	Annex I and Annex H
Lap shear strength at 10 mm/ min	23 °C	N/mm2	≥3,0	Annex J
	T_{max}	N/mm2	≥0,20	
Elongation at break E100/ E70)	23 °C	—	≥0,75	Annex M
Peel strength to pipe surface (P100/P70)		—	≥0,75	

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Table-4: Properties of Cold applied tapes

PROPERTY	TEST TEMPERATURE	UNIT	VALUE	TEST METHOD AS PER BS EN ISO 21809-3
Holiday detection at 10 kV/mm, max. 25 kV	—	—	No holiday	Annex C
Peel strength	23 °C	N/mm	>15	Annex H
	T_{max}	N/mm	>4,0	Annex H
Adhesion to pipe surface and plant coating after 28-day hot-water immersion test at T_{max} limited as per Annex I	23 °C	—	>10 N/mm	Annex I plus Annex H
Cathodic disbondment at 28 days	23 °C	mm	≤7	Annex G
	T_{max}	mm	≤10	Annex G
Impact resistance	23 °C	J/mm	5 × α × β	Annex D
Indentation resistance at a pressure of 10 N/mm2	T_{max}	mm	≤1,0	Annex E

5.0 INSPECTION AND TESTING

The contractor shall establish and maintain a proven quality assurance system to ensure that supplied pipes & fittings comply in all respects with the requirements of this specification. The minimum inspection and testing to be performed shall be as per relevant clauses of DIN 30670, BS EN ISO 21809-1 & 3 and DIN EN 10289. Prior to starting the coating job, the contractor /supplier/coating applicator shall prepare coating application procedure and ITP based on the above mentioned standards in consultation with OWNER/PMC and submit for their approval. Coating Job shall start only after approval of the same.

6.0 HANDLING, TRANSPORTATION AND STORAGE

6.1 The vendor shall load, unload, transport and stockpile the coated pipes, flanges, valves and fittings within the coating plant using approved suitable means and in a manner to avoid damage to the coating.

6.2 Coated pipes, flanges, valves and fittings may be handled by means of slings and belts of proper width (minimum 60 mm) made of non- abrasive/non-metallic materials. In this case, pipes, flanges, valves and fittings to be stacked shall be separated row by row to avoid damages by rubbing the coated surface in the process of taking off the slings. Use of round sectional slings is prohibited. Forklifts may be used provided that the arms of the forklift are covered with suitable pads, preferably rubber/PVC/Teflon.

6.3 Coated pipes, flanges, valves and fittings at all times shall be stacked completely clear from the ground, at least 300 mm, so that the bottom row of pipes remains free from any stagnant surface water. The pipes and fittings shall be stacked at a slope so that driving rain does not collect inside the pipe. Coated pipes and fittings may be stacked by placing them on ridges of sand free from stones and covered with a plastic film or on wooden supports provided with suitable cover. Flanges and valves shall be provided with covers/wrapping to ensure that there is no water stagnation/accumulation to protect the coating. This cover can be of dry, germ free straw covered with plastic film, otherwise

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foam rubber may be used. The supports shall be spaced in such a manner as to avoid permanent bending of the pipes. Stacks shall consist of limited number of layers such that the pressure exercised by the pipe's own weight does not cause damages to the coating. Each pipe section shall be separated by means of spacers suitably spaced for this purpose. Stacks shall be suitably secured against falling down and shall consist of pipe sections having the same diameter and wall thickness. The weld seam of pipes shall be positioned always in a manner so as not to touch the adjacent pipes. The ends of the pipes and fittings during handling and stacking shall always be protected with bevel protectors.

6.4 The trucks used for transportation shall be equipped with adequate pipe supports having as many round hollow beds as there are pipes to be placed on the bottom of the lorry bed. Total width of the supports shall be at least 5% of the pipe length and min. 2 no. support shall be provided. These supports shall be lined with a rubber protection and shall be spaced in a manner as to support equal load from the pipes. The rubber protection must be free from all nails and staples where pipes are in contact. The second layer and all following layers shall be separated from the other with adequate number of separating layers of protective material such as straw in plastic covers or mineral wool strips or equivalent, to avoid direct touch between the coated pipes.

All stanchions of Lorries used for transportation shall be covered by non-abrasive material like rubber belts or equivalent. Care shall be exercised to properly cover the top of the stanchions and other positions such as reinforcement of the truck body, rivets, etc. to prevent damage to the coated surface. Slings or non-metallic straps shall be used for securing loads during transportation. They shall be suitably padded at the contact points with the pipe.

6.5 In case of any marine transportation of coated pipes, flanges, valves and fittings involved, the same shall be carried out in compliance with API RP 5LW.

7.0 MARKING

Vendor shall place marking on the outside surface of the coating at one end of the coated pipe and marking shall be as per the requirements of DIN 30670, BS EN ISO 21809-1 & 3 and DIN EN 10289.

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SCOPE OF WORK
AND
JOB SPECIFICATIONS
FOR
SIDE STREAM FILTRATION AND CHLORINE-DI-OXIDE GENERATION & DOSING SYSTEM
FOR
RECIRCULATING COOLING WATER SYSTEM

PROJECT : POLYPROPYLENE UNIT

OWNER : NUMALIGARH REFINERY LIMITED

EPMC : ENGINEERS INDIA LIMITED

JOB NO. : C050

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
0	06.08.2025	ISSUED FOR TENDER	UJ/DD	RM/CP	VS

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1.0 SIDE STREAM FILTRATION SYSTEM

NUMALIGARH REFINERY LIMITED (NRL) 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). Side Stream Filters (SSFs) shall be provided for Cooling Water System (CT) of the project in order to remove the suspended solids from the recirculating cooling water.

Side Stream Filters (SSFs) shall be provided for Polypropylene Unit Cooling Water System (CT) in order to remove the suspended solids from the recirculating cooling water.

This specification covers the Design Data and the Contractor's Scope of Work for the Side Stream Filters for the Recirculating Cooling Water Systems in Numaligarh Refinery.

1.1 SCHEME FOR SIDE STREAM FILTRATION SYSTEM

Side Stream Filters shall be provided in the return headers of the Polypropylene Unit Cooling Water System (CT).

Two Nos. of Side Stream Filters in the cooling towers are to be provided as per the Design data and specifications given in this document.

1.1.1 DESIGN DATA FOR SIDE STREAM FILTERS (SSF)

S. No.	Description	SSF for Cooling Water System
i.	Item No.	1U68-ZGN-4271 A/B
ii.	Type	Vertical
iii.	Total No. of Filters	2 (Both working)
iv.	Design Capacity of Each Filter (m^3/hr)	80

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v.	Rate of Filtration ($m^3/m^2/hr$)	9
vi.	Bed Expansion (%)	50
vii.	Suspended Solids at inlet (ppm)	60
viii.	Suspended Solids at outlet (ppm)	10
ix.	Operating Pressure (kg/cm^2 g)	1.8
x.	Max. Allowable Pressure drop in system (kg/cm^2 g)	0.5
xi.	Utilities Available	As per process datasheet: C050-IU68-79-41-DS-1902
xii.	Operating Temperature (Deg C)	45
xiii.	Design Pressure (Kg/cm2.g)	8
xiv.	Design Temperature (Deg C)	65
xv.	Material of Construction	CS (boiler quality epoxy painted inside)
xvi.	Applicable code for Design and Fabrication	ASME SEC VIII, Division-I
xvii.	Bachwash frequency	Once in a day
xviii.	Backwash rate, ($m^3/m^2/hr$)	18
xix.	Air scouring rate, ($Nm^3/m^2/hr$)	45 - 50
xx.	No. of Manholes & DIA	2 Nos. & 25”
xxi.	Corrosion Allowance, mm	3

1.2 SCOPE OF WORK

The Contractor’s scope of work includes design, engineering, procurement, fabrication, supply, transport, handling, storage at site, erection, civil, electrical, piping, painting, mechanical and instrumentation works, testing, pre-commissioning, commissioning, trial run and guarantee of Side Stream Filtration systems for Cooling Water System and handing over of the same to the Owner.

The scope of supply in general shall include, but not limited to the following:

a. **2 (Two) Nos. of Side Stream Filters** (Vertical pressure filters with sand as filter media) for **Polypropylene Unit cooling water system (CT)** including all internals

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(inlet distributor, collector), initial charge of media (filter sand & silex), manholes, hand holes, sight glasses, earthing cleats, lifting lugs, etc shall be provided

b. The inlet/outlet and backwash piping arrangement for the filters shall be as per EIL Tender P&ID no. C050-79-41-1U68-1111 for Polypropylene Unit cooling water system.

c. Incase pressure is inadequate for Backwash purpose; contractor shall take tapping from the cooling water pump discharge line for backwash purpose. In such a situation design pressure of side stream filter and associated facilities shall be revised accordingly. Pressure regulation if any as per SSF system requirement shall be done by contractor.

d. Flow measurement shall be made at the inlet of filters as per P&ID by providing flow instruments (FE-FT-FI). Straight length as required shall be provided by the contractor.

e. Complete piping and valves including piping for Plant air for air scouring, pressure relief, drains and frontal piping as per Tender P&ID no. C050-79-41-1U68-1111 for cooling water system.

f. All instruments for filtration system as shown in P&ID C050-79-41-1U68-1111 including all PG, PI, PCV, DPT-DPI, FE-FT-FI, PSV, PRV, NRV, etc. shall be contractor's scope of work.

g. Strainer plate with supports shall be provided for the filters.

h. Mechanical, Civil (supports, foundation, ladders, platforms etc), electrical and instrumentation works all complete shall be provided for all the filters.

i. Vessel plate thickness shall be reviewed during detail engineering.

j. Corrosion allowance of 3.0 mm (minimum) shall be provided.

k. The filters shall be anti-corrosive-epoxy painted on inside. Outside painting shall be as per EIL specifications.

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l. Sand (with specification particle size 0.6-1.2 mm, effective size 0.45-0.7, uniformity coefficient 1.3 – 1.7, bulk density 1400-1600 kg/m3) and Silex are to be provided as the Filter media.

m. Bed depth for sand media shall be 600 mm (minimum).

n. Depth of Silex media shall be 200 mm minimum.

o. Filter internal distribution shall be Inverted Bell or header for Top system and Strainer plate with Nozzles (20mm thick) for Bottom system. No. of nozzles on strainer plate shall be confirmed by vendor during detail engineering.

p. The scope and general scheme shall be as per P&ID no. C050-79-41-1U68-1111, Process Datasheet No. C050-1U68-79-41-DS-1902 for Cooling Tower and this specification.

q. Platform and ladders / stairs (with hand railings) for approach to manholes, as required. Davit arrangement for loading and unloading of media shall be provided.

r. Complete (including interconnecting) piping, all fittings, bends, tees, reducers, valves, flanges, bolts, gaskets, isolation valves, permanent strainers, etc, including pipe racks and supports, jointing, etc, and any other work as required.

s. Differential pressure transmitter with alarm shall be used to measure the pressure drop in the filter i.e., between inlet and outlet of filter. Pressure gauges shall be provided at the inlet and outlet of each pressure filter and at air inlet line. All pressure gauges shall have isolating valves. PSV shall be provided on each filter.

t. Backwashing of filters shall be done by motive water and air scouring in the filter shall be done by plant air. Pressure control valve shall be provided on the plant air line.

u. Backwash shall be done once in a day. Backwash wastewater shall be collected in a localized pit and shall lead to the nearest CRWS.

v. Pressure control valves as required shall be used in backwash water lines and on plant air supply line.

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w. The operation (including air scouring and backwash) of filters shall be manual. Backwash of Filters shall be carried out manually upon receipt of PDT alarm.

x. Painting of vessel (external surface), exposed pipelines, steel structures, operating platforms, ladders, stairs, hand railing, etc, as per EIL painting specifications.

y. All piping i.e. pipes, valves, fittings, etc. in the filtration system shall conform to class-A3A of EIL piping specifications.

z. All instrumentation shall be as per EIL instrumentation standards and specifications as attached.

2.0 CHLORINE-DI-OXIDE (ClO_2) GENERATION AND DOSING SYSTEM

2.1 INTRODUCTION

Chlorine dioxide (ClO_2) shall be used as a Biocide for microbiological control in cooling Tower systems for the Polypropylene Unit facility. Chlorine dioxide (ClO_2) generation & dosing system along with chemicals unloading, storage & dosing facility shall be provided for the Recirculating Cooling Tower Systems of Polypropylene Unit facility.

This part of specification covers the Design Data and the Contractor's scope of work for the ClO_2 generator and associated chemical handling systems for the Polypropylene Unit Cooling Water System.

2.2 SCOPE OF WORK FOR ClO_2 GENERATION & DOSING SYSTEM

The contractor's scope of work includes design, engineering, procurement, fabrication, supply, transport, handling, storage at site, erection, installation, civil, electrical, piping, painting, mechanical and instrumentation works, testing, pre-commissioning, commissioning, trial run and guarantee of ClO_2 Generator Systems along with the associated chemical storage and dosing facilities for Cooling Water System and handing over of the same to the Owner.

The scope of supply in general shall include, but not limited to the following:

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a. Chlorination system for **Cooling Water System shall include 2 (1W+1S) Chlorine dioxide generators each of capacity 7 Kg/hr** and its associated facilities of chemical dosing pumps, bulk chemical storage and unloading facilities as mentioned in this document and shall be in the Contractor's scope of work. All instruments as indicated in P&ID Nos. C050-17-42-1U68-1111/1112/1113 shall be in contractor's scope of work. The ClO_2 generation and dosing system for cooling water system shall be controlled through a dedicated PLC based Control System which shall be in Contractor's scope. All interlocks shall be realized in the PLC. Repeat signal from PLC of ClO2 system shall be provided to main control room.

b. Any other additional facilities if required shall also be considered as part of ClO_2 generation and dosing systems.

Following facilities/equipment shall also be provided by the contractor for ClO_2 generation & dosing System for Cooling Water System:

- Complete piping from Chlorine-di-oxide generator to cooling water sump diffusers with flow control valves, drain valves, Y-strainers, vents, ejector, Manifold piping and fittings, flexible coil connectors, etc as required. The diffuser shall be of UPVC and shall span horizontally across minimum 80% of the sump length.

- Complete piping (including interconnecting), all fittings, bends, tees, reducers, valves, flanges, bolts, gaskets, specials, isolation valves, permanent strainers, etc, including pipe racks and supports, jointing, etc, and any other work as required for the system and as per P&IDs to be provided.

- Dedicated Residual ClO_2 Analyzers shall be provided in the return headers in the Cooling Towers for monitoring the residual ClO_2 concentration and control the ClO_2 dosing in the Cooling tower to maintain 0.2 – 0.4 ppm of residual ClO_2 in the return header.

- ClO_2 leak Detector with alarm shall be installed at ClO_2 generator room.

- Necessary approvals for item(s) as specified in scope of supply, if any, from any regulatory/ statutory body shall be in the scope of contractor.

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- 2 (Two) No. Safety shower and eye wash facility (one located just outside the Chlorine-dioxide generator room & another near HCL and NaClO2 unloading bays) to be provided by contractor.

- ClO_2 diffuser in cooling water sump to be provided by contractor.

- Neutralization facility along with chemical dosing system consisting of dosing tanks and pumps shall be provided separately for HCl and NaClO2 bulk tanks. 2 Nos of Potable pumps shall be provided for filling of neutralization chemicals into the respective tank.

- Neutralized effluent shall be routed to storm sewer. Pumps for evacuation of content of the neutralization pit shall be provided. Air sparging with Plant Air shall be provided in each N.Pit.

- The following Safety equipment's shall be provided near the ClO_2 Generator room of Cooling Towers:

  2 (Two) nos. respiratory equipment (pressure demand type air masks-full face for working in leak area), 2 (Two) nos. canister type gas mask, Emergency repair kit, One No. Weather sock provided at a suitable location on the building, 2 (Two) each of Safety helmets, goggles, rubber boots, gloves and colored vests (aprons), Display charts of PFD, Safety checks, maintenance procedure, Emergency Action Plan, etc.

2.3 SCHEME FOR ClO_2 GENERATION & DOSING SYSTEM

Acid and $NaClO_2$ shall be unloaded using acid unloading pumps & sodium chlorite unloading pumps respectively and stored in bulk acid storage tank and bulk sodium chlorite storage tank. From there, it shall be dosed at controlled rate to the ClO_2 generator. ClO_2 shall be generated from the reaction of HCl and $NaClO_2$. Pressure regulation in the Dilution water line if required as per ClO_2 generator system shall be done by contractor.

2.4 INCLUSIONS

The contractor's scope of supply shall be in general but not limited to the following: -

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EQUIPMENT LIST

ClO_2 Generation & Dosing System for Cooling Water System:

S. No	Unit No.	Name of Equipment	Qty	Size	MOC
1	1U68-LZ-101 A/B	ClO_2 Generator	2	Capacity: 7 kg/hr	-
2	1U68-P-101 A/B	HCl Unloading Pumps	2	Capacity:15 m^3/hr Head : 15 mLC	Casing: PP Impeller: PP
3	1U68-T-101	Bulk HCl Storage Tank	1	Diameter:3.5 m Height: 3.3 m	FRP
4	1U68-P-102 A/B	HCl Dosing Pumps	2	Capacity: 50 LPH Head : 30mLC	Casing: PP/PVDF Diaphragm: Teflon
5	1U68-P-103 A/B	$NaClO_2$ Unloading Pumps	2	Capacity: 15 m^3/hr Head : 15 mLC	Casing: PP Impeller: PP
6	1U68-T-102	$NaClO_2$ Storage Tank	1	Diameter: 3.5 m Height: 3.3 m	FRP
7	1U68-P-104 A/B	$NaClO_2$ Dosing Pumps	2	Capacity: 50 LPH Head : 30mLC	Casing: PP/PVDF Diaphragm: Teflon

Notes:

1. ClO_2 generator data sheet with all details (including efficiency of ClO2 generator, mode of flow control, minimum and maximum concentration of ClO2 in solution) to be prepared & submitted by contractor during detail engineering to EIL for approval.
2. Head shall be confirmed by vendor based on hydraulics during detail engineering.

Any other item(s) if required for completeness of the system, safety requirements and to make the system operational shall also be included in Contractor's scope.

2.5 TECHNICAL SPECIFICATIONS FOR CHLORINE DIOXIDE GENERATION AND DOSING SYSTEM

a. The operating and control range of ClO_2 generation and dosing system shall be 10-100% of design capacity.

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b. The type of ClO_2 generator and dosing system shall be Submerged or water Encapsulated.

c. Dilution water for ClO_2 generation shall be taken from the cooling water supply header as indicated in P&ID No. C050-79-41-1U68-1111.

d. A ClO_2 generator shall be installed in a room.

e. A suitable approach road shall be provided to the storage tank area for unloading of the chemicals (HCl & $NaClO_2$). Sufficient tanker parking space shall be provided near all chemical unloading pumps.

f. ClO_2 Generators must be provided with flow transmitters in incoming HCl & $NaClO_2$ solution lines, Dilution water line and ClO_2 solution discharge line to the cooling tower sump.

g. Contractor shall submit all calculations/ details/ catalogue to EIL for their review/ approval during detail Engineering and shall confirm to recommendations of the relevant International/ Indian standards/ codes /PESO Guidelines. The same shall be substantiated by relevant documents.

h. All Chemical storage/ dosing tanks shall be located inside a dyked area (separate dykes for different chemicals), suitably lined (floor, inside dyke wall and all structures inside the dyked area) with acid/ alkali proof tiling as per EIL specs. The storage tanks shall be located on elevated platform, with platform elevation higher than dyke height. Dyke height shall be sufficient to hold total volume of chemical of the largest tank. Proper floor slope shall be provided for area drainage. Minimum distance of dyke wall inside from tank shell shall be half the tank's total height. Also, minimum distance between the two tanks (shell to shell distance) shall be half of the diameter of the tank. The dosing pumps shall be located on elevated platform inside the kerb wall of minimum 150 mm, with platform elevation higher than kerb height. Proper floor slope shall be provided for area drainage. Internal drainage of the dyke and kerb area should be routed to a neutralization pit.

i. Separate Neutralization pit to be provided for HCl & $NaClO_2$ solution in respective dyke area.

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j. Any other item(s) if required for completeness of the system, safety requirements and to make the system operational.

k. All other **instruments** like pressure gauges, pressure control valves, pressure safety valve, level indicators and transmitters, compound gauges, etc shall be provided as required.

l. ClO_2 Generators must be equipped with systems of dosing and/ or measurement for reagents. These systems must be able to shut down the operation of the generator in case any of the supplies is cut off.

m. In case of water supply to the ClO_2 generator stops, the chemical dosing pumps shall also stop automatically.

n. The dosing skids for the Generators shall be equipped with all necessary arrangement/ facilities to detect and control leakages and avoid slipping & mixing of the Reagents in the Chlorine di-oxide generator rooms.

o. The least count of ClO_2 leak sensor shall be 0.1 ppm and the complete ClO_2 generation system including the dosing pumps shall stop automatically.

p. ClO_2 leak detector shall be located in the ClO_2 generator room.

q. M.S. bolts clamps, etc. for all piping and SS holding down bolts and clamps for diffuser shall be provided.

r. Painting of exposed pipelines, steel structures, equipment's operating platforms, ladders, stairs, hand railing, etc, as per specification.

s. Provision shall be provided for routing of all dyke area & kerb area drains to storm water drain & respective neutralization pit.

t. All equipment / materials shall be procured from the vendors as per approved vendor list. Any item, for which vendor list is not provided, contractor shall obtain prior approval of EIL before placement of order.

u. Running / Stop indications of all pumps, level indications of all tanks, running / Stop indications of all ClO_2 generators and all flow indications shall also be routed to Control Room.

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v. Level Indicators and Transmitters shall be used for local & control room level indication and for tripping purposes (including low & high levels alarms in the control room).

w. Line Size Criteria to be based on following pipe/line velocities:

Pump Discharge	:	2.0 m/sec (maximum)
Pump Suction	:	1.2 m/sec (maximum)
Gravity Lines	:	0.8 m/sec (maximum)

3.0 GUARANTEE

3.1 The contractor shall guarantee for efficient running of filtration system in addition to the performance and mechanical guarantee for Filters, equipment, instruments etc.

3.2 The contractor shall demonstrate the performance & guarantee the complete Chlorine dioxide generator and dosing system including proper operation, adherence to specifications, proper functioning of instruments, etc. and mechanical guarantee of equipment's.

4.0 SPARES

4.1 Mandatory Spares

10% of the Total No. of Strainer Nozzles for each filter (working as well as standby) shall be provided as mandatory spares. The same shall be included in the Lump sum price quoted by the contractor. 15% of the total quantity of Sand Media in all Filters (including standby units).

4.2 Recommended Spares

An itemized list of spares (with price) as recommended by the contractor for two years of smooth, continuous and normal operation of Filtration and Chlorine dioxide generator and dosing systems shall be provided by the contractor. Cost of recommended spares are not to be included in the lump sum price quoted by the contractor.

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5.0 VENDOR DATA REQUIRMENT

S. No	DOCUMENT/DRAWING/DATA SHEET	With Offer	Detail Engg.
1	Technical Compliance (duly signed & stamped)	✓	-
2	**SIDE STREAM FILTRATION SYSTEM**		
A	Preliminary backwash water quality & quantity, air requirement for air scouring, PFD, etc.	-	✓
B	Basic Engg. Package including filter sizing calculations, backwash water and air requirements, Process Datasheets, Operating and backwash hydraulic / pressure drop calculations for Filters etc.	-	✓
C	P&ID with line size and instrumentation	-	✓
D	Layout drawing and details of foundations and supports for piping	-	✓
E	GA of vessel (with dimension) and internal arrangement specifying type of internals (distributor and collection system).	-	✓
3	**CHLORINATION SYSTEM**		
a	Process datasheet for all equipments including Chlorine dioxide Generator Unit indicating complete details, Model No., Material of Construction etc.	-	✓
b	P&ID for Chlorine dioxide generator system.	-	✓
c	Layout Drawing	-	✓
d	Manufacturers' catalogue of Chlorine dioxide solution generator.	-	✓
e	Complete Sizing and Capacity calculations for Chlorine dioxide generator system.	-	✓
4	Mandatory Spares	-	✓
5	Priced recommended spare list for 2 years smooth, trouble free operation.	-	✓

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6	Vendor list of sub ordered items.	-	✓
7	Operation manual with all catalogues, maintenance procedure for Side stream Filters and Chlorine dioxide generation and dosing system.	-	✓

6.0 VENDOR LIST

ClO2 generation system shall be provided only from the following approved vendor list of EIL.

- Capco water solutions Pvt. Ltd
- Chembond Ashland water Technologies Ltd
- Evoqua (Penwwalt)
- Prominent
- Purita Water Solutions Pvt. Ltd
- Vasu Chemical

7.0 REFERENCE DOCUMENTS

The following documents & drawing are also part of contractor's scope of work.

➢ **Document**

S. No.	Document Title	Document No.
1.	Technical Compliance- EIA & Sustainability and Water	C050-1U68-17-42-TC-1001

➢ **Datasheets**

S. No.	Document Title	Document No.
1.	Process Data Sheet – HCl Unloading Pumps	C050-1U68-17-42-DS-1001
2.	Process Datasheet – Bulk HCl Storage Tank	C050-1U68-17-42-DS-1002
3.	Process Datasheet – HCl Dosing Pumps	C050-1U68-17-42-DS-1003
4.	Process Data Sheet – $NaClO_2$ Unloading Pumps	C050-1U68-17-42-DS-1004
5.	Process Datasheet – $NaClO_2$ Storage Tank	C050-1U68-17-42-DS-1005

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S. No.	Document Title	Document No.
6.	Process Datasheet – $NaClO_2$ Dosing Pumps	C050-1U68-17-42-DS-1006

➢ **Drawings**

S. No.	Drawing Title	Document No.
1.	P&ID for Acid Handling System	C050-1U68-17-42-1111
2.	P&ID for $NaClO_2$ Handling System	C050-1U68-17-42-1112
3.	P&ID for ClO_2 Generator System	C050-1U68-17-42-1113

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HCl UNLOADING PUMPS			
PROJECT : POLYPROPYLENE UNIT			
JOB NO. : C050	**CLIENT : NRL**		**ITEM NO. : 1U68-P-101 A/B**
SERVICE : TO TRANSFER HCl SOLUTION TO HCl BULK STORAGE TANKS			
TYPE : CENTRIFUGAL, HORIZONTAL			
PROPERTIES OF LIQUID			
LIQUID HANDLED			30% HYDROCHLORIC ACID
PUMPING TEMPERATURE (^{0}C)			AMBIENT
VISCOSITY AT PUMPING TEMPERATURE (cp)			~ 1.14
LIQUID DENSITY (kg/m^3)			~ 1130
PRESENCE OF CORROSIVE / TOXIC COMPONENTS			CORROSIVE (HCl)
SOLIDS IN SUSPENSION (YES / NO)			NO
SIZE OF SOLID PARTICLES (mm)(MAX)			NA
OPERATING CONDITIONS			
FLOW RATE		NORMAL(m3/hr)	15
		MAX. (m3/hr)	15 (NOTE-1)
		MIN. (m3/hr)	(NOTE-1)
SUCTION PRESSURE (kg/cm2.a)			ATM.
DISHARGE PRESSURE (kg/cm2.a)			2.5
DIFFERENTIAL PRESSURE (kg/cm2)			1.5
DIFFERENTIAL HEAD (mLC)			15
NPSH AVAILABLE (m) MIN.			FLOODED SUCTION
NO. OF PUMPS			2 (1W+ 1SB)
CAPACITY CONTROL FOR VOLUMETRIC PUMPS			
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC			N.A.
TYPE			N.A.
RANGE (%)			N.A.
PRECISION AT MIN. RATE (%)			N.A.
MECHANICAL DATA			
DESIGN PRESSURE (kg/cm2.g)			3.5
DESIGN TEMPERATURE (^{0}C)			65
MATERIAL CODE		CASING	PP
		IMPELLER	PP
SEAL TYPE (MECHANICAL / PACKING)			MECHANICAL
LINE RATING IN / OUT			150# / 150#
DRIVER			ELECTRIC MOTOR

NOTES:

1	MAXIMUM/MINIMUM FLOW OF THE PUMP SHALL BE FURNISHED BY THE VENDOR BASED ON THE PUMP SELECTED
2	THE PUMP MOTOR SHALL BE DESIGNED FOR OPEN DISCHARGE CONDITION.
3	THE PUMP SHALL BE CAPABLE OF AUTO START / AUTO STOP OPERATION.

NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
0	06.08.2025	ISSUED FOR TENDER	UJ/DD	RM/CP	VS

	ENGINEERS INDIA LIMITED NEW DELHI	**HCl UNLOADING PUMPS**	**PROCESS DATA SHEET**	**REV.**
			C050-1U68-17-42-DS-1001	**0**

BULK HCl STORAGE TANK		
PROJECT : POLYPROPYLENE UNIT		
JOB NO. : C050	**CLIENT : NRL**	**ITEM NO. : 1U68-T-101**
SERVICE : STORAGE OF HYDROCHLORIC ACID		
PROCESS DATA		
LIQUID STORED		30% HYDROCHLORIC ACID
NOMINAL CAPACITY OF EACH TANK (m^3)		31.76
EFFECTIVE LIQUID HOLD UP OF EACH TANK (m^3)		25
STORAGE TEMPERATURE (^0C)		AMBIENT
DESIGN TEMPERATURE (^0C)		65
SP. GR. OF LIQUID AT STORAGE TEMPERATURE		~ 1.13
VISCOSITY AT STORAGE TEMPERATURE (Cp)		~ 1.14
DESIGN PRESSURE (kg/cm^2 abs.)		ATM.+ LIQUID COLUMN
DESIGN VACUUM PRESSURE		50 mmWC
UNIT DESCRIPTION		
NO. OF TANKS		1
TYPE		CIRCULAR, CONICAL ROOF
DIAMETER OF EACH TANK (m)		3.5
EFFECTIVE LIQUID DEPTH		2.60
DVD (m)+ FREE BOARD ABOVE TWL (m)		0.2 + 0.5
TOTAL HEIGHT (m)		3.3
SLOPE FOR TANK BOTTOM		(NOTE-1)
OVERFLOW ARRANGEMENT REQUIRED (YES / NO)		YES
BOTTOM DRAIN REQUIRED (YES / NO)		YES
HEATING COIL (YES / NO)		NO
VENT		YES (NOTE 3)
SLUDGE WITHDRAWL PITS (YES / NO)		NO
LEVEL INDICATION REQUIRED (YES / NO)		YES
LEVEL TRANSMITTER (YES / NO)		YES
LEVEL SWITCHES (YES / NO)		NO
LEVEL TRANSMITTER / SWITCH PLATFORM (YES / NO)		YES
LEVEL ALARM (YES/NO)		YES
CORROSION ALLOWANCE (mm)		NA
MATERIAL OF CONSTRUCTION		
TANK		FRP
PAINTING/LINING		NONE
STAIRS / HANDRAILINGS / OPERATING PLATFORM		AS PER ENGG. SPECS.

NOTES:

1	TO BE FURNISHED/COMFIRMED BY THE CONTRACTOR.
2	TANKS SHALL BE LOCATED WITHIN A DYKE.
3	FUME ABSORBER TO BE PROVIDED

NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
0	06.078.2025	ISSUED FOR TENDER	UJ/DD	RM/CP	VS

इं.भा.लि.	**ENGINEERS INDIA LIMITED NEW DELHI**	**BULK HCl STORAGE TANK**	**PROCESS DATA SHEET**	**REV.**
			C050-1U68-17-42-DS-1002	**0**

HCl DOSING PUMPS			
PROJECT : POLYPROPYLENE UNIT			
JOB NO. : C050	**CLIENT : NRL**		**ITEM NO. 1U68-P-102 A/B**
SERVICE : TO DOSE HCl SOLUTION FOR ClO2 GENERATOR			
TYPE : POSITIVE DISPLACEMENT, DIAPHRAGM			
PROPERTIES OF LIQUID			
LIQUID HANDLED			30% HYDROCHLORIC ACID
PUMPING TEMPERATURE (^{0}C)			AMBIENT
VISCOSITY AT PUMPING TEMPERATURE (cp)			~ 1.14
LIQUID DENSITY (kg/m3)			~ 1130
PRESENCE OF CORROSIVE/TOXIC COMPONENTS			CORROSIVE (HCl)
SOLIDS IN SUSPENSION (YES/NO)			NO
SIZE OF SOLID PARTICLES (mm) (MAX)			NA
OPERATING CONDITIONS			
FLOW RATE		NORMAL(litres/hr)	50
		RATED (litres/hr)	(NOTE-1)
		MIN. (litres/hr)	(NOTE-1)
SUCTION PRESSURE (kg/cm2.a)			ATM.
DISCHARGE PRESSURE (kg/cm2.a)			4.0
DIFFERENTIAL PRESSURE (kg/cm2.g)			3.0
DIFFERENTIAL HEAD (mLC)			30
NPSH AVAILABLE (m) MIN.			FLOODED SUCTION
NO. OF PUMPS			2 (1W+ 1SB)
CAPACITY CONTROL FOR VOLUMETRIC PUMPS			
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC			MANUAL
TYPE			STROKE ADJUSTMENT
RANGE (%)			10-100
PRECISION AT MIN. RATE (%)			(NOTE-1)
MECHANICAL DATA			
DESIGN PRESSURE (kg/cm2.g)			5.0
DESIGN TEMPERATURE (^{0}C)			65
MATERIAL CODE		CASING	PP/PVDF
		DIAPHRAGM	TEFLON
SEAL TYPE (MECHANICAL / PACKING)			NOT APPLICABLE
LINE RATING IN / OUT			150# / 150#
DRIVER			ELECTRIC MOTOR

NOTES:

1	MAXIMUM/MINIMUM FLOW OF THE PUMP SHALL BE FURNISHED BY THE VENDOR BASED ON THE PUMP SELECTED
2	PUMP SHALL HAVE EXTERNAL PRESSURE SAFETY RELIEF VALVE(IF NOT PROVIDED INTERNALL
3	FLOW DAMPNER TO BE PROVIDED ON INDIVIDUAL PUMP DISCHARGE LINE.
4	CALIBRATION POT TO BE PROVIDED AT PUMP SUCTION HEADER

NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
0	06.08.2025	ISSUED FOR TENDER	UJ/DD	RM/CP	VS

ENGINEERS INDIA LIMITED NEW DELHI	HCl DOSING PUMPS	PROCESS DATA SHEET	REV.
		C050-1U68-17-42-DS-1003	0

NaClO2 UNLOADING PUMPS			
PROJECT : POLYPROPYLENE			
JOB NO. : C050	**CLIENT : NRL**		**ITEM NO. : 1U68-P-103 A/B**
SERVICE : TO TRANSFER NaClO2 SOLUTION TO NaClO2 BULK STORAGE TANKS			
TYPE : CENTRIFUGAL, HORIZONTAL			
PROPERTIES OF LIQUID			
LIQUID HANDLED			25%-31% NaClO2
PUMPING TEMPERATURE (^{0}C)			AMBIENT
VISCOSITY AT PUMPING TEMPERATURE (cp)			NOTE -1
LIQUID DENSITY (kg/m^3)			~ 1280
PRESENCE OF CORROSIVE / TOXIC COMPONENTS			CORROSIVE (NaClO2)
SOLIDS IN SUSPENSION (YES / NO)			NO
SIZE OF SOLID PARTICLES (mm)(MAX)			NA
OPERATING CONDITIONS			
FLOW RATE		NORMAL(m3/hr)	15
		MAX. (m3/hr)	(NOTE-1)
		MIN. (m3/hr)	(NOTE-1)
SUCTION PRESSURE (kg/cm2.a)			ATM.
DISHARGE PRESSURE (kg/cm2.a)			2.5
DIFFERENTIAL PRESSURE (kg/cm2)			1.5
DIFFERENTIAL HEAD (mLC)			15
NPSH AVAILABLE (m) MIN.			FLOODED SUCTION
NO. OF PUMPS			2 (1W+ 1SB)
CAPACITY CONTROL FOR VOLUMETRIC PUMPS			
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC			N.A.
TYPE			N.A.
RANGE (%)			N.A.
PRECISION AT MIN. RATE (%)			N.A.
MECHANICAL DATA			
DESIGN PRESSURE (kg/cm2.g)			3.5
DESIGN TEMPERATURE (^{0}C)			65
MATERIAL CODE		CASING	PP
		IMPELLER	PP
SEAL TYPE (MECHANICAL / PACKING)			MECHANICAL
LINE RATING IN / OUT			150# / 150#
DRIVER			ELECTRIC MOTOR

NOTES:

1	MAXIMUM/MINIMUM FLOW OF THE PUMP SHALL BE FURNISHED BY THE VENDOR BASED ON THE PUMP SELECTED. VISCOSITY OF NaClO2 SOLUTION TO BE FURNISHED BY CONTRACTOR DURING DETAIL ENGINEERING
2	THE PUMP MOTOR SHALL BE DESIGNED FOR OPEN DISCHARGE CONDITION.
3	THE PUMP SHALL BE CAPABLE OF AUTO START / AUTO STOP OPERATION.

NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
0	06.08.2025	ISSUED FOR TENDER	UJ/DD	RM/CP	VS

ENGINEERS INDIA LIMITED NEW DELHI	NaClO2 UNLOADING PUMPS	PROCESS DATA SHEET	REV.
		C050-1U68-17-42-DS-1004	0

NaClO2 STORAGE TANKS		
PROJECT : POLYPROPYLENE UNIT		
JOB NO. : C050	**CLIENT : NRL**	**ITEM NO. : 1U68-T-102**
SERVICE : STORAGE OF SODIUM CHLORITE SOLUTION		
PROCESS DATA		
LIQUID STORED		25%-31% NaClO2
NOMINAL CAPACITY OF EACH TANK (m^3)		31.8
EFFECTIVE LIQUID HOLD UP OF EACH TANK (m^3)		25
STORAGE TEMPERATURE (^0C)		AMBIENT
DESIGN TEMPERATURE (^0C)		65
SP. GR. OF LIQUID AT STORAGE TEMPERATURE		1.28
VISCOSITY AT STORAGE TEMPERATURE (Cp)		(NOTE-1)
DESIGN PRESSURE (kg/cm^2 abs.)		ATM.+ LIQUID COLUMN
DESIGN VACUUM PRESSURE		50 mmWC
UNIT DESCRIPTION		
NO. OF TANKS		1
TYPE		CIRCULAR, WITH CONICAL ROOF
DIAMETER OF EACH TANK (m)		3.5
EFFECTIVE LIQUID DEPTH		2.60
DVD (m)+ FREE BOARD ABOVE TWL (m)		0.2+ 0.5
TOTAL HEIGHT (m)		3.3
SLOPE FOR TANK BOTTOM		(NOTE-1)
OVERFLOW ARRANGEMENT REQUIRED (YES / NO)		YES
BOTTOM DRAIN REQUIRED (YES / NO)		YES
HEATING COIL (YES / NO)		NO
VENT		YES
SLUDGE WITHDRAWL PITS (YES / NO)		NO
LEVEL INDICATION REQUIRED (YES / NO)		YES
LEVEL TRANSMITTER (YES / NO)		YES
LEVEL SWITCHES (YES / NO)		NO
LEVEL TRANSMITTER / SWITCH PLATFORM (YES / NO)		YES
LEVEL ALARM (YES/NO)		YES
CORROSION ALLOWANCE (mm)		NA
MATERIAL OF CONSTRUCTION		
TANK		FRP
PAINTING/LINING		NONE
STAIRS / HANDRAILINGS / OPERATING PLATFORM		AS PER ENGG. SPECS.

NOTES:

1	TO BE FURNISHED/COMFIRMED BY THE CONTRACTOR DURING DETAIL ENGINEERING.
2	TANK SHALL BE LOCATED WITHIN DYKE

0	06.08.2025	ISSUED FOR TENDER	UJ/DD	RM/CP	VS
NO.	**DATE**	**REVISION**	**PREPARED**	**CHECKED**	**APPROVED**

इ॰आई॰एल	**ENGINEERS INDIA LIMITED NEW DELHI**	**NaClO2 STORAGE TANK**	**PROCESS DATA SHEET**	**REV.**
			C050-1U68-17-42-DS-1005	**0**

SODIUM CHLORITE DOSING PUMPS

PROJECT : POLYPROPYLENE UNIT		
JOB NO. : C050	**CLIENT : NRL**	**ITEM NO. 1U68-P-104 A/B**
SERVICE : TO DOSE NaClO2 FOR ClO2 GENERATOR		
TYPE : POSITIVE DISPLACEMENT, DIAPHRAGM		
PROPERTIES OF LIQUID		
LIQUID HANDLED		25%-31% NaClO2
PUMPING TEMPERATURE (^{0}C)		AMBIENT
VISCOSITY AT PUMPING TEMPERATURE (cp)		(NOTE-1)
LIQUID DENSITY (kg/m3)		~ 1280
PRESENCE OF CORROSIVE/TOXIC COMPONENTS		CORROSIVE (NaClO2)
SOLIDS IN SUSPENSION (YES/NO)		NO
SIZE OF SOLID PARTICLES (mm) (MAX)		NA
OPERATING CONDITIONS		
FLOW RATE	NORMAL(litres/hr)	50
	RATED (litres/hr)	(NOTE-1)
	MIN. (litres/hr)	(NOTE-1)
SUCTION PRESSURE (kg/cm2.a)		ATM.
DISCHARGE PRESSURE (kg/cm2.a)		4.0
DIFFERENTIAL PRESSURE (kg/cm2.g)		3.0
DIFFERENTIAL HEAD (mLC)		30
NPSH AVAILABLE (m) MIN.		FLOODED SUCTION
NO. OF PUMPS		2 (1W+ 1SB)
CAPACITY CONTROL FOR VOLUMETRIC PUMPS		
CONTINUOUS / DISCONTINUOUS / MANUAL / AUTOMATIC		MANUAL
TYPE		STROKE ADJUSTMENT
RANGE (%)		10-100
PRECISION AT MIN. RATE (%)		(NOTE-1)
MECHANICAL DATA		
DESIGN PRESSURE (kg/cm2.g)		5.0
DESIGN TEMPERATURE (^{0}C)		65
MATERIAL CODE	CASING	PP/PVDF
	DIAPHRAGM	TEFLON
SEAL TYPE (MECHANICAL / PACKING)		NOT APPLICABLE
LINE RATING IN / OUT		150# / 150#
DRIVER		ELECTRIC MOTOR

NOTES:

1	MAXIMUM/MINIMUM FLOW OF THE PUMP SHALL BE FURNISHED BY THE VENDOR BASED ON THE PUMP SELECTED. VISCOSITY OF NaClO2 SOLUTION TO BE FURNISHED BY CONTRACTOR.
2	PUMP SHALL HAVE EXTERNAL PRESSURE SAFETY RELIEF VALVE(IF NOT PROVIDED INTERNALLY)
3	FLOW DAMPNER TO BE PROVIDED ON INDIVIUAL PUMP DISCHARGE LINE
4	CALIBRATION POT TO BE PROVIDED AT PUMP SUCTION HEADER

NO.	DATE	REVISION	PREPARED	CHECKED	APPROVED
0	06.08.2025	ISSUED FOR TENDER	UJ/DD	RM/CP	VS

इंआइएल	**ENGINEERS INDIA LIMITED NEW DELHI**	**SODIUM CHLORITE DOSING PUMPS**	**PROCESS DATA SHEET**	**REV.**
			C050-1U68-17-42-DS-1006	**0**

TECHNICAL COMPLIANCE

(EIA SUSTAINABILITY AND WATER)

FOR

SIDE STREAM FILTRATION AND CHLORINE-DI-OXIDE GENERATION & DOSING SYSTEM

FOR

RECIRCULATING COOLING WATER SYSTEM

PROJECT : POLYPROPYLENE UNIT

OWNER : NUMALIGARH REFINERY LIMITED

EPMC : ENGINEERS INDIA LIMITED

JOB NO. : C050

Rev. No	Date	Purpose	Prepared by	Reviewed by	Approved by
0	06.08.2025	ISSUED FOR TENDER	UJ/DD	RM/CP	VS

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S. No.	COMPLIANCE STATEMENT / QUERY	BIDDER'S CONFIRMATION / ANSWER
	GENERAL	
1.	Confirm your acceptance & compliance to complete scope of work/supply and performance guarantee stipulations as per bidding document requirements including specifications, standards, datasheets, drawings, amendments, technical questionnaire, etc. for SSF (side stream filtration) and ClO_2 dosing system for Polypropylene Unit cooling water system.	
2.	Note and confirm that no technical deviation/exception to bidding document have been taken by you for SSF and ClO2 dosing for Polypropylene Unit cooling water system.	
3.	All designs/documents/datasheets/drawings, etc. submitted along with your bid/offer are for bid purpose only. These details are not reviewed at this stage. These shall be submitted by you for review/approval during detail engineering. Any changes arising later on due to detail engineering review as per tender requirements shall not have any techno-commercial implications. Please confirm compliance.	
4.	Bidder to adhere to the EIL approved vendor list for ClO2 dosing system given in document no. C050-1U68-17-42-SP-1001. Any item for which vendor/sub-vendor list is not available in the Tender document, bidders are required to take specific approval from EIL/Client for vendor/sub-vendor suggested by them before procurement. Please confirm compliance.	
5.	Note and confirm that all the facilities/units/equipments etc. for SSF and ClO2 dosing for cooling water system as per tender requirements shall be accommodated within the area earmarked for SSF and ClO2 dosing system.	
6.	The metallurgy mentioned in C050-1U68-17-42-SP-1001 for ClO2 diffuser shall supersede the metallurgy mentioned else where in the tender.	

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OTHERS VENDOR

ACID TANKER

3"-UPVC

FQ FT

FT

M

DI

1/2"

SC

LAHH LAH LAL LALL

LI 1101 LT

LI LT

LI 1102 LAH LAL

NOTE-8

FA

TO N.PIT

SERVICE WATER

2"-UPVC

UC

3"-UPVC

2"

2"-UPVC

ACID/ALKALI PROOF TILING

DYKE WALL

3"-UPVC

3"-UPVC

3"-UPVC

ACID/ALKALI PROOF TILING

NEUTRALIZATION PIT
(NOTE-5)

SERVICE WATER

TO USERS

3"-UPVC 2"-UPVC 3"-UPVC 2"-UPVC

PI PI

M M

XL XL XL XL

CONC. HCL
UNLOADING PUMPS
(1U68-P-101 A/B)
CAPACITY : 15 M3/HR, 15M HEAD

3/4"-UPVC

HCL STORAGE TANKS
(1U68-T-101)
CAPACITY : 43.9 M3

TO HCl TANK
FOR NEUTRALIZATION

3/4"-UPVC

TO ClO2 GENERATOR

FQ FT L

FT

M

3/4"-UPVC

CP

PSV

3/4"-UPVC PD 3/4"-UPVC

PI

M

XL XL

PSV

3/4"-UPVC PD 3/4"-UPVC

PI

M

XL XL

ACID DOSING PUMPS
(1U68-P-102 A/B)
CAPACITY : 50 LPH
HEAD : 25 M

REF. DWG. NO.	REFERENCE DRAWING TITLE

NOTES :-

1. FOR STANDARD SYMBOLS AND NOMENCLATURE REFER DRAWING NO. B946-000-79-41-1191/1192.
2. TWO NUMBER SAFETY SHOWER & EYE WASH FACILITY TO BE PROVIDED AS PER TENDER SPEC.
3. HCl STORAGE TANK TO BE LOCATED IN DYKE WALL.
4. ALL SIGNALS & CONTROLS TO BE ROUTED TO PLC BASED CONTROL SYSTEM. ALL INTERLOCKS SHALL BE REALISED IN THE PLC. REPEAT SIGNAL FROM PLC TO MAIN CONTROL ROOM SHALL BE PROVIDED.
5. SEPARATE NEUTRALIZATION SYSTEM/PIT TO BE PROVIDED FOR HCL & NaClO2
6. PD : PULSATION DAMPNER
   CP : CALIBRATION POT
   SC : SAMPLING CONNECTION
   SS : STORM WATER SEWER
   UC : UTILITY CONNECTION
   FA : FUME ABSORBER
7. CONTRACTOR TO PROVIDE A SUITABLE CAPACITY OF PUMP FOR EMPTING N-PIT QUANTITY.
8. LEVEL SHALL BE READABLE AT GRADE.

INTERLOCK LOGIC : -

INTERLOCK NO	ACTUATED BY	ACTION UPON
I-1101	LALL-1101	TRIP PUMP 1U68-P-101 A/B
I-1101	LAHH-1101	TRIP PUMP 1U68-P-102 A/B

REV	DATE	DESCRIPTION	BY	CHKD	APPD	PEM
0	14.07.25	ISSUED FOR TENDER	AB	UJ/MJ	VS	

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NRL NUMALIGARH REFINERY LIMITED.

POLYPROPYLENE UNIT

PIPING & INSTRUMENTATION DIAGRAM
HCl HANDLING SYSTEM FOR CLO2 PACKAGE
COOLING WATER TREATMENT SYSTEM

SCALE	JOB NO.	UNIT	DIVN.	DEPT.	DWG. NO.	REV.
NTS	C050	1U68	17	42	11111	0

3-1641-0501 REV.5/ 06.12.2024 A1-841x594

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OTHERS VENDOR

NaClO2 TANKER

3"-UPVC

FT FQ

FT

DI

M

2"-UPVC

1/2"

SC

LAHH LAH LAL LALL

I 1101

LI 1101

LT

LI

LT

LI 1102

LAH LAL

NOTE-8

UC

2"

2"-UPVC

3"-UPVC

ACID/ALKALI PROOF TILING

DYKE WALL

3"-UPVC

3"-UPVC

3"-UPVC

ACID/ALKALI PROOF TILING

SS

NEUTRALIZATION PIT
(NOTE-5)

3"-UPVC 2"-UPVC 3"-UPVC 2"-UPVC

PI PI

M M

I 1102 I 1102

XL XL XL XL

NaClO2 UNLOADING
PUMPS
(1U68-P-103 A/B)
CAPACITY : 15 M3/HR, 15M HEAD

3/4"-UPVC

NaClO2 STORAGE
TANK
(1U68-T-102)

3/4"-UPVC

TO ClO2 GENERATOR

FT FQ L

FT

M

3/4"-UPVC

CP

3/4"-UPVC

PD

PSV

PI

M

I 1102

XL XL

3/4"-UPVC

3/4"-UPVC

PD

PSV

PI

M

I 1102

XL XL

NaClO2 DOSING PUMPS
(1U68-P-104 A/B)
CAPACITY : 50 LPH
HEAD : 25 M

REF. DWG. NO.	REFERENCE DRAWING TITLE

NOTES :-

1. FOR STANDARD SYMBOLS AND NOMENCLATURE REFER DRAWING NO. B946-000-79-41-1191/1192.
2. TWO NUMBER SAFETY SHOWER & EYE WASH FACILITY TO BE PROVIDED AS PER SPEC.
3. HCl STORAGE TANK TO BE LOCATED IN DYKE WALL.
4. ALL SIGNALS & CONTROLS TO BE ROUTED TO PLC BASED CONTROL SYSTEM. ALL INTERLOCKS SHALL BE REALISED IN THE PLC. REPEAT SIGNAL FROM PLC TO MAIN CONTROL ROOM SHALL BE PROVIDED.
5. SEPARATE NEUTRALIZATION SYSTEM/PIT TO BE PROVIDED FOR HCL & NaClO2
6. PD : PULSATION DAMPNER
   CP : CALIBRATION POT
   SC : SAMPLING CONNECTION
   SS : STORM WATER SEWER
   UC : UTILITY CONNECTION
   FA : FUME ABSORBER
7. CONTRACTOR TO PROVIDE A SUITABLE CAPACITY OF PUMP FOR EMPTING N-PIT QUANTITY.
8. LEVEL SHALL BE READABLE AT GRADE.

INTERLOCK LOGIC : -

INTERLOCK NO	ACTUATED BY	ACTION UPON
I-1101	LALL-1101	TRIP PUMP 1U68-P-103 A/B
I-1101	LAHH-1101	TRIP PUMP 1U68-P-104 A/B

REV	DATE	DESCRIPTION	BY	CHKD	APPD	PEM
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POLYPROPYLENE UNIT

PIPING & INSTRUMENTATION DIAGRAM
NaClO2 HANDLING SYSTEM FOR CLO2 PACKAGE
COOLING WATER TREATMENT SYSTEM

SCALE	JOB NO.	UNIT	DIVN.	DEPT.	DWG. NO.	REV.
NTS	C050	1U68	17	42	11112	0

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FROM HCl
DOSING PUMPS

3/4"-UPVC

FROM NaClO2
DOSING PUMPS

3/4"-UPVC

COOLING WATER SUPPLY HEADER
C050-1U68-79-41-1111

2"(H)-CWS-1U68-43008-A3A

FQ
FI
L
FT
M

ClO2 GENERATOR
(1U68-LZ-101 A)
CAPACITY : 7Kg/hr
(NOTE 4)

2"-UPVC

FQ
FI
FT
M

TO COOLING TOWER SUMP
C050-1U68-79-41-1111

1/2"
SC

HL
NOTE-4

FQ
FI
L
FT
M

ClO2 GENERATOR
(1U68-LZ-101 B)
CAPACITY : 7Kg/hr
(NOTE 4)

2"-UPVC

REF. DWG. NO.	REFERENCE DRAWING TITLE

NOTES :-

1. REFER NOTES IN P&ID NO:C050-79-41-1U68-1111.
2. ALL INSTRUMENTATION, CONTROL & INTERLOCK SYSTEM AS REQUIRED FOR ClO2 GENERATOR SHALL BE PROVIDED AS PER CLO2 SYSTEM VENDOR RECOMMENDATION.
3. THE FOLLOWING INSTRUMENTATION & CONTROL ARE MINIMUM REQUIREMENTS OF ClO2 GENERATOR
   - ON/OFF IN THE INLET LINES OF ACID/NaClO2/DILUTION WATER TO INDIVIDUAL GENERATORS WITH STATUS INDICATION IN PLC.
   - TRIP OF CLO2 GENERATOR INCASE OF FAILURE OF DILUTION WATER SUPPLY.
   - TRIP OF CLO2 GENERATOR IN CASE OF FAILURE OF OTHER CHEMICALS SUPPLY.
   - RELIEF VALVES FOR OVER PRESSURE SAFETY IN THE GENERATOR.
4. ClO2 DETECTOR SHALL BE PROVIDED IN THE ClO2 GENERATOR ROOM.

REV	DATE	DESCRIPTION	BY	CHKD	APPD	PEM
0	06.08.25	ISSUED FOR TENDER	AB	UJ/MJ	VS	

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NUMALIGARH REFINERY LIMITED.

POLYPROPYLENE UNIT

PIPING & INSTRUMENTATION DIAGRAM
CLO2 GENERATOR
COOLING WATER TREATMENT SYSTEM

SCALE	JOB NO.	UNIT	DIVN.	DEPT.	DWG. NO.	REV.
NTS	C050	1U68	17	42	11113	0

3-1641-0501 REV.5/ 06.12.2024 A1-841x594

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TECHNICAL DOCUMENTATION FRONT SHEET

Total Pages: 23

NUMALIGARH REFINERY LIMITED

NRL EXPANSION PROJECT

SPECIFICATION FOR INTERNAL COATING OF PIPING

D2	06-May-2021	Issued for Design/Enquiry	NR	DGK	NR		Digitally signed by Medini Kumar Bora Date: 2021.05.06 11:30:31 +05'30'	
D1	08-Jan-2021	Issued for Design/Enquiry	NR	DGK	NR			
Rev.	Date	Reason for Issue	Prepared by	Checked by	Approved by	Prepared by	Reviewed by	Reviewed by
			Discipline Engineer	Discipline Lead	Contractor Representative	Discipline Engineer	Project Engineer	Department Head

Numaligarh Refinery Limited

NRL		
Category	Code	Description
Facility Area Code	0Z	Common Document
Document Type		Specification
System Number	00	General
Life Cycle	01	Disk Ref.:

Originator / Contractor	Asset Code	Discipline	Document Type	Sequence Number	Revision
NR	0ZZZZ	CV	SPE	0019	D2

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FOREWORD

This document covers the Specification for Internal Coating of Piping for the new grass-root projects and also for the revamping projects handled In-house, using new materials.

This document is equally useful for the maintenance projects carried out through the “Management of Change” (MOC) procedures, if the internal coating of the piping is carried out. The work shall be certified by NRL inspection team in such cases.

This document serves dual purpose (i) It specifies the core requirements of NRL, which all external consultants are required to adhere to, (ii) It serves as a guideline for NRL’s In-house projects. Therefore, some of the details furnished hereinunder, may be or may not be relevant to the external Consultants. These details are meant for the guidance of the NRL personnel. If external consultants are in doubt about the validity and/or the applicability of a particular detail, they should consult NRL for the clarifications.

Attempts have been made to align the requirements with the Indian statutory regulations and national and international codes and standards, minimising the Owner’s preferences over the established norms. The consultants and the contractors shall ensure this spirit is maintained throughout the execution of the projects.

Although, it is recognized the engineering consultants may desire to modify, delete, or amplify sections of the national and international codes and standard, it is strongly recommended such modifications, deletions, and amplifications are initiated by supplementing the relevant national and international norms rather than by rewriting the revised clauses into consultants’ documents. Any modification(s) to the national and international codes and standards and to NRL specifications shall not be acceptable, unless approved by the concerned code authorities or NRL, as the case may be.

Throughout the document, the term “NRL” is used. It represents NRL Engineer(s) and the external parties, such as the Process Licensors, Consultants in various roles, Engineering Contractors, Suppliers, Sub-suppliers, Site Contractors and the third-party Inspectors engaged by NRL to act on behalf of NRL in a context-sensitive manner.

Compliance with this Specification does not in itself confer immunity from the mandatory legal and statutory requirements. In the event of a conflict of requirements, the order of precedence shall be as follows: (a) Indian Statutory Regulations like PNGRB, OISD, CPCB, IBR, (b) Project Specifications, (c) NRL Specifications, (d) Applicable Codes and Standards, (e) Process Licensor’s specific requirements. In case, the process licensor(s) requirements have a conflict with the documents higher in the hierarchy, they shall submit a list of deviations, detailing how their requirements differ and why these requirements need to be implemented.

NRL documents are drafted for viewing on a computer-screen as few diagrams may use colours to enhance clarity and viewing experience. If printed on a black-and-white printer, few diagrams may not reflect correctly.

NRL engineers will continue to enrich this document based on their in-house experience and the feed-back received from the consultants and contractors. Feedback, comments or suggestions derived from the application of this document at any stage of the project design, purchase, construction, field installation, commissioning, operation and maintenance are welcome and should be directed to NRL.

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1.0 SCOPE

This Specification describes the minimum requirements for surface preparation, application, inspection and testing of liquid epoxy and fusion bonded epoxy coating materials intended to be applied on the internal surfaces of steel piping, pipeline, weld joints and fittings. The Lining schedule shall be as below:

Pipeline Service	DFT Requirements	Pipeline Coating	Girth Weld	Fittings
Effluent Water, Produced water, Oily water, Hydrocarbon Condensate	Min 375µm & Max 625 µm.	Fusion Bonded Epoxy (FBE)	Fusion Bonded Epoxy (FBE)	Fusion Bonded Epoxy (FBE)
Brackish Water, Fire Water, Sea (Brine) Water	Min 300µm & Max as per the PDS	Liquid Epoxy	Liquid Epoxy	Liquid Epoxy
Fresh Water / Potable Water / Drinking Water	Min 375µm & Max 625 µm.	Epoxy / FBE	Epoxy / FBE	Epoxy / FBE

2.0 APPLICATION

All the materials and equipment used for surface preparation, lining application, inspection and testing shall conform to the requirements of this Specification and the referenced Standards and codes.

3.0 TERMINOLOGY

3.1 Definitions

For the purposes of this Specification, the following definitions shall apply.

a) **Applicator:** An organization, contractor or subcontractor having the technical capability, knowledge, equipment, qualified personnel that is approved by NRL for the lining processes as required by this Specification.

b) **Batch:** The quantity of lining material produced during a continuous production run and identified by a sequential batch number.

c) **Cathodic Disbondment:** The destruction of adhesion between a lining and the coated pipeline surface caused by products of a cathodic reaction.

d) **Cutback:** The length of the steel pipe left uncoated at each end of the pipe for jointing by welding.

e) **Gel Time:** Time Taken for specified volume of coating powder to become non-deformable under specified conditions after melting.

f) **Glass Transition Temperature:** The temperature at which a polymer changes from hard and brittle to soft and pliable.

g) **Holiday:** A discontinuity in a protective coating (e.g., cracks, pinholes, voids, etc.) that exhibits electrical conductivity when exposed to specific voltage.

h) **Weld Zone:** As used in this Specification, weld zone is the uncoated area on the pipeline that results when two joints with lining cutback are assembled in the field.

3.2 Abbreviations

CSA	Canadian Standards Association	PD	Pipe Diameter
DFT	Dry Film Thickness	PDS	Product Data Sheet
FBE	Fusion Bonded Epoxy	PE	Polyethylene
FTIR	Fourier Transform Infrared Spectroscopy	PP	Polypropylene
HCl	Hydrochloric Acid	PQT	Procedure Qualification Test
HSE	Health, Safety and Environment	QA	Quality Assurance
MSDS	Material Safety Data Sheet	QC	Quality Control
NACE	National Association of Corrosion Engineers	SSPC	Society for Protective Coatings

4.0 REFERENCE STANDARDS, CODES AND SPECIFICATIONS

4.1 Codes & Standards

The latest edition of the following standards, codes and specifications shall applicable:

API RP 5L7	Recommended Practice for Un-Primed Internal Fusion Bonded Epoxy Coating of Line Pipe
API RP 5LW	Recommended Practice for Transportation of Line Pipe on Barges and Marine Vessels
API RP 2217A	Safe Work in Inert Confined Spaces in the Petroleum and Petrochemical Industries
ASTM D522	Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
ASTM D4060	Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D5420	Standard Test Method for Impact Resistance of Flat Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
ASTM D7588	Standard Guide for FT-IR Fingerprinting of a Non-Aqueous Liquid Paint as Supplied in the Manufacturer's Container
AWWA C210	Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
AWWA C213	Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
ISO 2808	Paints and Varnishes - Determination of Film Thickness
ISO 8501-1	Preparation of Steel Substrates Before Application of Paints and Related Products - Visual Assessment of Surface Cleanliness - Part 1: Rust Grades and Preparation Grades of Uncoated Steel Substrates and of Steel Substrates After Overall Removal of Previous Coatings
ISO 8501-3	Preparation of Steel Substrates Before Application of Paints and Related Products - Visual Assessment of Surface Cleanliness - Part 3: Preparation Grades of Welds, Edges and Other Areas with Surface Imperfections
ISO 8502-3	Preparation of Steel Substrates Before Application of Paint and Related Products - Tests for the Assessment of Surface Cleanliness - Part 3:

	Assessment of Dust on Steel Surfaces Prepared for Painting (Pressure-Sensitive Tape Method)
ISO 8502-6	Preparation of Steel Substrates Before Application of Paints and Related Products - Tests for the Assessment of Surface Cleanliness - Part 6: Extraction of Soluble Contaminants for Analysis - The Bresle Method
ISO 8502-9	Preparation of Steel Substrates Before Application of Paints and Related Products - Tests for the Assessment of Surface Cleanliness - Part 9: Field Method for the Conductometric Determination of Water-Soluble Salts
ISO 9000	Quality Management Systems
NACE No.1	Joint Surface Preparation Standard White Metal Blast Cleaning
NACE No.2	Joint Surface Preparation Standard Near-White Metal Blast Cleaning
NACE TM0174	Laboratory Methods for the Evaluation of Protective Coatings and Lining Materials on Metallic Substrates in Immersion Service
NACE TM0185	Evaluation of Internal Plastic Coatings for Corrosion Control of Tubular Goods by Autoclave Testing
NACE TM0186	Holiday Detection of Internal Tubular Coatings of 250 to 760 µm (10 to 30 mils) Dry-Film Thickness
NACE RP0287	Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces using a Replica Tape
NACE RP0394	Application Performance and Quality Control of Plant Applied Fusion Bonded Epoxy External Pipe Coating
NACE RP0490	Holiday Detection of Fusion Bonded Epoxy External Pipeline Coatings of 250 To 760 Microns (10 to 30 mils)
NACE SP0274	High voltage electrical inspection of pipeline coatings.
SSPC SP1	Steel Structure Painting Council - Solvent Cleaning
SSPC PA2	Steel Structure Painting Council - Measurement of Dry Coating Thickness with Magnetic Gauges
SSPC SP10	Near White Metal Blast Cleaning

4.2 Specifications

TP-1ZZZA-PR-BOD-0001	Process Design Basis Overall
NR-0ZZZZ-CV-SPE-0020	Specification for Evaluation & Certification of Blasting & Coating Contractor / Applicator Personnel
NR-0ZZZZ-EL-SPE-0019	Specification for Hazardous Area Classification

5.0 ENVIRONMENTAL CONDITIONS

For environmental conditions in NRL, refer to TP-1ZZZA-PR-BOD-0001, which provides the detailed design information regarding the environmental, site and utility supply conditions prevailing throughout the NRL facilities.

6.0 HEALTH, SAFETY AND ENVIRONMENT

a) The Contractor / Applicator shall assure the compliance of necessary HSE requirements with a view to minimize the consequences and impacts of hazards on the surrounding environment and adjoining facilities as well as the occupational health and safety of working personnel.

b) Appropriate Permit to Work (PTW) with applicable Job Safety Analysis (JSA) document for the work to be carried out shall be prepared by the Contractor and submitted to NRL for review

and approval prior to starting work. The PTW and JSA documents shall address all relevant HSE requirements specified by the Coating Manufacturer and the applicable NRL HSE Procedures.

c) All Contractor / Applicator personnel shall have successfully undergone all the applicable training required for the pertinent coating application processes and such personnel shall be able to produce valid documentary evidences at the time of evaluation.

d) The Contractor personnel, including supervisory and inspection / testing personnel, involved in the coating processes, including pipe handling, cleaning and application processes, shall use the appropriate personal protective equipment (PPE) during the respective coating process.

e) The Contractor shall take all necessary precautionary measures to ensure the safe handling of pipes during the coating application.

f) The Contractor shall ensure that all equipment and accessories utilized for the coating application processes, including pipe handling and cleaning processes shall be in safe condition and certified by NRL.

g) All requirements stipulated in API RP 2217A shall be followed for internal coating of larger diameter pipelines in which any manual application of coating/ lining are envisaged.

h) All chemicals being used for surface preparation & lining / coating applications shall have a Material Safety Data sheet (MSDS) in the workplace and the storage, handling & application of such chemicals for surface preparation & Lining / Coating applications shall be as per Manufacturer's recommendations / MSDS.

i) All Applicator / Contractor personnel performing any surface preparation activity / coating applications shall use all the necessary Personnel Protective Equipment (PPE) and clothing appropriate for that application / activity.

j) All waste (Hazardous / non-hazardous) generated from the subject activities shall be managed and disposed safely as per NRL HSE requirements.

k) Safety precautions for Blast Cleaning Work shall be taken as per NRL HSE Procedures.

7.0 COATING MATERIALS

7.1 General

a) The products, excluding FBE, shall be capable to withstand a minimum operating temperature up to 65°C. Where the lining is applied for temperature higher than 65°C, it shall be specified in the project document. In such cases the product shall withstand at least 5°C above the maximum operating temperature specified. The lining material intended to use for such higher temperature shall have respective test certificates from independent laboratory.

b) All the products shall be capable to withstand a minimum pressure of 1000 psi. The products intended to be used for pressure higher than 1000 psi shall withstand recommended maximum operating pressure. The lining material intended to be used in such high-pressure services shall have respective test certificates from independent laboratory.

c) The FBE coating shall be capable of withstanding service temperature of 85°C continuously in oil, gas and water applications. It shall have excellent flexibility and high resistance to chemicals and undercutting at discontinuities. The products intended to use for temperature higher than 85°C shall withstand at least 5°C above the recommended maximum operating temperature.

d) For potable / drinking water service lines, the lining shall possess valid certificate of clearance to use on storage items intended to store water for human consumption from the Department of Public Health, Assam or valid certificate from internationally recognized approving agency such as WRAS (Water Regulations Advisory Scheme). The certified true copy of the test reports shall be submitted for NRL approval.

e) The lining applicator / manufacturer shall provide technical Specifications, Material Safety Data Sheets, physical properties and laboratory testing certificates for NRL review and approval.

f) All the lining materials intended to be used shall have a proper proven track history for the last Five (5) years in a similar media. The history including contact information and year applied shall be submitted to NRL for review and approval.

7.2 Materials Packaging and Storage

a) Lining materials shall be packaged and delivered along with pertinent Material Safety Data Sheets (MSDS) to the site in original, tightly sealed, Manufacturer's containers with batch code numbers, date of manufacture and date of expiry clearly marked thereon.

b) Lining materials shall be stored in covered cool dry areas and shall be kept clean, dry and free from any contaminants prior to and during application. Storage shall be as per the Lining Manufacturer Recommendations.

c) Lining materials shall have a minimum shelf life of twelve (12) months.

7.3 Liquid Epoxy Lining System

a) The lining material shall be of Phenolic or Epoxy resin. Original Certifications shall be submitted to NRL from independent testing laboratory that the lining when applied as per this Specification meets the criteria specified in **Table-1**.

Table-1: Physical and Performance Requirements for Liquid Epoxy Lining

Properties	Test Method (Note 1)	Requirements
FTIR Finger Printing	ASTM D7588	For material used for test panel preparation.
Adhesion	ASTM D4541	10 Mpa
Adhesion (after immersing the lining into 65°C water for 24 hours. The temperature of the test piece shall be brought down to lab conditions prior to adhesion test).	ASTM D4541	7 MPa
Atlas Cell Testing in Crude and Brine.	NACE TM0174, Method A (6 months) at 65°C*	ASTM D714 (No Blisters) ASTM D610 Degree of rusting shall be 9 or better. Hardness and Adhesion as per TM-0174.
Autoclave Test @ 93°C	NACE TM 0185	1000 Psi (min) and for 16 Hours.
Impact Test	ASTM D5420	2 Joules minimum.
Cathodic Disbondment @ 65°C for 30 Days	ASTM G 42	8 mm Max.
Flexibility Test	ASTM D522 / CSA Z245.20	No failure with 220mm mandrel
Abrasion resistance	ASTM D4060 (1000 cycles, CS17 wheel)	100 +/-10 mg weight loss or reduction in thickness < 40 microns.

Table-1: Physical and Performance Requirements for Liquid Epoxy Lining		
Properties	**Test Method (Note 1)**	**Requirements**
Note-1: Vendor can submit test reports or conduct tests as per international standards like ASTM, AWWA, NACE, CSA & ISO.		

7.4 Fusion Bonded Epoxy (FBE) Coating System

a) The FBE coating system shall consist of a primer coat and an epoxy powder top coat.

b) The primer shall be based on polyamide epoxy compound, phenolic modified.

c) The epoxy powder physical properties and the performance properties of the laboratory applied FBE materials shall be as per the **Table-2**.

Table-2: Physical and Performance requirements for FBE Material		
Properties	**Test Method (Note 1)**	**Requirements**
Specific gravity	API 5L 7	As per manufacturer +0.05 g/cc
Particle Size	API 5L 7	0.1% max retained on 60 mesh (250 microns)
Gel Time	API 5L 7	As per manufacturer +20%
Cure Cycle	API 5L 7	Capable of cure at temperature below 260°C.
Moisture content	API 5L 7	0.50% max (any suitable method)
Abrasion Resistance	API 5L 7 Appendix 8	20 mg max.
Adhesion	API 5L 7 –Appendix 9	2500 psi
Autoclave Test	API 5L 7 –Appendix 10	Free of blisters, Cracks, Delamination or other defects.
Cathodic Disbondment Test	API 5L 7 –Appendix 11	8 mm Max.
Chemical Resistance	API 5L 7 –Appendix 12	Without blistering.
Flexibility Test	API 5L 7 –Appendix 13	2.5°/PD at 5°C.
Hot water soak	API 5L 7 –Appendix 16	Rating Max 3
Note-1: Vendor can submit test reports or conduct tests as per international standards like ASTM, AWWA, NACE, CSA& ISO		

8.0 SURFACE PREPARATION

8.1 General Requirements

a) All root welding of pipes which are to be internally coated shall be done with suitable welding to have a smoother weld penetration or flushing of weld shall be carried out after approval by NRL.

b) The pipe internal surface shall be prepared to the satisfaction of NRL and in accordance with the requirements of this Specification and the recommendations of lining manufacturer. The contractor shall submit a detailed surface cleaning procedure for NRL review and approval.

8.2 Contaminants / Deposits Removal

a) The Applicator shall submit, for NRL review and approval, a surface preparation procedure, associated inspection methods, monitoring techniques and details of equipment to be used.

b) Prior to blast cleaning of pipe surface, foreign materials like scales / deposits, oil, grease, mill, lacquer, wax, old or temporary coatings, dirt, mud etc. shall be removed by the applicable methods.

c) Solvent cleaning shall be carried out in accordance with SSPC SP1 for the items which require the removal of hydrocarbon / chloride contamination.

d) Those solvents (e.g., Hexane, Xylol, etc.) that do not leave any oily residue on the surface shall be used.

e) Mechanical cleaning by scraper / wire brush pig and wiping down with clean lint free cloth can be used to remove contaminants from the interior pipe surface. Burn off Oven method can also be utilized for the effective removal of contaminants.

f) Pipe Lines previously used in salt water or brine service may contain chloride contamination. Insoluble chlorides usually require chemical treatment for removal. A sodium bicarbonate ($NaHCO_3$) wash or proprietary specialty chemical formulations shall be used for chloride removal, followed by high pressure water jetting. After chloride removal a final dry blasting is required prior to the Lining Application.

8.3 Defect / Imperfection Removal

a) Before surface preparation starts, each pipe shall be visually examined for dents, laps, defective bevels and any other defects to avoid lining unusable pipes. Defective pipes shall be removed from the lining line for repair or, if repair is not possible, rejection.

b) All surface imperfections such as slivers, scabs, slag, weld spatter etc. shall be removed or made smooth by wire brushing / grinding before the start of abrasive blast cleaning.

c) After any grinding or mechanical repairs, the remaining wall thickness shall be checked and compared with the minimum requirements of the code / specification. Pipes not meeting the minimum wall thickness shall be rejected.

8.4 Blast Cleaning

a) After the pre-cleaning operations, the interior steel pipe surface shall be abrasive cleaned.

b) Silica sand or Copper slag shall not be used as an abrasive material.

c) The surface anchor pattern, surface profile and presence of residual chlorides shall be in accordance with **Table-3 & 4** of this Specification.

d) Those surfaces with residual chloride level higher than the recommended value are to be cleaned chemically or by any other suitable method which shall lower the contamination level to the acceptable level as set in this Specification.

e) All dust and blast cleaning materials shall be removed from the interior surfaces of the blasted material prior to lining application or subsequent process.

f) The blast cleaned surfaces shall be verified for the presence of dust which shall meet the criterion specified in the **Table-3 & 4** of this Specification.

g) Blast cleaned pipe surfaces shall be protected from wet / humid air, rainfall and surface moisture conditions. No pipe shall be allowed to flash rust prior to lining application. If flash rusting occurs, the surfaces must be re-cleaned by blasting as above.

h) Surface profile shall be inspected using a replica tape and recorded in the daily production report.

i) Any grinded surface on a blast cleaned surface with an area larger than 25 cm^2 shall be re-blasted to the cleanliness and roughness as specified above.

j) For pipes which are below DN 100 (NPS 4") diameter, where the surface profile cannot be verified, the Applicator shall demonstrate the same on a split pipe to NRL for accepting the machine operator. The same operator shall be utilized for the entire work.

9.0 LINING APPLICATION AND QUALIFICATION

9.1 Liquid Epoxy Lining Application

a) Shop & Field Lining Application

i) The liquid epoxy lining of internal surfaces of pipes, pipelines, spools, connections and fittings shall be performed in accordance with the requirements of this Specification. Any area not specifically covered, shall be in accordance with AWWA C210.

ii) For pipes which are below DN 100 (NPS 4") diameter where the lining cannot be verified for Dry Film Thickness (DFT) and pinholes, the applicator shall demonstrate the lining application on a split pipe to NRL for accepting the machine operator. The same operator shall be utilized for the entire work.

iii) The cured Lining System shall be tested for pinholes / holidays and the entire pipe / spool shall be 100% pinhole free.

iv) Assure each coat is applied in a uniform thickness end to end, without any sags, floods, runs, blisters, bare spots and over spray.

v) Manufacturer's recommended curing interval shall be strictly adhered.

vi) The minimum DFT and the maximum thickness of the total lining system shall be as specified in **Table-3** of this Specification. The maximum DFT shall not be more than the manufacturer's recommended reading in the approved product data sheets.

vii) The internal cutbacks shall be a minimum of 50 mm from the ends of the pipe.

viii) The internal lining shall extend 10 mm on to the flange face in order to avoid creeping. The remaining flange face shall be coated with phenolic epoxy to a maximum DFT of 70 microns.

ix) Threaded connections, to be assembled and operated in the field, shall be left uncoated and shipped with anti-rust compound or strippable protective coating applied to the thread only. After final assembly, the compound shall be removed and any exposed thread shall be coated

b) Field Girth Weld Coating – Liquid Epoxy

i) The cured girth weld lining shall possess same property as of main line lining. DFT of the girth weld lining shall be as same as the mainline lining and shall be over coated to the existing lining to at least 100 mm.

ii) The contractor shall provide a detailed field joint lining procedure for NRL review and approval. The procedure shall conform to the requirements of this Specification.

9.2 Fusion Bonded Epoxy (FBE) Coating Application

a) Shop Application Method for Pipes, Spools and Fittings

i) FBE coating application for pipes, spools, connections and fittings shall be performed in accordance with the requirements of this Specification. Any area not specifically covered, shall be in accordance with AWWA C213 & API RP 5L7.

ii) The cured coating system shall be tested for pinholes / holidays and the entire pipe / spool shall be 100% pinhole free.

iii) When gas fired air circulated oven is utilized for heating, the oven shall be pre heated and the temperature shall be maintained in 180°C for at least 20 minutes prior to the loading of primed materials.

iv) Epoxy primer shall be applied (except for sweet hydrocarbon service piping) to a freshly prepared internal surface

v) The primer applied pipes, spools & fittings shall not be stored more than Four (4) hrs. from application timing. If the next process not carried out within 4 hours, the primer applied components shall be re-blasted.

vi) Pre-heating time/cycle time shall be recorded for each individual item.

vii) The fluidized epoxy powder, shall be uniformly applied to the preheated pipe, spool or fittings using flock spray techniques. Electrostatic spray technique shall be utilized to apply controlled DFT on flange faces.

viii) The internal lining shall extend 10 mm on to the flange face in order to avoid creeping. The remaining flange face shall be coated with phenolic epoxy to a maximum DFT of 70 microns.

ix) Jet air system method shall be allowed to be used for fluidized powder coating of pipes of diameters less than 150 mm (6 inches), the preheated pipe shall be rotated while the predetermined charge of powder is forced into and through the pipe. This is to assure continuous and uniform film thickness.

x) After the FBE coating application, the pipes / fittings shall be conveyed into the oven for curing in accordance with the manufacture's recommendations.

xi) The graph of post curing temperature shall be submitted along with the final reports.

xii) The cured coating shall meet the DFT requirements as specified in **Table-4.**

xiii) The internal cutbacks shall be a minimum of 50 – 75 mm the ends of the pipe / fittings.

b) Field Girth Weld Coating - FBE

i) The welded joints of FBE coated pipes shall be FBE coated. Suitable line travel FBE field girth weld coating equipment shall be used for internal cleaning, inspection and coating operations. PQT and daily sample joint application shall be made on a Pup piece. This Pup piece shall be the representative sample of the actual pipe joint with similar metallurgy ,diameter and thickness.

ii) The internal weld zone shall be cleaned free of all contaminants; weld spatter imperfections and exposed metal shall be blast cleaned to a minimum surface cleanliness of SA $2^{1}/_{2}$ in accordance with this Specification. Both ends of the pipes and welded spools shall be capped to prevent entry of dust and other foreign contaminants. Before carrying out the welding of pipe , weld joint identification shall be marked (leaving sufficient space after the coating overlap) on any one side of weld joints.

iii) The adjacent FBE coating shall be roughened by a suitable method i.e., light blasting, for a distance of 25 mm back from the cutback.

iv) Field FBE coating of the weld zone and the adjacent FBE coating shall be applied immediately after surface preparation inspection and approval.

v) The weld area shall be heated to a coating application temperature, recommended by coating manufacturer, using a suitable external induction heating coil. Immediately after heating, the weld area shall be uniformly coated with fluidized epoxy powder, using a suitable spray head system, for a minimum thickness of 375 microns and a maximum of 625 microns.

vi) The weld joint coating shall overlap the original pipe coating by minimum of 25 mm. DFT on the overlap and shall not exceed 1000 microns.

vii) The contractor shall submit a detailed application procedure for NRL review and approval.

Note: All joints shall be 100% holiday tested and DFT shall be measured as per sub-clause 9.2(b)-v & 9.2(b)-vi of this Specification. Visual inspection, DFT & holiday test shall be video recorded.

9.3 In-Situ Lining

a) General

i) In-situ Internal Cleaning and Coating Technology shall utilize special pigs to clean the pipeline mechanically followed by chemically and then to apply a corrosion-resistance coating to the full length of the pipeline.

ii) The Applicator shall have at least Five (5) years of successful application history in similar type of pipelines. The track history shall be submitted to NRL along with relevant contact details of the client for the job being carried out.

iii) Coating material shall be capable of not sagging or losing its ability to hold onto vertical surfaces, when applied in the recommended thickness.

iv) Drop out spool (Test Spool with girth welds in both open ends) shall be placed on equal intervals as instructed by NRL for the respective work order. Inspection shall be performed at dropout spools and any other accessible areas (downstream & up stream of the pipe line at drop out spool locations, valves etc.).

v) Oil-free air compressors and high-quality air dryers shall be utilized for the work.

vi) The Contractor / Applicator shall prepare a detailed application procedure which shall include but not be limited to the below mentioned requirement.

b) Surface Preparation

i) The entire cleaning procedure shall include, but not be limited to the following steps:

a1) Scraper Pig Cleaning

a2) Wire brush scraper

a3) Solvent and / or alkaline degreasing

a4) Inhibited acid rinse

a5) Inhibited water rinse

a6) Surface passivation

a7) Solvent drying

ii) Chemical used for cleaning and contamination removal shall be compatible with the coating system and as per the recommendation of coating manufacturer.

iii) Pipe line shall not be left more than Six (6) hours after acid batching. If such case is envisaged, the line shall be neutralized with inhibited potable water.

iv) Concentration of HCI shall be cross checked with “Iron Wool” test in addition to the titration method.

v) For surface preparation, the contractor shall prepare a detailed procedure incorporating the steps specified in clause 14.2(a) in this Specification and submit to NRL, for review and approval.

vi) The acid cleaning shall remove all residual iron oxide , mill scales and shall produce a surface finish cleanliness equal to, and not less than, a SA 2½ (near white metal cleaning).

vii) Prior to coating application the dew point at the receiver shall be made consistent with the dew point at the launcher.

c) Coating Application

i) Curing interval between coats shall be as specified by the coating manufacturer.

ii) The coating used in one pig run shall not be reused for the next pig run.

iii) A minimum of three (3) successive coats of epoxy coating shall be applied to achieve a total minimum DFT of 300 micron.

iv) Contractor shall maintain the following logs during course of work as described below. NRL inspector shall verify each log daily as part of permanent records.

a1) Run numbers

a2) Approximate batch sizes

a3) Approximate run times & velocity

a4) “Pig” selections

a5) Batch types

a6) Approximate PSIG pressures

a7) Temperatures, relative humidity & dew point

a8) Any other documentation/data deemed relative, such as pH values, patch concentrations

d) Inspection& Acceptance of In-Situ Lining

i) Purging air shall be 10°C below the pipeline temperature to prevent moisture forming in the internal wall of the pipe.

ii) The cleaning and coating applicator shall determine when the pipeline surface is to be inspected and shall notify the NRL inspector of the estimated inspection schedule.

iii) Flash rust after hydrochloric acid cleaning is anticipated and shall be cleaned by wiping the surface of the spool with a clean cloth and hydrochloric acid so as to clearly expose the surface.

iv) The acid cleaned surface shall be of SA 2½ as per ISO 8501-1.

v) Any evidence of inadequate surface cleaning shall need additional surface preparation.

vi) Black Light or Infrared Analyzer shall be used for determining the presence of hydrocarbons.

vii) Inspection may be called by the NRL any time within the coating application process to verify consistency and thickness of the coating.

viii) Coating consistency for Dry Film Thickness (DFT) measurement shall be as follows:

a1) The Minimum Coating Thickness shall be based on the Theoretical Calculation (carried out by Contractor / Manufacturer) approved by NRL, and shall not be less than 300 microns. Measurement of DFT shall be as per SSPC PA-2.

a2) If coating thickness falls outside the minimum and maximum range (recommended by the manufacturer), items shall be reprocessed at contractor / applicator's cost.

ix) The pipe internal lining shall be 100% pinhole free when tested using a pinhole tester (wet sponge tester). The voltage for holiday test shall be 90V DC unless otherwise specified by the coating manufacturer.

x) The cured coating shall be tested for adhesion pull off test as per ASTM D4541 on the test plates, delivering results in excess of 8 MPa.

xi) X – Cut test may also be carried out as per ASTM D6677 in addition to the pull off test in drop out spools for further evaluation of coating integrity. Acceptance values shall be rating 8 or 10.

xii) The integrity & appearance of the coating shall be verified with internal crawler cameras inserted through both upstream & downstream ends of the pipe line in all drop out spool pits. The camera shall be capable to verify minimum 40 meters distance.

9.4 Qualification of Product, Applicator and Application Procedure

a) General

i) The Contractor's coating inspector, blasters, applicators, foreman and supervisor shall be qualified by Coating Manufacturer and NRL as per NR-0ZZZZ-CV-SPE-0020.

ii) Details of the employee's experience for lining work shall be submitted to NRL for review and approval.

b) Qualification of New Products and Applicator

i) Qualification of new product and Applicator shall be carried out based on application procedure submitted by the Applicator. The lining procedure shall be approved only after the successful qualification of the Lining System.

ii) NRL shall have right to select the size and pipe / fittings for qualifications.

iii) Qualification of lining repair shall be performed on minimum three (3) repairs for each procedure / methods.

iv) The qualification test shall be repeated on an additional pipe / fittings subject to NRL approval. If retesting fails, the Applicator shall be disqualified.

v) All testing shall be carried out as per **Table-3** of this Specification for Liquid Epoxy or **Table-4** of this Specification for FBE.

c) Qualification of Application Procedure

i) The application procedure shall be qualified by a Procedure Qualification Test (PQT). Test methods, frequencies and acceptance criteria for PQT shall comply with the requirements as specified in **Table-3 / Table-4** of this Specification.

ii) Qualification tests shall be carried out on representative pipes having the same diameter and thickness of the pipeline and shall be witnessed by NRL.

iii) All tools and equipment (e.g. for induction heating, abrasive blasting, lining application and inspection) being used for PQT shall be of the same type intended to be used for the actual field joint lining.

iv) At least one (1) test sample shall be coated for PQT.

v) To carry out the application of blasting, lining, the Contractor or Applicator shall use only experienced and qualified manpower who had been tested by the Manufacturer and NRL. The Applicators for Liquid Epoxy and FBE for fitting and spools shall possess certificates from the Lining Manufacturer as well as NRL Qualification Card as per Specification NR-0ZZZZ-CV-SPE-0020.

vi) In addition, the Applicator shall appoint a NACE or equivalent Certified Inspector with relevant field experience of not less than five (5) years. The certified inspector shall be responsible for the proper application of the Lining System.

10.0 MARKING, TRACEABILITY, HANDLING, SHIPPING AND STORAGE

10.1 Marking and Traceability

a) The Contractor shall establish a system to record the identity of each pipe prior to lining. Where mill stencil information is removed during lining operation, the Contractor shall employ all necessary arrangements to maintain traceability of each joint of pipe so that exact stencil information is restored after lining.

b) The marking shall be legible from a distance of 1.5 m to 2 m with letter of not less than eight (8) mm size.

c) Marking shall be stenciled on the coated pipe utilizing waterproof permanent paint. It shall be written in English in the following sequence:

i) Lining applicator name

ii) Pipe identification No.

iii) Outside diameter in millimeters

iv) Wall thickness in millimeters

v) Pipe length in meters

vi) Pipe grade

vii) Pipe process of manufacture

viii) Date (DD/MM/YY) and batch of lining

d) Each pipe length / fittings shall be clearly marked on the outside surface "**Internally Epoxy Coated**".

e) Bare pipes/ fittings received in damaged or showing defects that may impair the lining such as extensive laminations, burrs, gouges, pits, metal slivers shall be reported to NRL for dispositions / clearance.

f) The Applicator shall provide details of storing and handling bare, during shop application & coated pipes / fittings.

g) Coated pipes shall be stored on padded skids, sand bags or other suitable means.

h) Coated pipe shall be handled with wide belt slings, padded forks or other means that shall not damage the pipe. Chains, cables likely to cause damage to the pipe lining shall not be used.

10.2 Handling, Shipping and Storage

a) Careful handling of coated pipe during stacking, loading, transportation, stringing and lowering shall be undertaken to avoid undue physical damage or deterioration to the lining system.

b) Adequate padded equipment and trained personnel shall be employed to carry out the specific loading and storage operation procedures. A load spreader beam shall be used for pipe lifting and for pipe lowering.

c) Separators shall be used when stacking coated items. A minimum of three (3) rubber rings shall be used for each 12 m pipe.

d) Coated items shall be placed on wooden skids covered with rubber when stringing.

e) Beveled ends shall be protected with suitable "caps" approved by NRL.

f) Unless otherwise specified, the loading and shipping of pipes shall be in accordance with API RP 5LW.

g) Pipe lining damaged during handling, transportation or other operations shall be repaired to the satisfaction of NRL and at the applicator's expense. The repair shall be in accordance with clause 12.0 of this Specification.

11.0 INSPECTION AND TESTING

a) An Inspection & Test Plan (ITP) for the lining application and inspection shall be prepared by the contractor and approved by the NRL. The ITP shall be prepared in line with the NRL requirements and shall include a Pre-Inspection Meeting (PIM).

b) NRL inspector(s) shall have the right to inspect at all times any tools, materials and equipment used in the performance of surface preparation and lining application to ensure compliance of this Specification.

c) NRL inspector(s) shall have access to all parts of the application plant concerned with the storage, surface cleaning, lining application, inspection, testing, and handling of coated pipes and material. in order to ensure compliance with this Specification.

d) NRL representative shall be authorized to take the photographs of the tests being carried out on the lining. They shall be also authorized to take photographs of any defective area, if any, within the lining.

e) The Contractor shall perform all inspections and tests that are necessary to assure that the lining complies with the requirements of this Specification on the selected pipe/ fittings, prior

to offering to NRL representatives. The inspection of the coated pipes shall be performed by qualified coating inspectors as specified in NR-0ZZZZ-CV-SPE-0020.

f) All the inspections activities need to be performed by the Contractor prior to informing to the NRL inspector.

g) For pipes / spools where close visual inspection is not possible, line travel pipe internal video camera inspection shall be used to confirm acceptable surface preparation prior to lining.

Table-3: Inspection & Testing During PQT for New Product & Applicator during Application of Liquid Epoxy Lining

Sl. No.	Description	Frequency	Procedure	Acceptance Limit
1	Material Certificate	Every Batch	**Table-1**	**Table-1**
2	Bare Pipe / Fittings	Every Batch	ISO 8501-3	Damage, Surface defects & steel conditions
3	Ambient & Dew Point Conditions	Start of shift and every 2 hrs.	ISO 8502-4	R.H≤85%, 5°C above Dew Point & as per NRL Specifications
4	Surface Preparation	Start of Shift and every 2 hrs.	NACE 1 or 2	Manufacturer Data Sheet
5	Anchor Pattern	Start of shift and every 2 hrs.	NACE RP 0287	Manufacturer Data Sheet
6	Dust Grade on Blasted surface	Start of shift and every 2 hrs.	ISO 8502-3	Rating ≤ 2
7	Maximum Chloride level	Start of shift	ISO 8502-6 &9	2µg/sq.cm
8	Lining Application	Each Pipe & Fittings	As per this Specification & Approved procedure	As per this Specification
9	Lining Visual Inspection	Each Pipe	As per this Specification	Free from Blisters/Sags/ Cracks, uniformity and Pinholes.
10	Lining Thickness – Each Coat	Start of shift and every 2 hrs. for pipes and every fitting/spool.	SSPC PA2 & As per this Specification	Min 300µm & Max as per the PDS
11	Adhesion Test	Per Shift	ASTM D 6677	Rating 8 or 10
12	Adhesion Test	Start of shift	ASTM D4541	10 MPa
13	Holiday Test	Each Pipe	NACE TM0186	No Pinholes

Table-4: Inspection & Testing During PQT for New Product, Applicator During Production for FBE

Sl. No.	Description	Frequency	Procedure	Acceptance Limit
1	Material Certificate	Every Batch	**Table-2**	**Table-2**
2	Bare Pipe / Fittings	Every Batch	ISO 8501-3	Damage, Surface defects & steel conditions

Table-4: Inspection & Testing During PQT for New Product, Applicator During Production for FBE				
Sl. No.	**Description**	**Frequency**	**Procedure**	**Acceptance Limit**
3	Ambient & Dew Point Conditions	Start of shift and every 2 hrs.	ISO8502-4	R.H≤85%, 5°C above Dew Point & as per NRL Specifications
4	Surface Preparation	Start of Shift and every 2 hrs.	NACE 1 or 2	Manufacturer Data Sheet
5	Anchor Pattern	Start of shift and every 2 hrs.	NACE RP 0287	Manufacturer Data Sheet
6	Dust Grade on Blasted surface	Start of shift and every 2 hrs.	ISO 8502-3	Rating ≤ 2
7	Maximum Chloride level	Start of shift	ISO 8502-6 &9	2µg/sq.cm
8	Primer Thickness	Each Pipe & Fittings	---	15 µm to 25µm or as per Manufacturer PDS
9	Pre-Heating & Surface Temperature	Complete cycle & Monitoring and Log / Batch Graph	As per Manufacturer Data Sheet	Approved Temperature
10	Lining Application	Each Pipe & Fittings	As per this Specification & Approved procedure	As per this Specification
11	Lining Visual Inspection	Each Pipe	AWWA C213	Free from Blisters / Sags / Cracks, uniformity and Pinholes.
12	Lining Thickness	Start of shift and every 2 hours for pipes and every fitting/spool.	AWWA C213	Min 375µm & Max 625 µm.
13	Adhesion Test	Per Shift	ASTM D 6677	Rating 8 or 10 as per manufacture data Sheet
14	Adhesion Test	Start of shift	ASTM D4541	8 MPa on test plates
15	Holiday Test	Each Pipe	NACE RP 0490	No Pinholes
16	Water Soak Test	Once Per day	API 5L 7 –Appendix 16*	Rating 1 -3
17	Interface Porosity	Once Per day	NACE RP0394	Rating 1-2 (fig G2)
18	Cross-Section Porosity	Once Per day	NACE RP0394	Rating 1-2 (fig G1)
19	Degree of Cure ΔTg	Every Shift	NACE RPO394	-2°C to +3 °C
20	Flexibility	PQT Only	API RP 5L7*: 2.5°/PD at 5°C.	No Cracks
21	CD Testing without primer	PQT Only	API RP 5L7*; 48hrs@66°c, -1.5V	Max. Average Radius 8.0mm
* Or Equivalent International Standard				

12.0 REPAIR OF LINING DAMAGES OR DEFECTS

a) Repair should be made to all portions of protective lining suffering visual damages, defects, imperfections or that fail shop or field inspection and testing.

b) Repairs on each 12 m length pipe shall not be more than 3 repairs of 25 cm^2 size. In the case of weld joints and fittings not more than 2 repairs of 5 cm^2 shall be repaired.

c) In case of repairs which exceeds than what is defined above, the subject item shall be reprocessed after completely removing the existing coating at applicator's cost.

d) Accessible areas of the pipe requiring repair shall be prepared to remove any debris and defective lining using suitable method recommended by lining manufacturer. The adjacent surrounding sound lining, 2.5 cm on all sides, shall be feathered / roughened using light blasting. All dust, debris, etc. shall be removed before repair application.

e) Repair epoxy lining system shall be applied on the prepared areas and the adjacent lining to the minimum DFT of the original pipe lining.

f) Areas not accessible for lining repair, shall be reprocessed and completely recoated as set forth in the original Standard.

g) Repairs shall be electrically inspected using holiday detector. All coated pipes shall be holiday free before shipment from the plant.

13.0 QUALITY ASSURANCE

a) The coating manufacturer and contractor shall operate quality system to ensure that the requirements of this Specification are achieved. The quality system shall preferably be based on ISO 9000 series of standards and the manufacturer and contractor shall demonstrate compliance by providing a copy of the accredited certificate or the manufacturer's and contractor's quality manual.

b) Verification of a manufacturer's or contractor's quality system is normally part of the pre-qualification procedure, and is therefore not detailed in the core text of this Specification.

14.0 DOCUMENTATION

14.1 General

a) All correspondence, instructions, data sheets, drawings, procedures, ITP and any other written information shall be in English language. In case of dual languages, one language shall be in English.

b) All dimensions, units of measurement, physical constants etc. shall be in SI units unless otherwise specified. (Pipe diameter shall be mentioned in inches).

c) All documents (text, data sheets, specifications, method statements etc.) shall be provided with electronic files in the approved software such as (MS Word, Excel, AutoCAD etc.) as applicable.

14.2 Work Proposal

The applicator shall submit, for NRL review and approval, a surface preparation and application procedure and details of equipment to be used. The field joint Lining Application Procedure shall include the following items:

a) Lining PQT procedure

b) Inspection & Test Plan

c) Operator training and certification procedure

d) Surface preparation of field joint lining area and factory coating overlaps

e) Inspection of field joints after surface preparation

f) Pre-heat method and description of equipment

g) Liquid epoxy primer application procedure

h) Heat shrink sleeve installation procedure

i) Field repair procedure

j) Testing and inspection of applied lining

k) Quality Control / Quality Assurance procedures

l) Equipment list including all cleaning, heating, lining, testing and inspection equipment to be used.

14.3 Work Records and Reports

The contractor shall operate a comprehensive recording and reporting system on all aspects of the surface preparation, coating application, inspection and testing. The data shall be set out on a coating record and data sheet within 24 hours of carrying out a specific work. A sample of this record and data sheet is shown in clause 15.0 of this Specification.

14.4 Final Report

A final report shall be submitted on completion of the coating works. The final report shall include a summary on all works performed and the final results of inspection and testing performed.

15.0 APPENDIX-1: PIPE / FITTINGS INTERNAL COATING RECORD & DATA SHEET

PIPE / FITTINGS INTERNAL COATING RECORD & DATA SHEET

Prepared by.....Checked by..... Date:.....

Items to be coated.....NRL Drawing No..... Location.....

Total Surface Area to be Coated.....m².

Type of work: □ New Construction □ Reconditioning / Rehabilitation

Project No.....

Contract No..... Contractor / Vendor Name.....

A) Items To be Coated Details

A1. Pipe Details

Nominal Pipe Size.....mm .

Actual Pipe Outside Diameter.....mm.

Pipe Internal Surface Area.....m².

Process of Manufacture .....

A2. Fitting/Attachment Details

Flanges.....Type..... Valves.....Type.....

Spools.....Type..... Others.....

B) Surface Preparation

□ Contaminants Removal □ Imperfection Removal □ Pipe Surface Pre-heating

□ Mechanical Scraper/Brush Cleaning

□ Blast Cleaning : Abrasive type.....Abrasive Sieve Size.....

Visual Standard.....Surface Profile.....

C) Weather Conditions

Ambient Temperature °C..... Dew Point.....

Relative Humidity (%)..... Surface Temperature °C .....

Other Weather Conditions (e.g., Rain, wind).....

D) Coating Materials

□ Type of Coating.....(As per clause 7.0 of this Specification)

Primer Product Name..... Batch No.....

Top Coat Product Name ..... Batch No.....

Material Performance Laboratory Testing.....

Manufacturer.....

E) Coating Application

Application type □ Shop/Plant □ Field

	Application Method.....
	Application Equipment.....
	Application Temperature(s).....
	Curing Temperature..... Curing Interval(s).....
	Cutbacks.....
F)	Inspection & Testing
F1.	Prepared Surface
	Surface Appearance (i.e., Video Camera Inspection).....
	Surface Cleanliness.....
	Visual Standard.....
	Surface Profile.....
F2.	Coated Surface
	Coating Appearance (i.e., Video Camera Inspection).....
	Primer DFT.....As per SSPC PA2
	Total Coating DFT..... As per SSPC PA2
	Holiday Detection Results.....As per NACE SP0274
	Adhesion Test (Pull- Off Test) Results.....As per ASTM D4541
	Repair.....Type.....Location.....(As per Clause 12 of this Specification)
	Marking.....(As per Clause 10 of this Specification)

Tested by:	Approved by:
Name:.....	Name:.....
Signature:.....	Signature:.....

Remarks :

****

JOB SPECIFICATION
STATIC & MACHINERY EQUIPMENT
ANNEXURE-C: ROTATING EQUIPMENT

COOLING TOWER PACKAGE
TENDER No.: C050-1U68-81-45-PB-T-8010

PROJECT : **EPCM SERVICES FOR POLYPROPLENE PROJECT AT NUMALIGARH REFINERY**

UNIT : **RECIRCULATING COOLING WATER SYSTEM**

CLIENT : **M/s NUMALIGARH REFINERY LIMITED(NRL)**

EPCM : **M/s ENGINEERS INDIA LIMITED (EIL)**

JOB NO. : **C050**

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
A	13.08.2025	ISSUED WITH TENDER	RPT	ME	TK

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1. GENERAL

1.1. Scope

This Specification covers the design criteria for the purpose of carrying out Engineering for Procurement of rotating equipment required and their requirements with regard to spare parts & special tools. This Job Specification shall be applied for Cooling Tower & CWTP package Cooling Tower & CWTP package (Tender no. **C050-1U68-81-45-PB-T-8010)** for **Polyproplene Project At Numaligarh Refinery** of M/s NRL.

The Contractor shall use data sheets / proformas as enclosed in this section of the bid package, for carrying out engineering for procurement at his end.
For the equipment, for which no such data sheets / proformas are furnished by PMC/Owner, the Contractor may use his standard data sheets / proformas or of Equipment Manufacturer's standard data sheets/ proformas.

1.2. Selection of Rotating Equipment

Selection of Rotating Equipment shall be based upon the following considerations:

- Suitability for the specified duty conditions.
- Standard Models under vendor's regular range of manufacture.
- Proven Track record in similar service as specified under acceptance criterion.
- Optimum operating and maintenance costs.
- Maximum Interchangeability of parts.
- Ease of operation and maintenance.

1.3. Order of Precedence

The design, manufacturing, testing etc. for the above equipment shall be as per the following documents applicable to this equipment and shall be in the same order of precedence:

a) Process data sheet/ Design data
b) P & IDs
c) This specification
d) Equipment Data Sheets
e) Applicable Standard specifications of individual equipment
f) Other International/National codes and standards referred to.

However, in case of any conflict, contractor shall bring out the same to the notice of Owner/PMC. Owner/PMC's decision shall be final.

1.4. In case deviations are considered essential by the contractor (after exhausting all possible efforts), these shall be clearly brought out and consolidated under technical exception chapter at bidding stage. However, vendor specific deviation (if any) to applicable codes/specifications shall be subject to NRL/EIL's approval during Detailed Engineering.

1.5. Electrical items, Instrumentation & Controls, Piping, Pressure Vessels, Mechanical equipment, Heat exchangers etc. associated with rotating equipment shall comply with the design requirements as given in the respective Engineering documents enclosed in the bid package.

1.6. Equipment design and engineering shall incorporate adequate safety features (as per applicable specifications of respective equipment as well as Health, Safety and Environment Codes & Standards applicable for the subject project) to provide protection to operating personnel, equipment and environment.

1.7. All electrical components & installations, instruments shall be suitable for the electrical area classification and grouping in which the equipment is installed.

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1.8. All drains shall be terminated with a flanged valve at the equipment battery limit. Further piping required for safe disposal shall be done by contractor.

1.9. All vents shall be taken to safe location, depending upon the properties of fluid to be vented.

1.10. Equipment noise level (For Driver + Driven Equipment + Auxiliary) shall not exceed 85 dBA when measured at 1 m distance from the equipment skid in any direction.

1.11. Maximum allowable working pressure and temperature of the equipment shall not be less than the design pressure and temperature specified in the data sheet nor less than those specified in specifications, codes and standards.

1.12. Unless otherwise specified, Equipment shall be either driven directly or through gearbox.

1.13. Driven equipment & drivers (including gear units and couplings if any) shall be designed to perform satisfactorily under specified start up conditions, part load operation, maximum differential pressure operation and relief valve set pressure and up to full speed.

1.14. Couplings between driver and driven equipment shall be of all metallic, non-lubricated flexible element type (i.e either diaphragm coupling or flexible membrane or flexible metallic disc pack) with spacer for all equipment except Diesel engine, for which manufacturer's standard may be followed.

1.15. Only Stainless-Steel shims shall be used for equipment alignment.

1.16. All rotating equipment base plates shall have jacking provision for leveling and screws for alignment. The jacking bolts shall be of stainless steel.

1.17. All rotating equipment shall be unitized along with their drivers at respective rotating equipment manufacturer's works.

1.18. Thermal relief valves shall be provided for components that may be blocked in by isolation valves including any cooling water return circuit piping of a cooler or a jacket.

1.19. For all equipment located on grade level, the height of foundation shall be minimized for easy accessibility, when it is not possible to do so suitable working platform shall be provided around the equipment for ease of operability and maintenance.

2. SCOPE OF SUPPLY AND WORK

Scope of supply and work shall be as indicated in Document No. **Annexure-C to C050-1U68-80-42-SOW-8010** forming part of this tender.

3. APPLICABLE CODES AND STANDARDS

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

S. NO.	EQUIPMENT DESCRIPTION	STANDARDS / CODES / SPECIFICATION
1.	Standard Specification for Centrifugal Pumps (Water Service)	EIL Standard Specification (6-41-0003)
2.	Centrifugal Pumps (General Purpose Process)	EIL Standard Specification (6-41-0002)
3.	Positive displacement (Controlled Volume) Pumps	API 675, EIL Standard Specification (6-41-0021)
4.	Dosing Packages	EIL Standard Specification 6-41-0301
5.	All other rotating equipment not listed above	Mfr. Std. (Also refer Engineering Design Basis - SME)

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For design aspects not specifically covered by datasheets, specification, codes & standards or regulations, the design shall be based on good engineering practices.

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4. EXPERIENCE CRITERIA

Experience Criteria specified in individual applicable standard specification should be applied for acceptance of all the offered Rotating Equipment.

5. SPECIAL REQUIREMENTS

5.1. SPECIAL REQUIREMENTS FOR CENTRIFUGAL PUMPS (LARGE CAPACITY WATER SERVICE-LCWS, for tag@ 1U68-PA-4301 A/B/C)

5.1.1. Selection of centrifugal pump model shall be based upon the following considerations:

- Suitability for the specified duty conditions
- Standard models under vendor's regular range of manufacture
- Proven track record

5.1.2. The pump model shall be from the existing pump model series. The offered model(s) shall be from the regular manufacturing range of the vendor & shall be proven for similar operating conditions ***(Prototypes/upgraded models are not acceptable)***.

5.1.3. All cooling water pumps shall be of horizontal, single stage & axially split type and shall be suitable for parallel operation from shut-off to end-of-curve limits.

5.1.4. Standard performance / characteristic curves for centrifugal pumps indicating maximum, rated & minimum impeller diameters over the complete operating range (viz. Q-H; Q-Eff.; Q-Power; Q-$NPSH_R$).

[Note: Computer generated print-outs shall be duly substantiated by the standard performance curves and supported by duly certified test data. Truncated performance curves shall become the basis for rejection.]

5.1.5. Bidder to furnish performance curves of pumps in operation duly superimposed on the system resistance.

5.1.6. All the pumps offered shall be from the regular manufacturing range of the vendor. Only previously demonstrated efficiencies for similar operating condition supported by test certificates shall be considered as valid. Vendor to furnish test certificates for the offered pump model in support of the value of efficiency quoted. *Quoted efficiency value shall not exceed 92%.*

5.1.7. $NPSH_R$ value shall be read from standard performance curve and NPSH margin should be at-least 1 m. The said $NPSH_R$ value shall correspond to the maximum value of $NPSH_R$ from rated flow down to the recommended minimum continuous stable flow specified by the vendor. Pump operation, even at extreme points (EOC: 120% of B.E.P. Flow) of the pump curve, shall maintain $NPSH_R$ below $NPSH_A$ throughout the curve.

5.1.8. Recommended rating for driver shall be based on 110% of pump rated BKW (including all transmission losses) or power at end of curve operation and open discharge valve condition of the pump, whichever is higher. The driver shall not be overloading over the entire range of operation.

5.1.9. All cooling water pumps shall be provided with non-API single balanced horizontal split seal type mechanical seal. Seal plan 11 with SS piping shall be provided. Tubing is not acceptable. Proper rigid piping for the seal system needs to be ensured.

5.1.10. All cooling water pumps shall have internal ceramic coating. Non-metallic wear rings shall be used in cooling water pumps.

5.1.11. Pump & driver including gear units (if any) and coupling shall be designed to perform satisfactorily under specified start up conditions, part load operation, maximum differential pressure operation & relief valve set pressure and up to full speed.

5.1.12. The maximum discharge pressure the pump is able to develop considering maximum suction pressure & maximum differential pressure including all test tolerances, when operating with the

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furnished impeller at the rated speed and maximum specific gravity at any specified operating condition, shall not exceed design pressure/ downstream design pressure specified in the respective process datasheet. Allowable working pressure & temperature of the rotating equipment shall be stringent of design pressure & temperature as specified in Mechanical/Process Data sheets.

5.1.13. Material of construction shall be as specified in the process data sheets / specifications. Vendors shall ensure that the materials offered for the equipment / components shall be suitable for the given application and installed environment.

5.1.14. Large Capacity Water Service (LCWS) Pumps shall be provided with non-API, balanced & horizontal split mechanical seals.

BEARINGS

5.1.15. All cooling water pumps shall be provided with oil lubricated bearings. Grease lubrication is not acceptable. This supersedes the requirement specified (cl. no. 2.7.2) in the standard specification (doc. no: 6-41-0003 Rev. 5).

5.1.16. All cooling water pumps shall be provided with desiccant breather, watchdog constant level oiler, separate oil sample point (if in case separate sample point is not possible, it must be through bearing housing drain) & bearing isolators (non-contact type) suitable for normal splash lubrication. Bearing isolators shall be of non-contact type.

5.1.17. 3D bulls' eye (360-degree view) to be provided in pump bearing housing for the easy monitoring of oil level and prevent lube oil related failures.

5.1.18. Oil Sight glass to be provided in bearing housing for visual inspection and identification of lube oil related failures.

INSPECTION & TESTING

5.1.19. The scope of Inspection and tests shall be as per the data sheets, ITPs and other referred /specified standards and specifications forming a part of this inquiry document.

5.1.20. Performance test of all pumps shall be done at rated flow & rated speed (this shall be done using shop driver) at pump vendor's shop. This shall continue as mechanical run test for 4 hours. Mechanical run test shall be carried out at full rated speed only.

5.1.21. NPSH test shall be with closed loop system.

5.1.22. All the pumps shall be subjected to dismantle & inspection after the above tests.

5.1.23. All LCWS pump hardware (impeller, casing internals, nuts & bolts etc) shall be provided with suitable internal performance enhancement coating. However, pump evaluation & testing will be carried out without considering coating. Pumps & internal shall be coated before dispatch.

5.1.24. Bidders shall provide cooling water sump model test for individual pump tag. Cooling water sump drawings shall be provided to the successful bidder post order to ensure that sump suction and discharge piping are suitable for the pump for smooth operation. Bidder shall furnish procedure along with the proper technical justification post order for EIL review.

5.1.25. Each rotating equipment shall be subjected to mechanical runt test (MRT) at vendor works.

5.1.26. All the pump units shall be subjected to unitization test at vendor's works.

5.1.27. Rejections made by Purchaser's Inspector, based on Inspection & Testing, shall be final. Acceptance by the inspector in no way release the vendor from guarantees as to materials, workman-ship, and performance of the equipment inspected.

5.1.28. Owner and/or his EPCM may participate along with their inspectors in any inspection and tests. The vendor shall notify to owner of all inspection and tests at least four weeks before the scheduled

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date of inspection and test and reconfirm the same at least one week before the date of inspection and testing.

5.1.29. **For LCWS Pumps, tag# 1U68-PA-4301 A/B/C:** The Vendor shall carry out detailed Computational Fluid Dynamics (CFD) analysis of the cooling tower basin and common pump intake arrangement. The objective of this analysis is to verify and ensure a hydraulically sound design. The CFD study shall demonstrate uniform flow distribution to all cooling water pumps, absence of surface, subsurface vortices/swirls, no air entrainment, minimization of recirculation zones, any flow separation and hydraulic losses. The analysis shall also confirm satisfactory hydraulic performance under different/entire pump operating combinations and varying water levels in the cooling tower basin. The Vendor shall submit the CFD analysis methodology, results/conclusions for Purchaser's review and approval.

5.2. **SPECIAL REQUIREMENTS FOR CENTRIFUGAL PUMPS (GENERAL PURPOSE PROCESS)**

5.2.1. Centrifugal Pump shall meet requirements as specified in Process Data Sheet, P&IDs, this Job specification, EIL Specification 6-41-0002 and other Specification referred therein.

5.2.2. Unless otherwise specified, Mechanical seals shall be of Cartridge design and shall conform to API Standard 682. Balanced mechanical seals shall be provided for centrifugal pumps (general purpose process service).

5.2.3. Seal flushing plans, piping material shall be of Stainless Steel. For cooling water plans, piping material shall be carbon steel.

5.2.4. The total head capacity curve of the pump should be continuously rising towards the shut-off.

5.2.5. Suction flange rating shall be same as that of discharge flange for all pumps.

5.2.6. Baseplates shall be provided with 2" flanged connection.

5.2.7. Equipment along with the drivers shall be procured from the respective driven equipment manufacturers as skid mounted units with all accessories, auxiliaries along with auxiliary piping.

5.2.8. A gate valve & a magnetic drain plug shall be provided for all centrifugal pumps bearing housings.

5.2.9. Centrifugal Pumps in H2SO4 / HCl / NaCl Service:

a) Material of construction for H2SO4 / HCl / NaCl unloading/transfer pumps shall be as specified in process package.

b) Single mechanical pusher type seal with single coil spring of Alloy-20 material, GFT/Ceramic Seal faces, Teflon secondary seals & Seal plan 11, 61 shall be used.

5.2. **SPECIAL REQUIREMENTS FOR POSITIVE DISPLACEMENT PUMP (CONTROLLED VOLUME)**

5.2.1. Pump shall meet the requirements as specified in Process Data Sheet, P&IDs, this Job specification, API 675 and EIL standard specification 6-41-0021.

5.2.2. Operating speed shall not be more than 100 strokes per minute.

5.2.3. Controlled Volume pumps shall be of double/sandwich diaphragm type with rupture detection system achieved through a pressure transmitter & a pressure gauge.

5.2.4. Pump unit complete with speed reducer, driver, suction pulsation dampener (if required or specified) & discharge pulsation dampener, suction and discharge manifold piping duly pre-fabricated for multi-head pumps, external relief valves, instrumentation & controls for diaphragm rupture detection system & automatic capacity control (as specified) etc. shall be mounted on a common baseplate and shall be supplied as a skid mounted package.

5.2.5. Controlled volume pumps shall have positive return stroke mechanism. Controlled volume pump with lost motion design or with spring return stroke mechanism shall not be permitted.

5.2.6. If automatic capacity control is required for any pump item, contractor shall provide 4-20 mA electronic signal for each of these pumps separately. All the necessary instruments required for

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automatic stroke adjustment shall be in vendor's scope of supply. In addition to the above, vendor shall provide necessary arrangement for manual stroke adjustment.

5.2.7. Only one number & common gas charging kit for discharge pulsation dampener (bladder / diaphragm, gas charged type) shall be supplied for a particular pump item tag.

5.3. **SPECIAL REQUIREMENTS FOR CHEMICAL DOSING SKIDS**

5.3.1. Chemical dosing skid supplier shall do the complete engineering for the chemical dosing package. Chemical dosing skid supplier shall meet the requirements of EIL standard Specification (6-41-0301)

5.3.2. Equipment shall meet the duty requirements and performance parameters as specified in process data sheets for dosing systems.

5.3.3. Equipment shall be designed for outdoor, without-roof and hazardous area location.

5.3.4. Strainers / Filters shall be provided before inlet of each pump as per respective P&IDs.

5.3.5. Drum Unloading Pump (if required)

a) Drum unloading pumps shall be of "Air Operated Double Diaphragm (AODD)" type.

b) Technical literature, manufacturer's standard performance curve, Plant air consumption data etc. for the AODD pumps & manufacturer's catalog for the flexible hoses shall also be submitted for purchaser's records during detailed engineering stage.

c) The drum unloading pumps wherever specified shall be of portable type, driven pneumatically i.e. by plant air and shall be suitable for the specified area classification.

d) These pumps shall be used for transfer of chemicals from the chemical drum / barrel (barrel of standard as 200 liters, placed on drum racks provided on the skid) to the dosing vessel/tank. Pumps shall be selected for a transfer rate of 1000 LPH.

e) For connecting the plant air supply to the air inlet side of each drum unloading pumps, air inlet shall be provided with an air dryer requiring no electric power, air filter cum regulator with pressure gauge, bleed type master air valve, pressure relief valve & flexible hoses of 10 m length. The air outlet shall be equipped with air discharge muffler.

f) For transferring the chemical from the drum/barrel to the dosing tank/vessel through drum unloading pump, flexible hose (suitable for handling the particular chemical) of around 5 m length with liquid filter, shall be provided in the inlet line. The outlet line should also be provided with a flexible metallic hose (suitable for handling the particular chemical) of around 5 m length with a check valve, isolation valve and a flanged connection which could be connected to the nozzle on the dosing vessel / tank.

g) The pump shall be provided with a suitable adapter such that it can fit on the top of chemical drum. Liquid inlet, outlet and air inlet connections of the pump shall be suitable for fitting the respective flexible metallic hoses.

h) The drum pump shall be procured from reputed vendors having proven experience for similar services. The pump shall be as per manufacturer's standard.

5.3.6. Skid

a) The skid shall be designed and built to ensure that all the equipment along with accessories, local control station(s) and piping are located and mounted suitably for ease & convenience of operation and maintenance.

b) All the components (i.e. dosing pumps with their drivers & accessories, pump inlet filters/strainers, calibration pots, dosing vessel/tanks, agitators with their drivers, instrumentation & controls, local control station(s) etc.) of a chemical dosing system shall be

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assembled & mounted on the respective skid(s), duly interconnected with piping & power/control cabling. The inlet and outlet connections for purchaser's interface shall be terminated at the skid edge with flanges of the specified sizes & ratings. The local control station(s) & the junction box(es) for instrumentation shall be located at the edge of skid.

c) Skid shall have a dedicated space (i.e. drum rack) for placing the chemical drum / barrel on it. The drum rack shall be located at one edge of the skid so that the chemical drum/barrel placed easily by the operator.

d) Skid shall be suitable for four point lift & shall be provided with lifting lugs.

e) Skid shall be provided with cable trays for routing of power / control cables.

6 EQUIPMENT STORAGE

6.1 All pumps shall be packed for an outside storage period of 12 months.

6.2 All the openings shall be plugged & sealed condition during dispatch.

6.3 Instruments like gauges, speed indicators, probes, oiler etc. shall be removed from the main equipment and dispatched separately to avoid the damage of these components during transportation handling and erection. The packing however, can be kept separately in same box as that of main equipment.

6.4 In addition to the normal packing the pump and motor skids shall be separately covered with weather and rain protection VCI (vaporize corrosion inhibitor) cover with opening for piping.

7 INSPECTION & TESTING

7.1 Inspection and Tests specified in Equipment Data Sheets, Applicable Specifications, Codes and Standards shall be carried out by the Equipment vendor at his works. Equipment Vendor shall furnish material test certificates showing the chemical & mechanical properties of the materials used in the equipment.

7.2 Contractor shall prepare Inspection and Test Plan for each equipment. These plans will form a part of the Enquiry Document as well as the Purchase Order on equipment vendor.

7.3 Contractor shall review material test certificates of all equipment. Contractor shall submit these certificates along with review records to OWNER.

7.4 Contractor shall conduct inspection and witness test of all equipment at vendor's works and issue inspection & test reports and records to OWNER.

7.5 OWNER and/or his consultant may participate with Contractor's inspectors in any inspection, test or non-destructive test. Contractor shall notify owner of all inspection and tests at least four weeks before the scheduled date of inspection and test and reconfirm the same at-least one week before the date of inspection and testing.

7.6 Field Trial Run Test/ Site Test

i. Field trial run test at site of the complete rotating equipment package shall be done under the supervision of respective rotating equipment vendors. This test shall be done with available media and load to ensure satisfactory performance, safe, smooth, reliable operation, mechanical integrity and sound level of the complete package.

ii. Modifications/ additions/ changes as required to resolve/ correct any fault in the rotating equipment package, detected during field trial run test shall be in that rotating equipment vendor's scope without any time/ cost implications to the purchaser.

iii. Duration of field trial run test for package shall be 72 hours. The duration of 72 hours shall be on sustained basis i.e. process interruptions shall be allowed to cumulate, however machine related interruptions shall not be counted.

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iv. If any additional equipment/ instruments are necessary in addition to those in rotating equipment vendor's scope of supply for the purpose of testing & measurement, that rotating equipment vendor shall bring them to site duly calibrated and shall take them back after successful completion. All utility and safety systems shall be operating during the test.

8 VENDOR DATA REQUIREMENT

Vendor Data Requirement as indicated in **Doc. # C050-1U68-80-42-VDR-8010** enclosed elsewhere in the tender package, shall be followed. Only critical vendor data/documents such as Equipment Data Sheets, P&ID's, Foundation Drawing, Equipment Layout, Inspection & Test Procedures etc. shall be taken for Owners/Consultant's review. All other drawings/documents shall be retained for Owners/Consultant's records.

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ANNEXURE-2: POLICY ON MAKE IN INDIA (MII)

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

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

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

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

1. The Principal or the Group Company shall be in the business of manufacturing of the offered product line (for at least last five years) for which the Indian Manufacturer is seeking to bid.

2. The Principal or the Group Company, whose PTR is being considered, shall already be enlisted either with EIL OR is in Licensor's vendor list, for the same product line[1].

3. The Principal or the Group Company shall have executed at least TWO orders for the same product line[1], within the last five years, reckoned from the bid due date.

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

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

1. The Bidder must be a subsidiary of the Foreign Principal (Principal holding at least 51% shares) for at least last one year, reckoned from the bid due date.

2. Scope/activity matrix between the Bidder and Principal or the Bidder and the Group Company, shall be submitted to EIL along with the bid. However, the bidder must also note that EIL shall reserve the right to mandate certain activities or sourcing to be from identified sources only, **(#)** depending upon the product line under consideration and its criticality. The bidder shall not claim any extra payment on account of any change in sourcing in-line with EIL's requirement.

3. The bidder shall source either bare performance & mechanical run tested machine from the Principal or the Group Company **OR** critical components from the Principal or the Group Company or directly from the manufacturers supplying the same to the Principal or the Group Company (a certificate to this effect shall be provided by the Principal or the Group Company) and source non critical components / auxiliary components supplies himself **(subject to # above)**.

[1]Same Product Line for Principal or Group Company: Same type of Equipment being sought (e.g. if a horizontal centrifugal pump (GPP) is being envisaged, the same product line would imply a horizontal centrifugal pump (GPP) having equal or higher that offered driver power).

[2]Same Product Line for Indian Manufacturer: Same type of Equipment being sought (e.g. if a horizontal centrifugal pump (GPP) is being envisaged, the same product line would imply a horizontal centrifugal pump (GPP) having at-least 50% of the (Offered driver power).

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4. The bidder shall have the necessary engineering, manufacturing capability and adequate infrastructure comprising of space, manpower, equipment corresponding to matrix cited above, duly approved by the Principal or the Group Company, as the case may be, for the product line under consideration.

5. As a minimum, the Principal or the Group Company as the case may be, shall carry out the following activities:
   - Design / Application engineering
   - Approval of sourcing of components
   - Approval of Quality Assurance Plans (QAP) identifying Hold, Check & Witness stages (by Principal)
   - Responsibility Matrix

6. The bidder shall have Manufacturing, Assembly and Testing facility for the proposed scope. However, in the remote case of the Manufacturer not having testing facility at all or not having appropriate testing facility, the Manufacturer shall outsource testing to another independent testing facility subject to acceptance by EIL.

7. The Bidder shall have an established service facility in India (either his own or an approved service provider) which must be approved by Principal or the Group Company, as the case may be.

8. The Bidder shall have executed and supplied minimum two orders in the same product line[2].

9. The Bidder shall be enlisted with EIL for the same product line[2].

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

DOCUMENTATION REQUIRED (ALONG WITH THE BID AND IN SINGLE LOT)

(i) General reference list of Principal/Group Company for the same product line, for the last five years
(ii) General reference list of bidders for the same product line
(iii) Filled-in ERP of Principal/Group Company, to qualify as per sr. nos. (a).1 & (a).3 above.
(iv) Filled-in ERP of bidder, to qualify as per sr. nos. (b).8 above.
(v) Certificate of Incorporation of the Bidder.
(vi) Documents for establishing the bidder as a subsidiary of the Foreign Principal (Principal holding at least 51% shares), to qualify as per sr. no. (b).1 above.
(vii) Documents for establishing the relationship of the group company, if applicable.
(viii) Scope / Activity Matrix between Principal / Group Company & bidder, duly approved by Principal/Group Company, to qualify as per sr. no. (b).2 above & as per sr. no. (b).5 above
(ix) List of critical components sourcing from Principal/Group Company, as per sr. no. (b).3 above.
(x) Letter from Principal/Group Company, to qualify as per sr. no. (b).4 above.
(xi) Letter from Principal/Group Company, to qualify as per sr. no. (b).7 above.
(xii) Enlistment Letter for Principal/Group Company, to qualify as per sr. no. (a).2 above.
(xiii) Enlistment Letter for bidder, to qualify as per sr. no. (b).9 above.
(xiv) Corporate Guarantee of the Principal/Group Company (in the format provided by EIL), to qualify as per sr. no. (b).10 above.

Note-1: In-case of MII option, CONTRACTOR to seek prior approval with above mentioned documentation from Owner/PMC along with FVSD. Only after final approval of FVSD from Owner/PMC, CONTRACTOR to shall submit the PR.

Note-2: PBG / Extender Warranty / Guarantee, etc. shall be pass-on to Owner/Client by CONTRACTOR. Refer commercial section for complete details.

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TECHNICAL DATA SHEET

COOLING TOWER

PROJECT:
CLIENT:

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

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S.NO	DESCRIPTION		BIDDER DATA
1.0	GENERAL		
1.1	MANUFACTURER'S NAME		
1.2	NUMBER OF CELLS		
1.3	STRUCTURE (MATERIAL)		
2.0	TOWER DATA		
2.1	TYPE		
2.2	FLOW		M^3/HR.
2.3	GUARANTEED DRIFT LOSS		%
2.4	EVAPORATION LOSS		%
2.5	ACTIVE TOWER VOLUME		M^3
2.6	SPLASH SURFACE		M^2
2.7	TOTAL WETTED SURFACE		M^2
2.8	MINIMUM PR. HEAD REQUIRD IN RISING MAIN AT 1.0M ABOVE FGL		M
2.9	WATER AREA / CELL		M^2
2.10	AIR INLET HEIGHT		M
2.11	AIR AREA / CELL		M^2
2.12	WATER FLOW / SQ. M OF WATER AREA		
3.0	OVERALL DIMENSIONS		
3.1	TOTAL LENGTH		M
3.2	TOTAL WIDTH		M
3.3	FAN DECK HEIGHT ABOVE BASIN CURB		M
3.4	FAN STACK HEIGHT		M
3.5	DIAMETER OF FAN STACK AT	STACK BASE	M
3.6		OUTLET	M
3.7	OVERALL TOWER HEIGHT		M
4.0	BASIN SIZE		
4.1	STORAGE CAPACITY (WITH CALCULATION)		M^3
4.2	LENGTH		M
4.3	WIDTH		M
4.4	DEPTH		M
4.5	MAXIMAM DEPTH OF WATER		M
4.6	MINIMUM DEPTH OF WATER		M
4.7	NORMAL OPERATING DEPTH OF WATER		M
4.8	FREE BOARD		mm

Date: / / (Bidder's signature with seal)

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S.NO	DESCRIPTION		BIDDER DATA
4.9	DIMENSION OF COLD WATER CHANNEL	WIDTH	M
		DEPTH	M
5.0	DISTRIBUTION SYSTEM		
5.1	TYPE (Description)		
5.2	HEIGHT OF HOT WATER INLET ABOVE BASIN CURB		M
5.3	NOZZLE DIAMETER		mm
5.4	SPECIFICATION OF ALL FLANGES		
5.5	NOMINAL DIAMETER & NUMBER OF HOT WATER INLET PER CELL		
5.6	NUMBER OF VALVES / CELL & SIZES		
6.0	FILLING SURFACES		
6.1	PURE FILM / SPLASH		
6.2	FLAT / CORRUGATED / TRIANGULAR		
7.0	INTERNAL FILL DETAILS		
7.1	FILL VOLUME OF ONE CELL		M^3
7.2	NUMBER OF LATH ROWS		
7.3	DISTANCE BETWEEN LATH ROWS	HORIZONTAL	mm
7.4		VERTICAL	mm
7.5	HORIZONTAL SPACING OF SPLASH BARS IN LATHS		mm
7.6	NET DIMENSION OF SPLASH BARS		mm
8.0	DETAILS OF MISCELLANEOUS SUPPLIES		
8.1	GANTRY & LIFTING TACKLES		
9.0	MATERIAL OF CONSTRUCTION		
9.1	FRAME WORK OF MEMBERS		
9.2	CASING		
9.3	PARTITIONS		
9.4	FILLING		
9.5	GRID DECKS		
9.6	LOUVERS		
9.7	FAN DECK		
9.8	FAN STACKS (FAN CYLINDERS)		
9.9	FAN RINGS FOR FAN STACKS		
9.10	DRIFT ELIMINATORS		
9.11	JOINT CONNECTORS & STRUCTURAL CONNECTORS		

Date: / / (Bidder's signature with seal)

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S.NO	DESCRIPTION	BIDDER DATA
9.12	NOZZLES & SPLASH PLATES	
9.13	DISTRIBUTION HEADER	
9.14	RISERS	
9.15	FLOW CONTROL VALVES	
9.16	BOLTS , NUTS , WASHERS	
9.17	NAILS	
9.18	ANCHOR CONNECTORS	
9.19	ANCHOR BOLTS	
9.20	CHAIN PULLEY BLOCK , MONORAIL (FOR LIFTING SCREENS)	
9.21	DOLLY / TROOLY, CHAIN PULLEY BLOCK, TRIPOD FOR FANS MOTORS ETC.	
9.22	TRACK	
9.23	PLATFORMS	
9.24	LADDERS , STAIRCASE & HANDRAIL	
9.25	MECHANICAL EQUIPMENT	
9.26	LATH SUPPORT & LATH	
9.27	OTHER HARDWARE & STEEL FITTINGS	
9.28	COLD WATER BASIN ,CHANNEL ,PITS & COLUMNS FOR FIXING MONORAIL	RCC
9.29	METAL INSERTS & CABLE TRAYS	
10.0	FAN DETAILS	
10.1	FAN MANUFACTURER	
10.2	MODEL NO.	
10.3	NUMBER OF FANS PER CELL	
10.4	TYPE	
10.5	MATERIAL OF FAN BLADES	
10.6	MATERIAL OF FAN HUB	
10.7	DIAMETER OF FANS	M
10.8	NUMBER OF BLADES	
10.9	BLADE ANGLE OF INCIDENCE	
10.10	NET DISCHARGE AREA	M^2
10.11	HUB DIAMETER	M
10.12	TOTAL DIFFERENCIAL PRESSURE (DROP) - mm H_2O)	
10.13	STATIC PRESSURE THROUGH COOLING TOWER - mm (H_2O)	
10.14	DROP THROUGH LOUVERS - mm (H_2O)	
10.15	DROP THROUGH FILLING - mm (H_2O)	
10.16	DROP THROUGH ELIMINATORS - mm (H_2O)	
10.17	VELOCITY PRESSURE - mm (H_2O)	

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S.NO	DESCRIPTION	BIDDER DATA
10.18	TOTAL EFFICIENCY OF FAN	
10.19	FAN AIR FLOW RATE / CELL	M^3 / HR.
10.20	SPEED	RPM
10.21	FAN TIP SPEED	M / Min.
10.22	FAN B.H.P.	
10.23	HORSE POWER TO DRIVE EACH FAN i. e. ACTUAL B.H.P. OF MOTOR	
10.24	NOISE LEVEL OF FAN AT RATED PITCH & SPEED	
10.25	FAN BALANCING	
10.26	AIR DENSITY AT FAN (KG.DRY AIR PER M^3)	
10.27	AIR DENSITY AT FAN (KG.MIXTURE PER M^3)	
10.28	TEMPERATURE OF OUTGOING MIXED AIR	
11.0	VIBRATION SWITCH	
11.1	TYPE , MAKE & MATERIAL SPEC.	
11.2	MAXIMUM VIBRATION AT WHICH IT TRIPS	
11.3	NORMAL VIBRATION ALLOWED IN TOWER	
12.0	GEAR REDUCERS	
12.1	TYPE	
12.2	NUMBER	
12.3	MODEL	
12.4	MANUFACTURER	
12.5	REDUCTION RATIO	
12.6	SIZE	
12.7	SERVICE FACTOR (AGMA) OF GEAR	
12.8	AGMA MECHANICAL H. P. RATING	
12.9	EFFINCIENCY	
12.10	NUMBER OF REDUCTIONS	
12.11	DESIGN BEARING LIFE	
12.12	OIL COOLING ARRANGEMENT	
12.13	LUBRICATION	
13.0	DRIVE SHAFT	
13.1	NUMBER PER CELL	
13.2	TYPE	
13.3	MODEL	
13.4	MANUFACTURER	
13.5	RATED H.P	
13.6	MATERIAL OF CONSTRUCTION	

Date: / / (Bidder's signature with seal)

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S.NO	DESCRIPTION	BIDDER DATA
14.0	COUPLINGS	
14.1	MAKE	
14.2	TYPE	
14.3	COUPLING BORE (NOMINAL)	
14.4	COUPLING MATERIAL	
15.0	RATING OF MOTOR , kW	

NOTES :-

1. Vendor to fill the required data in the data sheet & submit requisite number of copies.

Date: / / (Bidder's signature with seal)

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TOWER SIZING DATA FOR COOLING TOWER (BY FULKERSON'S METHOD)

PROJECT:
CLIENT:

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

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DATA FOR COOLING TOWER

S.N.	ITEM DESCRIPTION	UNIT	BIDDER'S DATA
1.	Cell Capacity	M^3 / HR.	
2.	Water flow / cell	US GPM	
3.	Cell size Length x Breadth	Ft. X Ft.	
4.	a) Water Area	$Ft.^2$	
	b) Water Loading	US GPM / $Ft.^2$	
5.	Fill Details		
	a) Fill Area	$Ft.^2$	
	b) Fill depth	Ft.	
	c) Type of Fill (**Quote Manufacturer's Name**)		
6.	L / G Ratio (Quoted) (Refer Note-1)		
7.	Air Velocity		
	a) Through Fill	FPM	
	b) Through Louvers	FPM	
	c) Through Eliminators	FPM	
8.	a) Air flow G	lb / min. / cell	
	b) Air density at inlet with 50% RH (Fulkerson's approach)	Lb. / $Ft.^3$	
	c) Air Inlet area per cell	$Ft.^2$	
9.	Leaving air enthalpy (H_{out}) From basic heat equation	BTU / lb.	
10.	Leaving air temperature	^{0} F	
11	Leaving air density		
	a) Mixture	lb. / $Ft.^3$	
	b) Average Mixture density	lb. / $Ft.^3$	
12	Entering Air Density		
	a) Dry Air	lb. / $Ft.^3$	
	b) Mixture	lb. / $Ft.^3$	
	c) Mixture density - Average	lb. / $Ft.^3$	
13.	Static Pressure losses (with density corrections) Refer Note-2		
	a) Louvers	Inch	
	b) Fill & Spray	Inch	
	c) Through drift eliminators	Inch	
	d) Total Pressure drop (Hs)	Inch	

Date: / / (Bidder's signature with seal)

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14.	a) Specific Volume of leaving air (Dry air)	Ft^3 / lb	
	b) Air per fan cell	CFM	
15.	Net Discharge Area NDA (Fan Area - Hub Area)	Ft^2	
16.	Velocity pressure Hv ={ Density out x (CFM / Cell)^2 } ÷ (1096.5 X NDA)^2	Inch	
17.	Fan Power Calculations :-		
	a) CFM / Fan cell :	CFM	
	b) Motor Efficiency	%	
	c) Gear Reducer Efficiency	%	
	d) Fan Efficiency	%	

NOTES :-

1. Using Fulkerson's paper and CTI demand curve.

2. Calculations, data obtained from use of charts, tables etc. shall show details & densities adopted at various steps in the tower.

3. In addition to the pressure drops listed, the drop due to air turning and the velocity recovery, if considered should be given in a parallel set of calculations for the part of calculations affected by such calculations.

4. A set of calculations sheets duly signed shall be enclosed.

Date: / / (Bidder's signature with seal)

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ELECTRICAL LOAD DATA

NOTES: -

1. Vendor shall fill the details of all electrical power consumer loads, which are included in the scope of this MR/Tender and submit with the offer.
2. Motors/load requiring emergency power supply shall be separately identified in this Electrical load data format.

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MOTOR

S.NO	TAG NO.	SERVICE	Make	Type of enclosure	Applicable standard for hazardous area application	Motor Kw	Duty (continuous /intermittent)	No. of poles	Type designation for cooling

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OTHER ELECTRICAL LOADS

S.NO	TAG NO.	SERVICE	Make	Type of enclosure	Applicable standard for hazardous area application	Rated KW	Duty (continuous /intermittent)	Voltage

Annexure-4

SPI Specificaiton Form Numbers

S.No.	Form Number	Process Function	Specification Sheet Title
1	1001	FLOW	Orifice Plates and Flanges
2	1002	FLOW	Restriction Orifice Plates
3	1003	FLOW	Flow Elements (Venturi)
4	1004	FLOW	Flow Elements (Flow Nozzle)
5	1005	FLOW	Averaging Pitot Tubes
6	1006	FLOW	Variable Area Flowmeter
7	1007	FLOW	Vortex Flow Meters
8	1008	FLOW	Magnetic Flowmeters
9	1009	FLOW	Mass Flowmeters
10	1010	FLOW	Ultrasonic Flow meters
11	1011	FLOW	Thermal Mass Flow Meter
12	1012	FLOW	Diff Pressure Instruments (Flow)
13	1101	TEMPERATURE	Temperature Gauges (Bimetallic, Filled System)
15	1102	TEMPERATURE	Temperature Switches
16	1103	TEMPERATURE	Optical Pyrometer
17	1104	TEMPERATURE	Temperature Transmitter
14	1105	TEMPERATURE	Temperature Elements, Thermo-wells
18	1201	LEVEL	Gauge Glasses and Cocks
19	1202	LEVEL	Level Gauge (Bi Colour)
20	1203	LEVEL	Magnetic Level Instruments (Indicator)
21	1204	LEVEL	Radar Level Instrument (Non-Contact)
22	1205	LEVEL	Spl. Level Instruments - Guided Wave Radar
23	1206	LEVEL	Spl. Level Instruments - Capacitance
24	1207	LEVEL	Spl. Level Instruments - Ultrasonic
25	1208	LEVEL	Spl. Level Instruments - Displacer / Float
26	1209	LEVEL	Spl. Level Instruments - Nucelonic
27	1210	LEVEL	Spl. Level Instruments - Servo
28	1211	LEVEL	Level Switch - Tunning Fork
29	1212	LEVEL	Diff Pressure Instruments (Level)
30	1301	PRESSURE	Pressure Gauges
31	1302	PRESSURE	Pressure Switches
32	1303	PRESSURE	Pressure Instruments
33	1304	PRESSURE	Diff Pressure Instruments
34	1401	Control Valve	Control Valves
35	1402	Control Valve	Special Control Valve (Butterfly, Angle, Ball)
36	1403	Control Valve	On-Off Valves
37	1404	Control Valve	Self Actuated Pressure Control Valves
38	1501	Relief Valve	Pressure Relief Valves
39	1502	Relief Valve	Pilot Operated Safety Valves
40	1503	Relief Valve	Breather Valve
41	1504	Relief Valve	Emergency Vent
42	1505	Relief Valve	Rupture Disc
43	1601	ANALYSER	LEL/HC Gas Detector
44	1602	ANALYSER	H2 Gas Detector

45	1603	ANALYSER	Toxic Gas Detector
46	1604	ANALYSER	CO Gas Detector
47	1605	ANALYSER	Flame Detector
48	1606	ANALYSER	Open Path Gas Detector (HC)
49	1607	ANALYSER	Open Path Gas Detector (H2S)
50	1608	ANALYSER	Portable Gas Det (Multi Gas)
51	1620	ANALYSER	pH Analyser
52	1621	ANALYSER	Conductivity Analyser
53	1622	ANALYSER	Density Analyser
54	1623	ANALYSER	Mositure Analyser
55	1624	ANALYSER	Water Quality (TOC) Analyser
56	1625	ANALYSER	Oxygen Analyser (Zirconia)
57	1626	ANALYSER	Dissolved O2 Anlayser
58	1701	GENERAL	Electronic Loop Indicator
59	1702	GENERAL	Corrosion Transmitter
60	1703	GENERAL	Flame Monitoring - IR Camera
61	1704	GENERAL	Beacon
62	1705	GENERAL	Hooter
63	1706	GENERAL	Push Button
64	1707	GENERAL	Solenoid Valves
65	1708	GENERAL	Limit Swtiches
66	1709	GENERAL	Flame Arrestor

GENERAL	1	Tag Number				
	2	Service				
	3	Line Number				
	4	Line Size	Line Sched.			
	5	Line I.D.	O.D			
	6					
PROCESS CONDITIONS	7	Fluid name	State			
	8	Flow Max.	Flow Min.			
	9	Flow Operating				
	10	Pressure Design	Oper.			
	11	Temperature Design	Oper.			
	12	Spec. Gravity at Base	Oper.			
	13	Molecular Mass				
	14	Viscosity at Operating Conditions				
	15	Steam density	Degree of Superheat			
	16	Compressibility Factor				
	17	Base Press.	Base Temp			
	18	Specific Heat Ratio				
	19	Relative Density at Oper.temp				
	20	Max allowable pressure drop				
ORIFICE PLATE	21	Type				
	22	Basis of Sizing				
	23	Plate Material				
	24	Plate Holder	Plate Holder material			
	25	Ring type(for RTJ flanges)				
	26	Ring material(for RTJ flanges)				
	27	Radius r Quadrant				
	28	Centre Distance, R				
	29	Thickness				
	30	Bore Diameter				
	31	Beta Ratio				
	32	Drain or Vent Hole				
	33	Flow Full Scale				
	34	Differential Pressure @ Full scale				
	35	Reynolds Number				
ORIFICE FLANGES	36	Flanges	Type of Flange			
	37	Size	Rating			
	38	Facing & Finish				
	39	Flange Material				
	40	Taps Size	Types of taps			
	41	No. of Taps Per Flange	Taps Orientation			
	42	Gasket Material				
	43	Stud Bolt Material	Nut Material			
TESTS	44	NACE	IBR			
	45	H2 SERVICE	Radiography			
	46					
PURCHASE	47	Manufacturer	Model			
	48	Purchase Order Number				
	49	Requisition number				

Notes:

No.	By	Date	Revision

INSTRUMENT SPECIFICATION
ORIFICE_PLATES_AND_FLANGES
Project :
Job No :
Unit No :

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

Sheet of

Code:1001 | Doc. No.: | Rev.:

GENERAL	1	Tag Number			
	2	Service			
	3	Line Number			
	4	Line Size	Line Sched.		
	5	Line I.D.	O.D		
	6				
PROCESS CONDITIONS	7	Fluid name	State		
	8	Flow Max.	Flow Min.		
	9	Flow Operating			
	10	Pressure Design	Oper.		
	11	Temperature Design	Oper.		
	12	Spec. Gravity at Base	Oper.		
	13	Molecular Mass			
	14	Viscosity at Operating Conditions			
	15	Steam density	Degree of Superheat		
	16	Compressibility Factor			
	17	Base Press.	Base Temp		
	18	Specific Heat Ratio			
	19	Relative Density at Oper.temp			
	20	Max allowable pressure drop			
ORIFICE PLATE	21	Type			
	22	Basis of Sizing			
	23	Plate Material			
	24	Plate Holder	Plate Holder material		
	25	Ring type(for RTJ flanges)			
	26	Ring material(for RTJ flanges)			
	27	Radius r Quadrant			
	28	Centre Distance, R			
	29	Thickness			
	30	Bore Diameter			
	31	Beta Ratio			
	32	Drain or Vent Hole			
	33	Flow Full Scale			
	34	Differential Pressure @ Full scale			
	35	Reynolds Number			
ORIFICE FLANGES	36	Flanges	Type of Flange		
	37	Size	Rating		
	38	Facing & Finish			
	39	Flange Material			
	40	Taps Size	Types of taps		
	41	No. of Taps Per Flange	Taps Orientation		
	42	Gasket Material			
	43	Stud Bolt Material	Nut Material		
TESTS	44	NACE	IBR		
	45	H2 SERVICE	Radiography		
	46				
PURCHASE	47	Manufacturer	Model		
	48	Purchase Order Number			
	49	Requisition number			

Notes:

No.	By	Date	Revision

INSTRUMENT SPECIFICATION
RESTRICTION ORIFICE PLATES
Project :
Job No :
Unit No :

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

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GENERAL	1	Tag Number			
	2	Service			
	3	Line No.			
	4	Line Size	Line Schedule		
	5	Line I.D.			
	6	P&ID No.			
PROCESS CONDITIONS	7	Fluid	Fluid State		
	8	Flow Max.	Min.		
	9	Flow Operating			
	10	Pressure Max.	Oper.		
	11	Temperature Max.	Oper.		
	12	Specific Gravity	Density		
	13	Molecular Mass			
	14	Viscosity at Oper. Condition			
	15	Compressibility Factor			
	16	Specific Heat Ratio (Cp/Cv)			
	17	Vapour Density Design			
	18	Liquid Base Specific Gravity			
	19	Reynolds Number			
VENTURI TUBE	20	Type: Classical / Rectangular			
	21	Material of Construction Venturi | Flange			
	22	End Connection Size & Rating			
	23	Facing & Finish			
	24	Sizing as Per			
	25	Beta Ratio			
	26	Bore Dia.			
	27	Overall Length			
	28	Angle of Divergence			
	29	Installation Horizontal / Vertical			
	30	Truncated / Non-Truncated			
	31	Irrecoverable Pressure Loss			
	32	Taps Type			
	33	Taps Size	Qty No of Pair		
	34	Taps Orientation			
METER	35	Flow Calibration			
	36	Annular Chamb/Piezometric Ring			
	37	Meter Maximum			
	38	Meter Diff Range			
	39	Max Allowable Press Drop			
	40	Accuracy	Repeatability		
	41	Straight Length : Upstream | Downstream			
TEST	42	NACE	IBR Certification		
	43	H2 Service	Radiography		
PURCHASE	44	Manufacturer			
	45	Model			
	46	Purchase Order Number			

Notes:

No.	By	Date	Revision

INSTRUMENT SPECIFICATION
FLOW ELEMENTS VENTURI
Project :
Job No. :
Unit No :

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

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Code: 1003 | Doc. No.: | Rev.:

GENERAL	1	Tag Number				
	2	Service				
	3	Line No.				
	4	Line Size	Line Schedule			
	5	Line I.D.				
	6	P&ID No.				
PROCESS CONDITIONS	7	Fluid	Fluid State			
	8	Flow Max.	Min.			
	9	Flow Operating				
	10	Pressure Max.	Oper.			
	11	Temperature Max.	Oper.			
	12	Specific Gravity	Density			
	13	Molecular Mass				
	14	Viscosity at Oper. Condition				
	15	Compressibility Factor				
	16	Specific Heat Ratio (Cp/Cv)				
	17	Vapour Density Design				
	18	Liquid Base Specific Gravity				
	19	Reynolds Number				
FLOW NOZZLE	20	Type: ISA-1932 / Long Radius				
	21	Material of Construction Nozzle				
	22	End Connection Size & Rating				
	23	Facing & Finish				
	24	Sizing as Per				
	25	Beta Ratio	Bore Dia.			
	26	Installation Horizontal / Vertical				
	27	Irrecoverable Pressure Loss				
	28	Spool Piece- Flanged | Welded				
	29	-Pipe Material				
	30	-Flange Material				
	31	-Length				
	32	Taps Type				
	33	Taps Size	Qty No of Pair			
	34	Taps Orientation				
	35	Flow Calibration				
	36	Straigth Vanes				
METER	37	Meter Maximum				
	38	Meter Diff Range				
	39	Max Allowable Press Drop				
	40	Straight Length Reqd (Excluding Spool Piece)				
	41	Upstream	Downstream			
Certification	42	NACE	IBR Certification			
	43	H2 Service	Radiography			
PURCHASE	44	Manufacturer				
	45	Model				
	46	Purchase Order Number				

Notes:

No.	By	Date	Revision

INSTRUMENT SPECIFICATION
FLOW ELEMENTS (FLOW NOZZLE)
Project :
Job No. :
Unit No :

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

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GENERAL	1	Tag Number							
	2	Service							
	3	Application							
	4	Line No.		P&ID No.					
	5	Line Size		Line Schedule					
	6	Line ID		Line OD					
	7	Electrical Area Classification							
PROCESS CONDITIONS	8	Fluid	Phase		State				
	9	Flow at Base Temp.	Min.	Norm.	Max.				
	10	Temperature	Min.	Norm.	Max.				
	11	Inlet Pressure		Norm.	Max.				
	12	Specific Gravity at Flow Temp							
	13	Operating Viscosity							
	14	Max. Allowable Press Drop							
	15	Relative Molecular Mass							
	16	Steam Density							
	17	Specific Heat Ratio							
	18	Compressibility Factor							
	19	Base Pressure							
	20	Base Temperature							
	21								
FLOW ELEMENT	22	Type							
	23	Installation		Material					
	24	Process Connection							
	25	Connection Size		Rating					
	26	Facing & Finish							
	27	Instrument Tap Connection							
	28	Accuracy							
	29	Repeatability							
	30	Irrecoverable Pressure Drop							
OPTIONS	30	Upper Range Value							
	31	Meter Differential Range (mmH2O)							
	32	Safety Chain							
	33	Insert Retract Mechanism							
	a.	Type							
	b.	Material		Packing Material					
	c.	Close Nipple Length		Close Nipple Material					
	d.	Close Cage Length		Close Cage Material					
	34	Line Isolation Valve		Quantity					
	a.	Type		End Connection					
	b.	Body Material		Trim Material					
	35	Impluse Isolation Valve		Quantity					
	a.	Type		End Connection					
	b.	Body Material		Trim Material					
	36	End Support							
	a.	Weld Nozzle Size		Material					
	b.	Support Plug Size		Material					
	37	Weld Nozzle for Mounting							
	38	Weld Nozzle Material							
CERTIFICATION/ TESTING	39	Statutory							
	40	NACE		IBR					
	41	H2 Service		Radiography					
PURCHASE	42	Manufacturer							
	43	Model							
	44	Requisition Number		PO Number					

Notes:

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INSTRUMENT SPECIFICATION
AVERAGING PITOT TUBES
Project :
Job No.:
Unit No:

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GENERAL	1	Tag Number									
	2	Service									
	3	Type									
	4	Line No.									
	5	Line Size		Line Schedule							
	6	Function		Mounting							
	7	Direction	Inlet	Outlet							
	8	Material	Fitting	Packing							
PROCESS CONDITIONS	9	Fluid		Fluid State							
	10	Flow	Min.	Nor.	Max.	UOM					
	11	Des Press.	UOM	Des Temp		UOM					
	12	Temp	Min.	Oper.	Max.	UOM					
	13	Pressure	Min.	Oper.	Max.	UOM					
	14	Oper.Relative Density		Molecular Mass							
	15	Operating Viscosity				UOM					
	16	Max. Allowable Pressure Drop				UOM					
	17	Density	Operating	Standard		UOM					
METER	18	Connection Type		Size		Rating					
	19	Facing & Finish									
	20	Tube Size		Float Guide							
	21	Material	Tube	Float							
	22	Scale	Type	Length							
	23	Scale Graduations		Scale Range							
	24	Meter Factor									
EXTENSION	25	Accuracy		Extension Well Materia							
	26	Gasket Material									
TRANSMITTER	27	Enclosure		Area Classification							
	28	Intrinsic Safety		Cable entry							
	29	Power Supply / Air Supply									
	30	Type									
	31	Output Type		Signal/Protocol							
	32	Scale Range	Max	Min							
OPTIONS	33	Protective Shield with Safety Glass									
	34	Jacketing									
	35		Medium	Connection							
	36		Pressure	Temperature							
	37	Needle Valve Reqmt		Location							
	38		Size	Material							
	39	Constant Differential Valve		D/P Regulator							
	40	Purge Meter Tubing									
	41	Filter Regulator with Gauge									
TESTS	42	NACE		IBR Certification							
	43	Hydrogen		Radiography							
CERTIFICATION	44	CCOE/PESO		Hydraulic Calib. Req.							
PURCHASE	45	Manufacturer									
	46	Model									
	47	Purchase Order No.		Requisition Number							
	48	Tube No.		Float No.							

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INSTRUMENT SPECIFICATION
VARIABLE_AREA_FLOWMETER
Project :
Job No :
Unit No:

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GENERAL	1	Tag Number								
	2	Service								
	3	Location								
	4	Line No.	P&ID No.							
	5	Line Size	Line Schedule							
	6	Electrical Area Classification								
	7									
SERVICE CONDITIONS	8	Fluid	Fluid State							
	9	Base Pressure	Base Temperature							
	10	Pressure Drop Min.	Opr.	Max						
	11	Flow	Min.	Oper.	Max.					
	12	Temperature	Min.	Oper.	Max.					
	13	Pressure	Min.	Oper.	Max.					
	14	Specific Gravity	Molecular Wt.							
	15	Ratio of Specific Heat	Viscosity							
	16	Sizing Density								
	17	Compressibilty Factor								
METER	18	Type								
	19	End Connection	Size							
	20	Rating	Facing & Finish							
	21	Flange Material								
	22	Body Material								
	23	Flow Element/ Sensor Material								
	24	Over Range Protection								
	25	Rangeability								
	26	Accuracy								
	27	Repeatability								
	28	Upper Range Value								
TRASNMITTER	29	Function								
	30	Location/ Mounting								
	31	Max Cable Length from :-								
	32	Sensor to Transmitter								
	33	Transmitter to Control Room								
	34	Output	Type							
	35	Signal/Protocol	Quantity							
	36	Enclosure	Intrinsic Safety							
	37	Power Supply	Power Consumption							
	38	Conduit Connection	Cable Entry							
OPTIONS	39	Compensation 1 and 2								
	40	Flow Straightner | Size	| Rating	| Material						
	41	Isolation Ball Valve assembly | Size								
	42	Special Cable | Type	| Qty.							
	43	IS Barriers	Integral Indicator							
	44	Remote Indicator including accessories								
	45	CCOE Approval	IBR Certification							
	46	NACE	H2 Service							
PURCHASE	47	Manufacturer	Model							
	48	PO Number	Requisition Number							

Notes:

				INSTRUMENT SPECIFICATION VORTEX FLOW METERS Project: Job No.: Unit No:	इंजीनियर्स इंडिया लिमिटेड ENGINEERS INDIA LIMITED (A Govt. of India Undertaking) Sheet of	
No.	By	Date	Revision	Code: 1007	Doc. No.:	Rev.:

GENERAL	1	Tag Number							
	2	Service							
	3	Electrical Area Classification							
	4	Line No.	P&ID No.						
	5	Line Size	Line Schedule						
PROCESS CONDITIONS	6	Fluid							
	7	Fluid Composition							
	8	Min Fluid Conductivity							
	9	Vacuum Possibility							
	10	Flow	Min.	Oper	Max.				
	11	Velocity	Max	Min.					
	12	Temperature	Min.	Oper.	Max.				
	13	Inlet Pressure	Min.	Oper.	Max.				
	14	Operating Relative Density							
METERING ELEMENT	15	End Connection Size	Rating						
	16	Facing & Finish	Material Meter						
	17	Material	Tube	Liner					
	18	Electrode Type	Electrode Material						
	19	Meter Casing							
	20	Power Supply							
	21	Enclousre							
	22								
	23	Grounding: Type	Material						
	24	Cable entry | Qty	Size						
	25	Range	Min	Max					
TRANSMITTER	26	Function	Type						
	27	Accuracy							
	28	Mounting Location							
	29	Intrinsic safety	Enclosure						
	30	Max Cable from Tube to transmitter							
	31	Power Supply							
	32	Output	Type & Protocol	Quantity					
	33	Load driving capability							
	34	Power consumption							
	35	Span Adjustment							
OPTIONS	36	Electrode Cleaner	Liner Heat System						
	37	Output Meter	Cathodic Protection						
	38	All Mounting Accesories							
CERTIFICATION	39	NACE							
	40	IBR							
	41	H2 Service							
	42	Radiography							
	43	CCOE Approvals							
PURCHASE	44	Manufacturer							
	45	Model Meter							
	46	Transmitter	Switch						
	47	Purchase Order Number							
	48	Requisition Number							

Notes:

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INSTRUMENT SPECIFICATION
MAGNETIC FLOWMETERS
Project :
Job No. :
Unit No :

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GENERAL	1	Tag Number							
	2	Service							
	3	Line No.							
	4	Line Size	Line Schedule						
	5	Electrical Area Classification							
	6								
	7								
PROCESS CONDITIONS	8	Fluid	State						
	9	Flow	Min.	Norm.	Max.				
	10	Temperature	Min.	Norm.	Max.				
	11	Pressure		Norm.	Max.				
	12	Specific Gravity Range							
	13	Operating Viscosity							
	14	Max. Allowable Press Drop							
	15	Relative Molecular Mass							
	16	Density							
SENSOR	17	Construction Type							
	18	Function							
	19	Enclosure							
	20	Connection Size	Rating						
	21	Facing & Finish							
	22	Body Material							
	23	Sensor Housing Material	Leads						
	24	Sensor/ Wetted parts Material							
	25	Intrinsic Safety							
	26	Range Minimum	Maximum						
	27	Accuracy							
	28	Conduit Connection							
	29	Jacketing: Medium	Connection						
	30	Temperature	Pressure						
TRANSMITTER	31	Function							
	32	Load Driving Capability							
	33	Output Type							
	34	Signal/Protocol	Quantity						
	35	Enclosure							
	36	Intrinsic Safety							
	37	Power Supply							
	38	Power Consumption in Watts							
	39	Local Display	Variables for Local Display						
	40	Inputs							
	41	Conduit Connection							
	42	Mounting Location							
	43	Max. Distance Allowable Sensor to Transmitter							
	44	Transmitter to CR Receiver							
OPTIONS	45	Filter Mesh Size							
	46	Mounting Brackets							
	47	Interconnecting Cables and Quantity							
	48	Cable Glands & Size							
	49	Switch Type & Contact Rating							
	50	Accessories for hot tap							
PURCHASE	51	Manufacturer							
	52	Model							
	53	Requisition Number							
	54	PO number							
	55								

Notes:

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INSTRUMENT SPECIFICATION
MASS_FLOWMETERS
Project:
Job No :
Unit No:

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GENERAL	1	Tag Number								
	2	Service								
	3	Line No.	P&ID No.							
	4	Line Size	Line Schedule							
	5	Type of Instrument								
	6	Area Classification								
	7	Meter Accuracy	Linearity	Repeatability						
PROCESS CONDITIONS	8	Fluid	Fluid State							
	9	Flow	Min.	Norm.	Max.					
	10	Temperature	Min.	Norm.	Max.					
	11	Pressure		Norm.	Max.					
	12	Specific Gravity Range								
	13	Viscosity Range								
	14	Molcular Weight								
	15	Ratio of Specific Heats	Compressibilty							
	16	System Pressure Drop								
	17	Corrosive / Abrasive Property								
METER / TRANSDUCER	18	Type of Probe	No. of Probes							
	19	End Connection:	Size & Rating							
	20		Facing & Finish							
	21	Material Body	End Connection							
	22	Flow Constant (Pulses / m3)								
	23	Flow Range								
	24	Cable Entry								
	25	Length of Element/ Transducer								
	26	BiDirectional flow								
PRE -AMPLIFIER & TRANSMITTER	27	PREAMPLIFIER :								
	28	Moumting / Location								
	29	Explosion proof	Intrisically Safe							
	30	Enclosure								
	31	Distance to Remote Location								
	32	TRANSMITTER								
	33	Power Supply	Output							
	34	Cable Entry: Signal	Power							
	35	Enclosure								
	36	Explosion proof	Intrinsically Safe							
	37	Mounting								
	38	Calibration Flow Range Min.	Max.							
	39	Turndown Ratio								
	40	Output Update Rate								
	41									
	42									
OPTIONS	43	Retractable Probes								
	44	Meter Runs								
	45	Pressure Tap on meter body								
	46									
CERTIFICATE	47	Statutory								
TEST	48	NACE	H2 Service							
	49	Radiography								
PURCHASE	50	Requisition number								
	51	Manufacturer								
	52	Model								
	53	Purchase Order Number								

Notes:

No.	By	Date	Revision

INSTRUMENT SPECIFICATION
ULTRASONIC FLOW METER
Project :
Job No.:
Unit No:

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GENERAL	1	Tag Number								
	2	Service								
	3	Line No.								
	4	Line Size	Line Schedule							
	5	Electrical Area Classification								
	6									
	7									
PROCESS CONDITIONS	8	Fluid	State							
	9	Flow	Min.	Norm.	Max.					
	10	Temperature	Min.	Norm.	Max.					
	11	Pressure		Norm.	Max.					
	12	Specific Gravity Range								
	13	Operating Viscosity								
	14	Max. Allowable Press Drop								
	15	Relative Molecular Mass								
	16	Density								
SENSOR	17	Construction Type	Enclosure							
	18	Installation Method								
	19	Insertion Length	Body Length							
	20	Connection Size	Rating							
	21	Facing & Finish								
	22	Body Material								
	23	Sensor	Housing Material							
	24	Sensor/ Wetted parts	Material							
	25	Intrinsic Safety	Accuracy							
	26	Range Minimum	Maximum							
	27	Online Removal	Isolation valve type							
	28	Conduit Connection								
	29	Jacketing: Medium	Connection							
	30	Temperature	Pressure							
TRANSMITTER	31	Function								
	32	Load Driving Capability								
	33	Output	Type							
	34	Signal/Protocol	Quanitity							
	35	Enclosure								
	36	Intrinsic Safety								
	37	Power Supply								
	38	Power Consumption in Watts								
	39	Local Display	Variables for Local Display							
	40	Inputs								
	41	Conduit Connection								
	42	Mounting Location								
	43	Max. Distance Allowable	Sensor to Transmitter							
	44	Transmitter to CR Receiver								
OPTIONS	45	Retractable Assembly								
	46	Interconnecting Cables and Quantity								
	47	Cable Glands & Size								
	48	Switch Type & Contact Rating								
	49									
	50									
PURCHASE	51	Manufacturer								
	52	Model								
	53	Requisition Number								
	54	PO Number								
	55									

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INSTRUMENT SPECIFICATION
THERMAL MASS FLOW METER
Project :
Job No :
Unit No:

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GENERAL	1	Tag Number				
	2	Service				
	3	Area Classification				
	4	Function	Power Supply			
	5	Mounting	Case			
	6	Type				
	7	Enclosure	Intrinsic Safety			
	8	Accuracy	Cable Entry			
	9	Output	Protocol			
	10	Driving Voltage				
PROCESS CONDITIONS	11	Pressure Oper.	Des. UOM			
	12	Temp. Oper.	Des UOM			
	13	Oper. Spec. Gravity	Oper. viscosity			
	14					
MEASURING UNIT	15	Inst.Range Min.	Max. UOM			
	16	Cal.Range Min.	Max. UOM			
	17	Elevation	Suppression			
	18	Element Type				
	19	Body Material				
	20	Element Material				
	21	Body Rating				
	22	Over Range Protection				
	23	Process Connection				
	24	Instrument connection	Connection Location			
DIAPHRAGM SEAL	25	Dia. Seal	Type			
	26	Wetted Part Material	Other Material			
	27	Process Connection (LP):				
	28	Size	Rating			
	29	Facing & Finish				
	30	Process Connection (HP):				
	31	Size	Rating			
	32	Facing & Finish				
	33	Flange Material				
	34	Capillary Material	Capillary Length			
	35	Armour Type	Armour Material			
	36	Gasket Material				
	37	Bolt Material	Nut Material			
	38	Flushing/Filling Connection with Plug				
OPTIONS	(a)	Air Filter Regulator				
	(b)	Integral Output Meter (Instrinsically Safe)				
	(c)	Manifold 5 valve				
	(d)	Manifold 3 Valve				
	(e)	Condensate Pots				
	(f)	Adjustable Dampner				
	(g)	Integral Square Root Extractor				
	(h)	Test Jack, Calibrating				
	(i)	Mounting Accessories for 2" NB pipe				
CERTIFICATION	39	CCOE/PESO				
PURCHASE	40	Requisition Number				
	41	Manufacturer				
	42	Model				
	43	Purchase Order Number				
	44	Notes				

Notes:

No.	By	Date	Description

INSTRUMENT SPECIFICATION
DIFF PRESSURE INST (FLOW)
Project:
Job No :
Unit No :

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PROCESS CONDITIONS	1	Tag Number					
	2	P&ID Number	Pipe Sepc				
	3	Area Classification	Location				
	4	Line Number	Equipment Number				
	5	Vibrations					
	6	Fluid	Fluid Phase	Fluid State			
	7	Service					
	8	Oper. Temperature	Max. Temperature				
	9	Oper. Pressure	Max. Pressure				
	10	Design Temp.	Design Press.				
GENERAL	11	Type					
	12	Scope of Supply					
	13	Mounitng					
	14	Cal. Range Min.	Max.				
	15	Dial Size	Dial Color				
	16	Case Material					
	17	Window Material					
	18	Accuracy					
	19	Enclosure					
	20	Zero Adj. Screw					
BIMETAL	21	Stem Type					
	22	Stem Material					
	23	Stem Size					
	24	Stem Diameter					
FILLED SYSTEM	25	SAMA Class					
	26	Compensation					
	27	Bulb					
	28	Bulb Material					
	29	Bulb Union					
	30	Extension					
	31	Bulb Diameter					
	32	Capillary Material					
	a.	Armour					
	b.	Material					
	c.	Capillary Length					
	33	Over Range Protection					
THERMOWELL	34	Thermowell					
	35	Material	Construction				
	36	Connection Process	Instrument				
	37	Well Dim. U	T				
	38	Flange Size	Rating				
	42	Facing and Finish					
	43	Flange Material					
OPTIONS	A	Liquid Filled Casing					
	B	Connectiion Location-Back					
	C	Connection Location-Bottom					
	D	Connection Location- Back Adjustable					
	E	Rotatable in all angles					
TEST	44	NACE	IBR				
	45	H2 Service	Radiography				
	46						
PURCHASE	47	Requisition No	PO Number				
	48	Manufacturer					
	49	Model No.					

Notes:

No.	By	Date	Revision

INSTRUMENT SPECIFICATION
TEMPERATURE GAUGES

Project :
Job No :
Unit No :

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

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GENERAL	1	Tag Number				
	2	Service				
	3	Line No.	Equipment No.			
	4	Area Classification				
	5					
	6					
	7					
PROCESS CONDITIONS	8	Fluid				
	9	Pressure Max	Oper.			
	10	Temperature Max.	Oper.			
	11	Design temp.	Design Press.			
	12					
	13					
ELEMENT	14	Type				
	15	Fill Material				
	16	Capillary Length				
	17	Capillary Material				
	18	Capillary Armor Material				
	19	Bulb Diameter				
	20	Bulb Length				
	21	Bulb Type				
	22	Bulb Connection				
	23	Well Material				
	24	Well Connection				
	25	Length Below Thread / Flanged (U)				
	26	Lagging Extension (T)				
	27					
	28					
	29					
SWITCH	30	Type				
	31	Contact Arrangement				
	32	Contact Rating				
	33	Set Point				
	34	On Measurement Increase Switch				
	35	Differential Range				
	36	Conduit Connection Size				
	37					
	38					
	39					
	40					
	41					
PURCHASE	42	Manufacturer				
	43	Model				
	44	Purchase Order Number				
	45	Requisition number				
	46					

Notes:

No.	By	Date	Revision

INSTRUMENT SPECIFICATION
Temperature Switch

Project:
Job no.
Unit no:

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

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GENERAL	1	Tag Number					
	2	Area Classification					
	3	Location					
	4	Equipment No.					
	5	P&ID Number					
	6	Service					
	7						
PROCESS CONDITIONS	8	Fluid Name	Fluid Phase	Fluid State			
	9	Design Press.	Design Temp.				
	10	Pressure Max.	Oper.				
	11	Temperature Max.	Oper.				
SENSOR	12	Type					
	13	Range					
	14	Enclousre					
	15	Process Connection	Rating				
	16	Facing & Finish					
	17	Power Supply					
	18	Target Size					
	19	Focusing Range					
TRANSMITTER	20	Output					
	21	Local Display					
	22	Mounting					
	23	Enclousre					
	24	Emissivity					
	25	Power Supply					
	26	Accuarcy					
	27	Response Time					
ACCESSORIES	28	Sight Glass					
	29	Isolation Valve- Type / Trim					
	30	Back Up Probe					
	31	Clean Out Probe					
	32	Adaptor/ Combustion Spool					
	33	Hand Held T/C Readout					
	34	Vortex Cooler					
	35	Swing out arrangement					
	36	Aspirator Assembly					
	37						
	38						
	39						
	40						
	41						
PURGING	42	Air Supply for air purging					
	43	Inst Air Connection					
	44	Air Pressure Min | Nor | Max					
	45						
	46						
CERTFICATE	47	Statutory Requirement					
	48	CCOE/PESO					
	49	Others					
PURCHASE	50	Manufacturer					
	51	Model					
	52	Purchase Order Number					
	53	Requisition Number					

Notes:

				INSTRUMENT SPECIFICATION OPTICAL PYROMETER Project : Job No : Unit No:	इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking) Sheet of	
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GENERAL	1	Tag Number					
	2	Service					
	3	Line No.	Equipment No.				
	4	Area Classification					
	5	Function	Type				
	6	Mounting					
	7	Enclosure	Intrinsically safe				
	8						
PROCESS CONDITIONS	9	Pressure Min.	Oper.	Max. UOM			
	10	Temperature Min.	Oper.	Max. UOM			
	11	Design Pressure	UOM	DesTemp UOM			
	12	Oper. Spec.Gravity					
	13						
	14						
TRANSMITTER	15	Type					
	16	Power Supply					
	17	Cable Entry					
	18	Case					
	19	Body Material					
	20	Accuracy Full Scale					
	21	Output Type, Output					
	22	Protocol					
	23	Sensor Element					
	24	Calibration					
	25	Self Diagnostic Facility					
	26	Instrument Range Min.	Max.				
	27	Calibration Range Min.	Max.				
MEASURING UNIT	28	Scope of Supply					
	29	No.of Elements					
	30	Sheath Material	Sheath OD in mm				
	31	Nipple & Union Material	Size				
	32	Head Cover Type	Head Material				
	33	Cable entry	No. of entries				
	34	Terminals					
	35	Thermowell Material	Thermowell Constructio				
	36	Process Connection	Instrument Connection				
	37	Gauge Material	Element Material				
	38	Well Dimension "U"	" T"				
	39	Flange Material					
	40	Rating	Facing&Finish				
OPTIONS	(a)	Mounting Brackets					
	(b)	IS Output Meter	Load capability				
CERTIFICATION	(c)	CCOE/PESO					
PURCHASE	44	Manufacturer					
	45	Model No.					
	46	Requisition Number	Purchase Order No.				
	47	Notes					

Notes:

				INSTRUMENT SPECIFICATION TEMPERATURE TRANSMITTER Project : Job No : Unit No :	इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking) Sheet of
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PROCESS CONDITIONS	1	Tag Number					
	2	Line Number		Pipe spec			
	3	P&ID No.		Area Classification			
	4	Location		Equipment Number			
	5	Vibrations					
	6	Fluid	Fluid Phase	Fluid State			
	7	Service					
	8	Oper. Temperature		Max. Temperature			
	9	Oper. Pressure		Max. Pressure			
	10	Design Temp.		Design Press.			
ELEMENT	11	Type					
	12	Scope of Supply					
	13	No. of Elements					
	14	Calibration					
	15	Construction					
		O.D. mm					
		Sheath material					
	16	Junction / Resistance at 0°C					
	17	Nipple and Union					
		Size inch					
		Material					
	18	Packed Connector					
	19	Gauge					
HEAD	20	Head Cover Type					
	21	Material					
	22	Cable Entry					
	23	No. of Entries					
	24	Terminals					
	25	Enclosure					
THERMOWELL	26	Thermowell					
	27	Material		Construction			
	28	Connection Process		Instrument			
	29	Well Dim. U		T			
	30	Flange Size		Rating			
	31	Facing and Finish					
	32	Flange Material					
OPTIONS	A	Extra Nipple Extension					
	B	CCOE Approval (if ex. T/C used)					
TEST	33	NACE		IBR			
	34	H2 Service		Radiography			
	35						
PURCHASE	36	Requisition No.		PO Number			
	37	Manufacturer					
	38	Model No.					

Notes:

				INSTRUMENT SPECIFICATION TEMPERATURE ELEMENTS _TW Project : Job No.: Unit No.:	इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking) Sheet of	
No.	By	Date	Revision	Code: 1105	Doc. No.:	Rev.:

PROCESS CONDITIONS	1	Tag Number			
	2	Service			
	3	P&ID Number			
	4	Area Classification	Location		
	5	Equipment No.	Pipe Spec		
	6	Fluid Upper	Lower		
	7	Oper. Temperature	Max. Temperature		
	8	Oper. Pressure	Max. Pressure		
	9				
GAUGE GLASSES	10	Type			
	11	Scope of Supply			
	12	C-C Length	Visible Length		
	13	Chamber Connection			
	a.	Size	Type		
	b.	Location	Vent & Drain		
	14	Material			
	a.	Chamber & Cover Plate			
	b.	Stud & Bolts			
	c.	Gasket			
	15	Minimum Rating			
ILLUMINATOR	16	Power Supply			
	17	Area Classification			
	18	Enclosure			
	19	Cable Entry			
GAUGE COCKS	20	Type			
	21	Connection Size			
	a.	Vessel			
	b.	Gauge			
	c.	Vent & Drain			
	22	Type of Connection			
	a.	Vessel	Gauge		
	23	Material			
	a.	Body	Trim		
	24	Construction			
	25	Ball Checks			
	26	Renewable Seats			
	27	Bonnet Type	Rating		
HEATING JACKET	28	Medium			
	29	Max Temperature	Max Pressure		
	30	Connection Inlet	Outlet		
OPTIONS	31	Illuminator			
	32	Heating Jacket			
	33	Mica Shield			
	34	Non-Frost Extension			
	35	Calibrated Scale			
	36	Check Valve			
TEST	37	NACE	IBR		
	38	H2 Service	Radiography		
PURCHASE	39	Manufacturer			
	40	Model No.			
	41	Requisition No.	Purchase Order No.		

Notes:

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INSTRUMENT SPECIFICATION
GAUGE GLASSES _COCKS
Project :
Job No :
Unit No :

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

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PROCESS CONDITIONS	1	Tag Number				
	2	Service				
	3	P&ID Number				
	4	Area Classification	Location			
	5	Equipment No.	Pipe Spec			
	6	Fluid Upper	Lower			
	7	Oper. Temperature	Max. Temperature			
	8	Oper. Pressure	Max. Pressure			
	9					
Bi-Colour Gauge	10	Type				
	11	Multi-port assembly				
	12	C-C Length	Visible Length			
	13	Chamber Connection				
	a.	Size	Type			
	b.	Location	Vent & Drain			
	14	Material				
	a.	Chamber & Cover Plate				
	b.	Stud & Bolts				
	c.	Gasket				
	15	Minimum Rating				
ILLUMINATOR	16	Power Supply				
	17	Enclosure				
	18	Cable Entry				
	19					
GAUGE COCKS	20	Type				
	21	Connection Size				
	a.	Vessel				
	b.	Gauge				
	c.	Vent & Drain				
	22	Type of Connection				
	a.	Vessel	Gauge			
	23	Material				
	a.	Body	Trim			
	24	Construction				
	25	Ball Checks				
	26	Renewable Seats				
	27	Bonnet Type	Rating			
OPTIONS	28	Circulating Tie-bar assembly				
	29	Gauge Valves				
	30	Max Pressure				
	31	Illuminator				
	32	Heating Jacket				
	33	Mica Shield				
	34	Non-Frost Extension				
	35	Calibrated Scale				
	36	Check Valve				
TEST	37	NACE	IBR			
	38	H2 Service	Radiography			
PURCHASE	39	Manufacturer				
	40	Model No.				
	41	Requisition No.	Purchase Order No.			

Notes:

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INSTRUMENT SPECIFICATION
LEVEL GAUGE (BI-COLOUR)
Project:
Job No :
Unit No :

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

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GENERAL	1	Tag Number									
	2	Service									
	3	Area Classification									
	4	Equipment No.	Pipe Class								
	5	P&ID No.									
SERVICE	6	Fluid	Upper	Lower							
	7	Specific Gravity	Upper	Lower							
	8	Operating Viscosity	Upper	Lower							
	9	Temperature	Min.	Oper.	Max.						
	10	Pressure	Min.	Oper.	Max.						
	11	Measuring Level	Low	Nor.	Max.						
GAUGE	12	Function	Mounting								
	13	Measuring Range									
	14	C-C Distance	Length of Float Guide Pipe								
	15	Local Indication	Type of Indication								
	16	Dial Size	Measuring Scale								
	17	Gauge Accuracy	Min. Scale Resolution								
	18	Gauge Connection	Size	Rating	Finsih						
	19	Drain Connection	Size	Rating	Finsih						
	20	Vent Connection	Size	Rating	Finsih						
	21	Material of Construction									
	i	Float Chamber	Float								
	ii	Float Guide Tube	Spring Assembly								
	iii	Indicating Tube	Measuring Scale								
	iv	Gauge Head Housing									
	22	Gasket Material									
	23	Bolt/Nut Material									
	24	Flange Material									
TRANSMITTER	25	Type									
	26	Mounting									
	27	Output									
	28	Interconnecting Cable b/w Gauge Head & Transmitter									
	29	Length of Cable									
	30	Power Supply									
	31	Enclosure Type									
	32	Conduit Connection									
	a.	Signal	Power								
	33	Cable Gland									
TESTS	34	NACE									
	35	IBR									
	36	H2 Service									
	37	Radiography									
	38	H2S									
CERTIFICATION	39	Statutory	Others								
PURCHASE	40	Manufacturer									
	41	Model Number									
	42	Requisition No.									
	43	Purchase Order No.									

Notes:

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INSTRUMENT SPECIFICATION
Magnetic Level Inst Indicator
Project :
Job No.:
Unit No.:

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

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GENERAL	1	Tag Number			
	2	Service			
	3	Area Classification			
	4	Function			
	5	P&ID No.			
	6	Equipment No.	Piping Class		
	7	Nozzle Projection	Nozzle schedule		
PROCESS CONDITIONS	8	Process Fluid			
	9	Oper. Temperature	Design Temperature		
	10	Oper. Pressure	Design Pressure		
	11	Operating S.G.	Viscosity		
	12	Dielectric Constant	Lower | Upper		
	13	Corrosive Constituents			
SENSOR	14	Antenna Type	Antenna Material		
	15	Measurement Range			
	16	Accuracy			
	17	Mounting	External Chamber		
	18	Process Connection:			
	a.	Size & Rating	Facing & Finish		
	19	Material of Construction:			
	a.	Flange	Other Wetted Parts		
TRANSMITTER	20	Output	Protocol		
	21	Power Supply			
	22	Cable Entry Size:			
	a.	Signal	Power		
	23	Hazardous area protection			
	24	Enclosure			
LOCAL INDICATOR	25	Type			
	26	Location			
	27	Enclosure			
	28	Hazardous area protection			
	29	Tag Number			
INTERFACE DEVICES	30	Water Cut Probe:			
	a.	Type	Level		
	b.	Dedicated	With Temp Probe		
	31	Temperature Element:			
	a.	Element Type	No. of elements		
	b.	Connection Size	Rating		
	c.	Element Anchoring			
	d.	Sheath Material			
OPTIONS	32	Calibration Pin	Power Switch		
	33	Still well	Mounting Brackets		
	34	Built-in Alarm contacts			
INTERCONNECTING CABLE	35	TankSide Indicator & Gauge head			
	36	Gauge & Temperature Element			
	37	Tank Gauge & Water Probe			
	38	Power cable bet.GH &Indicator			
CERTFICATION	39	Statutory Requirement			
	40	Others			
PURCHASE	41	Requition No.	PO Number		
	42	Manufacturer			
	43	Model			

Notes:

No.	By	Date	Revision

INSTRUMENT SPECIFICATION
Radar Level Inst.(Non-Contact)
Project :
Job No.:
Unit No.:

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

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GENERAL	1	Tag Number				
	2	Service				
	3	Location	P&ID No.			
	4	Function				
	5	Enclosure				
	6	Area Classification				
	7	Piping Class				
	8					
PROCESS CONDITIONS	9	Fluid				
	10	Pressure Max.	Oper.			
	11	Temperature Max.	Oper.			
	12	Lower Oper. S.G.	Lower Oper. Visc.			
	13	Corrosive Constituent				
	14	Upper Oper S.G.	Upper Oper. Visc.			
SENSOR	15	Guided Wave Type				
	16	Linearity	Repeatability			
	17	Response Time	Oper.Temp Effect			
	18	Connection	Orientation			
	19	Accuracy				
	20	Chamber Material	Flange Material			
	21	Process Flanges Facing & Finish				
	22	Process Wetted Parts Material				
	23	Connection Vent	Drain			
	24	C-C length				
TRANSMITTER	25	Type	Output			
	26	Cable Entry-Signal	Power			
	27	Power Supply				
	28	Type of Protection				
	29	Gauge Head Material				
LOCAL INDICATOR	30	Tag No.	Type			
	31	Location				
	32	Measurement Scale				
	33	Enclosure				
INTERFACE DEVICES	34	Temperature Element				
	35	Water Cut Probe				
WATER CUT PROBE	36	Type				
	37	Dedicated	Capillary Length			
TEMPERATURE ELEMENT	38	Type				
	39	Element Type	No. of elements			
	40	Connection size & Rating				
	41	Element Anchoring				
	42	Sheath Material				
OPTIONS	43	Calibration Pin	Power Switch			
	44	Still well	Mounting Brackets			
	45	Built-in Alarm contacts				
INTERCONNECTING CABLE	46	Tank Side Indicator&Gauge head				
	47	Gauge and Temperature Element				
	48	Tank Gauge & Water Probe				
	49	Power cable bet.GH &Indicator				
CERTFICATE	50	Statutory Requirement				
PURCHASE	51	Manufacturer				
	52	Model No.				
	53	Purchase Order No.				
	54	Requisition Number				

Notes:

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INSTRUMENT SPECIFICATION
Spl. Level Inst - GWR
Project:
Job No :
Unit No:

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GENERAL	1	Tag Number				
	2	Service				
	3	Line No.	Vessel No.			
	4	Application				
	5	Function				
	6	Area Classification	P&ID No.			
	7	Type of Fluid				
PROCESS CONDITIONS	8	Upper Fluid				
	9	Upper Fluid Dielectrical Constant				
	10	Lower Fluid				
	11	Lower Fluid Dielectrical Constant				
	12	Max. Pressure	Oper. Pressure			
	13	Max. Temperature	Oper. Temperature			
	14	Moisture				
	15	Vibration				
	16	Material Build - Up				
	17					
PROBE	18	Model No.				
	19	Orientation				
	20	Style				
	21	Material				
	22	Sheath Size	Sheath Material			
	23	Insertion Length				
	24	Inactive Length				
	25	Gland Size	Gland Material			
	26	Conduit Size & Connection				
	27					
AMPLIFIER	28	Location				
	29	Enclosure				
	30	Power Supply				
	31	Conduit Size & Connection				
	32	Power Consumption				
SWITCH	33	Type				
	34	Quantity	Form			
	35	Contact Rating				
	36	Load Type				
	37	Contacts Open on Level				
	38					
TRANSMITTER	39	Output Type				
	40	Power Supply				
	41	Enclosure				
	42	Calibration Range Min.	Max.			
	43	Protocol				
OPTIONS	44	Compensation Cable				
	45	Local Indicator				
	46	I/P Transducer				
	47	Signal Lights				
PURCHASE	48	Manufacturer				
	49	Model				
	50	Purchase Order No.				
	51	Requisition No.				
	52					

Notes:

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INSTRUMENT SPECIFICATION
Spl. Level Inst - Capacitance
Project :
Job No. :
Unit No.:

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GENERAL	1	Tag Number				
	2	Service				
	3	Location	P&ID No.			
	4	Function				
	5	Enclosure				
	6	Area Classification				
	7	Piping Class				
	8					
PROCESS CONDITIONS	9	Fluid Upper	Lower			
	10	Pressure Max.	Oper.			
	11	Temperature Max.	Oper.			
	12	Lower Oper. S.G.	Lower Oper. Visc.			
	13	Fluid State				
	14	Upper Oper S.G.	Upper Oper. Visc.			
SENSOR	15	Type				
	16	Principle				
	17	Range				
	18	Pulse Frequency	Resolution			
	19	Accuracy				
	20	Gauge Head Connection & Rating				
	21	Material				
	22	Probe Material				
	23	Angle of Emission				
	24	Cable entry for Sensor				
TRANSMITTER	25	Type	Output			
	26	Cable Entry-Signal	Power			
	27	Power Supply				
	28	Enclosure Material				
	29	Max Dist Allow Sensor to Tras				
LOCAL INDICATOR	30	Tag No.	Type			
	31	Location				
	32	Graduations				
	33	Enclosure				
INTERFACE DEVICES	34	Temperature Element				
	35	Water Cut Probe				
WATER CUT PROBE	36	Type				
	37	Dedicated	Capillary Length			
TEMPERATURE ELEMENT	38	Type				
	39	Element Type	No. of elements			
	40	Connection Size	Ratting			
	41	Element Anchoring				
	42	Sheath Material				
OPTIONS	43	Calibration Pin	Power Switch			
	44	Still well	Mounting Brackets			
	45	Built-in Alarm contacts				
INTERCONNECTING CABLE	46	TankSide Indicator & Gauge head				
	47	Gauge and Temperature Element				
	48	Tank Gauge & Water Probe				
	49	Power cable bet.GH &Indicator				
CERTFICATE	50	Statutory Requirement				
PURCHASE	51	Manufacturer				
	52	Model No.				
	53	Purchase Order Number				
	54	Requisition Number				

Notes:

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INSTRUMENT SPECIFICATION
Spl. Level Inst - Ultrasonic
Project :
Job No :
Unit No:

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GENERAL	1	Tag Number				
	2	Service				
	3	Vessel No.	P&ID No.			
	4	Type of Actuation				
	5	Type of Fluid				
PROCESS CONDITIONS	6	Upper Liquid				
	7	Lower Liquid				
	8	Density Upper	Density Lower			
	9	Max. Pressure	Oper. Pressure			
	10	Max. Temperature	Oper. Temperature			
	11					
BODY / GAGE	12	Body or Gage Material				
	13	Flange Material				
	14	Connection Size & Rating Upper				
	15	Connection Type Upper				
	16	Connection Size & Rating Lower				
	17	Connection Type Lower				
	18	Flange Facing & Finish				
	19	Type of Bonnet				
	20	Case Orientation				
	21	Cooling Extension				
	22	Rotatable Head				
	23	Rotable Head				
	24	Vent/Drain Connection Size				
	25					
	26					
	27					
DISPLACER OR FLOAT	28	Select Standard Span				
	29	Insertion Depth				
	30	Displacer Extension				
	31	Displacer or Float Material				
	32	Spring Material	Tube Material			
	33	Dimension of Element Length Diameter			MM	
	34					
	35					
TRANSMITTER	36	Function				
	37	Output				
	38	Control Modes				
	39	Calibration Range Min.	Max.			
	40	Output Actuator: Level Rise				
	41	Mounting				
	42	Electrical Enclosure Class				
	43	Power Supply				
	44	Cable entry Qty and Size				
	45	Accuracy				
OPTIONS	46	Airset	Supply Gage			
	47	Gage Glass Connection				
	48	Gage Glass Model No.				
	49	Contacts: No.	Form			
	50	Contact Rating				
	51	Action of Contacts				
PURCHASE	52	Manufacturer				
	53	Model				
	54	Purchase Order No.				
	55	Requisition No.				
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INSTRUMENT SPECIFICATION
Spl. Level Inst - Displacer
Project :
Job No.:
Unit No.

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

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Code: 1208 | Doc. No.: | Rev.:

GENERAL	1	Tag Number	PID No.			
	2	Service				
	3	Line No.	Equip. No.			
	4	Area Classification				
PROCESS CONDITIONS	5	Fluid	Fluid State			
	6	Oper. Temperature	Design Temperature			
	7	Operating Pressure	Design Pressure			
	8	Specific Gravity/ Density				
	9	Molecular Weight				
	10	% Solids				
	11	Wall Build-Up: Thickness				
	12	Wall Build-Up: Density				
	13	Level Pattern in Vessel (Vortex/Cone)				
	14					
	15					
LINE OR VESSEL DATA	16	Vessel Height				
	17	Vessel Material				
	18	Outer Diameter	Internal Diameter			
	19	Vessel Wall Thickness				
	20	Insulation Thickness				
	21	Insulation Material				
	22	Coolant Jacket				
	23	Inner Liner				
	24	Structure in Rad. Beam				
	25	Material Fall Thru Beam				
SOURCE	26	Collimation Angle				
	27	No. of Sources				
	28	Type	Tag No.			
	29	Source Holder Material	Source Strength			
	30	Weight				
	31	Housing Material				
	32	Connection				
	33	Safety Shutter Type	Source Half Life			
	34	Radioactive Element				
DETECTOR /TRANSMITTER	35	Detector Type	No. of Detector			
	36	Detector Length	Detector Cable Entry			
	37	Transmitter Power Supply				
	38	Housing Material	Detector Tag No.			
	39	Accuracy	Repeatability			
	40	Cooling	Shock Mounting			
	41	Temperature Compensation				
	42	Trans. Cable Entry Signal	Power			
	43	Enclosure Protection	Detector Output			
	44	Level Range Min.	Level Range Max.			
	45	Linearization	Mounting Bracket			
	46	Integral Indicator	Transmitter Mounting			
OPTIONS	47	Portable Detector	Dosimeter			
	48	Test Kit+Battery Charger	Radiation Sign Board			
	49	Statutory-BARC	CCOE			
	50					
PURCHASE	51	Manufacturer				
	52	Model No.-Source	Model No. Detector			
	53	Purchase Order Number				
	54	Requisition No.				

Notes:

No.	By	Date	Revision

INSTRUMENT SPECIFICATION
Spl. Level Inst - Nucelonic
Project :
Job No.:
Unit No :

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

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Code: 1209 | Dwg. No.: | Rev.:

GENERAL	1	Tag Number				
	2	Service				
	3	Location	P&ID No.			
	4	Equipment No.				
	5	Area Classification				
	6	Equipment Height	Equipment Internal Dia			
	7					
	8					
PROCESS CONDITIONS	9	Fluid				
	10	Pressure Max.	Oper.			
	11	Temperature Max.	Oper.			
	12	Lower Oper. S.G.	Lower Oper. Visc.			
	13	Corrosive Constituent				
	14	Upper Oper S.G.	Upper Oper. Visc.			
GAUGE	15	Type				
	16	Function- Indicating/Trans.				
	17	Cable Entry	Power Supply			
	18	Range	Accuracy			
	19	Float Material	Guide Wire Material			
	20	Gauge Head Material	Body Material			
	21	Gauge Head Connection & Rating				
TRANSMITTER	22	Type	Output			
	23	Cable Entry-Signal	Power			
	24	Power Supply	Intrinsically Safe			
	25	Enclosure Class	Protocol			
LOCAL INDICATOR	26	Type	Location			
	27	Enclosure				
	28	Tag Number				
INTERFACE DEVICES	29	Temperature Element				
	30	Water Cut Probe				
	31	Pressure Transmitter				
PRESSURE TRANSMITTER	32	Type				
	33	Make	Model No.			
	34	Process Connection Size & Rating				
	35	Range				
WATER CUT PROBE	36	Type	Level			
	37	Dedicated	With Temp Probe			
TEMPERATURE ELEMENT	38	Type				
	39	Element Type	No. of elements			
	40	Connection Size	Rating			
	41	Element Anchoring				
	42	Sheath Material				
OPTIONS	43	Calibration Pin	Power Switch			
	44	Still well	Mounting Brackets			
	45	Built-in Alarm contacts				
INTERCONNECTING CABLE	46	TankSide Indicator&Gauge head				
	47	Gauge and Temperature Element				
	48	Tank Gauge & Water Probe				
	49	Power cable bet.GH &Indicator				
CERTFICATE	50	Statutory Requirement (CCOE/PESO)				
PURCHASE	51	Manufacturer				
	52	Model				
	53	Purchase Order No.				
	54	Requition No.				

Notes:

No.	By	Date	Revision

INSTRUMENT SPECIFICATION

Project :
Job No :
Unit No:

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

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Code: 1210 | Doc. No.: | Rev.:

GENERAL	1	Tag Number				
	2	Service				
	3	Location	P&ID No.			
	4	Equipment No.				
	5	Area Classification				
	6	Equipment Height				
	7	Tank Type				
	8	Product				
PROCESS CONDITIONS	9	Fluid				
	10	Pressure Max.	Oper.			
	11	Temperature Max.	Oper.			
	12	Specific Gravity				
	13	Corrosive Constituent				
	14	Viscosity				
SENSOR	15	Type				
	16	Sensor Material				
	17	Head Material				
	18	Flange Material				
	19	Float Material				
	20	Connection Size				
	21	Connection Rating				
	22	Flange Facing				
	23	Flange Finsih				
	24	Location				
CONVERTOR	25	Function				
	26	Output				
	27	Electrical Power or Air Supply				
	28	Location				
	29	Quantity				
	30	Form				
	31	Contact Rating				
	32	On Alarm Contact				
	33	Enclosure Class				
	34	Cable Entry-Signal				
	35	Cable Entry- Power				
	36	Intrinsically Safe				
	37					
OTHERS	38	Overall Length from Flange Top to Tank Bottom				
	39	Tank Maximum Level				
	40	Tunning Fork Length				
	41					
CERTFICATE	42	Statutory Requirement				
	43					
	44					
	45					
PURCHASE	46	Manufacturer				
	47	Model				
	48	Purchase Order No.				
	49	Requition No.				
	50					
	51					
	52					
	53					
	54					

Notes:

				INSTRUMENT SPECIFICATION LEVEL SWITCH-TUNNING FORK Project : Job No : Unit No:	इंजीनियर्स इंडिया लिमिटेड ENGINEERS INDIA LIMITED (A Govt. of India Undertaking) Sheet of	
No.	By	Date	Revision	Code: 1211	Doc. No.:	Rev.:

GENERAL	1	Tag Number				
	2	Service				
	3	Area Classification				
	4	Function	Power Supply			
	5	Mounting	Case			
	6	Type				
	7	Enclosure	Intrinsic Safety			
	8	Accuracy	Cable Entry			
	9	Output Type	Protocol			
	10	Driving Voltage				
PROCESS CONDITIONS	11	Pressure Oper.	Des. UOM			
	12	Temp. Oper.	Des UOM			
	13	Oper. Spec. Gravity	Oper. Viscosity			
	14					
MEASURING UNIT	15	Inst.Range Min.	Max. UOM			
	16	Cal.Range Min.	Max. UOM			
	17	Elevation	Suppression			
	18	Element Type				
	19	Body Material				
	20	Element Material				
	21	Body Rating				
	22	Over Range Protection				
	23	Process Connection				
	24	Instrument Connection	Connection Location			
DIAPHRAGM SEAL	25	Dia. Seal	Type			
	26	Wetted Part Material	Other Material			
	27	Process Connection (LP):				
	28	Size	Rating			
	29	Facing & Finish				
	30	Process Connection (HP):				
	31	Size	Rating			
	32	Facing & Finish				
	33	Flange Material				
	34	Capillary Material	Capillary Length			
	35	Armour Type	Armour Material			
	36	Gasket Material				
	37	Bolt Material	Nut Material			
	38	Flushing/Filling Connection with Plug				
OPTIONS	(a)	Air Filter Regulator				
	(b)	Integral Output Meter (Instrinsically Safe)				
	(c)	Manifold 5 valve				
	(d)	Manifold 3 Valve				
	(e)	Condensate Pots				
	(f)	Adjustable Dampner				
	(g)	Integral Square Root Extractor				
	(h)	Test Jack, Calibrating				
	(i)	Mounting Accessories for 2" NB pipe				
CERTIFICATION	39	CCOE/PESO				
PURCHASE	40	Requisition Number				
	41	Manufacturer				
	42	Model				
	43	Purchase Order Number				
	44	C-C length				
	45	Notes				

Notes:

No.	By	Date	Description

INSTRUMENT SPECIFICATION
Diff Pressure Inst (Level)
Project:
Job No :
Unit No :

ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

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Code: 1212 | Doc. No.: | Rev.:

GENERAL	1	Tag Number					
	2	Line No	Pipe Spec				
	3	P&ID No.	Area Classification				
	4	Location	Equipment Number				
	5	Service					
PROCESS CONDITIONS	6	Fluid	Fluid Phase	Fluid State			
	7	Oper. Temperature	Max. Temperature				
	8	Oper. Pressure	Max. Pressure				
	9	Design Temp.	Design Press.				
	10	Pulsation	Vibration				
GAUGE	11	Type					
	12	Range Min.	Max.				
	13	Window Material					
	14	Enclosure Type					
	15	Mounting					
	16	Dial Size					
	17	Dial Color					
	18	Case Material					
	19	Bezel Ring	Ring Material				
	20	Over range Protection					
	21	Blow-Out Protection					
	22	Zero Adjustment					
	23	Pressure Element Type					
	24	Pressure Element Material					
	25	Socket Material					
	26	Connection Size					
	27	Connection Location					
	28	Movement Material					
	29	Nominal Accuracy					
DIAPHRAGM SEAL	30	Type					
	31	Wetted Parts Material	Other Material				
	32	Process Connection					
	33	Size	Rating				
	34	Facing and Finish					
	35	Capillary Length					
	36	Capillary Material					
	37	Armour Type	Material				
	38	Flushing Connection					
	39	Gasket and Backup Flanges					
	40	Mounting Acess for 2" NB Pipe					
OPTIONS	a	Pulsation Dampener					
	b	Syphon C Type					
	c	Pressure Limit Valve					
	d	Liquid Filled Casing					
	e	Vacuum Protection					
	f	Spacer Ring (Drip Ring)					
	g	Solid Front					
TEST	41	NACE	IBR				
	42	H2 Service	Radiography				
	43						
PURCHASE	44	Requisition No.	PO Number				
	45	Manufacturer					
	46	Model No.					

Notes:

No.	By	Date	Description

INSTRUMENT SPECIFICATION
Pressure Gauges
Project :
Job No.:
Unit No.:

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

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Code: 1301 | Doc. No.: | Rev.:

GENERAL	1	Tag Number				
	2	Service				
	3	Location	P&ID No.			
	4	Area Classification				
	5					
	6					
	7					
PROCESS CONDITIONS	8	Fluid				
	9	Pressure Max	Oper.			
	10	Temperature Max.	Oper.			
	11	Oper. Specific Gravity	Oper. Viscosity			
	12	Pulsation				
	13	Design Temp.	Design Press.			
	14					
	15					
ELEMENT	16	Type				
	17	Material				
	18	Connection Size				
	19	Orientation				
	20	Pressure Rating				
	21					
	22					
	23					
SWITCH	24	Type				
	25	Contact Arrangement				
	26	Contact Rating				
	27	Set Point				
	28	On Measurement Increase Switch				
	29	Certification				
	30	Conduit Connection Size				
	31	Calibration Range Min.	Max.			
	32					
	33					
	34					
	35					
DIAPHRAGM SEAL	36	Body Material				
	37	Diaphragm				
	38	Fill Liquid				
	39	Process Connection Size				
	40	Cleanout Connection				
	41					
	42					
	43					
PURCHASE	44	Manufacturer				
	45	Model				
	46	Purchase Order Number				
	47					
	48					

Notes:

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INSTRUMENT SPECIFICATION
Pressure Switches

Project:
Job No:
Unit no:

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

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Code: 1302 | Doc. No.: | Rev.:

GENERAL	1	Tag Number				
	2	Service				
	3	Area Classification				
	4	Function	Power Supply			
	5	Mounting	Case			
	6	Type	P&ID No.			
	7	Enclosure	Intrinsic Safety			
	8	Accuracy	Cable Entry			
	9	Output Type	Protocol			
	10	Driving Voltage				
PROCESS CONDITIONS	11	Fluid				
	12	Pressure Oper.	Des UOM			
	13	Temp. Oper.	Des UOM			
	14	Oper. Spec. Gravity	Oper. Viscosity			
MEASURING UNIT	15	Inst.Range Min.	Max. UOM			
	16	Cal.Range Min.	Max. UOM			
	17	Elevation	Suppression			
	18	Element Type				
	19	Body Material				
	20	Element Material				
	21	Body Rating				
	22	Over Range Protection				
	23	Process Connection				
	24	Connection Location				
DIAPHRAGM SEAL	25	Dia. Seal	Type			
	26	Wetted Part Material				
	27	Other Material				
	28	Process Connection:				
	29	Size	Rating			
	30	Facing & Finish				
	31	Capillary Material				
	32	Capillary Length				
	33	Armour Type				
	34	Armour Material				
	35	Flange Material				
	36	Gasket Material				
	37	Bolt Material	Nut Material			
	38	Flushing/Filling Connection with Plug				
OPTIONS	(a)	Air Filter Regulator				
	(b)	Output Meter (Instrinsically Safe)				
	(c)	Manifold 2 valve				
	(d)	Condensate Pots				
	(e)	Adjustable Dampner				
	(f)	Test Jack, Calibrating				
	(g)	Mounting Accessories				
CERTIFICATION	39	CCOE/PESO				
	40					
PURCHASE	41	Requisition Number				
	42	Manufacturer				
	43	Model				
	44	Purchase Order Number				
	45	Notes				

Notes:

				INSTRUMENT SPECIFICATION		
				Pressure Instruments		
				Project:		
				Job No :		
				Unit No :	Sheet	of
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GENERAL	1	Tag Number				
	2	Service				
	3	Area Classification				
	4	Function	Power Supply			
	5	Mounting	Case			
	6	Type	P&ID No.			
	7	Enclosure	Intrinsic Safety			
	8	Accuracy	Cable Entry			
	9	Output	Protocol			
	10	Driving Voltage				
PROCESS CONDITIONS	11	Pressure Oper.	Des. UOM			
	12	DP Oper.	Des. UOM			
	13	Temp. Oper.	Des UOM			
	14	Oper. Spec. Gravity	Oper. Viscosity			
MEASURING UNIT	15	Inst.Range Min.	Max. UOM			
	16	Cal.Range Min.	Max. UOM			
	17	Elevation	Suppression			
	18	Element Type				
	19	Body Material				
	20	Element Material				
	21	Body Rating				
	22	Over Range Protection				
	23	Process Connection				
	24	Instrument Connection	Connection Location			
DIAPHRAGM SEAL	25	Dia. Seal	Type			
	26	Wetted Part Material	Other Material			
	27	Process Connection (LP):				
	28	Size	Rating			
	29	Facing & Finish				
	30	Process Connection (HP):				
	31	Size	Rating			
	32	Facing & Finish				
	33	Flange Material				
	34	Capillary Material	Capillary Length			
	35	Armour Type	Armour Material			
	36	Gasket Material				
	37	Bolt Material	Nut Material			
	38	Flushing/Filling Connection with Plug				
OPTIONS	(a)	Air Filter Regulator				
	(b)	Integral Output Meter (Instrinsically Safe)				
	(c)	Manifold 5 valve				
	(d)	Manifold 3 Valve				
	(e)	Condensate Pots				
	(f)	Adjustable Dampner				
	(g)	Integral Square Root Extractor				
	(h)	Test Jack, Calibrating				
	(i)	Mounting Accessories for 2" NB pipe				
CERTIFICATION	39	CCOE/PESO				
PURCHASE	40	Requisition Number				
	41	Manufacturer				
	42	Model				
	43	Purchase Order Number				
	44	Notes				

Notes:

No.	By	Date	Description

INSTRUMENT SPECIFICATION
Diff. Pressure Instruments
Project:
Job No :
Unit No :
Code: 1304
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इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

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GENERAL	1	Tag No.																	
	2	Service																	
	3	Line No.		P&ID No.															
	4	Area Classification																	
	5	Ambient Temperature:		Min.		Max.													
	6	Allowable Sound Pressure Level dBA																	
	7	Control Action- On-Off (or) Modulating																	
	8	Available Air Supply Pressure:		Min.		Max.													
	9	Failure Position																	
PIPE LINE	10																		
	11	Line Size and Schedule		Inlet		Outlet													
	12	Inlet Line ID (in.)		Outlet Line ID (in.)															
PROCESS CONDITIONS	13	Deg of superheat																	
	14	Process Fluid		Fluid State		Fluid Phase													
	15	% Flash		% Solids															
	16	Differential Pressure-Shut Off																	
	17							Units		@ Max. Flow		@ Norm. Flow		@ Min. Flow					
	18	Flow Rate																	
	19	Inlet Pressure																	
	20	Pressure Drop																	
	21	Inlet Temperature																	
	22	Inlet Density / Specific Gravity / Molecular Mass						-											
	23	Inlet Compressibility Factor						-											
	24	Inlet Viscosity																	
	25	Inlet Specific Heat Ratio						-											
	26	Inlet Vapour Pressure																	
	27	Critical Pressure																	
CALCULATED RESULTS	28	Flow Coefficient Cv Max. Nor Min.						-											
	29	Travel		Inlet Velocity				%	m/sec										
	30	Sound Pressure Level						dBA											
BODY AND TRIM	31	MFR	Model																
	32	Body Type																	
	33	Body Size	Port Size																
	34	Rated Cv	Characteris.																
	35	End Connec. & Rating																	
	36	Facing and Finish																	
	37	Body,Bonnet Material																	
	38	Packing Material																	
	39	Rated Travel																	
	40	Lubricator	Isolat. Valve																
	41	Guiding	No. of Ports																
	42	Trim Type																	
	43	Trim Material																	
	44	Other Wetted Parts Material																	
	45	Soft Seat	Material																
	46	Seat Material																	
	47	Gasket Material																	
	48	Bonnet Type																	
ACTUATOR	49	MFR	Model																
	50	Type																	
	51	Size	Area																
	52	Air Failure Valve:																	
	53	Handwheel Location																	
	54	Bench Range																	
	55	Spring Action																	
POSITIONER	56	MFR	Model																
	57	Signal: Inlet	Outlet																
	58	Type																	
	59	Air Supply Pressure																	
	60	Bypass	Gauges																
ACCESSORIES	61	I/P Converter																	
	62	Silencer Exp Baffle Plate																	
	63	Pneu. Lock Relay/Vol. Bos																	
SOLENOID VALVE	64	Type																	
	65	When De-Enegr.Valve:																	
	66	Tag No.																	
	67	MFR	Model																
SWITCHES	68	Type	Quantity																
	69	Contacts / Rating																	
	70	Switching Position																	
	71	Tag No.																	
	72	MFR	Model																
AIR SET	73	Set Pressure																	
	74	Filter	Gauge																
	75	MFR	Model																
TIGHTNESS	76	Leakage Class																	
TESTS	77	NACE	H2 Service																
	78	IBR	Radiography																
PURCHASE	79	Manufacturer																	
	80	Model																	
	81	Req. Number																	
	82	Purchase Order Num.																	
	83																		

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INSTRUMENT SPECIFICATION
Control Valves
Project :
Job No.:
Unit No.:

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

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GENERAL	1	Tag No.																	
	2	Service																	
	3	Line No.		P&ID No.															
	4	Area Classification																	
	5	Ambient Temperature:		Min.		Max.													
	6	Allowable Sound Pressure Level dBA																	
	7	Control Action- On-Off (or) Modulating																	
	8	Available Air Supply Pressure:		Min.		Max.													
	9	Failure Position																	
PIPE LINE	10																		
	11	Line Size and Schedule		Inlet		Outlet													
	12	Inlet Line ID (in.)		Outlet Line ID (in.)															
PROCESS CONDITIONS	13	Deg of superheat																	
	14	Process Fluid		Fluid State		Fluid Phase													
	15	% Flash		% Solids															
	16	Differential Pressure-Shut Off																	
	17							Units		@ Max. Flow		@ Norm. Flow		@ Min. Flow					
	18	Flow Rate																	
	19	Inlet Pressure																	
	20	Pressure Drop																	
	21	Inlet Temperature																	
	22	Inlet Density / Specific Gravity / Molecular Mass						-											
	23	Inlet Compressibility Factor						-											
	24	Inlet Viscosity																	
	25	Inlet Specific Heat Ratio						-											
	26	Inlet Vapour Pressure																	
	27	Critical Pressure																	
CALCULATED RESULTS	28	Flow Coefficient Cv Max. Nor Min.						-											
	29	Travel		Inlet Velocity				%	m/sec										
	30	Sound Pressure Level						dBA											
BODY AND TRIM	31	MFR	Model																
	32	Body Type																	
	33	Body Size	Port Size																
	34	Rated Cv	Characteris.																
	35	End Connec. & Rating																	
	36	Facing and Finish																	
	37	Body,Bonnet Material																	
	38	Packing Material																	
	39	Rated Travel																	
	40	Lubricator	Isolat. Valve																
	41	Guiding	No. of Ports																
	42	Trim Type																	
	43	Trim Material																	
	44	Other Wetted Parts Material																	
	45	Soft Seat	Material																
	46	Seat Material																	
	47	Gasket Material																	
	48	Bonnet Type																	
ACTUATOR	49	MFR	Model																
	50	Type																	
	51	Size	Area																
	52	Air Failure Valve:																	
	53	Handwheel Location																	
	54	Bench Range																	
	55	Spring Action																	
POSITIONER	56	MFR	Model																
	57	Signal: Inlet	Outlet																
	58	Type																	
	59	Air Supply Pressure																	
	60	Bypass	Gauges																
ACCESSORIES	61	I/P Converter																	
	62	Silencer Exp Baffle Plate																	
	63	Pneu. Lock Relay/Vol. Bos																	
SOLENOID VALVE	64	Type																	
	65	When De-Enegr.Valve:																	
	66	Tag No.																	
	67	MFR	Model																
SWITCHES	68	Type	Quantity																
	69	Contacts / Rating																	
	70	Switching Position																	
	71	Tag No.																	
	72	MFR	Model																
AIR SET	73	Set Pressure																	
	74	Filter	Gauge																
	75	MFR	Model																
TIGHTNESS	76	Leakage Class																	
TESTS	77	NACE	H2 Service																
	78	IBR	Radiography																
PURCHASE	79	Manufacturer																	
	80	Model																	
	81	Req. Number																	
	82	Purchase Order Num.																	
	83																		

Notes:

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INSTRUMENT SPECIFICATION
Special Control Valve
Project :
Job No. :
Unit No.:

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

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GENERAL	1	Tag No.									
	2	Service									
	3	Line No.		P&ID No.							
	4	Area Classification									
	5	Ambient Temperature:		Min.	Max.						
	6	Allowable Sound Pressure Level dBA									
	7	Control Action- On-Off (or) Modulating									
	8	Available Air Supply Pressure:		Min.	Max.						
	9	Failure Position									
PIPE LINE	10	Line Size		Line Schedule							
	11	Inlet Line ID (mm)		Outlet Line ID (mm)							
	12										
PROCESS CONDITIONS	13	Fluid Name	Fluid State	Fluid Phase							
	14	% Flash	% Solids								
	15	Leakage Class									
	16	Differential Pressure-Shut Off									
	17					Units	@ Max. Flow		@ Norm. Flow		@ Min. Flow
	18	Flow Rate									
	19	Inlet Pressure									
	20	Pressure Drop									
	21	Inlet Temperature									
	22	Inlet Density / Specific Gravity / Molecular Mass									
	23	Inlet Compressibility Factor				-					
	24	Inlet Viscosity									
	25	Inlet Specific Heat Ratio				-					
	26										
	27										
CALCULATED RESULTS	28	Flow Coefficient Cv Max. Nor Min.				-	-		-		-
	29	Travel		Inlet Velocity		%	m/sec	-	-	-	-	-	-
	30	Sound Pressure Level				dBA		-		-		-	
BODY AND TRIM	31	MFR	Model								
	32	Body Type									
	33	Body Size									
	34	Bonnet Type									
	35	Body,Bonnet Material									
	36	Trim Type	Trim Size								
	37	Trim Material									
	38	Seat Material									
	39	Stem/Shaft material									
	40	Guiding Type									
	41	Packing Material									
	42	Characteristics									
	43	Conn. In	Size & Rating								
	44	Conn. In	Facing & Finish								
	45	Conn. Out	Size & Rating								
	46	Conn. Out	Facing & Finish								
	47	TSO	Leakage Class								
	48	Bolt/Nut Material									
	49	Gasket Material									
ACTUATOR	50	Type									
	51	Air Failure Position									
	52	Handwheel Location									
	53	Fire Safe									
	54	MFR	Model								
	55	Open/Close Time									
Positioner	56	MFR									
	57	Model									
	58	Type									
	59	Air Supply Pressure									
	60	Bypass	Gauges								
	61	Signal: Inlet	Outlet								
ACCESSORIES	62	Air Reservoir									
	63	Air Lock Device									
Solenoid Valve	64	Type	Qty.								
	65	When De-Enegr.Valve:									
	66	Tag No.									
	67	MFR	Model								
Switches	68	Type	Quantity								
	69	Voltage									
	70	Switching Position									
	71	Tag No.									
	72	MFR	Model								
Air Set	73	Set Pressure									
	74	Filter	Gauge								
	75	MFR	Model								
Tests	76	Nace									
	77	IBR									
	78	Hydrogen									
	79	Radiography									
PURCHASE	80	Manufacturer									
	81	Model									
	82	Purchase Order Num.									
	83	Requistion No.									

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INSTRUMENT SPECIFICATION
On-Off Valves
Project :
Job No.
Unit No.:

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

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GENERAL	1	Tag Number								
	2	Service								
	3	Line No.	Line Size	Schedule						
	4	Tightness Requirements								
PROCESS CONDITIONS	5	Fluid	Fluid State							
	6	Flow Operating								
	7	Flow	Max.	Min.						
	8	Inlet Pressure	Max.	Operating	Min.					
	9	DP Valve Sizing Operating								
	10	DP Valve Sizing Min.	Max.							
	11	Shut - Off DP	Max.							
	12	Temperature	Min.	Operating	Max.					
	13	Operating relative density	UOM							
	14	Molecular Mass	Compressibility	Cp/Cv						
	15	Viscosity at Base	Operating							
	16	Inlet Velocity	Degree of superheat							
	17	Vapor Pressure	Critical Pressure							
	18	Predicted Allow Sound Level dBA								
	19	Cv Calculated	Max.	Min.	Nor.					
BODY	20	Size	Trim Size	Selected Cv						
	21	Type	Function							
	22	End Connections Type	Size							
	23	Rating	Facing Finish							
	24	Body Material	Bonnet Type							
	25	Stem Material	Packing Material							
	26	Flow Action to								
	27	Lubricator	Iso. Valve							
TRIM	28	Guiding	No. Ports	Characteristic						
	29	Plug Material								
	30	Seat Material								
	31	Trim Material								
	32	Gasket Material								
	33	Bushing Material								
ACTUATOR / PILOT	34	Model	Size							
	35	Type								
	36	Pilot								
	37	Supply to Pilot								
	38	Self Connection	External Connection	Size Rtng						
	39	Diaphragm Material								
	40	Spring Range								
	41	Set Point								
	42	Diaphragm Rating								
	43									
ACCESSORIES	44	Filter Regulator								
	45	Line Strainer								
	46	Housing Vent								
	47	Internal Relief								
	48	Pressure Gauge								
	49									
TESTS	50	NACE	IBR							
	51	Hydrogen	Radiography							
PURCHASE	52	Manufacturer								
	53	Model								
	54	Requisition No.	Purchase Order No.							
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INSTRUMENT SPECIFICATION
Self Actuated PCV
Project:
Job No:
Unit No:

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GENERAL	1	Tag Number				
	2	Service				
	3	Line No.	Eqp./Line Protected			
	4	Nozzle (Full, Semi)				
	5	Design	Safety, Relief, Safety-Relief			
	6	Type	Conventional, Bellow, Pilot Operated			
	7	Bonnet Type				
	8	Valve Discharge to				
PROCESS CONDITIONS	9	Fluid	State			
	10	Required Capacity				
	11	Molecular Mass				
	12	Oper. Pressure	Set Pressure			
	13	Oper. Temperature	RelievingTemperature			
	14	Back Pressure	Constant			
	15		Variable			
	16		Total			
	17	% Allowable Overpressure				
	18	Overpressure Factor				
	19	Compressibility Factor				
	20	Latent Heat of Vaporization				
	21	Ratio of Specific Heats				
	22	Relative Density @ Rel. Temp.				
	23	Viscosity @ Rel. Temp.				
	24	Barometric Pressure				
	25	Cold Bench Test Pressure	Blowdown %			
	26	Vessel Wall Temp.	Vessel Surface Area			
BASIS AND SELECTION	27	Design Code				
	28	Sizing Basis				
	29	Calculated Area				
	30	Selected Area				
	31	Orifice Designation				
	32	Number of Valves	(To Meet Capacity)			
	33	Total Capacity				
	34					
CONNECTIONS	35	Inlet : Size	Rating			
	36	Facing and Finish				
	37	Outlet: Size	Rating			
	38	Facing and Finish				
MATERIALS	39	Body and Bonnet				
	40	Nozzle and Disc				
	41	Resilient Seat Seal				
	42	Guide and Rings				
	43	Spring				
	44	Bellows				
OPTIONS	45	Cap: Screwed or Bolted				
	46	Lever: Plain or Packed				
	47	Test Gag				
TESTS	48	NACE	IBR			
	49	Hydrogen	Radiography			
PURCHASE	50	Manufacturer				
	51	Model				
	52	Purchase Order Number				
	53	Requisition number				
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INSTRUMENT SPECIFICATION
Pressure Relief Valves
Project :
Job No :
Unit No :

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

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GENERAL	1	Tag Number				
	2	Service				
	3	Line No.	Vessel No.			
	4	PID No.				
	5	Nozzle (Full, Semi)				
	6	Design	Safety, Relief, Safety-Relief			
	7	Type	Conventional, Bellow, Pilot Operated			
	8	Bonnet Type				
PROCESS CONDITIONS	9	Fluid	State			
	10	Required Capacity				
	11	Molecular Mass				
	12	Oper. Pressure	Set Pressure			
	13	Oper. Temperature	RelievingTemperature			
	14	Back Pressure	Constant			
	15		Variable			
	16		Total			
	17	% Allowable Overpressure				
	18	Overpressure Factor				
	19	Compressibility Factor				
	20	Latent Heat of Vaporization				
	21	Ratio of Specific Heats				
	22	Relief Density				
	23	Relief Viscosity				
	24	Barometric Pressure				
	25	Cold Bench Test Pressure				
	26	Blowdown				
BASIS AND SELECTION	27	Design Code				
	28	Sizing Basis		Liquid Filled Vessel		
	29	Calculated Area				
	30	Selected Area		in²		
	31	Orifice Designation				
	32	No. of valves (To meet capacity)				
	33	Total Capacity				
CONNECTIONS	34	Inlet: Size	Rating			
	35	Facing	Finish			
	36	Outlet: Size	Rating			
	37	Facing	Finish			
MATERIALS	38	Body and Bonnet				
	39	Nozzle and Disc				
	40	Resilient Seat Seal				
	41	Spindle and Guide				
	42	Spring				
PILOT MATERIAL	43	Body/ Cylinder & Bonnet				
	44	Nozzle _Disc				
OPTIONS	45	Cap: Screwed or Bolted				
	46	Lever: Plain or Packed				
	47	Test Gag				
	48	Back Flow Preventer				
TESTS	49	NACE	IBR			
	50	Hydrogen	Radiography			
PURCHASE	51	Manufacturer				
	52	Model				
	53	Purchase Order Number				
	54	Requisition No.				

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INSTRUMENT SPECIFICATION
Pressure Relief Valves
Project:
Job No:
Unit No.:

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GENERAL	1	Tag Number						
	2	Service						
	3	Equipment No.		Line Number				
	4	P&ID No.		Area Classification				
FLUID DATA	5	Fluid	Fluid Phase	Fluid State				
	6	Fluid Gas Group						
	7	Flash Point						
	8	Oper. Temperature		Design Temperature				
	9	Oper. Pressure		Design Pressure				
	10	Molecular Wt.						
	11	Inert Gas Blanket						
	12	Capacity (Equivalent Air) at:						
		In Breathing		Out Breathing				
	13	Tank Design Pressure						
	14	Design Vacuum						
	15	Discharge to						
	16	Allowable Pressure Drop						
	17	Continous / Intermitent						
BREATHER VALVE	18	Type						
	19	Mounting						
	20	Sizing						
	21	Set Pressure		Set Vaccum				
	22	% Over Pressure:						
		@ Set Pressure		@ Set Vacuum				
	23	Full Open Pressure						
	24	Capacity (equivalent air):						
		@ Set Pressure		@ Set Vacuum				
	25	Type of Seating						
	26	Material:						
		Body		Seat / Pallet				
		Diaphragm		Oring				
	27	End Connections, Inlet:						
		Size		Rating				
		Facing & Finish						
	28	End Connections, Outlet:						
		Size		Rating				
		Facing & Finish						
	29	Test Connecton Bellow Pallet						
	30	Gasket Material						
	31	Nut & Bolt Material						
TEST	32	NACE		IBR				
	33	H2 Service		Radiography				
PURCHASE	34	Requisition No		PO Number				
	35	Manufacturer						
	36	Model No.						

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INSTRUMENT SPECIFICATION
BREATHER VALVE
Project :
Job No :
Unit No :

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GENERAL	1	Tag Number						
	2	Service						
	3	Equipment No.	Line Number					
	4	Area Classification	P&ID Number					
FLUID DATA	5	Fluid	Fluid Phase	Fluid State				
	6	Fluid Gas Group						
	7	Flash Point						
	8	Temp. Nor.	Min.	Max.				
	9	Pressure Nor.	Min.	Max.				
	10	Flow Nor.	Min.	Max.				
	11	Design Temperature	Design Pressure					
	12	Design Vaccum						
	13	Molecular Wt.						
	14	Allowable Pressure Drop						
	15	Continous / Intermitent						
	16	Inert Gas Blanket						
	17	Capacity (Equivalent Air) at						
	18	In Breathing	Out Breathing					
	19	Tank Design Pressure						
	20	Design Vacuum						
	21	Discharge to						
EMERGENCY VENT	22	Type						
	23	End Connection Size	Rating					
		Facing & Finish						
	24	Capacity (equivalent air) at						
		Design Pressure						
		Design Vacuum						
	25	Material Body	Cover					
		Mesh	Diaphragm					
	26	Flange Material						
	27	Set Pressure						
	28	Over Pressure						
	29	Full Open Pressure						
	30	Nominal Tank Capacity						
	31	Emergency Venting Capacity						
		Pressure Relief Air Capacity (PRV)						
		Vaccum Relief Capacity (VRV)						
	32	Location						
TEST	33	NACE	IBR					
	34	H2 Service	Radiography					
PURCHASE	35	Model No.						
	36	Manufacturer						
	37	Purchase Order Number						
	38	Requisition Number						

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INSTRUMENT SPECIFICATION
EMERGENCY VENT
Project :
Job No :
Unit No :

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GENERAL	1	Tag Number				
	2	Service				
	3	Line No.	Equipment No.			
	4	Line Size	Line Schedule			
	5	Line I.D.				
	6	PID No.				
BASIS	7	Design Code				
	8	Basis for Selection				
	9	Applicaiton (Primary / Secondary Relief)				
PROCESS CONDITIONS	10	Fluid	Fluid State			
	11	Flow Capacity				
	12	Estimated Burst Pressure at 22 Deg C				
	13	Oper. Pressure	Burst Pressure			
	14	Temperature Rel.	Temperature Oper.			
	15	Back Pressure				
	16	Burst Press Min.	Max.			
	17	Discharges				
	18	Relative Density	Molecular Weight			
	19	Ratio of Specific Heat	Compressibility			
	20	Viscosity at Releiving temp.				
	21	Design Temperature				
	22					
DISC	23	Type				
	24	Size	Rating			
	25	Material				
	26	Coating Inlet	Outlet			
VACCUM SUPPORT	27	Material				
	28	Quantity Per Assembly				
	29	Attached to Disc				
	30					
DISC HOLDER	31	Type of Assembly				
	32	Connection Size	Rating			
	33	Facing & Finish				
	34	Disc Holding Material	Hold Down Material			
	35	Connecting pipe ID				
	36	Connecting pipe OD				
	37	Tap in Hold Down Flange				
	38	Bolt Material				
	39	Nut Material				
OPTIONS	40	Preassembly Screw				
	41	Companion Flanges	Size & Rating			
	42		Facing & Finish			
	43	Studs and Nuts				
	44	Excess Flow Check Valve				
	45	Pressure Gage				
	46	Jack Screws				
	47	J - Bolts				
	48					
PURCHASE	49	Requisition Number				
	50	Manufacturer				
	51	Model No. Safety Head	Disc			
	52	Purchase Order No.				
TEST	53	NACE	IBR			
	54	H2S	Radiography			

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				INSTRUMENT SPECIFICATION Rupture Disc Project : Job No: Unit No.:	इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking) Sheet of	
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GENERAL	1	Tag Number			
	2	Area Classification	Location		
	3	Service			
	4	P&ID Number	Equipment No		
	5	Enclosure Type			
PROCESS DATA	6	Gas MW	Major Constituents		
	7	LEL (%V/V IN AIR)			
	8	Type of Vapour Detection			
	9	Alarm at: High Alarm	High-High Alarm		
	10				
LEL/HC GAS DETECTOR	11	Detetor Type			
	12	IR Detector Type	IR Source (Lamp) Life		
	13	Detector Output			
	14	Material of Construction			
	a	Body			
	b	Cap			
	c	Filter			
	15	Response Time			
	16	Range			
TRANSMITTER	17	Location			
	18	Enclosure Type			
	19	Type			
	20	No. of detectors per transmitter			
	21	Output			
	a	Analogue			
	b	Serial			
	22	Display			
	23	Power Supply			
	24	Min Operating Voltage			
	25	Cable b/w Detecor & Transmitter			
	a	Power			
	b	Signal			
	26	Cable b/w Transmitter & Remote reciever			
	a	Power			
	b	Signal			
	27	Cable Glands			
	28	Cable Entry			
ACCESSORIES	29	Mounting			
	30	Mounting Accessories			
	31	Portable Calibration Kit			
	32	Type			
	33	Service			
	34	Carrying Case			
	35	Calibration Gas Cylinders			
	36	Protective Cap for Dust/ Rain Cover			
	37	Aspirator assembly			
OTHERS	38	Statutory			
	39	CCOE / PESO			
	40				
PURCHASE	41	Manufacturer			
	42	Model			
	43	Purchase Order Number			
	44	Requisition Number			
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				INSTRUMENT SPECIFICATION	ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)	
				LEL/HC GAS DETECTOR		
				Project :		
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GENERAL	1	Tag Number			
	2	Area Classification	Location		
	3	Service			
	4	P&ID Number	Equipment No		
	5	Enclosure Type			
PROCESS DATA	6	Gas MW	Major Constituents		
	7	LEL (%V/V IN AIR)			
	8	Type of Vapour Detection			
	9	Alarm at: High Alarm	High-High Alarm		
	10				
	11				
H2 GAS DETECTOR	12	Detetor Type			
	13	Detector Output			
	14	Material of Construction			
	a	Body			
	b	Cap			
	c	Filter			
	15	Response Time			
	16	Range			
TRANSMITTER	17	Location			
	18	Enclosure Type			
	19	Type			
	20	No. of detectors per transmitter			
	21	Output			
	a	Analogue			
	b	Serial			
	22	Display			
	23	Power Supply			
	24	Min Operating Voltage			
	25	Cable b/w Detecor & Transmitter			
	a	Power			
	b	Signal			
	26	Cable b/w Transmitter & Remote reciever			
	a	Power			
	b	Signal			
	27	Cable Glands			
	28	Cable Entry			
ACCESSORIES	29	Mounting			
	30	Mounting Accessories			
	31	Portable Calibration Kit			
	32	Type			
	33	Service			
	34	Carrying Case			
	35	Calibration Gas Cylinders			
	36	Protective Cap for Dust/ Rain Cover			
	37	Aspirator assembly			
OTHERS	38	Statutory			
	39	CCOE / PESO			
	40				
PURCHASE	41	Manufacturer			
	42	Model			
	43	Purchase Order Number			
	44	Requisition Number			
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INSTRUMENT SPECIFICATION
H2 GAS DETECTOR
Project :
Job No.:
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इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

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GENERAL	1	Tag Number			
	2	Area Classification	Location		
	3	Service			
	4	P&ID Number	Equipment No		
	5	Enclosure Type			
PROCESS DATA	6	Gas MW	Major Constituents		
	7	LEL (%V/V IN AIR)			
	8	Type of Vapour Detection			
	9	Alarm at:	High Alarm / High-High Alarm		
	10				
	11				
TOXIC GAS DETECTOR	12	Detetor Type			
	13	Detector Output			
	14	Material of Construction			
	a	Body			
	b	Cap			
	c	Filter			
	15	Response Time			
	16	Range			
TRANSMITTER	17	Location			
	18	Enclosure Type			
	19	Type			
	20	No. of detectors per transmitter			
	21	Output			
	a	Analogue			
	b	Serial			
	22	Display			
	23	Power Supply			
	24	Min Operating Voltage			
	25	Cable b/w Detecor & Transmitter			
	a	Power			
	b	Signal			
	26	Cable b/w Transmitter & Remote reciever			
	a	Power			
	b	Signal			
	27	Cable Glands			
	28	Cable Entry			
ACCESSORIES	29	Mounting			
	30	Mounting Accessories			
	31	Portable Calibration Kit			
	32	Type			
	33	Service			
	34	Carrying Case			
	35	Calibration Gas Cylinders			
	36	Protective Cap for Dust/ Rain Cover			
	37	Aspirator assembly			
OTHERS	38	Statutory			
	39	CCOE / PESO			
	40				
PURCHASE	41	Manufacturer			
	42	Model			
	43	Purchase Order Number			
	44	Requisition Number			
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INSTRUMENT SPECIFICATION
TOXIC GAS DETECTOR
Project :
Job No. :
Unit No.

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GENERAL	1	Tag Number			
	2	Area Classification	Location		
	3	Service			
	4	P&ID Number	Equipment No		
	5	Enclosure Type			
PROCESS DATA	6	Gas MW	Major Constituents		
	7	LEL (%V/V IN AIR)			
	8	Type of Vapour Detection			
	9	Alarm at: High Alarm	High-High Alarm		
	10				
CO GAS DETECTOR	11	Detetor Type			
	12	IR Detector Type	IR Source (Lamp) Life		
	13	Detector Output			
	14	Material of Construction			
	a	Body			
	b	Cap			
	c	Filter			
	15	Response Time			
	16	Range			
TRANSMITTER	17	Location			
	18	Enclosure Type			
	19	Type			
	20	No. of detectors per transmitter			
	21	Output			
	a	Analogue			
	b	Serial			
	22	Display			
	23	Power Supply			
	24	Min Operating Voltage			
	25	Cable b/w Detecor & Transmitter			
	a	Power			
	b	Signal			
	26	Cable b/w Transmitter & Remote reciever			
	a	Power			
	b	Signal			
	27	Cable Glands			
	28	Cable Entry			
ACCESSORIES	29	Mounting			
	30	Mounting Accessories			
	31	Portable Calibration Kit			
	32	Type			
	33	Service			
	34	Carrying Case			
	35	Calibration Gas Cylinders			
	36	Protective Cap for Dust/ Rain Cover			
	37	Aspirator assembly			
OTHERS	38	Statutory			
	39	CCOE / PESO			
	40				
PURCHASE	41	Manufacturer			
	42	Model			
	43	Purchase Order Number			
	44	Requisition Number			
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				INSTRUMENT SPECIFICATION CO GAS DETECTOR Project : Job No. : Unit No.	इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उद्यम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking) Sheet of	
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GENERAL	1	Tag Number			
	2	Area Classification	Location		
	3	Service			
	4	P&ID Number	Equipment No		
	5	Enclosure Type			
PROCESS DATA	6	Gas MW	Major Constituents		
	7	LEL (%V/V IN AIR)			
	8	Type of Vapour Detection			
	9	Alarm at: High Alarm	High-High Alarm		
FLAME DETECTOR	10	Detetor Type			
	11	IR Detector Type	IR Source (Lamp) Life		
	12	Detector Output			
	13	Field of view			
	14	Material of Construction			
	a	Body			
	b	Cap			
	c	Filter			
	15	Response Time			
	16	Range			
TRANSMITTER	17	Location			
	18	Enclosure Type			
	19	Type			
	20	No. of detectors per transmitter			
	21	Output			
	a	Analogue			
	b	Serial			
	22	Display			
	23	Power Supply			
	24	Min Operating Voltage			
	25	Cable b/w Detecor & Transmitter			
	a	Power			
	b	Signal			
	26	Cable b/w Transmitter & Remote reciever			
	a	Power			
	b	Signal			
	27	Cable Glands			
	28	Cable Entry			
ACCESSORIES	29	Mounting			
	30	Mounting Accessories			
	31	Portable Calibration Kit			
	32	Type			
	33	Service			
	34	Carrying Case			
	35	Calibration Gas Cylinders			
	36	Protective Cap for Dust/ Rain Cover			
	37	Aspirator assembly			
OTHERS	38	Statutory			
	39	CCOE / PESO			
	40				
PURCHASE	41	Manufacturer			
	42	Model			
	43	Purchase Order Number			
	44	Requisition Number			
	45				

Notes:

No.	By	Date	Revision

INSTRUMENT SPECIFICATION
FLAME DETECTOR
Project :
Job No. :
Unit No.

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

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Code: 1605 | Dwg. No.: | Rev.:

GENERAL	1	Tag Number			
	2	Area Classification	Location		
	3	Service			
	4	P&ID Number	Equipment No		
	5	Enclosure Type			
PROCESS DATA	6	Gas MW	Major Constituents		
	7	LEL (%V/V IN AIR)			
	8	Type of Vapour Detection			
	9	Alarm at: High Alarm	High-High Alarm		
OPEN PATH (HC) GAS DETECTOR	10	Detetor Type			
	11	Detector Output			
	12	Range			
	13	Path length			
	14	Material of Construction			
	a	Body			
	b	Cap			
	c	Filter			
	15	Response Time			
	16				
TRANSMITTER	17	Location			
	18	Enclosure Type			
	19	Type			
	20	No. of detectors per transmitter			
	21	Output			
	a	Analogue			
	b	Serial			
	22	Display			
	23	Power Supply			
	24	Min Operating Voltage			
	25	Cable b/w Detecor & Transmitter			
	a	Power			
	b	Signal			
	26	Cable b/w Transmitter & Remote reciever			
	a	Power			
	b	Signal			
	27	Cable Glands			
	28	Cable Entry			
ACCESSORIES	29	Mounting			
	30	Mounting Accessories			
	31	Portable Calibration Kit			
	32	Type			
	33	Service			
	34	Carrying Case			
	35	Calibration Gas Cylinders			
	36	Protective Cap for Dust/ Rain Cover			
	37				
OTHERS	38	Statutory			
	39	CCOE / PESO			
	40				
PURCHASE	41	Manufacturer			
	42	Model			
	43	Purchase Order Number			
	44	Requisition Number			
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Notes:

				INSTRUMENT SPECIFICATION		
				OPEN PATH GAS DETECTOR (HC)		
				Project :		
				Job No. :		
				Unit No.		
No.	By	Date	Revision	Code: 1606	Dwg. No.:	Rev.:

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

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GENERAL	1	Tag Number			
	2	Area Classification	Location		
	3	Service			
	4	P&ID Number	Equipment No		
	5	Enclosure Type			
PROCESS DATA	6	Gas MW	Major Constituents		
	7	LEL (%V/V IN AIR)			
	8	Type of Vapour Detection			
	9	Alarm at: High Alarm	High-High Alarm		
OPEN PATH (H2S) GAS DETECTOR	10	Detetor Type			
	11	Detector Output			
	12	Range			
	13	Path length			
	14	Material of Construction			
	a	Body			
	b	Cap			
	c	Filter			
	15	Response Time			
	16				
TRANSMITTER	17	Location			
	18	Enclosure Type			
	19	Type			
	20	No. of detectors per transmitter			
	21	Output			
	a	Analogue			
	b	Serial			
	22	Display			
	23	Power Supply			
	24	Min Operating Voltage			
	25	Cable b/w Detecor & Transmitter			
	a	Power			
	b	Signal			
	26	Cable b/w Transmitter & Remote reciever			
	a	Power			
	b	Signal			
	27	Cable Glands			
	28	Cable Entry			
ACCESSORIES	29	Mounting			
	30	Mounting Accessories			
	31	Portable Calibration Kit			
	32	Type			
	33	Service			
	34	Carrying Case			
	35	Calibration Gas Cylinders			
	36	Protective Cap for Dust/ Rain Cover			
	37				
OTHERS	38	Statutory			
	39	CCOE / PESO			
	40				
PURCHASE	41	Manufacturer			
	42	Model			
	43	Purchase Order Number			
	44	Requisition Number			
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				INSTRUMENT SPECIFICATION OPEN PATH GAS DETECTOR (H2S) Project : Job No. : Unit No.	इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking) Sheet of	
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GENERAL	1	Tag Number				
	2	Area Classification				
	3	Service				
	4	Location	Equipment No			
	5	Enclosure Type				
PROCESS DATA	6	Gas MW	Major Constituents			
	7	LEL (%V/V IN AIR)				
	8	Type of Vapour Detection				
	9	Alarm at: High Alarm	High-High Alarm			
	10					
PORTABLE GAS DETECTOR	11	Detetor Type				
	12	Battery Type				
	13	Battery Charger				
	14	Battery Charger Voltage				
	15	Display Type				
	16	Display of Fault Warning				
	17	TWA, STEL and Peak Hold Display				
	18	Auto Set Points Display				
	19	Lock Alarm Feature (Exceeds 100%LEL)				
	20	Radio Frequency Interference Protection				
	21	Gas Measurements Required		Gas Sensor Type	Range	
	a	HC / LEL				
	b	CO				
	c	H2S				
	d	O2				
	e					
	22					
	23					
ALARM	24	Each Gas Channel Alarm (Low and High)				
	25	Audible Alarms				
	26	Visual and Internal Vibrator Alarms				
	27	Low Battery Alarm				
	28	Sensor Fail Alarm				
	29	TWA/ STEL Alarms				
	30					
	31					
	32					
ACCESSORIES	33	Allegator Clip				
	34	Aspirator assembly				
	35	Shoulder Strap				
	36	Carrying Case				
	37	Chest harness				
	38	Calibration/ Sample Shield				
	39	Event Logging Facility				
	40	Event Logging Capacity				
	41					
OTHERS	42	Statutory				
	43	CCOE / PESO				
	44					
PURCHASE	45	Manufacturer				
	46	Model				
	47	Purchase Order Number				
	48	Requisition Number				
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INSTRUMENT SPECIFICATION
PORTABLE GAS DET (MULTI GAS)
Project :
Job No. :
Unit No.

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

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GENERAL	1	Tag Number					
	2	Line Number	Equipment No.				
	3	Service					
	4	P&ID No.	Area Classification				
	5	Sample Handling System					
	6	Sample Bypass Facility					
PROCESS DATA	7	Fluid	Fluid Phase	Fluid State			
	8	Oper. Temperature	Design Temperature				
	9	Oper. Pressure	Design Pressure				
	10	Viscosity					
	11	Operating S.G.	Operating pH				
	12	Fluid Composition					
TRANSMITTER	13	pH Type					
	14	Pre Amplifier					
	15	Output	Protocol				
	16	Enclosure	Ingress Protection				
	17	Accuracy	Repeatablilty				
	18	Linearity	Input Impedence				
	19	Local Display	Display Resolution				
	20	Power Supply	Intrinsically Safe				
	21	Analyzer Fault Contact					
	22	Slope adjustment in %					
	23	Body Material					
	24	Display Function	Diagnostic Facility				
	25	Temp. Compensation	Calibration				
	26	Cable Entry	Mounting Acces.				
SENSOR	27	Type					
	28	Measurement Range					
	29	Electrode Protection					
	30	Mounting					
	31	Process Conn. Size	Rating				
		Facing & Finish					
	32	pH Sensor Extension Cable					
	33	Type of pH Glass					
	34	Type of Reference					
	35	Response Time					
	36	Sensor Drift					
	37	Sensor Life with Perform. Gurantee					
	38	Impedance of Sensor					
CERTIFICATION	39	Statutory Requirements					
	40	Others					
PURCHASE	41	Requisition No.	PO Number				
	42	Manufacturer					
	43	Model No.					

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INSTRUMENT SPECIFICATION
pH Analyser
Project :
Job No :
Unit No.:

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

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Code: 1620 | Dwg. No.: | Rev.:

GENERAL	1	Tag Number					
	2	Line Number		Equipment No.			
	3	Service					
	4	P&ID No.		Area Classification			
PROCESS DATA	5	Fluid	Fluid Phase	Fluid State			
	6	Oper. Temperature		Design Temperature			
	7	Oper. Pressure		Design Pressure			
	8	Operating S.G.		Viscosity			
	9	Fluid Composition					
CONDUCTIVITY TRANSMITTER	10	Detector Type					
	11	Range					
	12	Output Type		Protocol			
	13	Accuracy		Repeatablilty			
	14	Response Time		Calibration			
	15	Cell Constant		Electrode			
	16	Electrode Immersion Length					
	17	Enclosure of Electrode					
	18	Mounting Cell					
	19	Temperature Compensation					
	20	Material of Construction:					
	a.	Cell					
	b.	Electrode					
	c.	Process connection					
	21	Process Conn. Size		Rating			
	22	Facing & Finish					
	23	Power Supply		Intrinsically Safe			
	24	Control unit/ Transmitter					
	25	Enclosure of Transmitter					
	26	Local Indicator		Fault Contact			
	27	Cable b/w Sensor & Transmitter					
	28	Cable Entry		Qty.			
SAMPLING SYSTEM	29	Type of sampling system					
	30	Material of Construction					
	31	Max. Distance (take off to analyser)					
	32	Condensate Cooling					
	33	Sample flow rate					
	34	Mounting					
CERTIFICATION	35	Statutory Certificates					
	36	Others					
PURCHASE	37	Requisition No.		PO Number			
	38	Manufacturer					
	39	Model No.					

Notes:

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INSTRUMENT SPECIFICATION
Conductivity Analyser
Project :
Job No.:
Unit No.:

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

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Code: 1621 | Dwg. No.: | Rev.:

GENERAL	1	Tag Number					
	2	Line Number		Line Schedule			
	3	Service					
	4	P&ID No.		Area Classification			
PROCESS DATA	5	Fluid	Fluid Phase	Fluid State			
	6	Oper. Temperature		Design Temperature			
	7	Oper. Pressure		Design Pressure			
	8	Operating S.G.		Viscosity			
	9	Fluid Composition					
DENSITY TRANSMITTER	10	Measuring Principle					
	11	Calibration Range					
	12	Output Type		Protocol			
	13	Accuracy		Repeatability			
	14	Process Conn. Size		Rating			
	15	Facing & Finish					
	16	Material of Construction:					
	a.	Wetted parts		Others			
	17	Power Supply		Haz. Area Protection			
	18	Control Unit/ Transmitter					
	19	Enclosure of transmitter					
	20	Local Indicator		Fault contact			
	21	Manual Zeroing Facility					
	22	Manual calibration Facility					
	23	Cable Entry		Qty.			
SAMPLE HANDLING SYSTEM	24	Probe with retractor and isolation valve					
	25	Probe length					
	26	Probe material / Probe housing material					
	27	Max Sample Lag Time					
	28	Sample Take-off and Return Tubing:					
	a.	Take-Off Length		Return Length			
	b.	Size		Material			
	29	Sample Return Conditions:					
	a.	Oper. Pressure		Design Pressure			
	b.	Oper. Temperature		Design Temperature			
	30	Connection Size and Rating:					
	a.	@ Take-Off		@ Return			
CERTIFICATION	31	Statutory Certificates					
	32	Others					
PURCHASE	33	Requisition No.		PO Number			
	34	Manufacturer					
	35	Model No.					

Notes:

No.	By	Date	Revision

INSTRUMENT SPECIFICATION
Density Analyser
Project :
Job No.:
Unit No.:

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

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Code: 1622 | Dwg. No.: | Rev.:

GENERAL	1	Tag Number					
	2	Line Number		Line Schedule			
	3	Service					
	4	P&ID No.		Area Classification			
PROCESS DATA	5	Fluid	Fluid Phase	Fluid State			
	6	Oper. Temperature		Design Temperature			
	7	Oper. Pressure		Design Pressure			
	8	Operating S.G.		Viscosity			
	9	Heat Capacity		Dew Point			
	10	Mol. Wt.		Comp. Factor			
	11	Fluid Composition					
ANALYSER	12	Location					
	13	Enclosure					
	14	Analyzer Type					
	15	No of Channel per Analyzer Electronic/ Trans.					
	16	Power Supply					
	17	Measurement Range					
	18	Accuracy		Repeatability			
	19	Response Time		Sensitivity			
	20	Auto Calibration					
	21	Output					
	22	Display Unit					
SAMPLE CONDITIONING SYSTEM	23	Items Required					
	24	Location					
	25	Enclosure					
	26	Sensor Type					
	27	Flow Rate / Pressure / Purity					
	28	Flow Meter					
	29	Utility (at one point in the field)					
	30	Power Requirement					
SAMPLE HANDLING SYSTEM	31	Probe with retractor and isolation valve					
	32	Probe Length		Probe Material			
	33	Process connection Size, Rating & MOC:					
	a.	@ Take-Off		@ Return			
	34	Sample Take-Off and Return Tubing:					
	a.	Take-Off Length		Return Length			
	b.	Size		Material			
	35	Sample Return Conditions:					
	a.	Oper. Pressure		Design Pressure			
	b.	Oper. Temperature		Design Temperature			
CERTIFICATION	36	Statutory Certificates					
	37	Others					
PURCHASE	38	Requisition No.		PO Number			
	39	Manufacturer					
	40	Model No.					

Notes:

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INSTRUMENT SPECIFICATION
Mositure Analyser
Project :
Job No.:
Unit No.:

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Code: 1623 | Dwg. No.: | Rev.:

GENERAL	1	Tag Number					
	2	Line Number		Line Schedule			
	3	Service					
	4	P&ID No.		Area Classification			
PROCESS DATA	5	Fluid	Fluid Phase	Fluid State			
	6	Oper. Temperature		Design Temperature			
	7	Oper. Pressure		Design Pressure			
	8	Operating S.G.		Viscosity			
	9	Heat Capacity		Dew Point			
	10	Mol. Wt.		Comp. Factor			
	11	Fluid Composition					
ANALYSER	12	Location					
	13	Enclosure					
	14	Analyzer Type					
	15	No of Channel per Analyzer Electronic/ Trans.					
	16	Power Supply					
	17	Measurement Range					
	18	Accuracy		Repeatability			
	19	Response Time		Sensitivity			
	20	Auto Calibration					
	21	Output					
	22	Display Unit					
SAMPLE CONDITIONING SYSTEM	23	Items Required					
	24	Location					
	25	Enclosure					
	26	Sensor Type					
	27	Flow Rate / Pressure / Purity					
	28	Flow Meter					
	29	Utility (at one point in the field)					
	30	Power Requirement					
SAMPLE HANDLING SYSTEM	31	Probe with retractor and isolation valve					
	32	Probe Length		Probe Material			
	33	Process connection Size, Rating & MOC:					
	a.	@ Take-Off		@ Return			
	34	Sample Take-Off and Return Tubing:					
	a.	Take-Off Length		Return Length			
	b.	Size		Material			
	35	Sample Return Conditions:					
	a.	Oper. Pressure		Design Pressure			
	b.	Oper. Temperature		Design Temperature			
CERTIFICATION	36	Statutory Certificates					
	37	Others					
PURCHASE	38	Requisition No.		PO Number			
	39	Manufacturer					
	40	Model No.					

Notes:

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INSTRUMENT SPECIFICATION
Water Quality (TOC) Analyser
Project :
Job No.:
Unit No.:

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

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Code: 1624 | Dwg. No.: | Rev.:

GENERAL	1	Tag Number			
	2	Equipment No.	Area Classification		
	3	Location	P&ID No.		
	4	Analyser Type			
PROCESS DATA	5	Process Fluid			
	6	Oper. Temperature	Design Temperature		
	7	Oper. Pressure	Design Pressure		
	8	Mol. Wt.	Dew Point		
	9	Fluid Composition			
SENSOR UNIT	10	Measuring Element			
	11	Enclosure	Mounting		
	12	Sensor Assembly Material			
	13	Temperature Detector	Heat Shield		
	14	Elec. Res. Furnace	Bypass Assembly		
PROBE	15	Probe Material	Probe Length		
	16	Process Connection:			
	a.	Size & Rating	Facing & Finish		
	b.	Nozzle Length	Nozzle ID / Sch.		
	17	Flange Material			
	18	Probe Filter	Filter Material		
CONTROL UNIT	19	Control Unit Type	Location		
	20	Enclosure			
	21	Self Diagnostics	Temp. Controller		
	22	Configuration Changes			
	23	Measurement Range			
	24	Output	Fault Contact		
	25	Accuracy	Repeatability		
	26	Response Time			
	27	Power Supply			
	28	Auto Zeroing facility	Auto Calibration facility		
	29	Automatic Blow Back Facility			
REMOTE CALIBRATION UNIT	30	Items Required			
	31	Location			
	32	Reference Gas	Calibration Gas		
	33	Reference / Calibration Gas Connection			
	34	Manual Calibration bypassing auto calibration			
	35	Mounting Accessories			
UTILITY	36	Power Consumption	Utility Requirement		
	37	Inst Air. Min. | Nor | Max. | Design			
CERTIFICATION	38	Statutory Certificates			
	39	Others			
PURCHASE	40	Requisition No.	PO Number		
	41	Manufacturer			
	42	Model No.			

Notes:

No.	By	Date	Revision

INSTRUMENT SPECIFICATION
Oxygen Analyser (Zirconia)
Project :
Job No.:
Unit No.:

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

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Code: 1625 | Dwg. No.: | Rev.:

GENERAL	1	Tag Number					
	2	Line Number					
	3	Service					
	4	P&ID No.		Area Classification			
PROCESS DATA	5	Fluid	Fluid Phase	Fluid State			
	6	Oper. Temperature		Design Temperature			
	7	Oper. Pressure		Design Pressure			
	8	Operating S.G.		Viscosity			
	9	Fluid Composition					
DETECTOR TRANSMITTER	10	Detector Type					
	11	Measurement Range					
	12	Output Signal		Protocol			
	13	Accuracy		Repeatablilty			
	14	Response Time		Calibration			
	15	Enclosure					
	16	Process Connection:					
	a.	Size & Rating		Facing & Finish			
	17	Power Supply					
	18	Control unit/ Transmitter					
	19	Temperature Compensation					
	20	Local Indicator		Fault Contact			
	21	Cable b/w Sensor & Transmitter					
	22	Electrical Connection		Qty.			
	23	Mounting					
SAMPLE HANDLING SYSTEM	24	Items Required					
	25	Type of sampling sys.		Material			
	26	Max. Distance (take off to analyser)					
	27	Condensate Cooling					
	28	Sample flow rate					
	29	Mounting Accessories					
	30	Utility Requirement					
CERTIFICATION	31	Statutory Certificates					
	32	Others					
PURCHASE	33	Requisition No.		PO Number			
	34	Manufacturer					
	35	Model No.					

Notes:

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INSTRUMENT SPECIFICATION
Dissolved O2 Anlayser
Project :
Job No.:
Unit No.:

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

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GENERAL	1	Tag Number	
	2	Area Classification	
	3	Type	
	4	Function	
	5	Intrinsically Safe	
	6	Range	
SPECIFICATION	7	Window Size	
	8	Window Material	
	9	Case Material	
	10	Dial Size	
	11	Dial Colour	
	12	Mounting	
	13	Enclosure	
SIGNAL AND POWER	14	Power Supply	
	15	Power for transmitter	
	16	Signal Cable Entry	
	17	Input Signal	
	18	Signal Input resistance	
	19	Accuracy	
	20	Zero Adjustment	
	21	Accessories	
	22	Scale	
	23	Graduation	
CERTIFICATION	24	CCOE/PESO	
PURCHASE	25	Manufacturer	
	26	Model	
	27	Purchase Order Number	
	28	Requisition number	

Notes:

				INSTRUMENT SPECIFICATION Electronic Loop Indicator Project: Job No: Unit No.:	इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking) Sheet of	
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GENERAL	1	Tag Number				
	2	Service				
	3	Line Number	P&ID No.			
	4	Electrical Area Classification				
	5	Mounting	Case			
	6	Function				
	7	Enclosure	Intrinsic Safety			
	8	Accuracy	Repeatability			
	9	Type				
	10	Cable Entry				
PROCESS CONDITIONS	11	Fluid				
	12	Pressure Oper.	Des UOM			
	13	Temp. Oper.	Des UOM			
	14	Oper. Spec. Gravity	Oper. Viscosity			
MEASURING UNIT	15	Element Type				
	16	Body Material				
	17	Element Material				
	18	Body Rating				
	19	Process Connection:				
	20	Size	Rating			
	21	Facing & Finish				
	22					
TRANSMITTER	23	Output				
	24	Load Driving Capability				
	25	Power Supply				
	26	Output Meter (LCD Display)				
	27	Instrument Connection				
	28	Connection Location				
	29	Flange Material				
	30					
	31					
OPTIONS	(a)	Mounting Acc for 2" NB Pipe				
	(b)	Options				
	(c)					
	(d)					
CERTIFICATION	32	CCOE Approval				
PURCHASE	33	Requisition Number				
	34	Manufacturer				
	35	Model				
	36	Purchase Order Number				

Notes:

				INSTRUMENT SPECIFICATION Corrosion Transmitter Project: Job No : Unit No :	ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)	
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No.	By	Date	Description	Code: 1702	Doc. No.:	Rev.:

GENERAL	1	Tag Number				
	2	Service				
	3	Area Classification				
	4	Location				
	5	P&ID Number				
	6	Quantity				
	7					
	8					
PROCESS CONDITIONS	9	Fluid Name				
	10	Press. Max.	Press. Nor.			
	11	Temp. Max	Temp. Nor.			
	12	Design Pressure				
	13	Design Temperature				
CAMERA	14	Type				
	15	Range				
	16	Enclosure				
	17	Power Supply				
	18	Target Size				
	19	Focusing Range				
	20	Output				
	21	Local Display				
	22	Mounting				
	23	Emissivity				
	24	Accuarcy				
	25	Response Time				
	26					
	27					
ACCESSORIES	28	Mounting Accessories				
	29	Vortex Cooler				
	30	PAN & TILT arrangement				
	31	Aspirator Assembly				
	32	Air Supply for air purging				
	33	Inst Air Connection				
	34	Air Pressure Min | Nor | Max				
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
CERTFICATE	47	Statutory Requirement				
	48	CCOE / PESO				
	49	Others				
PURCHASE	50	Manufacturer				
	51	Model				
	52	Purchase Order Number				
	53	Requisition Number				

Notes:

				INSTRUMENT SPECIFICATION Flame Monitoring - IR Camera Project : Job No : Unit No:	इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking) Sheet of	
No.	By	Date	Revision	Code: 1703	Doc. No.:	Rev.:

GENERAL	1	Tag Number		
	2	Service		
	3	Area Electrical Class		
	4	Location		
	5	Enclosure Protection		
	6	Application		
	7	Protective Cap for Dust/ Rain Cover		
	8			
	9			
SERVICE CONDITIONS	10	Ambient Temperature		
	11	Ambient Humidity		
	12			
	13			
	14			
BEACON	15	Type		
	16	Reverse Polarity Protection		
	17	Lens Color		
	18	Luminous Intensity		
	19	Flashing Frequency		
	20	Lamp Type		
	21	Lens Material		
	22	Lens gaurd / Cage		
	23	Power Supply		
	24	Electrical Connection		
	25	Wiring System		
	26			
	27			
	28			
BODY	29	Material		
	30	Coating	Sealing	
	31	Cable Connection		
	32	External Wiring Connection		
	33			
	34			
	35			
OPTIONS	36	Mounting		
	37	Mounting Accessories		
	38	Power Consumption		
	39	Cable Glands		
	40	Safely Integerity Level		
	41	Nameplate		
	42	Weight		
	43			
	44			
	45			
	46			
CERTIFICATION	47	Statutory		
	48	CCOE / PESO		
	49	OTHERS		
PURCHASE	50	Manufacturer		
	51	Model		
	52	Purchase Order Number		
	53	Requisition Number		
	54			

Notes:

No.	By	Date	Description

INSTRUMENT SPECIFICATION
Beacon

Project :
Job No. :
Unit No. :

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

Sheet of

Code: 1704 | Doc. No.: | Rev.:

GENERAL	1	Tag Number		
	2	Service		
	3	Area Electrical Class		
	4	Location		
	5	Enclosure Protection		
	6	Outdoor / Indoor Installation		
	7	Protective Cap for Dust/ Rain Cover		
	8			
	9			
SERVICE CONDITIONS	10	Ambient Temperature		
	11	Ambient Humidity		
	12			
	13			
	14			
HOOTER	15	Type		
	16	Mode of Operation		
	17	Audible Tones		
	18	Sound Level		
	19	Volume Adjustable		
	20	Tone Type		
	21	Tone Frequency		
	22	Reverse Polarity Protection		
	23	Electrical Connection		
	24	Power Supply		
	25	Wiring System		
	26			
	27			
	28			
BODY	29	Material		
	30	Coating	Sealing	
	31	Cable Connection		
	32	External Wiring Connection		
	33			
	34			
	35			
OPTIONS	36	Mounting		
	37	Mounting Accessories		
	38	Power Consumption		
	39	Cable Glands		
	40	Safely Integerity Level		
	41	Nameplate		
	42	Weight		
	43			
	44			
	45			
	46			
CERTIFICATION	47	Statutory		
	48	CCOE / PESO		
	49	OTHERS		
PURCHASE	50	Manufacturer		
	51	Model		
	52	Purchase Order Number		
	53	Requisition Number		
	54			

Notes:

No.	By	Date	Description

INSTRUMENT SPECIFICATION
Hooter

Project :
Job No. :
Unit No. :

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

Sheet of

Code: 1705 | Doc. No.: | Rev.:

GENERAL	1	Tag Number					
	2	Service					
	3	Area Electrical Class					
	4	Location					
	5	Enclosure Protection					
	6	Outdoor / Indoor Installation					
	7						
	8						
	9						
SERVICE CONDITIONS	10	Ambient Temperature					
	11	Humidity					
	12	Corrosive Agent					
	13	Submersion					
	14						
	15						
	16						
PUSH BUTTON	17	Type					
	18	SPDT	DPDT	TPDT	Other		
	19	Number of Contacts					
	20	Contact Rating					
	21	Cable Entry					
	22	Duty Label					
	23	Color Finish					
	24	Wiring System					
	25						
BODY	26	Material					
	27	Coating	Sealing				
	28	Cable Connection					
	29	External Wiring Connection					
	30	Spring Material					
	31						
	32						
	33						
	34						
OPTIONS	35	Mounting					
	36	Mounting Accessories					
	37	Cable Gland					
	38	Contact Status Before Actuation					
	39	Contact Status After Actuation					
	40	Safety Integrity Level					
	41	Test Key					
	42	EOL Resistor					
	43						
	44						
	45						
	46						
CERTIFICATION	47	Statutory					
	48	CCOE / PESO					
	49	OTHERS					
PURCHASE	50	Manufacturer					
	51	Model					
	52	Purchase Order Number					
	53	Requisition Number					
	54						

Notes:

No.	By	Date	Description

INSTRUMENT SPECIFICATION
Push Button

Project :
Job No. :
Unit No. :

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

Sheet of

Code: 1706 | Doc. No.: | Rev.:

GENERAL	1	Tag Number			
	2	Service			
	3	Electrical Area Classification			
	4	Location	P&ID Number		
	5				
	6				
PROCESS CONDITIONS	7	Fluid			
	8	Flow Max.			
	9	Oper. Diff. Pressure	Min.	Max.	
	10	Oper. Temperature	Min.	Max.	
	11	Oper. Pressure	Min.	Max.	
	12	Operating Viscosity	Operating Specific Gravity		
	13	Relative Mol Mass			
	14	Max. Allowable Differential			
	15	Shutoff Diff.			
	16	Value CV			
VALVE BODY	17	Type			
	18	Size: Body	Port		
	19	Connection Size	Body Rating		
	20	Body Material			
	21	Trim Material			
	22	Action			
	23	Operation			
	24	Packing			
SOLENOID	25	Enclosure			
	26	Intrinsic Safety			
	27	Type Of Energisation			
	28	Power Consumption			
	29	Inrush Current			
	30	Type of Coil			
	31	Style of Coil			
	32	Insulation Class			
	33	Pulse Duration			
	34	Power Supply			
	i	Energisation			
	ii	Dropout			
	iii	Frequency			
OPTIONS	a	Control Room Manual Reset (CMR)			
	b	FMR with Lever Type			
	c	FMR with Pushbutton Type			
	d	Latching On Energise			
	e	Latching On De-Energise			
	f	Auto Reset Type			
CERTIFICATION	44	Statutory			
	45	CCOE / PESO			
PURCHASE	46	Manufacturer			
	47	Model			
	48	Purchase Order Number			
	49	Requisition Number			

Notes:

				INSTRUMENT SPECIFICATION Solenoid Valves Project : Job No. : Unit no. :	इंजीनियर्स इंडिया लिमिटेड ENGINEERS INDIA LIMITED (A Govt. of India Undertaking) Sheet of	
No.	By	Date	Revision	Code: 1707	Doc. No.:	Rev.:

GENERAL	1	Tag Number					
	2	Service					
	3	Area Electrical Class					
	4	Location					
	5	Enclosure					
	6	Mounting					
	7	Application					
	8	P&ID Number					
	9						
SERVICE CONDITIONS	10	Ambient Temperature					
	11	Humidity					
	12	Corrosive Agent					
	13	Submersion					
	14						
	15						
	16						
SWITCH	17	Type					
	18	SPDT	DPDT	TPDT	Other		
	19	Mounting					
	20	Type of Protection					
	21	Power Supply					
	22	Contact Rating					
	23	Cable Entry					
	a	Power					
	b	Signal					
BODY	24	Material					
	25	Coating	Sealing				
	26	Cable Connection					
	27	External Wiring Connection					
	28	Spring Material					
	29	Bolts Material					
	30						
	31						
	32						
OPTIONS	33	IS Barrier					
	34	IS Barrier Type					
	35	Switching Amplifier					
	a	Type					
	b	Contact Rating					
	38	Contact Status Before Actuation					
	39	Contact Status After Actuation					
	40	Mounting Accessories					
	41						
	42						
	43						
	44						
CERTIFICATION	45	Statutory					
	46	CCOE / PESO					
	47	OTHERS					
PURCHASE	48	Manufacturer					
	49	Model					
	50	Purchase Order Number					
	51	Requisition Number					
	52						

Notes:

No.	By	Date	Description

INSTRUMENT SPECIFICATION
Limit Swtiches

Project :
Job No. :
Unit No. :

ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

Sheet of

Code: 1708 | Doc. No.: | Rev.:

GENERAL	1	Tag Number			
	2	Line Number	Tank / Equipment No.		
	3	Service			
	4	P&ID No.	Area Classification		
FLUID DATA	5	Fluid			
	6	Fluid Gas Group			
	7	Flash Point			
	8	Oper. Temperature	Design Temperature		
	9	Oper. Pressure	Design Pressure		
	10	Oper. Vacuum	Design Vacuum		
	11	Molecular Weight			
	12	Inert Gas Blanket			
	13	Continous / Intermitent			
	14	Capacity (Equivalent Air) at			
	a.	In Breathing	Out Breathing		
	15	Allowable Pressure Drop / Sizing DP			
	16	Discharge to			
FLAME ARRESTER	17	Type	Quantity		
	18	Mounting			
	19	Material of Construction:			
	a.	Body	Flange		
	b.	Shell	Bank		
	20	Bank Type			
	21	Upstream End Connection:			
	a.	Size	Rating		
	b.	Facing & Finish			
	22	Down Stream End Connection:			
	a.	Size	Rating		
	b.	Facing & Finish			
	23	Capacity (equivalent air) at			
	a.	Oper. Pressure	Oper. Vacuum		
	b.	Design Pressure	Design Vacuum		
PURCHASE	24	Requisition No.	PO Number		
	25	Manufacturer			
	26	Model No.			

Notes:

				INSTRUMENT SPECIFICATION Flame Arrestor Project : Job No.: Unit No.:	ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)	
					Sheet of	
No.	By	Date	Revision	Code: 1709	Doc. No.:	Rev.:

LIST OF DATA SHEETS & ERP FORMATS
STATIC & MACHINERY EQUIPMENT
ANNEXURE-C: ROTATING EQUIPMENT

COOLING TOWER PACKAGE
TENDER No.: C050-1U68-81-45-PB-T-8010

PROJECT : **EPCM SERVICES FOR POLYPROPLENE PROJECT AT NUMALIGARH REFINERY**

UNIT : **RECIRCULATING COOLING WATER SYSTEM**

CLIENT : **M/s NUMALIGARH REFINERY LIMITED(NRL)**

EPCM : **M/s ENGINEERS INDIA LIMITED (EIL)**

JOB NO. : **C050**

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
A	13.08.2025	ISSUED WITH TENDER	RPT	ME	TK

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LIST OF DATA SHEETS & ERP FORMATS FOR ROTATING EQUIPMENT

S. NO.	DESCRIPTION	DOC. NO.
1.	Mechanical Datasheet (Typical): Centrifugal Horizontal Pump (LCWS)	C050-1U68-80-42-DS-9996
2.	Mechanical Datasheet (Typical): Centrifugal Horizontal Pump (GPP)	C050-1U68-80-42-DS-9997
3.	Mechanical Datasheet (Typical): Controlled Volume Pump	C050-1U68-80-42-DS-9998
4.	Mechanical Datasheet (Typical): Air Operated Double Diaphragm Pump	C050-1U68-80-42-DS-9999
5.	Experience Record Pro-forma: Centrifugal Horizontal Pump (LCWS)	C050-1U68-80-42-ERP-9996
6.	Experience Record Pro-forma: Centrifugal Horizontal Pump (GPP)	C050-1U68-80-42-ERP-9997
7.	Experience Record Pro-forma: Controlled Volume Pump	C050-1U68-80-42- ERP-9998
8.	Experience Record Pro-forma: Packaging of Dosing Skid	C050-1U68-80-42- ERP-9999

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1	**GENERAL**								
2	Project: **EPCM SERVICES FOR POLYPROPLENE PROJECT AT NRL**					Job No.: **C050**			
3	EPCM: **M/s EIL**					Site: Unit No.: **1U68**			
4	Purchaser: **M/s NRL**					Unit: **COOLING WATER SYSTEM**			
5	Item No.: **1U68-PA-4301 A/B/C**					Service: **Recirculating cooling water**			
6	No. Reqd.: **3**	Working: **2**	Standby: **1**			Parallel Operation Required:	■ Yes	☐ No	
7	Applicable to	■ Proposal	☐ Purchase			☐ As Built			
8	■ Scope option & Information specified by purchaser ☐ Information Reqd. from & option left to vendor. Vendor to cross ☒ the selected option.								
9	Driver: Working	**ELECTRIC MOTOR**	Standby	**ELECTRIC MOTOR**		Driver Supplied & Mounted By:	■ Pump Mfr.	☐ Other	
10	**OPERATING CONDITIONS (Also Refer Pump PDS attached elsewhere)**								
11	Liquid Handled	**COOLING WATER**				Capacity (Min./Normal/Rated) (m^3/hr):	**-- / -- / 4000**		
12	Pumping Temp. (°C):	**Amb.**				Discharge Pressure (kg/cm², G):	**5.3**		
13	Specific Gravity at P.T.:	**0.995**				Suction Pressure (Nor./ Max.) (kg/cm², G):	**(-)0.1 / 0.26**		
14	Vapour Pressure at P.T. (kg/cm², A):	**0.06**				Diff. Pressure (kg/cm²):	**5.4**		
15	Viscosity at P.T. (cP):	**0.75**	Corr./Eros. By: **No**			Diff. Head @ Rated Capacity (m):	**54.3**		
16	Solids in suspension:	☐ Yes ■ No	Size:	**--**		NPSH Available (m):	**9.0**		
17	**MANUFACTURERS SPECIFICATIONS**								
18	Pump Manufacturer: _____					Model No.: _____			

19	**CONSTRUCTION**					**PERFORMANCE**			
20	Casing Mounting:	☐ Centerline	☐ Foot	☐ Inline		Proposal Curve No. _____			
21	Casing Split:	■ Axial	☐ Radial			Visc. Corr. Factor: C_η _____ C_Q _____ C_H _____			
22	Type:	☐ Single Volute	☐ Double Volute	☐ Diffuser		NPSH Reqd. (Water) (m): _____ F/L Speed: _____rpm			
23	Casing Connection:	■ Vent	■ Drain	☐ Gauge		No. of stages: **ONE** Efficiency (%): ____			
24	Nozzles	Size	ANSI Rating	Facing	Position	Rated BkW (0% Tol.): _____ kW Max.BKW Rtd. Imp.: ___ kW			
25	Suction		**150#**	**RF**	**SIDE**	BkW @ MCF (ρ=1.0): ____ kW Rec. Driver Rating: ____kW			
26	Discharge		**150#**	**RF**	**SIDE**	Max. Head Rtd. Imp. (m): _____ Cap@ BEP(m^3/hr.):			
27	Imp. ϕ (mm): **Max:** _____ **Rated**: _____ **Min**: _____				Type: **CLOSED**	MCF (m^3/hr.) Stable: _____ Thermal: _____			
28	Brg. Type/No.- Radial:		Thrust:		Lub: **OIL**	M.A.W.P @ 15ºC/P.T./Design Temp. (kg/cm², G): __/__/__			
29	Cplg. Make/Type:	**FLEXIMETL W/SPACER**	Non-spark Guard	■ Yes ☐ No		Hydrostatic Test pressure (kg/cm², G): _____			
30	Driver Half Cplg. mounted by:	■ Pump Mfr.	☐ Others			Rotation facing coupling end: ☐ CW ☐ CCW			
31	Packing Type: **NA**	Size: **--**	No. of rings: **--**			Seal flush/ Quench plan: **11** Material:			
32	Mech. Seal (Rem. 8): Make		Model:	API Code:		Ext. seal flush fluid: -- LPM: -- @ kg/cm²G/--ºC			
33	Base Plate Drain Rim Type:	■ Yes ☐ No	Fdn. Bolts:	■ Yes ☐ No		Seal Barrier fluid: -- LPM: -- @ kg/cm²G/--ºC			
34	Throat Bush:	☐ Yes ☐ No	Matl.: _____	Bal. Device:	☐ Yes ☐ No	Ext. quench fluid: -- LPM: -- @ kg/cm²G/--ºC			

35	**MATERIALS**			**MOC**	**ASTM Grades**	C.W. Plan: -- LPM: -- @ kg/cm²G/--ºC			
36	I - Cast Iron	Casing		**S**		Weight(kg): Pump+Base+Coupling: _____ Driver:_____			
37	B – Bronze	Impeller		**C**		**AUXILIARY PIPING INTERFACE CONNECTIONS**			
38	S - Carbon Steel	Inner Case parts				(All interface conn. shall be terminated with a flng. block valves)			
39	C - 11-13% Chr. Stl.	Sleeve Packed					**Size**	**Rating (ANSI)**	**Facing**
40	h – Hardened	Sleeve Seal				Lantern Ring Inlet/Outlet	--	--	--
41	f – Faced	Casing ring	ΔH-BHN			Ext. Seal flush fluid Inlet/Outlet	--	--	--
42	K -SS 304	Impeller ring	50 (min.)			Seal Quench fluid Inlet	--	--	--
43	L -SS 316	Shaft				Seal pot vent/ drain	--	--	--
44	X - AISI 410	Throttle Bush				Casing vent/ drain	__ / __	**150**	**RF**
45	Y	Throat Bush				C.W Inlet/ Outlet	--	--	--
46	Z	Balance Drum				Base plate drain (only flanged)	**2"**	**150**	**RF**
47	■ Driver suitable for Pump starting with open discharge valve condition.					Casing steam jacket	--	--	--

48	**INSPECTION & TESTS (EACH PUMP)**						
49		Witness	Observe			Witness	Observe
50	■ Shop Test / Inspection	☐	☐	■ NPSH (As Reqd.) ■ Per Spec. ☐ Mandatory		■	☐
51	■ Material Certificates	☐	■	■ Dismantle Insp. & Re-assembly after Test		■	☐
52	■ Hydrostatic	■	☐	■ Unitisation/Dimensional Check		■	☐
53	■ Performance/Sound Level	■	☐	■ Check for direction of rotation of pump & driver.		■	☐
54							
55	**APPLICABLE SPECIFICATION: JOB SPECIFICATION & EIL STD. SPEC. NO. 6-41-0003.**						
56							
57	**REMARKS: -**						
58	1) Max. allowable casing working pressure shall not be less than **8** kg/cm²(g) @ **65** ºC.						
59	2) Down Stream Design Pressure is **8** kg/cm²(g). Maximum shut-off, considering max suction pressure, including all tolerances shall not exceed this value.						

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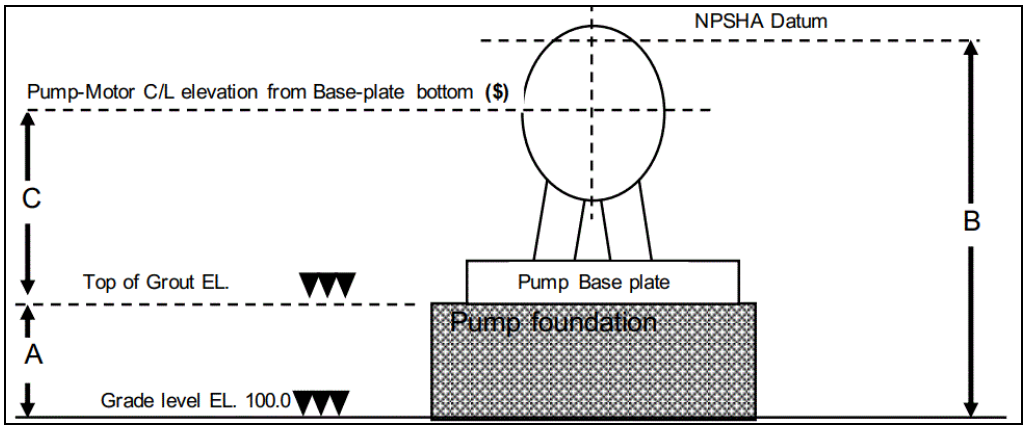
60	3) Unitization of Pump and Driver on common baseplate shall be done in pump manufacturer's shop before dispatch.
61	4) Electric Motor (Driver) shall be sized for End of the Curve (EOC) operation/entire range of operation.
62	5) Tripping of any operating pump shall not cause any cascading effect to trip the other operating pumps.
63	6) Electric Motor (Driver) shall be suitable for automatic reacceleration and auto start.
64	7) Vendor shall supply companion flanges along with gaskets & fasteners for each purchaser interface connection.
65	8) Non-API single balanced horizontal split seal type mechanical seal.
66	9) Automatic Re-Acceleration & Auto-Start Facility shall be provided for CW Pump Motors.
67	10) -deleted-
68	11) Vendor to indicate: $NPSH_R$ (Water) (m) at Rated Point = _____ $NPSH_R$ (Water) (m) at MCF = _____ $NPSH_R$ (Water) (m) at EOC = _____
69	12) Vendor shall arrive at exact $NPSH_A$ at Pump centerline and provide details / calculation for $NPSH_A$ as per the following figure:-  **A** (Foundation height) = **0.3** m **B** (Datum considered for $NPSH_A$) = **2.2** m from Grade level **C** (Pump-Motor C/L height/elevation from Base-plate bottom) =_____m (Vendor to indicate). ***($) Based on quoted model, the Pump-Motor C/L elevation (C) can be above or below the NPSHA datum elevation*** . *$NPSH_A$ (m) @ Pump C/L = $NPSH_A$ Value specified at Datum (refer PDS) + (B – (C + A))* =_____ *(Vendor to indicate)* ***Note: The dimension C confirmed by the bidder in the bid stage shall be FIRM and FINAL. Any change in the confirmed value during detailed engineering (in case of an order) shall not be allowed.***
70	14) Non-metallic wear rings shall be provided.
71	15) Also refer notes indicated on respective pump process datasheet.

19.08.2025	A	RPT	ME/TK
Date	**Rev**	**Job Engineer**	**Rev. & Approved By**

Signature Not Verified
Digitally signed by MD MAZHER ALI
Date: 2026.04.09 17:54:12 IST
Location: eProcure-EPROC

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