TECHNICAL	PROCURE	MENT SPE		N	32679-02-PS-001				
	PAGE 1 OF 1								
TPS No:	32679-0)2-PS-001							
STATUS	ENQUIRY	,							
ORIGINATING DEP	T. PCE								
P.O / W.O No:									
PROJECT CONVERSION OF BURNERS TO RLNG AT FACT-UC									
LOCATION	UDYOGA	MANDAL,KOCI	ΗI						
CLIENT	FACT-UD	Yogamandai	COMPLEX						
PURCHASER	FACT-UD	YOGAMANDAI	COMPLEX						
VENDOR									
1 : RLNG	burner for T	hermal Oil H	leater (F 590	92)					
2 FOR ENQUIR	Y-REVISED	LA	SK	AAN	Z9.07.21				
1 FOR ENG	QUIRY	LA	SK	AAN	14.01.21				
0 FOR CLIENT	REVIEW	SK	GPG	AAN	17.09.20				
Rev. Deta	ils	Ву	Chkd	Appr	d Date				
FACT ENGIN	EERING AN	DD DESIGN	ORGANISA	TION	FEDO				

TE PRO	TECHNICAL PROCUREMENT ATTACHMENTS 32679- 02-PS-001 AT									
SPEC	CIFICATION		ATTACHMENTS		PAGE	E 1 (DF 2	R2		
TPS	No.: 3267	9-02-PS-001								
S.No.	D	oc. No.	Description	No. of pages	Re 1	ev. No.	with Is	sue 4		
1	SCOPE OF V	VORK		1 0		2	0	-		
1.1	32679-02-PS	-001 SW (PCE)	Scope of Work - PCE	1	0	0	1			
1.2	32679-02-PS	-001 SW ELE	Scope of Work - Electrical	1	0	0	0			
2	VENDOR DA	TA REQUIREME	NTS							
2.1	32679-02-PS	-001 VDR (PCE)	Vendor Data Requirements - PCE	2	0	1	1			
2.2	32679-14-PS	-001 VDR (INST)	Vendor Data Requirements - Instrumentation	4	0	0	1			
2.3	32679-03-PS- (PIPING)	001 VDR	Vendor Data Requirements - Piping	1	0	0	0			
2.4	32679-02-PS	-001 VDR (ELEC)	Vendor Data Requirements - Electrical	1	0	0	0			
3	VENDOR DA	ATA INDEX								
3.1	32679-02-PS	-001 VDI (PCE)	Vendor Data Index	1	0	0	0			
4	SPECIAL RE	QUIREMENTS O	F THE PROJECT							
4.1	32679-02-PS	-001 SPL (PCE)	Special Requirements of Project - PCE	20	0	1	2			
4.2	32679-14-PS	-001 SPL (INST)	Special Requirements of Project - Instrumentation	4	0	2	2			
4.3	32679-03-PS-	001 SPL (PIPING)	Special Requirements of Project - Piping	1	0	0	0			
5	DATA SHEE	тѕ								
5.1	32679-02-DA	-001	Data Sheet - RLNG Burner Thermal Oil Heater	1	0	0	0			
5.2	32679-14-DA	-00001	Data Sheet For Programmable Logic Controller (PLC) Instruments	4	0	1	1			
5.3	32679-13-DA	-90001	General requirement for electrics	1	0	0	0			
5.4	32679-13-DA	-91001	Medium voltage induction motors	2	0	0	0			
5.5	32679-13-TP	-91001	Medium voltage induction motors - Technical Particulars	3	0	0	0			
6	ENGINEERI	NG SPECIFICATI	ONS							
6.1	00 ES 001 / 2	2010	Vendor Data Submission Procedure	4	-	-	-			
6.2	02 ES 023 / 2	2010	Painting	13	-	-	-			
6.3	03 ES 010 / 1	10	Piping Turnkey Package	2	-	-	-			
6.4	25 ES 205 / 9	94 - R1	Fabrication & erection of steel piping	28	-	-	-			
6.5	13 ES 900 / 1	14	General requirement of electric	4	-	-	-			
6.6	13 ES 910 /1	4	Medium voltage induction motors	6	-	-	-			
7	SCOPE OF I	NSPECTION AND	TEST							
7.1	32679-02-PS	-001 INS ELEC	Scope on inspection and test (Electrical)	1	0	0	0			
Ν	lote: 1. The real 2. All att	ceipt of all attachmer achments of this TPS	nts shall be checked and asertained. S shall be retained since only revised sheets, if any, sha	ll be issued.						
	20.07.5			T A				4 37		
2	29.07.21		FOR ENQUIRY - REVISED	LA LA		K K	A. A	AIN AN		
0	29.09.20		FOR CLIENT REVIEW	SK	G	PG	A	AN		
REV.	NO. DATE		DESCRIPTION	PRPD	СН	KD	AP	PRD		
	FACT EN	NGINEERIN	G AND DESIGN ORGANISAT	ION	FRCI		i ei d	00		

TE PRO SPEC	CHNICAL CUREMENT CIFICATION		32679- 02-PS-001 AT PAGE 2 OF 2 R2				
TPS	5 No.: 32679-02-PS-001						
S.No	Doc. No.	Description	No. of pages	R(ev. No. 2	with Is 3	ssue 4
8	SPARES						
8.1	32679-02-PS-001 SPR (M)	Spares - Mandatory (Mechanical)	1	0	1	1	
8.2	32679-02-PS-001 SPR (R)	Spares - Recommended for 2 yr operation (Mechanical)	1	0	1	1	
8.3	32679-14-PS-001 SPR (INST)	Spares - Instrumetation	2	0	1	1	
9	SUB VENDOR LIST						
9.1	32679-02-PS-001 SV (MECH)	Sub Vendor List - Mechanical	1	0	1	1	
9.2	32679-14 -PS-001 SV (INST)	Sub Vendor List - Instrumentation	4	0	1	2	
9.3	32679-03-PS-001 SV (PIP)	Sub Vendor List - Piping	6	0	0	0	
10	32679-02-PS-001 CS	Compliance Statement	1	0	0	0	
11	ANNEXURE I						
11.1	B-RB-345	Existing Burner Assembly Drawing of Thermal Oil Heater	1	1	1	1	
12	ANNEXURE II	1					
12.1	Control Valve Specification Sheet	Tags: FPV 5960	2	OR	OR	OR	
13	ANNEXURE III						
13.1	32352-03-KP-00004	Piping key plan(for Existing RLNG piping)	1	2	2	2	
13.2	32352-03-KP-00013	Piping key plan(for Existing RLNG piping)	1	2	2	2	
14	ANNEXURE IV						
14.1	32679-11-PD-001	P&ID for RLNG Pipe line for FACT-PD	1	0	0	0	
14.2	32679-11-PD-002	P&ID for supply of Natural Gas Burner for Thermal Oil Heater	1	0	1	1	
14.3	HTCS-2-7234-00-A-001	P&ID for Thermal Oil Heater	1	F	F	F	
14.4	HTCS-1-7234-00-A-003	General Arrangement of Thermal Oil Heater	1	A2	A2	A2	
14.5	IF-F-100-00/2K2	General Arrangement of FD Fan	1	С	С	С	
					L		
	FACT ENGINEERI	ING AND DESIGN ORGANISAT	ION	E		FE	DO

SCOPE OF WORK CONVERSION OF BURNERS TO RLNG AT FACT-UC

R 1

ITEM: RLNG Burner of Thermal Oil Heater

(space for vendor's name, signature & seal)

PAGE 1 OF 1

EQPT. No.: F 5902

The scope of work for the equipment listed above shall include (but not limited to) design, Engineering (including HAZOP during design), manufacture, test, supply, erection, post-modification performance guarantee tests, commissioning, and handing over of equipment with material and engineering work as tick marked below. Vendor shall fill in the column marked as "offer from vendor" and return the same along with the offer, without which the offer will be considered as incomplete.

Sl. No	Description	Reqd.	Offer from vendor	Sl. No	Description	Reqd.	Offer from vendor
1	Design & Engineering	YES		15	Refractory drying out (if required)	YES	
2	Fabrication	YES		16	Other statutory requirements and clearances if any	YES	
3	Supply of material	YES		17	Start up & Commissioning spares	YES	
4	Transporting to site	YES		18	Mandatory Spares	YES	
5	Loading & unloading	YES		19	Special tools & tackles for maintenance(if applicable)	YES	
6	Erection	YES		20	Submission of drawings /documents as per VDR.	YES	
7	Commissioning	YES		21	Safety devices	YES	
8	Instruments for performance test	YES		22	Control Devices	YES	
9	Acceptance test	YES		23	Piping in B.L	YES	
10	Testing and Inspection	YES		24	FD fan & ducting (if required)	YES	
11	Instrumentation & controls	YES		25	Guarantee	YES	
12	Insulation & cladding (If required)	YES		26	List of 2 years normal operation spares	YES	
13	Surface preparation & Painting (If required)	YES		27	Guarantee run on fuel as applicable	YES	
14	Refractory work (If required)	YES					
 							

TK. AAN AAN 29.07.21 FOR ENQUIRY - REVISED 1 00F⁻00FT013/94 TK. GPG29.09.20 AAN 0 FOR ENQUIRY REV. NO. CHKD APPRD DATE DESCRIPTION PRPD **FIRE** 8 8 DX(FACT ENGINEERING AND DESIGN ORGANISATION

	SCOPE OF WORK	32679-0	2-PS-001SW EL	EC
SPECIFICATION	SCOPE OF WORK	Pag	ge 1 of 1	R0
TPS NO.	32679-02-PS-001			
ITEM :	FD Fan			
EQPT. NO.	As per data sheets attached			
The Scope of	work include the following		-	
SI.No.	Description	Required	Remarks	

	ELECTRICS		
1.0	Design, detailed engineering, manufacturing, testing at works and supply of all electrics required for the package, fully conforming to the attached specification and data sheets, including but not limited to the following:-	YES	
1.1	Medium Voltage squirrel cage induction motors including all accessories and spares	YES	
	Note:- All electrics supplied shall be of FLAMEPROOF construct	tion	
2.0	Arranging for Inspection & Tests as per "Scope of Inspection & Tests" attached	YES	
3.0	Furnishing all documents as per "Vendor Data Requirements" attached	YES	

0	21-10-'20	Issued for enquiry	SM	IK	IK
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
FAC	CT ENGIN		FEDO		

00FT013 / 14

TECHNICAL PROCUREMENT VENDOR DATA REQUIREMENTS 32679-02-PS-001 VDR (P						1 VDR (PCE)		
SPECI	FICAT	ION				P	AGE	1 OF 2
Ρ	ROJEC	T : CONVERSION OF BURNER TO ITEM	RLNG B	urner fo	r Ther	mal Oil F	leate	r (F 5902)
C	LIENT	: FACT-UC	TPS No.	3267	9-02-F	PS-001		
S	TATUS		P.O No	Э.				
SI.	Group		Qty.	A	fter Co	mmitmen	t .	Qty. of fir
No.	Code	Description	offer	Qty.	Reqd.	Propd [@]	/eeks Agrd	docs. (@@
1	В	Burner description of the modifications required	15	4P+1S	4			4P+1S
2	В	Process Flow Diagragm for Burner	1S	4P+1S	4			4P+1S
3	В	P&I Diagram for Thermal Oil Heater	1S	4P+1S	4			4P+1S
4	В	Duly filled Data Sheet for Burner	1S	4P+1S	4			4P+1S
5	С	List of similar jobs excecuted by the Vendor	15					
6	С	schedule of execution in the form of Bar Chart	15	4P+1S	4			
7	А	PERT Chart of Hook-up & Commissioning.	15	4P+1S	4			4P+1S
8	А	Resposibility Matrix	1S	4P+1S	4			
9	В	Quality Assurance Plan	1S	4P+1S	6			4P+1S
		Documents required vide sl. No. 10 to 21 be shall be submitted for each equipment:-	elow					
10	В	Dimensioned General Arrangement Drawings with B	МС	4P+1S	8			4P+1S
11	В	Design Basis & Detailed Calculation		4P+1S	8			4P+1S
12	В	Piping Isometrics for Tie-in points		4P+1S	8			4P+1S
13	В	Detailed Fabrication drawings		4P+1S	8			4P+1S
14	В	Piping Material Specifications		4P+1S	8			4P+1S
15	В	Piping Isometrics		4P+1S	12			4P+1S
16	В	Valve Data Sheets		4P+1S	8			4P+1S
17	В	Procedure for Refractory lining & Dry-out (If require	d)	4P+1S	12			4P+1S
18	В	Procedure for Commissioning & Guarantee Run		4P+1S	12			4P+1S
Lege Note	nd : G D s : @ Vo @@ Ea de	roup code : A - For review and detailed engineering, B - For review and detailed engineering, B - For comment type : R - Reproducible, P - Print, S - Soft copy endor shall fill in proposed lead time if different from the reach set of final documents shall be submitted in a folder in espatched with the equipment. Balance documents shall be	or review, C - in Autocad/ M quired lead tin 2 separate CD e forwarded to	For inform S word/Ac ne. / DVD. Tv FEDO.	nation ai lobe Acr wo such	nd record obat folders sha	ill be p	acked and
1	14.01			T.A		G.P.C.	-+	A.A-Ñ
0	17.01			s.rt		20 L G.PG	-+	AAN
U	17.09			9/ 5		a, 4		202001

TEC PROC	CHNICA UREM	VENDOR DATA REQUIREMENTS							32679-02-PS-001 VDR (PCE)				
SPECI	FICAT	ION		-					PA	GE 2	OF 2 R1		
Р	ROJEC	CONVERSION	N OF BURNER TO CT-UC	ITEM:	R	LNG Bu	rner fo	r Therr	nal Oil	Heater	⁻ (F 5902)		
C	LIENT	: FACT-UC			ТР	S No.	32679	9-02-F	S-001				
S	TATUS	X ENQUIRY	COMMITMENT			P.O No							
SI.	Group		Description			Qty.	A	fter Cor	nmitme	nt	Qty. of final		
No.	Code		Description			offer	Qty.	Reqd.	Propd [®]	Agrd	docs. (@@)		
19	В	Procedure for Comm	nissioning & Guarantee Ru	In				12			4P+1S		
20	С	List of spares				1S	4P+1S				4P+1S		
21	С	Data folder with the	following documents										
		Drawing Index									4P+1S		
		As-built drawings									4P+1S		
		Material Test Certifi	cates								4P+1S		
		WPS / PQR / WPQ									4P+1S		
		Inspection and Test	Reports								4P+1S		
		Performance Test R	esults								4P+1S		
		Operation Maintena	ance Manual of the System	l							4P+1S		
										1			
F	ACT	ENGINEER	ING AND DESIG	N OF	RG	ANIS	ATIC	DN	FACT		EDO		

INS							ите	3	2679-14	-PS-0	01 VDR
-			•	VENDOR DATA	REQUIRE		113		Page 1	of 4	R1
									.		•
PRC				IVERSION OF BUR	NERS IO	RLI	NG A I	FAC	I-UC		
	<u>л:</u>		Instru	umentation items fo	r RLNG Bi	Irne	rs- Th	ermal	Oil Furr	nace	
STA	TUS		ENQ	UIRY/ COMMITME	NT			onnai			
PO	NUMBE	R									
					OFFER		AFTE	R CC	<u>MMITM</u>	ENT	FINAL
SL	GRP.	DES	SCRIP	TION			τv		d Time Ir	٦	OTV
NO	CODE				QIY	Q	ΙΥ	Rea.	Prop	Aard	
Α		From	m pac	kage vendor						, igi ci	
1.	В	Dev	iation	list	1S						
2.	С	Doc	ument	ts and drawings	1S	1F	P+1S	2			3P+1S
3.	В	Bido	der's c ched v	hecklist- Filled (If with tender)	1S						
4.	В	Con	trol sy	stem Architecture		1F	°+1S	4			3P+1S
5.	В	Instr	rumen	t schedule	1S	1F	°+1S	4			3P+1S
6.	В	Spa	re par	ts list	1S	1F	°+1S	6			3P+1S
7.	В	Instr	rumen	t specifications		1F	°+1S	2			3P+1S
8.	В	Instr philo	rumen osoph	t design v		1F	P+1S	2			3P+1S
9.	В	Instr diag	rumen Iram	t installation		1F	P+1S	4			3P+1S
10.	В	Fun diag	ctiona ram	l loop schematic		1F	P+1S	4			3P+1S
11.	В	Instr pane drav	rumen el arra vings	t location & cable ingement/wiring		1F	P+1S	4			3P+1S
12.	В	Bill	of ma	terial	1S	1F	°+1S	4			3P+1S
13.	В	Con pane drav	trol pa el arra vings.	anel & inter lock Ingement/wiring		1F	P+1S	8			3P+1S
14.	В	Mar: box)	shallir draw	ng box(termination ings		1F	P+1S	8			3P+1S
15.	В	Juno	ction b	oox schedule/ n drawings		1F	P+1S	6			3P+1S
									·	· [
1	29/0	7/21		FOR ENQUIRY - R	EVISED		D	CK	DP\	/	MS
0	28/0	9/20		FOR ENQUI	٦Y		DC	CK	DP\	/	MS
REV	DA	TE		DESCRIPTIC	ON		PR	PD	СНК	D	APPRD
	FACT	ENG	INEE	RING AND DESIGN		SAT	ION		A SHACK		DO

14FT910/15

INS	TRUME	NTATION	VENDOR DATA F	REQUIREN	IENTS	3267	9-14-PS-(001 VDR	INST
	DEPAR	ſMENT					Page 2 o	f 4	R1
16.	В	Cable sche	edule		1P+1S	4		;	3P+1S
17.	В	Logic diag	ram, Interlock write up		1P+1S	6		;	3P+1S
18.	B	Control roc	om layout		1P+1S	4		÷	3P+1S
19.	В	IO List of F	YLC		1P+1S	4			3P+1S
20.	В	Alarm and	trip schedule		1P+1S	4		:	3P+1S
21.	В	Grounding	details		1P+1S	4		;	3P+1S
22.	В	Air distribu	tion drawings		1P+1S	4		;	3P+1S
23.	В	Instrument (Process H hookup, Pr	hookup drawings lookup, Electrical neumatic Hookup)		1P+1S	6			3P+1S
24.	В	Instrument installation supports a	/ junction box drawings with nd canopy		1P+1S	6		:	3P+1S
25.	В	Test proce	dures for lines etc		1P+1S	6		:	3P+1S
26.	В	Pre-commi commissio Procedure	issioning and ning checklist, etc		1P+1S	10			3P+1S
27.	С	Loop folde drawings o loop in a fo dedicated	rs (All connected of every instrument older in a CD/DVD)			4\$:	2S
28.	С	All docume in CDs/DV	ents and drawings Ds (Editable copy)		1S	2\$		2	2S
29.	С	As built dra	awings		1P+1S	4\$			3P+1S
		<u> </u>							

Group code:

A- For review and detailed engineering,

B- For review,

C- For information and record document type:

R- Reproducible,

P- Print,

M- Microfilm

S- Soft (CD/DVD)

\$- Counts from Date of Startup

Notes:

@ Vendor shall fill in proposed lead-time if different from the required lead-time.
@ @ Each set of final documents shall be submitted in a folder. Two such folders shall be packed and dispatched with the equipment.

14FT910A/15

FACT ENGINEERING AND DESIGN ORGANISATION

INSTRU	MEN	ΓΑΤΙ	ON
DEPA	RTM	ENT	•

32679-14-PS-001 VDR INST

C	DEPAR1	MENT	• -		F	Page 3 of 4	R1
	-		1 -	I			
SL	GRP.	DESCRIPTION	OFFER	AFTER			FINAL
NO	CODE		QTY	QTY	Lead	Time In	QTY
					VVeek		_
D		Vandar data requirement			Req	Prop Agra	
P		from instrument					
		manufactures					
1.	С	Manufactures catalogue with		1P+1S	12		3P+1S
	•	model code no.					
2.	В	Manufactures technical		1P+1S	12		3P+1S
		specification indicating range,					
		material, utility requirements					
3.	В	Quality assurance plan		1P+1S	12		3P+1S
4.	В	FAT/ SAT Procedure for		1P+1S	4BD		3P+1S
		DCS /PLC			М		
5.	В	Control valve sizing & noise		1P+1S	12		3P+1S
	_	level calculations					
6.	B	I hermowell wake trequency			12		3P+1S
7	D	and sizing calculation		10,10	10		20.10
/.	Ð			12+13	+2		37+13
8.	В	Dimensioned outline		1P+1S	14		3P+1S
		drawings for instruments/					
0	R	Control papel/ interlock papel		10+10	1/		2D+1C
9.	Ъ	drawings		117713	14		56415
10	В	Wiring drawings		1P+1S	14		3P+1S
11	В	Control panel/ interlock panel		1P+1S	14		3P+1S
		detail fabrication drawing		_			
12	В	Termination, wiring & power		1P+1S	12		3P+1S
		supply distribution drawings					
13	В	Instrument assembly drawing		1P+1S	14		3P+1S
14	В	Performance curves/test		1P+1S	2BD		3P+1S
		certificates			М		
15	С	Third party (IBR, CMRS etc)		1P+1S	2BD		3P+1S
		certificates			M		0.5.40
16	С	Detailed spare parts manual		1P+1S	12		3P+1S
17	С	Operation, installation,		1P+1S	(1)		3P+1S
		maintenance, service manual					
10	Р	for each instrument		40.40			20.40
18	В	Material test report		10+15			3P+15
10	C	Weather proof Certificates		1D_10			3D+1S
19		Weather proof Certificates			M		
20	С	Hvdro test certificates.		1P+1S	2BD		3P+1S
	_	Leakage test certificates			M		
			-				I
	FACT						D(O)

14FT910A/15

		VENDOR DATA R	EQUIREM	IENTS	32679)-14-PS-	001 VD	VDR INST	
DEPARI					F	Page 4 c	of 4	R1	
21 B	General A	rangement		1P+1S	14			3P+1S	
	drawings o	f panels							
22 C	All docume	ents and drawings		1S	4\$			2S	
(1)-dispate	ched along	with instrument/ syst	tem					I	
BDM- Befo	BDM- Before dispatch of material								
Note: All	the above	indicted time sche	edule is ty	/pical ar	nd sha	ll be op	otimized	I (Early	
submission	n) to comple	ete the project within	time sche	dule indi	cated in	n NIT if i	required	.	



TECH PROC SPEC	HNICAL DECUREMENT VENDOR DATA REQUIREMENTS							3267 PAC	32679-03-PS-001 VDR PAGE 1 OF 1 R0				
PRO	JEC.	T : ^{TP}	PS for RLNG b	urner of Therma	al Oil Heater (F 5902)	ITEM		вι	JRNEF	R PIPING HE	FOR	THERM	ial oil
CLIE	NT	: M/	/S. FACT			TPS N	lo	32	2679-0	3-PS-00)1		
STA	TUS	:	√ E	ENQUIRY		PO No)						
SI.	Grp					Offer		A	fter Co	nmitmen	ıt	Fina	al@@
No	Code	e		Description		Qty	Qt	ty	Lead Reqd	time in w Prop@	veeks Agrd	QI	ty
1.0	С	Drawing	s				3P+	-1S	4			1P+1S	
1.1	С	Piping lav	yout Drawing				3P+	-1S	4	1		1P+1S	;
1.2	С	Isometric	, <u> </u>				3P+	-1S	4	1		1P+1S	;
1.3	С	Piping su	pports, operat	ting platforms d	rg.		3P+	-1S	4	1		1P+1S	;
2.0	С	Material	Take-offs	2.	-		3P+	·1S	4	1		1P+1S	
3.0	В	Material	and Purchas	e Requisitions	of Piping Items		3P+	-1S	4	1		1P+1S	;
4.0	В	Valve Da	tasheet & Ve	ndor Drawing			3P+	·1S	4	1	1	1P+1S	
5.0	С	As built I	Drawing	0			3P+	·1S	4	1		1P+1S	
5.1	С	Piping lay	yout Drawing				3P+	·1S	4			1P+1S	
5.2	С	Isometric	s				3P+	-1S	4	İ	Ī	1P+1S	
6.0	С	All inspec	ction, testing &	NDT Records.			3P+	-1S	4			1P+1S	
								_					
		1								1			
	Lege Grou Doct Note '@	end : up code : A ument type es : 0 ' Vendo 0@ ' Each s and do	- For review a : R - Reprodu or shall fill in p set of final doo espatched wit	nd detailed Eng cible , P - Print roposed lead tii cuments shall b h the equipmen	gineering , B - For reviev , M - Microfilm, S - Soft (me if different from the r e submitted in a folder. ⁻ t.	v , C - F Copy requirec Two suc	for in d lead ch fol	form d tim	nation a ne s shall l	and recor	rd		
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	FACT ENGINEERING AND DESIGN ORGANISATION												

VENDOR DATA REQUIREMENTS

32679-02-PS-001 VDR ELEC

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ITEM: MEDIUM VOLTAGE INDUCTION

R0

PROJECT: TPS for RLNG Burners

CLIENT : FACT-UD

TPS. NO: 32679-02-PS-001

MOTORS

STATUS : ENQUIRY

COMMITMENT P.O. NO.:

			Offer		After con	nmitmen	t	@@ Final
SI. Grp. No. code	Description	Otv	Otv	Lead time in weeks			Ċţv	
			Qty.	હાપ્ર.	Reqd.	@ Propd	Agrd.	Qiy.

1.0	Α	Duly filled in Technical particulars of Medium Voltage induction motor as per proforma enclosed	1S+1P	1S+1P	4	4P+1S
2.0	Α	Dimensional GA. Drawings, separately for motors and terminal boxes		1S+1P	4	4P+1S
3.0	Α	Foundation drawings / Mounting details		1S+1P	4	4P+1S
4.0		Performance characteristic curves		1S+1P		4P+1S
4.1	В	Speed v/s torque		1S+1P	4	4P+1S
4.2	В	Speed v/s current		1S+1P	4	4P+1S
4.3	В	Speed v/s time		1S+1P	4	4P+1S
4.4	В	Thermal withstand curves under hot & cold conditions (at 100% & 80% rated voltage)		1S+1P	4	4P+1S
5.0	С	Type test certificates for similar Motors		1S+1P		4P+1S
6.0	С	Routine test certificates		1S+1P	4	4P+1S
7.0	с	CMRI certificate / certification from statutory authority of the country of origin, For hazardous area applications		1S+1P	4	4P+1S
8.0	С	Installation, operation and maintenance Manuel				4P+1S
9.0	В	Spare parts list				
10.0	В	Duly filled and signed Compliance statement stating item wise deviation from specs, if any				

Legen	d:	Gr rec	oup code: A - For review and	d detailed Engine	ering, B - For rev	view, C - For information and			
Notes:	@ @@	 Document type: R - Reproducible, P - Print, S – Soft-pendrive/CD Vendor shall fill in proposed lead time if different from the required lead time. Each set of final documents shall be submitted in a folder. Two such folders shall be packed and despatched with the equipment. Final documents shall be submitted in soft copy also. 							
0	21-10-'2	20	Original Issue	SM	IK	IK			
REV.	DATE		DESCRIPTION	PREPARED	CHECKED	APPROVED			
FACT	FACT ENGINEERING AND DESIGN ORGANISATION								

13FT910C/14

	TECHNI	CAL												32	2679-02-PS-	-001-V	DI
	PROCURE SPECIFIC/						VEND	OR DAT	'A IN	DEX				Р	AGE 1 OF	1	R0
Ы	ROJECT:	CONVE FACT-U	RSION JC	OF BUF	RNERS TO	O RLNG A	PROJE	ECT NO. : 3	2679-0	2-PS-001	VENDOR	:					
ІТ	EM:	Burne	ers for T	Thermal C)il Heater	(F 5902).			P.C	NO.:			DATE:				
S N	SI. Io.	Doc. / D	rawing No) .		De	escription			Rev. 0 Date	Rev. 1 Date	Rev. 2 Date	Rev. 3 Date	Rev. 4 Date	Rev. 5 Date	Relev This	ant to
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1.0 GENERAL DESCRIPTION OF THE PROJECT

- 1.1 FACT Petrochemical Plant operates a Thermal Oil Heater (F5902), which employs Furnace Oil as fuel, at its Petrochemical plants in Udyogamandal Complex (UC), located at Udyogamandal, Cochin.
- 1.2 In view of the availability of R-LNG (Re-gasified LNG) at PD, FACT proposes to replace the consumption of FO with R-LNG, at PD, Anone Plant located at Udyogamandal complex.
- 1.3 As a part of this project, it is proposed to provide R-LNG firing burners for the Thermal Oil Heater in Anone Plant currently employing FO as the primary fuel.
- 1.4 After fuel change over to RLNG it is envisaged to have a single burner with a single burner block along with pilot burner and associated controls for 100% heat release.
- 1.5 The entire work shall be carried out adhering to all relevant standards, regulations and the best engineering practices, utilizing best quality materials and best quality workmanship. The absence of specification on any aspect shall imply that the best engineering practices shall prevail.
- 1.6 However to the pilot burners of the Thermal Oil Heaters RLNG was hooked up in house to enable RLNG firing in addition to provision for LPG firing.
- 1.7 The Bidder shall inform the purchaser in the event of any conflict between data give in this specification and the requirements with respect to statutes/standards/regulations. The purchaser will provide his resolution in such cases and the Bidder shall follow the same without any impact on cost or time schedule.
- 1.8 Exceptions & Deviations, if any, from the various Codes / Standards / technical specifications / requirements shall be clearly spelt out with proper reference to the specific clause number through the Pre-Bid queries only. In absence of any such indication, it shall be assumed that the offer complies with all requirements and such assumptions shall strictly be binding on the LSTK Contractor. Any deviation not brought out in this form and written elsewhere in the offer shall not be recognized and the same shall be treated as null and void. Contractor to note that OEM standards wherever applicable shall be based on respective national / international standards.

2	29.07.2021	FOR ENQUIRY - REVISED		SK	AAN				
1	14.01.2021	FOR ENQUIRY	LA	SK	AAN				
0	21.09.2020	FOR CLIENT REVIEW	SK	GPG	AAN				
REV.	DATE	DESCRIPTION	PREPARED	REPARED CHECKED					
FA	FACT ENGINEERING AND DESIGN ORGANISATION								

SPECIAL REQUIREMENT OF THE PROJECT (PROCESS & COMBUSTION EQUIPMENTS)

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2.0 STANDARD DEFINITIONS

Company/Owner/Client	ERTILISERS AND CHEMICAL TRAVANCORE LTD. FACT)						
PMC (Consultant)	Project Management Consultant - FACT Engineering and Design Organisation (FEDO)						
LSTK Contractor / Bidder	Lump Sum Turn Key Contractor						
Vendor / Sub Vendor / Sub Contractor	Party with whom the Contractor has an arrangement for manufacture and supply etc. of components and equipment, commissioning services etc.						
TPIA	Third Party Inspection Agency						

3.0 CODES & STANDARDS

- 3.1 The Latest Edition of codes and standards as listed below shall be followed for design and manufacturing. Generally the manufacturer will comply with these codes and standards as indicated therein with minor deviations that are normally adopted by manufacturer and are reasonably accepted as per good engineering practice.
- 3.2 Contractor to also note that requirement mentioned in the relevant codes & standards regarding any optional requirement or any bulleted points mentioned in the applicable codes, owner's decision shall prevail. Owner may ask for the compliance or relaxation during detail engineering on submission/ technical justification from bidder.

CODE	DESCRIPTION
KSPCB	Kerala State Pollution Control Board Norms.
СРСВ	Central Pollution Control Board Norms
NFPA	National Fire Protection Association
NFPA 30	Flammable and Combustible Liquid Code
NFPA 54	National Fuel Gas Code
NFPA 56	Standard for Fire and Explosion Prevention During
	Cleaning and Purging of Flammable Gas Piping Systems
NFPA 85	Boiler and Combustion Systems Hazards Code
ASME	American Society of Mechanical Engineers
ASME B31.1	Power Piping
ASME B31.3	Process Piping
API	American Petroleum Institute
API STD 520	Sizing, Selection, and Installation of Pressure-Relieving

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EXCI A

	Devices in Refineries
API RP 521	Guide for Pressure-Relieving and De-pressuring Systems
API STD 526	Flanged Steel Pressure Relief Valves
API STD 535	Burners for Fired Heater in General Refinery Service
API STD 560	Fired Heaters for General Refinery Service
OISD-STD-106	Process Design and Operating Philosophies on Pressure
	Relief and Disposal System
OISD-STD-118	Layouts for Oil and Gas Installations
OISD-STD-152	Safety Instrumentation for Process System in Hydrocarbon
	Industry

4.0 SITE DATA:

Site conditions at Udyogamandal (UC) are as follows: -

Elevation above MSL	4000 mm
Design Relative humidity	100 %
Barometric Pressure	1005 milli bar
Seismic factor	Zone – III as per IS 1893
Ambient Temp. (DBT)	35°C
Wind velocity (Basic wind speed)	39 m/s (140 km/hr) as per IS 875 Fig. 1
Rain fall intensity	
Maximum recorded rainfall	169.5 mm per day
Design rainfall intensity	40 mm per hour
Hazardous area classification	Class I,ZONE 2, GROUP II A

5.0 EXISTING FACILITY:

5.1 THERMAL OIL HEATER:

- 5.1.1 Thermal Oil Furnace (F-5902) is an integral part of Anol dehydrogenation process section of Anone Plant. In dehydrogenation process Cyclohexanol (anol) is converted into Cyclohexanone (Anone) and Hydrogen by an endothermic, vapor phase equilibrium reaction at about atmospheric pressure. The reaction takes place on the surface of zinc magnesium oxide catalyst placed in tubes of a reactor (heat exchanger type tubular reactor R-5901) at temperature ranging from about 220°C to about 280°C. The heat necessary for the reaction is supplied by circulating thermal oil around reactor tubes.
- 5.1.2 Thermal oil furnace F5902 is used to heat thermal oil, which in turn is used to supply heat to Cyclohexanol (Anol) vapors in the endothermic reaction of the Anol dehydrogenation

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system. Thermal oil is flowing through coils inside the furnace. Currently thermal oil furnace is using furnace oil as fuel which needs to be changed to RLNG. There are two oil burners and one of them is used as stand by. Furnace oil burner details and duty conditions of thermal oil furnace F5902 are furnished in Table. The pilot burners which were earlier using LPG are given provision for using RLNG.

- The flow rate of Furnace oil (FO) to be burnt is controlled by TPV-5906 and the 5.1.3 temperature of the thermal oil to reactor R-5901 is maintained at the value required for obtaining 50-60% wt % Anone in the outlet of R-5901.
- 5.1.4 Furnace oil from battery limit is supplied to an oil storage tank T-0702. A furnace oil pump P-0703 which supplies the oil to the burner of F-5902 after heating in a steam heater to the temperature about 110°C. The discharge pressure of P-0703 is controlled by PIC 5958, the excess oil is being recycled to tank T-0702. The FO is atomized in the burner by medium pressure (MP) steam supply and the MP steam is controlled by PDIC 5954 which maintains a slightly higher steam pressure than the FO pressure before burner.
- Temperature of flue gas leaving radiant section of the Heater is 739⁰ C and flue gas leaving 5.1.5 convection section is 362° C.

1.	Equipment	Thermal Oil Heater
2.	Tag No.	F5902
3.	Location	Anone Plant
4.	Make	BHPV
5.	Heat Absorption MM KCAl/Hr	1.2
6.	Capacity TPH	88.650
7.	Туре	Vertical Cylindrical with Forced Draft Type
8.	No. of Burner	2
9.	Fuel	FO

5.2 DESIGN SPECIFICATION SUMMARY OF EXISTING THERMAL OIL HEATER:

5.3 DETAILED DESIGN SPECIFICATION OF EXISTING THERMAL OIL HEATER

SL. NO.	PARAMETERS	DESIGN	95% OF DESIGN	NORMAL
1.	Tag No.	F5902		
2.	Total duty per heater mm Kcal / hr	1.2	1.14	0.928
3.	Heater section	RAD+CON	RAD+CON	RAD+CON
4.	Service	THEM.OIL	THEM.OIL	THEM.OIL
5.	Heat absorption mm Kcal / hr	1.2	1.14	0.928

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SL. NO.	PARAMETERS	DESIGN	95% OF DESIGN	NORMAL
6.	Fluid name	THEM. OIL	THEM.OIL	THEM.OIL
7.	Flow rate kg/hr	88650	84218	68500
8.	Pressure drop (allowable, clean/fouled) kg/sq.cm	1.5	1.5	1.5
9.	Pressure drop (calculated. Clean/fouled) kg/sq.cm	0.38	0.34	0.23
10.	Fouling allowance hr ⁰ C-sq m / Kcal	0.0004	0.0004	0.0004
11.	Average radiant flux density(cal)do	21475	20565	17250
12.	Average convection flux density (cal)does	16185/11835	15290 / 10880	12135 / 7680
13.	Max. Allowable inside film temp. ⁰ C	< 370	< 370	< 370
	INLET CONDITIONS			
14.	Temperature ⁰ C	293 (See Note)	293 (See Note)	293 (See Note)
15.	Pressure kg/sq.cm (G)	5.0	5.0	5.0
16.	Liquid flow Kg/hr	88650	84218	68500
17.	Viscosity, Liquid, cP	0.434	0.434	0.434
18.	Specific heat, liquid Kcal/Kg ⁰ C	0.608	0.608	0.6085
19.	Thermal conductivity, liquid Kcal / hr $- m - {}^{0}C$	0.082	0.082	0.082
20.	Density liquid, kg/cu.m	814.46	814.46	814.46
	OUTLET CONDITIONS			
21.	Temperature ⁰ C	315 (See Note)	315 (See Note)	315 (See Note)
22.	Pressure kg/sq.cm (G)	4.62	4.66	4.77
23.	Liquid Flow kg/hr	88650	84218	68500
24.	Vapor flow kg/hr			
25.	Viscosity, liquid, cP	0.369	0.369	0.369
26.	Specific heat, liquid, Kcal/kg ⁰ C	0.627	0.627	0.627
27.	Thermal conductivity, liquid, Kcal / hr $-m - {}^{0}C$	0.08	0.08	0.08
28.	Density liquid. Kg/cu.m	797.36	797.35	797.33
	COMBUSTION DESIGN CON	DITIONS		
29.	Type of fuel FURNACE OIL			
30.	Excess air, percent	20		
31.	Calculated heat release, mm Kcal / hr (LHV)	1.5		

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SL. NO.	PARAMETERS	DESIGN	95% OF DESIGN	NORMAL
32.	Calculated thermal efficiency , Percent (LHV)	80		
33.	Radiation loss, % of heat release (LHV)	2.5		
34.	Flue gas temp. leaving radiant Section, ⁰ C	739		
35.	Flue gas temp. leaving convection section, ⁰ C	362		
36.	Ambient air temp., ⁰ C	DESIGN=38, MIN =19		
37.	Altitude above sea level, M	4		

STRUCTURAL DESIGN DATA					
HEATER SECTION PROCESS FEED					
COIL D	ESIGN	RAD CON			
1.	Design Basis for tube wall thk. (code)	API 530, 1988 (THIRD EDITION			
2.	Design basis for rupture strength (min.or.avg)	MINI	MUM		
3.	Design life, hr	1,00	,000		
4.	Elastic design pressure, kg/sq.cm(g)	8	.5		
5.	Rupture design pressure, kg/sg.cm(g)	8.5			
6.	Temperature allowance, 0 ^C	28			
7.	Corrosion allowance, mm		3		
8.	Stress relieve (yes or no)	Y	ES		
9.	Weld inspection requirements, X- ray or other (no. of welds and degree of coverage)				
10.	Hydrostatic test pressure, kg/sq.cm(g)				
11.	Max. tube metal temp, (clean) ^{0}C	-	-		
12.	Design tube metal temp., ⁰ C	410			
13.	Inside film co-efficient, Kcal/hr- ⁰ C-sq.m				
COIL C	COIL CONFIGURATION				
14.	Tubes (vertical or Horizontal)	VERTICAL (HELICAL)	HORIZONTAL		
15.	No. of flow passes / tubes per row	2/14	2/4		
16.	Effective tube length, m	7.95	2.5		



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17.	Bare tubes, number	14	12/
18.	Bare tubes, total exposed surface, Sq. m	40	10.8/
19.	Extended surface tubes, number		/16
20.	Ext. surface tubes, total exposed surface, sq.m		/49.7
21.	Tube spacing, cl to cl (staggered) (inline),mm	251	203
		(STAC	GGERED)
TUBES		× *	,
22.	Material (ASTM specification and grade)	SA 106 GR B	SA 106 GR B
23.	Outside diameter, mm	114.3	114.3
24.	Wall thickness, (minimum)	6.02 (AVG.)	6.02(AVG.
DESCO	TION OF EXTENDED SUBFACE		
25	Type (studs, segmented fins or solid		STUDS
25.	fins) Material	-	
20.	Dimensions (height y	N.A	25 x 12
27.	diameter/thickness) mm		23 X 13
28.	Spacing		14SPP
29.	Maximum tip temperature. ⁰ C		63 SPPM
30.	Extension ratio	-	
	·		·
TERMIN	NALS	PROCESS FEED	
1.	Type (welded or flanged)	WELDED	
INLET	· · · ·		
2.	Material (ASTM specification and grade)	SA 106 Gr. B	
3.	Size / rating, schedule or thickness	4"x SCH 40	
4.	No. of terminals	TWO	
OUTLE	Γ	·	
5.	Material (ASTM specification and grade)	SA 106 Gr B	
6.	Size / rating, schedule or thickness	4"x SCH 40	
7.	No. of terminals	TWO	
MANIFO	OLDS		
8.	Connection to tubes (welded or flanged)	WELDED	
9.	Location (internal or external)	External	
INI FT			
INLEI			

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	grade)	
11.	Size / Schedule or thickness	6" x Sch 40
12.	Flange material (ASTM specification and grade)	SA 105
13.	Flange or size rating	6" x 150#
OUTLE	T	
14.	Material (ASTM specification and grade)	SA 106 Gr B
15.	Size / Schedule or thickness	6" x Sch 40
16.	Flange material (ASTM specification and grade)	SA 105
17.	Flange or size rating	6" x 150#
CROSS	OVERS	RADIANT
18.	Location (internal or external)	Internal
19.	Pipe material (ASTM specification and grade)	SA 106 Gr B
20.	Pipe size / schedule or thickness	4" SCH 40
21.	Flange material (ASTM specification and grade)	N.A
22.	Flange size and rating	
TUBE S	UPPORTS	
23.	Location (top. bottom, intermediate)	PIPE SUPPORTS
24.	Material (ASTM specification and grade)	SS 310 S
25.	Spacing	
26.	Coating (type and thickness)	
TUBE G	UIDES	
27.	Location and spacing	
28.	Material (ASTM specification and grade)	N.A
SETTIN	GS	
FLOOR		
29.	Lining thickness (mm) 65+100+100 750 °C	Hot face temp. calculated Design
30.	Materials/thickness/service temp : REFRACTORY FIRE BRICK (1400 $^{\circ}$ C) + INS 11 (1350 $^{\circ}$ C) + INS 7 (1100 $^{\circ}$ C)	
31.	Anchor (type and material) : SS	
32.	Casing : Material and thickness (mm) : CS / 8 (MIN), Temp $< 90^{\circ}$ C	
·		
EXPOS	ED VERTICAL WALLS	

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34.	Material / thickness / service temp : WHYTHEAT K (1600 0 C) + INSULYTE 9 (1100 0 C)
35.	Anchor (type and materials) SS
36.	Casing : Material and thickness (mm) : CS / 6 MIN Temp : < 90 ⁰ C

NOTES

- When catalyst is new we can operate with thermal oil inlet/outlet temperature = $220/242^{\circ}C$.
- *Temperature difference is same in all cases. Thermal oil outlet temperature controlled by temperature control valve.*

5.4 DESIGN SPECIFICATION OF EXISTING BURNER:

SL. NO.	PARAMETERS	SPECIFICATION	
1.	Tag No.		
2.	No. of	2 (1)	W+1S)
3.	Fuel	FO (Fu	rnace Oil)
4.	Temperature , °C (MIN/NOR/MAX)	19.0/3	38.0/45.0
5.	Viscosity of fuel at operating temp,(CST)	1:	5-25
6.	Relative Humidity, %(Min/Nor/Max)	64/9	93/100
7.	Draft available at burner(mmWC), Max		100
8.	Combustion Air Pressure Drop across Burner(mmWC)	100	
0	Capacity of Each Burner	MAIN OIL GUN	AUX. OIL GUN
).	(min./nor./max.)	32/75/94	16/37.5/47
10.	Turn Down Ratio		1:3
11.	Fuel Calorific Value (HHV)		
12.	Fuel Calorific Value (LHV)	9973	Kcal/kg
13	Heat Release Per	MAIN OIL GUN	AUX. OIL GUN
15.	Burner(Max/Nor/Min), MM kcal/hr	0.94/0.75/0.32	0.47/0.375/0.16
14.	Oil Pressure at Burner kg/cm ² G		5.5
15.	Type of Burner	Cylindrical, Oil	Fired, Forced Draft
16.	Manufacturer	M/s ZEECO,USA	
17.	Direction of Firing	Vertical Upshot	
18.	Fuel temperature@ Burner ⁰ C	110	
19.	Atomization Medium	MP Steam	
20.	Atomizing Steam Pressure (Op/Des)	12-13/14.8 kg/cm ² G	
21.	Atomizing Steam /Oil ratio, kg/kg	0.25-0.4(Max)	
22.	Excess Air	20%	

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SL. NO.	PARAMETERS	SPECIFICATION
23.	Combustion Air per Burner(Min/Nor/Max)	1540/1280/768
24.	Combustion Air Temperature(Min/Nor/Max), °C	19/38/45
25.	Fuel Pressure at burner(Max) kg/cm ² G	5.5
26.	Flame Length &Dia at Max heat release, m	2.8x0.34
27.	PILOTS	
28.	No. of	2 (1 per burner)
29.	Туре	Continuous gas pilot
30.	Ignition method	Manual (By electric Spark Ignition)
31.	Ignitor Capacity	20000 Kcal/hr
32.	Fuel Type	Fuel Gas (LPG)
33.	Gas Pressure at Ignitor, kg/cm ² G	0.75
34.	Flame Scanner	
35.	No. of	One set per burner
36.	Scanner Type	UV
	FD FAN	
37.	Туре	Centrifugal Single suction
	Capacity ,m3/sec	
29	Min	0.2 (720m ³ /hr)
30.	Normal	0.65 (2340m ³ /hr)
39.	Drive	Direct Coupled

6.0 **FUEL SPECIFICATIONS**

The detailed specification of existing liquid fuels and proposed gaseous fuels along with their supply conditions at battery limit are given below:

7.0 FURNACE OIL (FO)

SL. NO.	SPECIFICATION	UNITS	VALUE
1.	Density at 15 °C	kg/M ³	970
2.	Acidity, Inorganic	-	NIL
3.	Ash	%	0.05 % by weight
4.	Flash Point (PMCC)	°C	66 (min)
5.	Pour Point	°C	24 (max)
6.	Asphaltenes	%	6.0 % by weight (max)
7.	Kinematic Viscosity at 50 ⁰ C	CST	125 - 180



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SL. NO.	SPECIFICATION	UNITS	VALUE
8.	Sulphur	%	3.2 total % by mass (max)
9.	Water content	%	0.5 % by volume (max)
10.	Sediments	%	0.10 % by mass (max)
11.	Gross Heating Value	Kcal/kg	10,100 (min)
12.	Vanadium	ppm	100 (max)
13.	Sodium	ppm	30 (max)
14.	Aluminum + Silicon	ppm	30 (max)
15.	Na/V Ratio		< 25 or > 40

8.0 RE-GASIFIED LIQUEFIED NATURAL GAS (RLNG)

RLNG will be made available at a pressure of 5 kg/cm² (G) and temperature of 30°C at contractor's battery limit. The supply condition of RLNG at battery limit is given below: Supply Pressure

Min.	:	$3.0 \text{ kg/cm}^2(\text{G})$
Nor.	:	$3.5 \text{ kg/cm}^2(\text{G})$
Max.	:	$5.0 \text{ kg/cm}^2(\text{G})$
Supply Temperature	:	$30^{\circ}C$

SL. NO.	SPECIFICATION	UNITS	
-	Composition	Mol %	
1.	C1, Methane	88.00% min	
2.	C2	1.50 to 6.00%	
3.	C3	3.50% max.	
4.	C4	2.00% max	
5.	C5	0.10% max.	
6.	С6	Nil	
7.	CO ₂	100 ppm	
8.	N2	1.00% max.	
9.	H ₂ S	5.0 mg/NM ³ , max	
10.	02	50 ppm, max	
11.	Mercaptan Sulphur	7.0 mg/NM ³ , max	
12.	Impurities	Will be reasonably free from dust gum forming constituents and other deleterious solid and/ or liquid matter.	
13.	Water content / moisture	No free water will be present.	

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SL. NO.	SPECIFICATION	UNITS		
	PROPERTIES OF R-LNG & BATTERY LIMIT CONDITIONS			
1.	Gross Calorific Value (GCV)			
2.	min. / max 9340 / 10,420 Kcal/SM3			
3.	Specific Density 0.65 (w.r.t air at ATP)			
4.	Molecular Weight 18.29			

9.0 UTILITIES

SL. NO.	DESCRIPTION	SUPPLY PRESSURE / CONDITION
1	Instrument Air	$4.5-5.5 \text{ kg/cm}^2(\text{G})$
2	Nitrogen	$1-5 \text{ kg/cm}^2(\text{G})$
3	Power	3000 / 415V @ 50Hz, 3Phase
4	Atomizing Steam	$12-13 \text{ kg/cm}^2(\text{G}) @ 290^{\circ}\text{C}$
5	Plant Air/Service Air	$7 \text{ kg/cm}^2(\text{G})$

10.0 BATTERY LIMIT

The distances indicated are approximate only.

Description	Battery Limit
R-LNG	At a point 5M away from the boundary of proposed heater.
STEAM	From one point of feeding piping at 12-13 Kg/cm ² g and 290°C
ELECTRIC POWER	At the terminal of high and low tension incoming switchgears in the substation in the plant.
INSTRUMENT AIR	At a point one meter away from the boundary of proposed heater.

11.0 SCOPE OF WORK / SUPPLY

BASIC DESIGN PARAMETERS

SI. No.	Heater	Fuel Combinations	No. of Burners	
1.	Thermal oil Furnace	100% RLNG	1 (1 Main Burner+1 Pilot Burner)*	



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*At present there are two burner blocks, each with one Furnace oil gun, one pilot burner attached with one pilot flame scanner and one main flame scanner along with associate controls. A spare auxiliary Furnace oil gun which suits to both burner blocks in place of the main oil gun is maintained.

After fuel change over to RLNG it is envisaged to have a single burner block with one main burner, one pilot burner along with necessary controls. However contractor shall supply an additional similar burner block with one main burner, one pilot burner along with necessary controls as ware house stand by.

The scope of work of the LSTK contractor includes but not limited to the following:

- 11.1 Study of the existing system and firming-up of modifications required to carry out the conversion of Thermal Oil heater (F 5902) to enable firing using R-LNG fuel.
- 11.2 The modifications shall address the conditions arising due to firing so as to ensure the continued safe and reliable operation at design condition and conformity to statutory norms/regulations.
- 11.3 The Thermal Oil Heater (F 5902) shall be designed to have the post conversion capability of achieving duty conditions specified in the Process Specification, with 100% RLNG firing at individual burner.
- 11.4 Burner shall be supplied with dedicated scanner for gas & pilot fuel, RLNG fired pilot flame type igniter for burner throat, insulation & cladding material as necessary for proposed upgrade. New burner control panels are to be provided as per instrumentation requirements attached along with the Tender documents.
- 11.5 Suitability of existing FO fired main burner RLNG fired pilot gas lines to individual pilot burners along with its valves & fittings may be checked and if found not suitable pilot burner suitable for main burners, associated piping, valves & fittings to be supplied along with the main burners. Prior to main burner testing the pilot shall be proven stable over the full firing range of the main burner. It shall also remain stable upon loss of main burner fuel, minimum draft, and all combustion air rates and for all operating conditions.
- 11.6 LSTK contractor to check any modification requires for duct / air flow requirement of existing FD fan. If any modification requires the same shall be in scope of LSTK contractor.
- 11.7 New RLNG gas train including piping, instruments and accessories from battery limits to burners shall be under the scope of LSTK contractor(s).
- 11.8 Latest technology shall be considered for the proposed modification / retrofitting of the Thermal oil Heater (F 5902). The emission from Thermal oil Heater (F 5902) post conversion for RLNG shall adhere to norms as per CPCB/KSPCB.
- 11.9 The burners shall be designed in such a way that there will not be any flame impingement on any of the wall on all operating conditions.
- 11.10 The tender purpose retrofit P&IDs for Thermal oil Heater (F 5902) is attached along with the Tender documents. The P&IDs are indicative only containing minimum requirements. Vendor shall prepare detailed P&ID incorporating all necessary control schemes &

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interlock logics for normal/safe operation as per this tender document and also shall adhere to NFPA requirement. For additional information please refer to special requirement for instrumentation doc no. 32679-14-PS-001 SPL

- 11.11 Adequacy of existing fuel oil pipelines, atomizing steam pipelines, hoses, solenoids and other mechanical fittings, wind box/existing burner openings/front wall panel/pressure parts etc shall be verified for the burner conversion and necessary modifications if required shall be carried out for achieving duty conditions specified in the existing facility of thermal oil heater and applicable emission norms. The cost required for the above modifications shall be in the LSTK contractor(s) scope in all respect and the quoted price shall consider the modifications.
- 11.12 The proposed burners shall be designed for the specified RLNG parameters.
- 11.13 RLNG shall be fed into common header (downstream of individual flow control valve) and the gas shall be fired.
- 11.14 The gas line fittings in the burner zone shall be modified as per gas firing layout and NFPA requirement.
- 11.15 Supply of all materials required for the necessary modifications shall be under the scope of LSTK contractor(s).
- 11.16 Detailed Engineering of the modifications and submission of drawings, data sheets, and design calculations for review and approval by FACT/FEDO. HAZOP study of the facilities shall be included in design & implementation of its recommendations shall be at Contractors own costwith no cost implication to Owner.
- 11.17 Design / Selection and Supply of RLNG Burners for Thermal Oil Heater.
- 11.18 Supply, Fabrication and Erection of all materials and bought-out items including Steel plates, Piping, pipe fittings, corrosion wear pad, pipe support, Structural, Supports, Tubes etc within the battery limit.
- 11.19 Fabrication of the Heater components as per good engineering practices (non-pressure parts).
- 11.20 Inspection and testing of the components as per Codes/Specifications/Standards.
- 11.21 Transportation of the components to site including Transit insurance, etc.
- 11.22 Loading and unloading of the components at various stages.
- 11.23 Dismantling of components (requiring replacement) from the existing Heater and transporting of these components to the scrap yard located within 2.0 km.
- 11.24 Erection of the components at site.
- 11.25 Design, Supply and application of Refractory lining for the burner throat.
- 11.26 Supply and application of Insulation and Cladding as necessary.
- 11.27 Painting of the items modified by the LSTK Contractor including supply of painting materials.
- 11.28 Fabrication & Erection of Structural Supports, Ladders and Platforms if necessary.
- 11.29 Refractory drying out, chemical cleaning, boiling out, etc.
- 11.30 External cleaning of Heater pressure parts and scaffolding work required, prior to the inspection.

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- 11.31 Commissioning of the Burners and axillaries after hook-up.
- 11.32 Conducting Trial run and Guarantee run of the equipment, for 72 hours (as per performance guarantee clause) after stabilization of the plant at rated capacity.
- 11.33 Supply of spares as per attached list (Doc. No. 32679-02-PS-001 SPR (M) and Doc. No. 32679-02-PS-001SPR(R)).
- 11.34 Submission of Final Documentation.
- 11.35 Any other items which are required to make the system complete in all respects and not specifically mentioned is also included in the scope of LSTK Bidder.
- 11.36 Refer Doc. No. 32679-14-PS-001 SPL for Special Requirements for the Project. (Instrumentation)
- 11.37 Refer Doc. No. 32679-03-PS-001 SPL for Special Requirements for the Project. (Piping)
- 11.38 Material of construction for piping items shall be as per applicable ASME standards listed out under head CODES & STANDARDS of this document.
- 11.39 MOC of instrument air piping shall be as per Doc. No. 32679-14-PS-001 SPL Special Requirements for the Project. (Instrumentation)
- 11.40 No extra claim will be entertained for any changes, which may arise during detailed engineering and enabling work during execution.

12.0 GUARANTEE

12.1 PERFORMANCE GUARANTEE & TEST RUN

Broad scope of Heater performance testing is described below:

SL. NO.	PARAMETER	FUEL	NORMAL	TOLERANCE
1	Fuel (RLNG) Consumption	RLNG	Thermal Equivalent of fuel consumption after fuel changeover to RLNG shall not exceed the thermal equivalent of fuel consumed by firing FO before changeover. For calculating the thermal equivalent of fuel, Net Calorific Value (NCV) of the respective fuels shall be used.	+2.0%
2	Thermal oil	PI NG	88650 Kg/hr	
2	Heat Absorption	KLNU	1.2 MM Kcal/hr	
3	CPCB Emission Standards G.S.R 820(E)Limiting concentration in mg/Nm31.Sulphur Dioxide SO22.Oxides of Nitrogen,	RLNG	50 350	NIL

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	NOx		
3.	Particulate Matter, PM	10	
4.	Carbon Monoxide, CO	150	

- 12.1.1 After Mechanical Completion has been achieved, Contractor shall conduct the Sustained Load Test (SLT) in association with owner under the direction and supervision of Contractor for a consecutive period as indicated in 12.1.6 below:
- 12.1.2 On successful completion of the sustained load test, contractor shall give notice in writing for commencing the Performance Guarantee test. On receipt of the notice, but not later than three days after the notice, the guarantee test shall be conducted by the contractor in agreement with the owner.
- 12.1.3 During the guarantee test, no stand by items of equipment and machineries shall be used in parallel for proving the guarantee. The range of operating conditions shall be within the design conditions as specified.
- 12.1.4 Performance guarantee is proposed to be assessed by conducting test runs after the conversion. The Burner shall be tested for thermal and emission performance and the heater shall meet the rated capacity during test run. The burner system and parts shall be guaranteed against defects in design, materials, workmanship and performance for a period of 36months from the date of commissioning or 42 months from the date of supply whichever is earlier. BMS system shall be guaranteed against defects in design, materials workmanship & performance for a period of 12months from the date of commissioning or 18 months from the date of supply whichever is earlier.
- 12.1.5 The vendor shall at least ensure that test run case is achieved.
- 12.1.6 The duration of SLT shall be 48 hours and guarantee test run for RLNG (post-conversion) shall be 48 hours. In determining the ability of RLNG burner to meet the guarantees as specified, all operating parameters shall be averaged over a period consisting of any 24 consecutive hours selected out of the 48 hours test period so long as this includes a continuous and uninterrupted run of 24 (Twenty Four) hours.
- 12.1.7 If during the SLT, corrective measures are required and involve procurement of new items or modification of items, the Contractor shall under take the same at his own risk and cost.
- 12.1.8 Measurements during Guarantee Test For determination of the average performance achieved during the guarantee test mentioned vide 12.1.4 above, all inputs and outputs shall be measured through appropriate measuring instruments like flow / pressure/temperature instruments etc. If any measurement is inconsistent with the bulk of the data, or is otherwise suspected to be

If any measurement is inconsistent with the bulk of the data, or is otherwise suspected to be incorrect, then the data will be adjusted to achieve consistency and correctness in accordance with general accepted engineering principles and practice as mutually agreed by owner and contractor. No other adjustments shall be made on the measurements and data recorded during the guarantee test.

- 12.1.9 The heat release at the turndown ratio of the R-LNG fired burners shall match the heat release at the turndown ratio of the currently employed F.O fired burners.
- 12.1.10 During test run, the skin point temperature of heater coils shall be below the design metal temperature of tubes.



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- 12.1.11 During the test run, vendor to meet all parameters in flue gas from Heater strictly as per latest Central Pollution Control Board and Kerala State Pollution Control Board Emission Norms that prevail at the time of PGTR without any additional cost to the owner.
- 12.1.12 The existing analyzers for continuous monitoring of flue gases already in place at PD shall be utilized to analyze the flue gas from Heater.
- 12.1.13 If contractor fails to achieve the Emission norms as specified in Table 12.1 (3), no negative tolerance is allowed, Burner shall have to be modified at Contractor's own risk & cost within a reasonable time.

12.1.14 MAKE GOOD CLAUSE

In case of any shortfall in the guaranteed performance within the limit, contractor has the option to either replace or repair the burner to the extent required within a reasonable time from test run, or opt for levy of damages wherever applicable.

However, if the guaranteed performance beyond the tolerance provided as per clause 12.1 above, contractor shall carry out corrective action at no extra cost to owner and demonstrate the guaranteed performance at least up to the limit where performance deficiency damages is applicable, within a reasonable time frame. However, if guarantees are not attained even after corrective action by contractor, owner have option to undertake modifications/ additions for fulfillment of guarantees at the risk and cost of the contractor and contractor's liability in such case shall be unlimited.

12.2 MECHANICAL GUARANTEE

- 12.2.1 LSTK contractor shall have final and total responsibility for the design and performance of all equipments / items / components / materials etc furnished / supplied under his scope. Contractor shall also warrant the equipment / item /components (including the equipment and all auxiliaries) furnished by him in respect of design, materials and fabrication and / or workmanship and the performance of the said equipment / item in accordance with this specification and with guarantee / warranty requirements given in the bid package, including process parameters and end product quality assurance at designed load capacity. Guarantee / Warranty period of equipment shall be as specified in the commercial tender documents.
- 12.2.2 Company's approval of the equipment's design shall not relieve LSTK contractor and equipment vendor of their responsibilities to ensure satisfactory performance of the items / equipments supplied.
- 12.2.3 Contactor and equipment vendor shall warrant that all materials used are new, satisfactorily passed through acceptance procedure and is acceptable in quality, form and appearance.
- 12.2.4 If any defect or malfunction occurs due to design fault and /or due to manufacturing fault, material selection fault, during the guarantee period, LSTK contractor and equipment vendor / manufacturer shall make all necessary alteration, repairs, and replacements free of charge.
- 12.2.5 During guarantee run and subsequent running of the Heater in RLNG with in guarantee period prescribed, no part of the burner shall be subjected to temperatures beyond the



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permitted limits, distress, etc by virtue of improper design, construction of burners or other reasons attributed to the vendor and covered in LSTK contractor(s) scope of work. During the guarantee period such defects noticed shall be set right by the LSTK contractor(s) at his own cost.

13.0 STATUTORY APPROVALS

Liaisoning for obtaining Pollution control board, or any other relevant statutory approval shall be under the scope of LSTK contractor. Fees paid for the same shall be reimbursed at actual by FACT.

14.0 INSPECTION AND TESTING

- 14.1 Testing of all materials shall be as per relevant codes/standards/specifications.
- 14.2 FACT/FEDO Engineers shall have free access to the work site of the LSTK contractor(s) or his subcontractor (if any) to carry out the inspection of items covered under the scope of work.
- 14.3 Company's approval of the equipment's design, supply, modification and Installation shall not relieve LSTK contractor and equipment vendor of their responsibilities to ensure satisfactory performance of the items / equipments supplied.

15.0 SPARES / SPECIAL TOOLS & TACKLES

15.1 MANDATORY SPARES

- 15.1.1 The spares required for satisfactory operation of equipment supplied under this project are listed in the attached Spare Parts List Doc. No. 32679-02-PS-001 SPR. These spares shall be purely ware house spares. Bidder shall supply spares parts as per list of spares for satisfactory operation of the Burner & Heater. If any of the spares required for the offered machines are not indicated in the list, bidder may include the same with appropriate justification. However owner's decision regarding inclusion / exclusion of the spares shall be final and binding on the bidder.
- 15.1.2 Bidders shall indicate the itemized price for each of the spares in the list. The price of spares in the list will be considered for evaluation and the same shall be supplied by bidder at the time of commissioning / hand over of the plant as applicable.

15.2 START UP & COMMISSIONING SPARES

All commissioning spares shall be included by LSTK Contractor in their scope of supply and shall be part of the main equipment.

15.3 SPARES FOR 2 YEARS NORMAL OPERATION

15.3.1 The Bidder shall submit the list including unit & quantity of recommended spares for two years normal operation & maintenance in un-priced part as per format attached and item wise price shall be submitted in priced part.

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- 15.3.2 The Purchaser reserves the right to buy any or all recommended spares.
- 15.3.3 Prices of recommended spares will not be used for the evaluation of Bids. Prices of Spares shall remain valid for two years from the end of Warranty period; Owner may order such spares any time during this period.

15.4 SPECIAL TOOLS AND TACKLES (IF APPLICABLE)

Contractor shall supply one set of special tools & tackles for each equipment tag if required for erection, pre-commissioning and complete & easy maintenance. Cost of special tools & tackles shall be included in the base price.

16.0 VENDORS / SUB VENDOR LIST

- 16.1 All equipment shall be procured/fabricated as per approved vendor list attached.
- 16.2 Make of the equipment not indicated and any other make for the specified equipment shall be subjected to owner's/consultant's approval.
- 16.3 Bidder shall indicate make of various equipment offered by them in the bid.
- 16.4 For works/supplies to be carried out by sub-contractor/vendor, LSTK contractor(s) shall obtain prior approval from FACT/FEDO regarding the scope of such works and the parties to whom such sub-contracting is proposed.

17.0 ERECTION, HOOK-UP AND COMMISSIONING

- 17.1 The modifications, erection at site, hook-up and commissioning of burners shall be completed within 45 days.
- 16.5 LSTK contractor(s) shall submit the detailed procedure for erection, hook-up & commissioning of burner and the schedule of activities in the form of a PERT Chart.

18.0 VISIT TO SITE

LSTK contractor(s), if desired so, shall visit the site and acquaint himself with the details of the equipment and site conditions, before submitting his offer.

19.0 OBLIGATIONS BY OWNER

- 19.1 FACT will provide necessary office space and storage space. LSTK contractor(s) requirements shall be indicated in the offer.
- 19.2 Water and Electricity will be provided at one point, free of cost. LSTK contractor(s) to arrange for distribution ELCB, etc.
- 19.3 Crane facility will be provided by FACT, depending on availability, on chargeable basis. Non-Supply of crane at any point of time by FACT cannot be cited as a reasons for any delays in execution.

20.0 EXCLUSIONS

The following items / activities are excluded from the LSTK contractor(s) scope.

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- Supply of RLNG at the required specifications at battery limit. 20.1
- 20.2 All foundations for equipment and buildings and other civil works unless otherwise stated are excluded from the scope of the LSTK contractor(s). However, Civil scope drawings with loading data and foundation details shall be furnished by LSTK contractor(s).

21.0 TRAINING OF COMPANY PERSONNEL

After commissioning of the complete system, LSTK Contractor is required to operate the System successfully. During operational period Contractor shall deploy their supervisory staff for providing training to owner's operating staff up to full satisfaction of the owner.

22.0 LSTK CONTRACTOR/VENDOR DOCUMENTATION

- 22.1 Successful Bidder shall submit all documents related to quality and technical such as Calculations, Drawings, QAP, ITP, and Test procedures etc. as per attached Vendor Data Requirements (VDR) Doc No. 32679-02-PS-001 VDR for review / approval. In addition to the attached VDR, any documents or drawing deemed necessary for the review/approval of the Client/Consultant shall be provided by the Bidder.
- 22.2 In addition to hard copies all final documents such as specifications, datasheets, drawings and manufacturers record book shall be provided in approved electronic software formats (Native files). Calculations shall be submitted in widely used software forms
- 22.3 PMC's/Owner's comments are to be duly incorporated by contractor and afterwards contractor shall proceed with procurement activity with respective OEMs. Technical Bid Evaluation (TBE) documents are to be furnished by bidder to PMC's/Owner's for information.
- 22.4 The un-priced or priced copies of purchase requisition / purchase orders detailing both technical and commercial aspects for all items shall be submitted to PMC's / Owner's for review & comments. Contractor to proceed for placement of order on corresponding successful OEM only after receipt of clearance from Owner against the subject PR/PO.
- DOCUMENT TO BE SUBMITTED ALONG WITH THE OFFER 22.5 Vendor shall furnish the following along with his offer. (Technical bid) without which his offer shall not be considered for further evaluation.
- Duly filled Compliance Statement (Doc. No. 32679-02-PS-001CS).Deviation shall be 22.5.1 furnished in the attached format only. Marking of deviation elsewhere in the tender document will not be considered.
- 22.5.2 Duly filled Scope of Work (Doc. No. 32679-02-PS-001 SW)
- 22.5.3 Duly filled format for Mandatory spares (Doc. No. 32679-02-PS-001 SPR (M)).
- 22.5.4 Duly filled format for Recommended Spares for two years of normal operation (Doc. No. 32679-02-PS-001 SPR(R)).
- 22.5.5 Duly filled format for Medium voltage induction motor (Doc. No. 32679-13-TP-91001).
- 22.5.6 List of Spares for Startup & Commissioning.
- 22.5.7 Documents required to be submitted along with the offer as per the attached Vendor Data Requirements (Doc. No. 32679-02-PS-001 VDR).

1.0 INTRODUCTION

M/s FACT intends to convert the Thermal oil Heater (F5902) of petrochemical division to use RLNG as fuel. The following covers the requirements for instrumentation for the associated burner management system and field instrumentation.

2.0 SCOPE

The scope of instrumentation works include Design, Procurement, Inspection, supply, testing, calibration, erection and commissioning of all instruments and Burner Management system(BMS) for the safe and smooth operation of the burners. Vendor shall furnish all engineering and vendor documents relevant to the system.

3.0 GENERAL INSTRUCTIONS TO THE VENDOR

- 3.1 All the instruments and accessories supplied shall be designed considering ambient conditions and the specified nature of the plant.
- 3.2 The instrument supplied shall be of high quality and shall be from manufacturer of good repute.
- 3.3 Suitable interlocks are to be implemented for the start-up, shut-down and operation of the system.
- 3.4 Supply and installation of all the instruments within the battery limit shall be in the scope of the vendor.
- 3.5 Power supply of 110VAC, UPS supply will be made available at battery limit. The distribution inside battery limit as per system requirement shall be done by vendor.
- 3.6 Instrument air with a supply pressure of 4-5.5 kg/cm2 will be made available at the battery limit; further distribution shall be in vendor's scope.

2	12/01/21	FOR ENQUIRY	DCK	DPV	MS	
1	14/10/20	FOR COMMENTS	DCK	DPV	MS	
0	28/09/20	FOR COMMENTS	DCK	DPV	MS	
REV	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED	
FACT ENGINEERING AND DESIGN ORGANISATION						

- 3.7 A local panel shall be provided for the mounting of PLC, instruments, relays etc pertaining to the BMS. For the BMS panel, hoods shall be provided. Panel shall be weatherproof IP 65. Purging (type Z) shall be provided for the panel, suitable for the area classification. The Z type purging required for the BMS panel shall be continuous.
- 3.8 The interlocks shall be achieved through the BMS PLC as per attached datasheet (32679-14-DA-00001), Special requirement of the project (32679-02-PS-001 SPL PCE) and P&ID diagram (32679-11-PD-002).
- 3.9 For main flame monitoring, Vendor shall offer two numbers of UV type Flame scanners. Both flame scanners shall function as redundant units (2002 logic) for flame monitoring. The offered Flame monitors shall be remote and shall be front mounted in the panel in such a way that it is visible without opening the panel door. Flame failure status (potential free contact) and analog output (4-20ma) shall be available from both flame monitors for indicating flame intensity and the same shall be repeated to main control room also.
- 3.10 Independent fixed type igniter/pilot burner with ionization feedback shall be offered. The igniter/ pilot burner shall be sturdy and suitable for the burner temperature and pressure conditions. It shall also be non-retractable once the main flame is established.
- 3.11 Pilot ignitor offered shall be of robust make suitable for retrofit to the existing burners.
- 3.12 The ON/OFF valves supplied shall be designed to operate with a minimum air pressure of 4 Kg/cm² or lesser.
- 3.13 Solenoid valve used shall be of universal type. Flying leads are not acceptable for the connections and the vent port shall be bug proof.
- 3.14 Provision shall be given in the panel to inhibit the accidental operation of critical switches. The signals requiring retransmission to the DCS in the central control room shall be terminated in a Junction Box in the battery limit by the vendor. Also one number of serial port (RS 422/RS 485) shall be provided for PLC.
- 3.15 Supply of all cables, junction boxes and installation materials such as pipes, tubes, pipe/tube fittings, cable tray (Perforated Aluminium type), cable glands etc within battery limit are included in vendor's scope.
- 3.16 Erection of all field instruments in the battery limit, calibration, testing and commissioning are under vendor's scope. Vendor shall assist Purchaser/ control system engineer in the configuration of data in DCS/ control room.
- 3.17 Inputs/Outputs (Burner trip status, Flame intensity, Permissive to start etc.) to be repeated to main control room shall be terminated in a junction box in the battery limit. Provision for connecting 2 nos of hydrocarbon (HC) detector shall be provided in the junction box. Supply and erection of HC detector is not included in the scope of bidder.
- 3.18 Earthing shall be provided for all instruments, junction boxes, panels etc. Earth wires shall be terminated to the nearest earthing terminal/earth pit in the location.
- 3.19 All similar instruments shall be supplied from the same sub-vendor and to the extent possible the number of sub-vendors shall be kept to a minimum.
- 3.20 All field instruments shall be weatherproof IP 65.
- 3.21 All instruments located outdoor shall be provided with rain hood/ canopy irrespective of ingress protection certification. This includes Instruments, junction boxes, local panel etc.
- 3.22 All electronic instruments, junction boxes and cable glands shall be explosion proof Exd., suitable for the hazardous area classification (Zone 2, Gr. IIA, T3) and weatherproof IP 65.
- 3.23 This document provides only general guidelines for the selection of instruments and instrument items. Actual selection of the instrument, material of construction etc. shall be based on the various aspects such as type of process fluid handled, operating condition, environmental condition etc.
- 3.24 All instruments and control panel shall conform to relevant API RP standards. Also, the installation of instruments & panel shall be as per API RP 550.
- 3.25 Panel wiring shall be as per the drawings approved By PMC/Owner. Wires of suitable rating shall be used.

- 3.26 Necessary tools and tackles for commissioning activities (calibrators, multi meters, programming units etc) and spares shall be under the scope of the vendor.
- 3.27 Bidder shall submit Quality assurance plan (QAP) and test certificates for Double block and bleed valves, PLC, Instruments and junction boxes for review and approval of PMC/Owner.
- 3.28 Factory Acceptance Test (FAT) shall be carried out at OEM manufacturing unit/ Vendors facility for BMS so as to ensure that the system is expected to work smoothly at site. Vendor shall intimate commencement of FAT at least two weeks in advance to owner.
- 3.29 Bidder shall check P&ID 32679-11-PD-002 and Annexure II for more details regarding existing flow control valve and shall consider the same during system design. The suitability of the existing control valve shall be confirmed by the bidder and replacement/modification if required for achieving desired functionality shall be intimated to Owner.



PIPING DEPARTMENT

1.0.0 SCOPE

1.1 GENERAL

- 1.1.1 The scope of work covers but is not limited to design & detailed engineering of burner piping, supply of items, fabrication, erection, testing, painting of piping items and commissioning.
- 1.2 IDENTIFICATION
- 1.2.1 The following special requirements for the project are to be followed:
 - Piping shall confirm to the provisions of **ASME B 31.3**.
 - All hoses shall be of SS braided type.
 - CS piping below 50 NB shall be minimum Sch 80 thick and SS piping below 50 NB shall be Sch40S thick minimum.
 - The design and supply of pipe/pipe fittings from the Tie-in point to the burner shall be solely under vendor's scope. Bidder can refer piping layout attached with this package for locating the existing RLNG piping Tie-in location with reference to heater and same to be verified at site by bidder. It is bidder's responsibility to route the piping without any interferences by verifying all existing items in plant.
 - All the erection activities shall be as per good engineering practices and shall be to the full satisfaction of site in charge of PMC/Owner
 - Painting:-All structural items used for support shall be painted with two coats after surface preparation followed by red oxide zinc chromate primer application.
 - Contractor has to co-ordinate with TPIA/PMC for all technical design approval and clearance before proceeding with execution of work at site.
 - Preparation of QAP and getting approval through TPIA/PMC for valves is also included in scope of work.
 - Corrosion pad to be welded on all support locations including shoe supports for all sizes and services.
 - Erection and Commissioning spares as required for piping to be included, by the bidder
 - Low point drains and high point vents shall be plugged or capped suitably.
 - Height of pipe support pedestals from pavement should be minimum 150mm.

0	27-09-2020	ISSUED FOR TENDERING	KR	JTG	KK		
REV	DATE	DESCRIPTION	PRPD	CHKD	APPRD		
FACT ENGINEERING AND DESIGN ORGANISATION							

DATA SHEET	BURNER					32679-02 DA-001 (RLNG)		
						PAGE	1 OF	1
Eqpt. No.	: F 5902			No. of Bu	irners :	1Working stand by	+ 1 Ware hous	se.
Eqpt. Name	: Thermal C	il Heate	r (F 5902)	_				
manufacturer				burner size				
type				ignition type				
mounting	horizontal	ver	tical	flame scanner				
firing	up fired	dov	wn fired	type of pilot				
location of burner				atomising med	ium 🗌 pr	. 🗌 ste	eam 🗌 air	
heat release				comb. Air temp	D.		C	°C
max.			kcal/hr	pr. drop across	burner		mr	nwc
min.			kcal/hr	draught at bur	ner		mr	nwc
normal			kcal/hr	ignition ports n	10.			
excess air			%	ignition ports d	lia.			
fuel burning capacity				firing ports no.				
turn down ratio				firing ports dia				
	-				R			
main fuel	R-LNG			NCV main fuel			kca	al/kg
aux. Fuel				NCV aux. fuel			kca	al/kg
fuel pr. across burner			kcal/cm ² g	temp. at burne	r		C	°C
viscosity at burner			CS	atomising pres	sure		kg/	cm²g
max. noise level			dBA	max. flame din	nensions			
connection details				material				
main flange size (NB)				burner tin / no	7710			
no & size of holts				shell				
other nozzles	size (NB)		flange std	flange				
N1	5120 (112)		nango sta.	gasket				
N2				refractory block	k			
N3								
	<u> </u>			1				
spares				accessories off	ered			
removable tips / nozzle	es							
bolts / nuts								
gasket								
				•				
gasket Notes :- Data in t	he blank cells st	nall be fur	nished by the	bidder along with	n the bid.			
4				LOCATION	FACT-UC			
3					FACT			
1				PROJECT NO. PROJECT	CONVERSIO	ON OF RLN	IG BURNERS AT	FAC
0 17.09.20	TK.	<u>GPG</u>	ÄÄN	P.O No.	UC			
	-	~ ~						

Page 1 of 4

1.0 General

- 1.1 The general specification for the BMS PLC for fired burner required for the Thermal oil heater (F5902) of Anone plant is given below.
- 1.1.1 Vendor shall supply PLC with all required hardware, software and programming for the logics required for the operation of burner. All the interlocks and control functions shall be implemented in the PLC. All the inputs will be connected to the PLC. The capacity of the PLC shall be decided considering the input/output capacity for proposed units.
- 1.1.2 Electronic cards shall be conformance coated to level G3 as per ISA 71.4.
- 1.1.3 The system shall be internally protected against system errors and hardware damage resulting from electrical transients on power wiring & signal wiring. The system shall have EMI/ RFI immunity as per SAMA Standard PMC-33.1/ IEC-61801. The surge withstanding capability of any module shall be as per IEC 61643-21. A separate surge protection device shall be provided for the PLC panel.
- 1.1.4 Hot standby redundancy to be ensured for the CPU, Power supply module and Communication module.
- 1.1.5 PLC system shall be designed for fail safe i.e de-energize to trip.
- 1.1.6 The PLC shall be able to communicate with main DCS using serial communication for data exchange. Critical signals shall be repeated to DCS through hardwiring only.
- 1.1.7 The PLC shall be powered from UPS supply of 110VAC.

2.0 Configuration

The basic system shall consist of the following major sub-systems.

2.1 Input/ Output subsystem

2.1.1 The required AI/AO modules for continuous control shall be considered. Analog input modules shall be designed to accept 4-20mA. Transmitter powering (24VDC) to be considered for all analog channels. The maximum number of channels per DI/DO

REV	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
0	28/09/20	FOR COMMENTS	DCK	DPV	MS
1	12/01/21	FOR ENQUIRY	DCK	DPV	MS



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modules shall be 32 and that of AI/AO modules are 8. Installed spare capacity of 20% to be considered.

- 2.1.2 Each external signal must be totally (galvanically) isolated from the internal bus system, from the power supplies, and from other I/O signals. Interposing relays are to be provided for digital inputs and digital outputs to MCC and SOVs.
- 2.1.3 All field switch contacts shall be potential free. Interrogation voltage shall be 24VDC. All terminals (DI/DO) are to be provided with fuses and shall have fuse blown indication.
- 2.1.4 Each I/O shall be protected against the reversal of polarity of the power voltage to I/O. Each I/O module shall have a LED per channel to indicate the status of input / output. Relays shall be provided with LED, which shall provide input status of each digital input.
- 2.1.5 The I/O signal and the I/O modules shall be checked for correct operation by the fault diagnostic function of the PLC.
- 2.1.6 Input wiring shall be double ended type i.e. Two wires per input and not with common return for all inputs.
- 2.1.7 All Terminals shall be of Elmex / Phoenix/ Wago make Polyamide terminals of different colours for different signals.

2.2 Processor system

- 2.2.1 The processor shall have capability to implement all the control functions required to implement the logic scheme, as logic symbol or ladder diagram.
- 2.2.2 The size of the memory shall be sufficient for storage of the program instructions required by the logic schemes and other functional requirements.
- 2.2.3 Memory shall be non-volatile. EEPROM/ Flash memory card shall be used. Suitable measures for backing up the program shall be provided.

2.3 System software

- 2.3.1 The system software shall include all programs for the PLC, which is required to perform all PLC functions including communication.
- 2.3.2 The PLC programming language for implementation of logic operations shall be any of following types:



Page 3 of 4

- a) Functional Logic diagrams Binary logic symbols such as AND, OR, NOT Gates, Timers and flip-flops.
- b) Ladder Diagram (preferred)
- 2.3.3 Diagnostic package and its related equipment and software shall be supplied. All the software offered by the vendor shall be licensed.

2.4 **Programmer**

- 2.4.1 Licensed software shall be supplied and the same shall be compatible to use with the Owners Windows (OS) based laptop PC. Software shall be installed in owner's laptop PC by the vendor during commissioning stage itself and the communication with PLC shall be checked in presence of Engineer in charge.
- 2.4.2 Necessary connector required for establishing the communication of PLC with programmer (Owner's Laptop PC) shall be supplied by the vendor.
- 2.4.3 The installation CDs/DVDs shall be handed over to Owner with the supply of items.
- 2.4.4 All illegal entries should be rejected with audible alarm. It shall be possible to add/delete/ modify the application program on line without affecting the outputs.
- 2.4.5 The programming software shall have all diagnostic features and trouble shooting functions. It shall have I/O forcing functions. Forced/masked I/O list shall be available.
- 2.4.6 The programming software shall allow display of logic and/or ladder diagram indicating signal flow and shall show description and status of each contact. It shall be possible to display process alarms and diagnostic messages as and when they appear. Further it shall also be able to display I/O map in a user-defined format.
- 2.4.7 It shall be able to display process dynamic interlock sequences. Also it shall be possible to start/stop the machinery indicated on the sequence diagram. All such displays shall be user configurable.

2.5 BMS PLC PANEL

- 2.5.1 The BMS PLC panel shall be furnished with annunciator window, push buttons and lamps (LED type) required by the operator to carry-out the burner start-up & shutdown operations and to monitor the status of the burners at all times.
- 2.5.2 The panel shall have a Power on lamp and a lamp test push button.



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- 2.5.3 The Flame scanner unit fronts mounted in the panel shall be visible without opening the panel door.
- 2.5.4 Bus bar for 24 VDC to be provided for power distribution for interrogation voltage and transmitter powering.
- 2.5.5 Separate coloured wires to be provided for different IO types.
- 2.5.6 Cross ferrules to be provided for each and every termination inside the panel.
- 2.5.7 Push buttons shall be positioned at suitable height for ease of operation.
- 2.5.8 Legends shall be provided for push buttons and lamps.
- 2.5.9 Anti vibration shoe pad shall be provided below base frame of the BMS PLC panel.
- 2.5.10 The BMS PLC panel will be located in outdoor area, hence necessary shelter/hoods shall be provided. Provision shall be given in the panel to inhibit the accidental operation of critical switches.
- 2.5.11 Purging shall be provided for the panels.
- 2.5.12 Electronic/ pneumatic hooter shall be provided in the panel.
- 2.5.13 Factory Acceptance test conducted for BMS PLC panel shall be conducted at Vendor's OEM's facility. FAT procedure shall be submitted for review and approval of FACT/FEDO.

3.0 WARRANTY

3.1 The PLC system shall be warranted against defect/ faulty workmanship for a period of 12 months from the date of SAT or 18 months from the date of supply, whichever is later.

4.0 SITE SUPPORT DURING INSTALLATION AND COMMISSIONING

4.1 The OEM/ vendor shall be available for supervision of PLC erection and commissioning and necessary provision shall be considered for the same.



DATA SHEET

GENERAL REQUIREMENT FOR ELECTRICS

32679-13-DA-90001

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R0

1.0	Project	TPS for RLNG Burners
2.0	Owner	FACT-UD
3.0	Location	Udyogamandal, Kochi
4.0	Service conditions	
4.1	Altitude	< 1000m above mean sea level
4.2	Humidity Min	64%
4.3	Humidity max.	93%
4.4	Humidity design	100% at 40 ⁰ C
4.5	Ambient temperature ⁰ C-Min.	19.2
4.6	Ambient temperature ⁰ C-Max.	40
4.7	Ambient temperature ⁰ C-Design	40
4.8	Rain fall – Max . Record in an hour	40mm
4.9	Rain –fall Max record in 24 Hours	169.5mm
5.0	Environment	Tropical atmosphere+ corrosive gases normally present in fertilizer plant atmosphere.
6.0	Wind velocity for structural design	-
7.0	Seismic factor for design	Within seismic Zone 3 as per IS 1893
8.0	Soil data	
8.1	Soil resistivity	
8.2	Type of soil (hard / loose)	
9.0	Power system	
9.1	Voltage (V) & Variation (± %)	415±10%
9.2	Frequency (Hz) & Variation (±%)	50 Hz±5%
9.3	No of phases	3
9.4	No. of wires	4
9.5	Fault level (MVA)	35 MVA
9.6	Method of neutral earthing	Solidly earthed

						- PROJECT	TPS for RLNG burners
						CLIENT	FACT-UD
						P.O. NO.	
	0	21-10-20	SM	IK	IK	VENDOR	
	REV.	DATE	PRPD.	CHKD.	APPRD.	TENDOR	
13FT900A/14							FEDO

MEDIUM VOLTAGE INDUCTION MOTORS – DATA SHEET

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R0

1.0	Driven equipment details – TO BE FURNI	SHE	D BY DRIVEN	EQF	PT. VI	END	OR
1.1	Equipment number & Name of equipment	K-	5903-FD Fan				
1.2	Type of equipment						
1.3	Absorbed [power						
1.4	Rated speed						
1.5	Speed torque curve						
1.6	GD ² value of rotating parts with reference to motor shaft in Kgm ² at motor speed						
1.7	Type of drive transmission						
1.8	Additional details / questionnaire for the selection of motors						
2.0	Motor details						
2.1	Operating conditions						
	a) Rated Voltage & Frequency	41	5V +/- 10%, 50	Hz +,	/- 5%	5, 3 p	hase AC
	c) Maximum ambient temperature	40	⁰ C				
2.2	Type of motor (Clause 5.1.0)	Sq	uirrel cage indu	uctior	n mot	tor, E	Energy efficient –IE3
2.3	Rated output in KW	То	be furnished b	y dri∖	ven e	quip	ment. vendor
2.4	Rated speed in RPM	- 0	- ot				
2.5	Type of mounting	- 0	- ot				
2.6	Class of duty as per IS: 325 (Clause 4.1)	S1					
2.7	Hazardous area classification (Clause 4.2)	На	zardous Zone	1, Gr	oup l	IA/II	В
2.8	Method of starting (Clause 5.1.0)	Dir	ect On Line or	VFD	as p	er th	e process requirement
2.9	Limit of starting current (Clause 5.2.3)	60	0% of Full Load	d Cur	rrent		
2.10	Number of permissible starts (Clause 6.1.0)	a) c) -	3 successive c 4 uniformly spa	old st iced s	tarts starts	s per	B) 2 successive hot starts hour
2.11	Suitability for automatic restart (Clause 4.6.0)		Not required		Requi	ired v	vith 100% out of phase residual voltage
2.12	Insulation class (Clause 7.1.0)	Class F with temperature rise limited to Class B					
21.3	Enclosure (Clause 8.2.0)	Flameproof Eexd IIA/IIB T3					
2.14	Frame size (Clause 8.4.0)	As per IS					
2.15	Capacitors at motor terminals (Clause 8.6.0)		Not required				Required of rating
2.16	Location		Indoor		Π		Outdoor

					- PROJECT	TPS for RLNG Burners
					CLIENT	M/s.FACT-UD
					P.O. NO.	
0	21-10-'20	SM	IK	IK	VENDOR	
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MEDIUM VOLTAGE INDUCTION MOTORS – DATA SHEET

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2.17	Cable glands a) Power Cable (Clause 8.6.0)	Required to suit cable sizes				
	b) Anticondensation heater	Required to suit the cable size of 3x4 sq mm YFY/YWY cable				
2.18	Fault withstand time of T.Box (Clause 12.3.0)	System fault level of 35 MVA for 0.25 seconds				
2.19	Size of earth conductor (Clause 13.1.0)	PVC covered Al.cable(size shall be not less than half of power cable.)				
2.20	Anticondensation heater (Clause 17.1.0)	Required (with Voltage rating of 240V), for motors of rating 37 kW & above				
2.21	RTD/Thermistor with control relay (Cl. 18.1.0)	Required Image: Not required				
2.22	Painting (Deviations if any on those specified in 13ES900)	Epoxy painting				
2.23	Make of motors	KIRLOSKAR ELECTRIC / SIEMENS / BHARAT BIJLEE / BHEL				
2.24	Size of cables	Actual sizes of cables will be furnished during issue of purchase order . Terminal box with Flameproof cable gland to suit the same shall be provided.				
2.24.1	Minimum sizes of cables shall be as follows for different motor ratings (DOL starting)					
2.24.1.1	Motors \leq 3.7 kW	1 # of 3 x 4 sq.mm Cu				
2.24.1.2	Motors>3.7kW ≤7.5 kW	1 # of 3 x 6 sq.mm .Al				
2.24.1.3	Motors>7.5kW ≤11 kW	1 # of 3 x 10 sq.mm				
2.24.1.4	Motors>11kW ≤15 kW	1 # of 3 x 16 sq.mm				
2.24.1.5	Motors>15kW ≤22 kW	1 # of 3 x 25 sq.mm				
2.24.1.6	Motors>22kW ≤30 kW	1 # of 3 x 35 sq.mm				
2.24.1.7	Motors>30kW ≤37 kW	1 # of 3 x 50 sq.mm				
2.241.8	Motors>37kW ≤45 kW	1 # of 3 x 70 sq.mm				
2.24.1.9	Motors>45kW ≤55 kW	1 # of 3 x 95 sq.mm				
2.24.1.10	Motors>55kW ≤60 kW	1 # of 3 x 150 sq.mm				
2.24.1.11	Motors>60kW ≤75 kW	1 # of 3 x 185 sq.mm				
2.25	Note:					
	All the electrical equipments, motors, aux and Gas Group IIA IIB, PESO (Petroleum	xiliaries shall meet the Hazardous Area Classification Division 1 and Explosives Safety				



TECHNICAL PARTICULARS

MEDIUM VOLTAGE INDUCTION

MOTORS

32679-13-TP-910 01

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1.0	Make of motors					
2.0	Applicable codes / standards					
3.0	Equipment No.					
4.0	Continuous rating in KW (Clause 4.1.0)					
5.0	Rated voltage & frequency					
6.0	Speed in RPM (syn)					
7.0	Frame size (Clause 8.4.0)					
8.0	Method of starting					
9.0	No load current					
10.0	Full load current					
11.0	Starting current (%FLC) (Clause 5.2.3)					
12.0	Full load torque (Nm)					
13.0	Starting torque (%FLT)					
14.0	Pull up torque (%FLT)					
15.0	Pull out torque (%FLT)					
16.0	Slip (%) (Clause 4.5.0)					
17.0	Efficiency (%) and power factor					
17.1	At full load					
17.2	At 3/4 load					
17.3	At 1/2 load					
18.0	Stator resistance					
19.0	Locked rotor current					
20.0	Locked rotor withstand time					
20.1	Hot (seconds)					
20.2	Cold (seconds)					
21.0	Starting time of motor on DOL with driven equipment coupled					
21.1	At 100% voltage					
21.2	At 80% voltage					
22.0	Minimum voltage required for starting with equipment and corresponding starting time					
23.0	Pull out voltage at full load					
24.0	Allowable number of starts with driven equipment (Clause 6.0.0)					

					PROJECT	TPS for RLNG Burners
					CLIENT	FACT-UD
					P.O. NO.	
					VENDOR	
REV.	DATE	PRPD.	CHKD.	APPRD.		



TECHNICAL PARTICULARS

MEDIUM VOLTAGE INDUCTION MOTORS

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24.1	Successive starts from cold condition	
24.2	Successive starts from hot condition	
24.3	Uniformly spaced starts per hour	
25.0	Time interval required for restarting the motor after the permissible successive starts	
26.0	Guaranteed temperature rise under worst conditions of voltage and frequency	
27.0	Maximum allowable sustained voltage drop and time in seconds the motor can be kept running with full load without exceeding the permissible temperature rise	
28.0	Design class of rotor as per NEMA standards	
29.0	GD ² value of rotating parts in Kg/m ² at rated speed	
30.0	Speed v/s torque curve	
31.0	Current v/s time curve (with driven machine)	
32.0	Current v/s speed curve	
33.0	Thermal withstand characteristics (hot & cold)	
34.0	Start withstand time	
34.1	Hot (seconds)	
34.2	Cold (seconds)	
35.0	CMRS Certificates (for Flame - proof motors)	
36.0	Capacitors	
36.1	Maximum rating of capacitors in KVAR that can be connected to motor terminals (Clause 8.6.0)	
36.2	Terminal box for capacitor / star delta starter (Clause 12.9.0)	
37.0	Bearings (Clause 10.0)	
37.1	Drive end bearing No. & type	
37.2	Non drive end bearing No. & type	
37.3	Make of bearings	
38.0	Lubricants (Clauses 10.2.0, 10.6.0 & 10.7.0)	
38.1	Make	
38.2	Type & grade	
38.3	Lubrication schedule of motor	
39.0	Percentage residual voltage reconnection allowed (Clause 4.6.0)	
40.0	Slip ring motors	
40.1	Rotor open circuit voltage	
40.2	Rotor current	
40.3	Make of brush	



TECHNICAL PARTICULARS

MEDIUM VOLTAGE INDUCTION MOTORS

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40.4	Grade of brush	
40.5	Details of starting resistance	
40.6	Type of rotor winding	
41.0	Net weight of motor	
42.0	Shipping weight of motor	
43.0	Shipping volume of motor	
44.0	Critical speed (Clause 4.4.0)	
45.0	Margin between starting time and thermal withstand time (hot) as per clause 5.2.2	
46.0	Material of external screws, bolts, & nuts (Clause 8.1.0)	
47.0	Maximum vibration and noise levels (Clause 8.3.0)	
48.0	Ventilation	
48.1	Method of ventilation (Clause 9.1.0)	
48.2	Material of construction of fans & tubes (Clause 9.2.0)	
48.3	Whether bidirectional, if not, direction of rotation (Clause 9.3.0)	
49.0	No. of auxiliary terminal boxes and their purpose (Clause 12.7.0)	
50.0	Anti condensation heaters (Clause 17.0.0)	
51.0	Details of thermistors and thermistor control relay (Clause 18.1.0)	
52.0	Insulation class of winding (Clause 7.1.0)	
53.0	Protective coatings / treatments provided (Clause 7.4.0)	
54.0	Enclosure (Clause 8.2.0	
55.0	Mounting	
56.0	Special requirement (Clauses 21.2.0)	
57.0	Foundation rails, nuts, bolts, etc (Clause 8.8.0)	
58.0	Additional accessories / requirements (Clause 21.1.0)	
59.0	Coupling / pulley (Clause 16.1.0)	
60.0	Whether motor is energy efficient as per IS:12615	
61.0	Cable gland type & size	



CONTENTS

- 1.0.0. SCOPE
- 2.0.0. VENDOR DATA REQUIREMENTS
- 3.0.0. CLASSIFICATION OF DOCUMENTS
- 4.0.0. VENDOR DATA INDEX
- 5.0.0. QUALITY OF VENDOR DRAWINGS
- 6.0.0. CONDITIONS OF FEDO REVIEW

PRPD.BY:- JC	СНКД.ВҮ:-СК	APPRD. BY:- JK	ISSU	ED ON:-April 2010
FACT ENGINEER	ING AND DESIGN C	ORGANISATION	FACT	FEDO

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1.0.0. SCOPE

- 1.1.0. This document together with "VENDOR DATA REQUIREMENTS (VDR)" defines FEDO's requirements for vendor drawing and data for any enquiry, work order or purchase order.
- 1.2.0. Bidders unable to comply with these requirements must detail all exceptions in their proposal. The timely delivery of quality drawings and data is as crucial as delivery of the equipment itself and hence the same shall be strictly adhered to after commitment.
- 1.3.0. Failure provide adequate to preliminary data / drawing may render a proposal non-responsive and hence may be rejected. After commitment failure to provide documents as per purchase order may delay progressive payments and adversely affect future invitation to bids.

2.0.0 VENDOR DATA REQUIREMENTS (VDR)

- 2.1.0 FEDO will provide a partially completed VDR form along with each enquiry. This form explains group code of the document, quantity of each document required and lead time for submission. Columns are available for the vendor to fill in his deviations, if any, from FEDO's requirements.
- 2.2.0 The vendor shall forward a filled-in VDR form along with his offer, if he has got any deviation from FEDO's requirements. In the absence of a filled-in VDR form along with the offer, it will be presumed that the vendor is accepting FEDO's requirements specified in the VDR.
- 3.0.0. CLASSIFICATION OF DOCUMENTS

- 3.1.0. Documents are classified based on their status and nature of content.
- 3.1.1. Status of documents:
 - 1. Preliminary documents
 - 2. required along with the offer.
 - 2. Documents to be submitted after commitment.
 - 3. Final documents.
- 3.2.0. The documents are further classified into Groups A,B and C, depending on the nature of the documents as explained below.
- 3.2.1. Group A requirements

These documents are urgent in nature and contain information that is required for proceeding with the detailed engineering of surrounding / down stream equipments in the plant and hence are to be submitted on priority basis.

3.2.2. Group B requirements

These documents are to be reviewed by FEDO for compliance with the purchase order / work order specifications but are not essential for other engineering activities of FEDO.

3.2.3. Group C requirements

Documents in this group contains data / information / records which are final in nature and that are required for the equipment user and need not be reviewed by FEDO.

4.0.0. VENDOR DATA INDEX (VDI)

4.1.0. Vendor shall forward a filled up and updated VDI along with each vendor data transmittal. VDI shall list out all documents that are being prepared for the particular order, their current revision status and indicate the documents included in the present transmittal. A blank VDI is attached along with this document, which shall be used for this purpose.

FACT

FEDO

ENGINEERING VENDOR DATA SUBMISSION PROCEDURE SPECIFICATION

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5.0.0. QUALITY OF VENDOR DRAWINGS

- 5.1.0. Vendor drawing and data shall be supplied in full size drawings, reproducible and CDs as specified in the VDR.
- 5.2.0. All drawings / documents shall be clear, legible, right reading and made out of originals prepared in black ink. English language and metric units shall be used for the preparation of all documents.
- 5.3.0. The documents shall be prepared n any of the following standard sizes.
- 5.3.1. A1: 594 mm x 840 mm
- 5.3.2. A2: 420 mm x 594 mm
- 5.3.3. A3: 297 mm x 420 mm
- 5.3.4. A4; 210 mm x 297 mm
- 5.4.0. All documents submitted to FEDO shall be folded into A4 size (210 x 297 mm) except originals / reproducible which may be rolled. All reproducible shall be in high quality polyester films. Soft copies shall be furnished in CD for final drawings / documents.
- 5.5.0. Each drawing / document shall have a title block at the right hand bottom corner with the following information.
- 5.5.1. Name of Vendor.
- 5.5.2. Drawing title.
- 5.5.3. Name of Project, Owner and location.
- 5.5.4. Name of Consultant: FEDO
- 5.5.5. FEDO Purchase Order Number.
- 5.5.6. Equipment name & Number
- 5.5.7. Drawing number, revision and page number.
- 5.6.0. All drawings shall be drawn to some standard scales only and the same shall be indicated in the drawing.
- 5.7.0. The status of the document like "PRELIMINARY, FINAL, FOR REVIEW" etc. shall be stamped on all copies forwarded to FEDO.

- 5.8.0. All documents shall have a block of 100 mm x 100 mm space left vacant for FEDO to put their stamp after review.
- 5.9.0. All drawing/document shall have a revision block explaining revision number, revision description, data of revision, revision authorization etc. When the revised drawings are submitted all currently revised area shall be clearly demarcated by clouding. Any revisions made on other parts of the documenting will not be reviewed by FEDO.
- 5.10.0. When drawings are received back from FEDO with comments, vendor shall incorporate all the comments and resubmit the same. If the vendor is not in a position to incorporate certain comment made by FEDO, then the reason for such deviation shall be highlighted in the forwarding letter to FEDO.
- 5.11.0 The respective engineering specification and other purchase order spec. Will explain the minimum data / details required in various drawings. In the absence of any such information in the purchase order documents, vendor shall follow the standard good engineering practices in detailing the drawing.

6.0.0. CONDITIONS OF FEDO REVIEW

6.1.0. FEDO and / or its client reserve the right to review the vendor documents. FEDO'S REVIEW WITH OR WITHOUT COMMENTS OF THE VENDOR DOCUMENTS SHALL NOT RELIEVE THE VENDOR OF RESPONSIBILITY TO COMPLY WITH ALL PURCHASE ORDER TERMS AND CONDITIONS, including all implied requirements relating to fitness for service and good engineering practices. Approval or acceptance does not imply or infer determination relating anv to compliance by the vendor with its full

F F D O

VENDOR DATA SUBMISSION PROCEDURE

00ES001/2010

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responsibilities under the purchase order.

ENGINEERING

SPECIFICATION

- 6.2.0. FEDO's comments are limited to identifying requirements within the scope of the purchase order or failure by the vendor to comply with the requirements of purchase order, as revealed by the limited review. Oversights in the above limited review cannot be taken as approval for the vendor to deviate from the purchase order conditions. **FEDO** reserve the right to point out any such deviations at any stage of the order execution. The vendor shall comply with all such requirements without any price / delivery implications.
- 6.3.0. FEDO review will be authorized by an official stamp as given below, properly filled and signed by the concerned. Comments if any will be indicated in red ink or clouded in the case of copies of commented drawings.

Appropriate comment in the 'comments' column and 'status of review' column will be marked.

Comment	Status of Review
As noted	Revise and resubmit
	for review
No	Proceed as noted and
comments	submit revised docs.
	For records
Not	No further review
reviewed	required
	Forward final docs.
	As per P.O.

- 6.4.0. All documents received in FEDO shall be dispatched after review within 15 days from the date of receipt. Vendor shall notify FEDO of non-receipt of reviewed documents in time immediately, to take corrective actions.
- 6.5.0. The delivery of the equipment shall in no case be linked with the review of the vendor drawings and data by FEDO. It is the sole responsibility of the vendor to execute the job as per the purchase order conditions. If required the vendor shall depute his technical personnel to FEDO after submission of documents for timely finalisation of documents.

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CONTENTS:

- 1.0.0. SCOPE
- 2.0.0. MATERIALS
- **3.0.0. SURFACE PREPARATION**
- 4.0.0. STORAGE OF PAINTING MATERIALS
- 5.0.0. MIXING AND THINNING
- 6.0.0. PAINTING
- 7.0.0. SAFETY
- 8.0.0. INSPECTION
- 9.0.0. GUARANTEE
- **10.0.0. CODIFICATION OF PAINTING MATERIALS**
- **11.0.0. SCHEME OF PAINTING**

12.0.0. COLOUR CODING & MATERIAL FOR PIPING TABLES

PRPD.BY:- JC	CHKD.BY:- CK	APPRD. BY:- JK	ISSUED ON:- April 2010
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1.0.0. **SCOPE**

- 1.1.0. This specification covers the requirements for surface preparation, painting and painting materials for equipment, structures and piping (including those painted/primed at shop and those painted at Field/Site.
- 1.2.0. Requirement of painting for any item shall be as specified in any of the following documents.
 - a) Equipment Data Sheet
 - b) Piping line schedule
 - c) Design Basis for package items
 - d) Painting schedule
- 1.3.0. The purpose of painting described in this specification is generally for protection against corrosion.
- 1.4.0. Painting for other reasons shall be as indicated in the respective equipment data sheets or painting schedule.
- 1.5.0. The following surfaces exposed to atmosphere are covered by this specification, which are not provided by any other form of covering/coating.
 - a) Pressure vessels, Tanks, Heat Exchangers and other process equipment with Carbon steel and low alloy steel as material of construction.
 - b) Machinery items including motors.
 - c) Steel structures
 - d) Carbon and low alloy steel piping
- 1.6.0. The following items shall not be painted unless otherwise specifically required by respective equipment Data Sheets/Painting schedule

- a) Non ferrous surfaces, stainless steel and High Alloy steel surfaces.
- b) Glass, tile or ceramic surfaces
- c) Name plates and identification tags
- d) Valve stems
- e) Machined contact surfaces
- f) Galvanised surfaces
- g) Insulation covers
- h) Plastics
- i) Underground / buried piping and equipments which are provided with special type of protective coatings.
- j) Surfaces / Items which are excluded from painting due to specific reasons.
- 1.7.0. This specification also covers painting of "Markings" and color-coding of carbon steel, low/high alloy steel, stainless steel, galvanized iron and insulated pipes.

2.0.0. MATERIALS

- 2.1.0. All painting materials shall be of good quality as covered by respective IS or other international specifications
- 2.2.0. Special paints and painting materials shall have proven quality and shall meet the requirements laid down in the respective data sheets for equipment and piping.
- 2.3.0. All painting materials shall not have passed the date of expiry or shelf life as recommended by manufacturer.

3.0.0 SURFACE PREPARATION

3.1.0 All surfaces to be painted shall be free from rust, oil, grease, dust, stain, moisture or any other foreign material/contamination, as per IS 1477 Part I.

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- 3.2.0 Surfaces to be painted shall be completely dry.
- 3.3.0 Oil, grease, stains and other similar contaminants shall be completely removed by using proper solvents and removers, After cleaning, the surfaces shall be free from even traces of contaminants and solvents/removers.
- 3.4.0 Dust shall be removed by air blowing or vacuum cleaning.
- 3.5.0 Hard and caked dust, mud, mill scale and rust shall be removed by mechanical means like wire brushing, sand blasting , shot blasting or grit blasting.
- 3.6.0 Wet surfaces shall be dried by blowing warm air.
- 3.7.0 All surfaces cleaned by different methods shall be painted immediately with out allowing the clean surfaces togather dust, rust and other external substances.
- 3.8.0 During the course of painting if it is found that the surfaces are contaminated due to any reason, the same shall be cleaned by any of the methods described earlier, before further proceeding with painting.
- 3.9.0 All surfaces to be painted after sand, grit or shot blasting shall exhibit almost clean white metal and shall have surface finish of SA 2 ¹/₂ as per IS 9954.
- 3.9.1 Blast cleaned surfaces shall be primed within 2 hrs, after blasting, before rerusting starts and before contamination.
- 3.9.2. Blast cleaning shall not be carried out when temperatures are less than 20°C

or when the relative humidity of air exceeds 90%.

- 3.9.3. Blasting operations shall not be carried out during rain, snow, or strong winds.
- 3.9.4. Blasting medium viz. Slag, grit, or shot shall be completely dry and shall be free from any sort of contaminants like dust, oil, grease etc.
- 3.9.5. Blasting air shall be completely dry and shall have minimum pressure of 3.5 kg/cm^2 .
- 3.10.0 Surfaces which are not suitable for blast-cleaning or could not be blastcleaned due to practical reasons shall be thoroughly wire brushed to exhibit a pronounced metallic sheen, equivalent to St 3 as per IS 9954.
- 3.10.1 Absence of compressed air, slag/shot/grit and/or blasting equipment and accessories shall not be a reason for not carrying out blast cleaning.

4.0.0. STORAGE OF PAINTING MATERAILS

- 4.1.0. Paints, varnishes, thinner, additives and other volatile substances shall be stored in a flame proof enclosure, away from heat.
- 4.2.0. Fire extinguishers or sand and water for emergency fire fighting operations shall be provided near storage area at easily accessible place for use, in case of fire.
- 4.3.0. Warning Boards and signs shall be exhibited around the storage area.

5.0.0. MIXING AND THINNING

5.1.0 Mixing and thinning of paints shall be carried out as per manufacturer's recommendations.

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- 5.2.0 Mixing and thinning operations shall be carried out in well ventilated rooms.
- 5.3.0 Only that quantity of paint which is sufficient to cover the required area within the specified painting time, shall be mixed at a time.
- 5.4.0 Mixed paints shall be used with in the time span as recommended by manufacturer. Mixed paints, for which standing time specified has elapsed, shall not be used.
- 5.5.0 Ready-mixed paints containers shall be opened only at the time of painting. Containers shall be closed air tight after drawing paint from it.
- 5.6.0 Ready-mixed paints shall be stirred well before drawing from the storage container as well as during painting operations.
- 5.7.0 Ready-mixed paints shall be thinned only if absolutely necessary by using thinners commended by manufacturer.
- 5.8.0 Balance of ready-mixed paints shall not be poured back into the main container after use, but shall be kept in a separate air tight container.

6.0.0 PAINTING

- 6.1.0 General Requirements.
- 6.1.1 Painting of equipment, piping and structurals shall be carried out at shop or site as prescribed in the respective eqpt. data sheets, piping line schedule or structural detail drawing.
- 6.1.2 Painting shall not be carried out on surfaces not prepared and not meeting the requirements of clause 3.0.0.
- 6.1.3 Painting shall be carried out only under favourable conditions. Painting shall

not be carried out in dusty and draught conditions in damp areas and during rainy seasons or cold atmosphere.

- 6.1.4 During painting, adjacent equipments or surfaces shall be protected from paint sprays, splashes or drips.
- 6.1.5 Painting shall be carried out only by using brushes, rollers, air/airless spray.
- 6.1.6 Caution boards indicating 'wet paint' shall be posted after painting is over and kept till the curing time is completed.
- 6.1.7 For painting of multiple coating, each coat shall be applied only after sufficient curing time has elapsed after the previous coat, as recommended by manufacturer.
- 6.1.8 All painted surfaces shall have a uniform and smooth regular finish. The surfaces shall be free from foreign particles, brush marks, bristles, ridges, waves, laps wrinkles etc. If such surface defects occur, the same shall be removed by using abrasive paper/cloth and re-painted.
- 6.1.9 Surfaces inaccessible after assembly shall be painted to requirement before assembly.
- 6.1.10 Any imperfect or damaged layer/coat shall be repaired before subsequent coating.
- 6.1.11 At places where welding is to be carried out at field after assembly, a space of 100 to 200 mm width shall be left unpainted on both sides of the welding joint.
- 6.1.12 Field welded areas shall be thoroughly cleaned as required in clause 3.0.0 and painted in the same manner as the remaining area.

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6.2.0 Shop Painting/Priming.

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- 6.2.1 Shop painting/priming shall be carried out as specified in the respective data sheets/line schedule etc. and shall meet all the requirements of this specification.
- 6.3.0 Painting at Field /Site.
- 6.3.1 Field/site painting shall be carried out as specified in the data sheets/painting schedule and shall meet all the requirements of this specification for painting.
- 6.3.2 Where equipments/piping/structures have already received shop painting/priming, the painted/primed surfaces shall be thoroughly cleaned and inspected for any damage or defects. Such damages or defects shall be repaired before starting the filed/site painting.

7.0.0. SAFETY

- 7.1.0. Sufficient safety precautions shall be taken to ensure protection of Personnel, equipments, piping structures and buildings in the vicinity, where painting materials are stored and painting and blasting operations are carried out.
- 7.2.0. Open flames and exposed elements or sources of ignition of any kind shall be prohibited in the area where painting materials are stored and painting operations are carried out.
- 7.3.0. 'Warning' or 'Caution' boards indicating chances of fire shall be displaced around the paint storage and painting areas.
- 7.4.0 Electrical fittings and appliances shall be spark proof and shall not cause a fire in the painting storage and painting areas.
- 7.5.0 Cleaning agents with flash point less than 40° C shall be used.

- 7.6.0 Adequate ventilation shall be ensured during painting and storage of paints.
- 7.7.0 Painting workmen shall wear face masks, gloves and protective clothing during painting and mixing operations. In addition, workmen engaged in blasting operations shall be earmuffs also.
- 7.8.0 Area where painting is carried out, as well as materials are stored shall be clean, After work, the areas shall be cleared of all scaffoldings, balance materials etc. in order to prevent fire hazards and hinder fire fighting operations.
- 7.9.0 Painting materials shall be stored and painting and blasting operations shall be carried out only in areas where fire fighting equipments/vehicles and personnel evacuation vehicles can have easy access. In areas where such easy access is not available suitable precautions are to be ensured.

8.0.0 INSPECTION

- 8.1.0. All painting materials and related items shall be inspected to check the suitability of the same for the specified purposes.
- 8.2.0. Painting surfaces are to be inspected after cleaning operation, to ensure that the surfaces are fit for painting.
- 8.3.0. Finished surfaces shall be checked for uniformity in colour, finish and appearance as well as for defects.
- 8.4.0. Thickness of each coat of paint shall be checked after curing time. The total thickness of multiple coats shall be as specified in the data sheets/piping line schedules/painting schedules.
- 8.5.0. Paint thickness gauge shall be either mechanical or electronic. The gauges



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shall be calibrated regularly. Defective gauges shall not be used.

- 8.6.0. Absence of paint thickness gauge shall not be made for each eqpt/line/structure separately.
- 8.7.0. A detailed quality / inspection report shall be made for each eqpt / line / structure separately

9.0.0. GUARANTEE

Guarantee shall cover materials and workmanship.

10.0.0. CODIFICATION OF PAINTING MATERIALS

- 10.1.0. Primers
 - A.01 Synthetic Zinc Phosphate Primer
 - A.02 Epoxy based Zinc Phosphate Primer
 - A.03 Epoxy based Zinc Rich Primer
 - A.04 Alkyd High Build Zinc Phosphate Primer
 - A.05 Inorganic Zinc Silicate Primer
 - A.06 Chlorinated Rubber based High Build Zinc Phosphate Primer

10.2.0. Finish Paints

- B.01 Epoxy Resin based Enamel
- B.02 Epoxy Resin based Micaceous Iron Oxide Paint
- B.03 Epoxy Resin based High Build Paint
- B.04 Coal Tar Epoxy Resin based Paint
- B.05 Chlorinated Rubber Paint

10.3.0. Bituminous Coating

- C.01 Nontoxic Inert Coating for drinking water tanks
- C.02 Acid Alkali and Heat Resisting Coating
- 10.4.0. Heat Resistant Paints
 - D.01 Dual Pack Aluminium Paint (upto 250°C)

- D.02 Single Pack High Temperature Silicon Aluminium Paint (upto 600°C)
- 10.5.0. Polyurethane Coating. (For low temp. application)
 - E.01 Two-Pack Polyurethane Holding Primer
 - E.02 High Build Polyurethane Coating
- 10.6.0. General Purpose Paints
 - F.01 Synthetic Resin based Enamel
 - F.02 Chemical Resistant Enamel
 - F.03 Alkyd, Antiskid Abrasion Resistant Synthetic Floor Paint

10.7.0. Special Applications

- G.01 Bituminous Mastic Coating
- G.02 Asphalt doping as per IS 10987 App-B
- G.03 Thermocolour Paint
- 10.8.0 As an alternative, in place of one coat of E.01 Two pack Polyurethane Holding Primer, one coat of Epoxy Zinc Phosphate Primer A02 (20 microns) followed by one coat of High Build Epoxy containing Micaceous Iron oxide-Bo2 (20 microns) shall be applied before applying finish paint E-02-High build Polyurethane coating.

11.0.0 SCHEME OF PAINTING

- 11.1.0. Scheme of painting of equipment, piping, structures and other items shall conform to class 1, class II or class III as specified in the equipment data sheet/ piping line schedule/ painting schedule/ structural drawings.
- 11.2.0 Representation of painting

Requirement of painting of an item shall be indicated in respective drawings/ data sheets/ line schedule/ painting schedule as follows. Indicate primer or finish or both as required followed by subclass indicated in Table 1, Table 2 or table 3 as the case may be.

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Eg

Primer	Class I	(1)L
Finish	Class I	(1)L
Primer & Finish	Class I	(2)M
Primer	Class II	(2)0
Primer & finish	Class II	(3)O/P
Primer	Class III	(1)
Finish	Class III	(1)
Primer & Finish	Class III	(3)

12.0.0 COLOUR CODING AND MARKING FOR PIPING

- 12.1.0 In addition to the requirements of painting as per 11.0 the finish painting of the piping shall have the specified colors as per Table 4 Color coding for pipes, for purposes of identification of service.
- 12.2.0 All pipes and pipe lines covered under
 1.7 shall be provided with "Markings" such as color bands, hazard markings, line identification markings, flow arrow markings etc. at specified locations/intervals and dimensions as indicated in Table 5 Marking of pipes.

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FABL	ABLE 1 – CLASS I – Pressure Vessels, Heat Exchangers, Reactors, Towers, Tanks and Piping								
Sl.	SERVICE	OPERAT	PAINT		PRIME	R		FINISH	
No.	CONDITIONS	ING TEMP.	SUB- CLASS	Туре	No.of coats	*DFT	Туре	No.of coats	*DFT
1	UN	=/< 15	(1) L	E.01	1	30	E.02	2	30
	INSULATED	=/< 65	(1) N	A.01	2	20	F.01	2	20
	NON	=/< 125	(1) M	D.01	2	20	D.01	2	20
	CORROSSIVE ATMOSPHERE	=/< 400	(1) H	D.02	2	20	D.02	2	20
2	UN	=/< 15	(2) L	E.1	1	30	E.02	2	20
	INSULATED	=/< 65	(2) N	A.06	2	20	B.05	2	20
	CORROSSIVE	=/< 125	(2) M	A.02	2	20	B.02	2	20
	ATMOSPHERE	=/< 400	(2) H	D.02	2	20	D.02	2	20
3	INSULATED	=/< 15	(3) L	E.01	1	30	-	-	-
	NON	=/< 65	(3) N	A.04	2	25	-	-	-
	CORROSSIVE	=/< 125	(3) M	D.01	2	20	-	-	-
	ATMOSPHERE	=/< 400	(3) H	D.02	2	20	-	-	-
4	INSULATED	=/< 15	(4) L	E.01	1	30	-	-	-
	CORROSSIVE	=/< 65	(4) N	A.06	1	30	-	-	-
	ATMOSPHERE	=/< 125	(4) M	D.01	1	30	-	-	-
		=/< 400	(4) H	D.02	1	30	-	-	-
5	SUPPORTS	=/< 15	(5) L	E.01	1	30	E.02	2	30
	FOR ALL	=/< 65	(5) N	A.01	2	20	F.01	2	20
	EQPTS.(INSUL	=/< 125	(5) M	D.01	2	20	D.01	2	20
	ATED/UN INSULATED)	=/< 400	(5) H	D.02	2	20	D.02	2	20
6	EQPT. AND	=/< 15	(6) L	E.01	1	30	E.02	2	30
	STRUCTRURE	=/< 65	(6) N	A.06	2	20	B.05	2	30
	S SUBJECTED	=/< 125	(6) M	A.02	2	20	B.01	2	30
	TO SALINE ATMOSPHERE UN	=/< 400	(6) H	D.02	2	20	D.02	2	20
	INSULATED								

* DFT – Dry film Thickness per coat microns

Notation:

- L Low Temperature N Normal Temperature
- M Moderate Temperature
- H High Temperature

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TABLE 2 – CLASS II – OTHER EQUIPMENTS

					PRIME	R		FINISH	
Sl. No.	TYPE OF ITEM		PAINT SUB CLASS	Туре	No.of coats	*DFT	Туре	No.of coats	*DFT
1	Chimneys,Stacks, Furnaces,heaters (fired and unfired)operating Temp upto450°C	Outside	(1)	A.05	2	25	D.02	2	20
2	D.M.Water	Outside	(2)O	A.01	2	20	F.01	2	25
2	Storage Tanks	Inside	(2)P	A.03	2	35	B.03	2	35
3	Fresh Water/fire Water Storage	Outside	(3)0	A.01	2	20	F.01	2	25
	Tanks	Inside	(3)P	A.03	2	35	B.04	2	75
Δ	Drinking Water	Outside	(4)O	A.01	2	20	F.01	2	25
	Storage Tanks	Outside	(4)P	A.01	2	20	C.01	3	20
5	Acid/alkali Storage Tanks	Outside	(5)	A.04	2	30	C.02	3	25
6	Storage Tanks/Vessels for	Outside	(6)O	A.04	2	50	D.01	2	25
0	Petroleum Products	Inside	(6)P	A.02	2	30	B.03	2	75
7	Floating Roof Tanks:Inside of shell, top of bottom	Outside	(7)0	A.04	2	50	D.01	2	25
	plate.topside and								
	underside of deck,		(7)P	A.02	2	30	B.03	2	75
	inside of pontoon		(7)Q	A.01	2	25			
8	Underside of Bottom Plate of Tanks		(8)	A.01	1	20	G.01	1	80
9	Underground Tanks (buried)	Outside	(9)	A.01	1	20	G.02		
10	Below Ground (submersible) Tanks	Outside	(10)	A.06	2	35	B.05	3	35
11	Secondary Reformer& Similar Eqpt.(Thermo colour paint)		(11)	G.03	2	**	G.03	1	**

Dry Film Thickness per coat microns *DFT : **

: Notation: As per Manufacturer's recommendations

O- Outside P-Product Side

Q-Specified Side

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TABLE 3 – CLASS III – MISCELLANEOUS

		DAINTING	PRIMER			FINISH		
Sl. No.	TYPE OF ITEM	SUB CLASS	Туре	No. of coats	*DFT	Туре	No.of coats	*DFT
1	Steel structures, Platform Supports	(1)	A.04	2	20	B.01	2	25
2	Chequered Plate,Floorplanks&Gang ways	(2)	A.04	2	20	F.03	2	25
3	Handrails Posts,Railings,Ladders and Stairways	(3)	A.04	2	20	B.01	2	25

* DFT – Dry Film Thickness per coat microns



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TABLE 4 – COLOUR CODING FOR PIPES

Sl.	Service	Identification	Colour Band - 1	Colour Band - 2
No.		Ground / Finish Colour		
1	Instrument Air0	Sky Blue	White	-
2	Service Air	Sky Blue	Light Brown	-
3	Plant Air	Sky Blue	French Blue	-
4	Cooling Water	Sea Green	French Blue	-
5	Service Water	Sea Green	French Blue	Signal Red
6	Demineralised Water	Sea Green	Light Orange	French Blue
7	Boiler Feed Water	Sea Green	-	-
8	Steam Condensate	Sea Green	Light Brown	-
9	Boiler Blow Down	Sea Green	White	Signal red
10	Turbine condensate	Sea Green	White	-
11	Process Condensate	Sea Green	Black	-
12	Low Pressure Steam	Silver Grey	Light Orange	-
13	Medium Pressure Steam	Silver Grey	Light Brown	-
14	High Pressure Steam	Silver Grey	Signal Red	-
15	Very High Pressure	Silver Grey	Signal Red	French Blue
	Steam			
16	Naphta Liquid	Light Brown	French Blue	-
17	Naphta Vapour	Light Brown	French Blue	White
18	Fuel Oil	Light Brown	White	-
19	Antifoam Solution	Black	Sea Green	-
20	Phosphate	Black	Signal Red	-
21	Hydrazinc	Black	Signal Red	Sea Green
22	Waste Water	Black	Sea Green	Signal Red
23	Oily Water	Black	White	-
24	Ammonia Liquid	Dark Violet	French Blue	-
25	Ammonia Water	Dark Violet	French Blue	Sea Green
26	Ammonia gas	Dark Violet	French Blue	Canary Yellow
27	MDEA Solution	Dark Violet	Black	White
28	Process Vent	Canary Yellow	Light Grey	Signal Red
29	Carbondioxide	Canary Yellow	Light Grey	-
30	Hydrogen	Canary Yellow	Signal Red	-
31	Nitrogen	Canary Yellow	Black	-
32	LPG	Canary Yellow	French Blue	-
33	Fuel gas	Canary Yellow	Light Brown	-
34	Process Gas	Canary Yellow	Sea green	-
35	Synthesis Gas	Canary Yellow	White	-
36	Effluent	Black	Sea Green	Signal Red
37	Drinking Water	Sea Green	Light Orange	-



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TABI 1 0	LE 5 – MARKING FOR GROUND COLOUR	PIPES		UNIT OF	MFASUR	FMFNT
1.0.	Insulated Line – all (excludes buried line)				MEASOR	
1.1.	Un-insulated Lines–Stat Steel,GI ,Alloy steels & Other non-ferrous pipel (excludes buried line)	inless : Ground co of ines	olour for a length 2 meters	Per Marki below incl	ng as per pa luding pipe s	ara 6.0 supports
1.2.	Un-insulated carbon ste Lines (excluded buried Lines)	el : Ground co throughout	Run lengtl centreline as per Para pipe suppo	h in Meters a including M a 6.0 below orts	along Iarkings &	
2.0.	COLOUR BANDS MA	ARKINGS				
2.1	Colour band(s)and its w along the direction of flo	vidth,Band 2 down ow)	stream of Band 1	(ie.after band	d 1	
	Pipe size NB		Band 1	B and 2		
	(D-pipe size in inches)	mm	mm		
	80 NB and below		75	¹ ⁄ ₄ of Ban	id 1	
	Above 80 NB(3") up	to 100 NB(4"")	D x 25	(Rounded	d to the	
	Above 100 NB(4") up	to 300 NB(12")	D X 20	nearest m	nm)	
	Above 300 NB(12")		D x 15			
3.0	HAZARD	Diagonal strips	of Black and	golden Yel	llow as pe	er IS2379
	MARKINGS	superimposed or marking shall be the direction of f	n the ground color painted downstre	r. If color ba am of the ba	nds exists, t nds (ie. afte	the hazard or bands in
40	LINE	Color shall be F	Rlack or White to	contrast wit	th the color	on which
	IDENTIFICATION	they are painted	It shall consist	of Line No	Line size F	Fluid code
	MARKINGS	& Pipeline Spe IS2379.	c. No. The lette	ring dimens	ions shall	be as per
5.0	FLOW ARROW	Color shall be F	Black or White to	contrast wit	th the color	on which
210	MARKINGS	IARKINGS they are painted. The dimension of the arrow shall be as follows and is based on the size of the pipeline.			ollows and	
			1	50NB &	200NB &	Z
	↓ ∧			below	above	
	d [> ⊺a □	a	65	90	
		∕_↓ □	b	30	50	
		h	C	95	125	

d

20

30

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6.0 LOCATION OF MARKINGS

Marking includes 2M long ground color, color band(s), hazardous marking, Line No. & flow direction arrow which shall be located at the following points with proper visibility as per IS2379.

- a. Battery Limit Points
- b. Either side of walls & dyke walls
- c. For long yard piping at 30M interval
- d. Inter-section on pipe bridge
- e. Any other location indicated by the Engineer-in-charge at site

7.0 **PIPE SUPPORTS**

- 7.1 This includes base springs, hanger springs, shoes and trunnions etc. and excludes pipe bridge structures, platform, equipment support structures and such structures which do not actually support the pipeline.
- 7.2 The painting of pipe supports forms part of the pipelines and a separate rate will not operate.
- 7.3 The painting specification for pipe supports shall be same as that for pipe ground colour.



PIPING TURNKEY PACKAGE

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- 1.0.0 SCOPE
- 2.0.0 DESIGN CONSIDERATIONS
- **3.0.0** BATTERY LIMITS FOR PIPING
- 4.0.0 DETAILS OF DRAWINGS/ DOCUMENTS
- 5.0.0 GENERAL

1.0.0 SCOPE

1.1.0 GENERAL

- 1.1.1 The scope of work includes but is not limited to basic design, detailed engineering, supply, fabrication, erection, testing, painting, insulation, commissioning and guarantee run of the Piping / Ducting on turnkey basis.
- 1.1.2 The supply of hardware and engineering shall be completed as there will be no other supplier other than the vendor within the battery limit indicated.
- 1.2.0 IDENTIFICATION
- 1.2.1 The scope of work includes but not limited to:
 - a. Basic engineering for the piping / ducting for the Package.
 - b. Detailed engineering for piping/ducting within the Package. This includes preparation of plot plan, piping layouts, isometrics, support drawings, bill of materials, procurement, special instructions for storage, special instructions for identification of pipe lines and components, special instructions for erection, special instructions for testing, special instructions for pickling of oil lines if any, blowout procedure etc.. Submission of these drawings to FEDO, incorporating comments made by FEDO and obtaining necessary IBR / Statutory approvals.
 - c. Stress Analysis of all pipe lines and ducts above 100 deg.C, all IBR lines and all lines connected with rotating equipments.

These stress analysis reports shall be submitted to FEDO for review and comments. Compensators and spring supports shall be finalized and provided based on the stress analysis reports.

All pipe lines shall be anchored at the Battery Limit.

Nozzle loads on rotating equipments, viz, turbines, etc., shall comply to API/ NEMA codes and the reports shall be submitted to FEDO for review.

d. Supply of all materials based on the piping bill of materials and any additional material required for the satisfactory completion of the system. Supply includes all materials for piping such as pipes & ducts, pipe & duct fittings, flanges, gaskets, bolts and nuts, pipe supports, valves, expansion bellows, spring supports, shut-off plates, safety valves, etc. as per approved piping layouts and P&IDs. Supply inclusive of testing, packing and forwarding.

- e. Insulation of all insulated lines and Painting of all uninsulated CS / AS pipes and ducts shall be as per specification attached. Color coding shall be as per FEDO color coding.
- f. All piping items covered by Indian Boiler Regulations (IBR) shall be supplied along with IBR certificate
- g. Any other work related to the completion of the Package.
- All items included in the vendor's scope may be subjected to inspection by FEDO / Client. The items are to be cleared by the designated inspector before dispatch.
- i All piping larger than 50 NB shall be prefabricated. Pipes smaller than 50 NB shall be delivered in commercial lengths, properly marked with type and material. 10% excess pipe shall be supplied for all sizes and materials.
- j. All vents shall be at a safe location and shall include necessary supports.

2.0.0 DESIGN CONSIDERATIONS

- 2.1.0 Design of all piping systems, except those listed below, shall be as per ANSI / ASME B 31.3.
 - a. All boiler feed water and steam lines shall be as per the latest issue of IBR and ANSI / ASME B31.1.
- **2.2.0** All dimensions and elevations shall be given in metric units.
- **2.3.0** Flange and valve ratings shall be as per class designation in ANSI B16.5 and ANSI B16.34 respectively.
- 2.4.0 32, 65 & 125 NB pipe sizes shall not be used.
- **2.5.0** Traps & strainers shall be provided wherever necessary. Normally a shut off valve shall be provided ahead of each strainer /trap. Union or flanges shall be provided for removal of traps.
- **2.6.0** The clear headroom over platforms, walkways, passage ways and working areas shall be at least 2.2 m.
- **2.7.0** All pipes shall have a slope of minimum 1 in 1000 and shall be provided with drain line at the lower most point.
- **2.8.0** All equipment location, layout, design and general arrangements shall conform to the relevant statutory requirements.
- **2.9.0** Valves shall be located where there is ease of operation and maintenance. Gear arrangement shall be provided for all valves as per clause 5.5.

3.0.0 BATTERY LIMITS FOR PIPING

3.1.0 All incoming and outgoing lines shall be terminated at the Battery Limits specified in the battery limit list attached.

4.0.0 DETAILS OF DRAWINGS/ DOCUMENTS

This is only a general guide line for preparing various drawings / documents, highlighting the

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minimum details to be furnished. The vendor is obliged to include any other details found to be wanting in the drawing/document, after review of the same by FEDO.

- 4.1.0 GENERAL LAYOUT DRAWING
- 4.1.1 The Layout should be of A1 size and should give the following details using the coordinate system to locate each item.
 - a. Size Location and Point Of Support (POS) elevation of all equipments, location and size of buildings.
 - b. Battery Limits.
 - c. Pipe Bridge Locations.
 - d. Sewer and Drain Details.
 - e. Free area required around equipment / exchangers for maintenance / tube removal.
 - f. Paved area and elevations.
 - g. Plant North.
 - h. The Layout shall also contain a table showing the complete list of equipments with location and point of support details.
- 4.2.0 PIPING LAYOUT
- 4.2.1. The Piping Layout shall be drawn on a scale of 3:100. The layout shall give the following details using the coordinate system to locate each equipment and line.
- 4.2.2. Routing of all pipelines and ducts showing all fittings, valves, strainers, springs, bellows, line Nos., direction of flow, location and elevations, pipe supports etc.
- 4.2.3. Nozzle schedule of all equipments giving the following details of all nozzles on each equipment.
 - a. Size and Rating
 - b. End Connection
 - c. Orientation
 - d. Elevation
 - e. Standout
 - f. Description
- 4.2.4 Separate details for lines / areas which cannot be clearly drawn on the layout.
- 4.2.5 All platforms on vessels and structural platforms.
- 4.2.6 All instruments, control valves, MOV, PSV, traps, etc.
- 4.2.7 Any other detail required by FEDO during review.
- 4.3.0 ISOMETRICS:
- 4.3.1 Isometrics shall be drawn for all lines irrespective of size, including isolation valves on equipments. The isometric shall include a Bill of Materials showing the complete list of materials and quantity required for fabrication and erection of the line.

4.3.2 The isometric drawings shall indicate the relevant line numbers, flow direction, pipe specification, insulation / painting details, stress analysis requirements, pipe supports like trunnions, line fluid conditions such as pressure, temperature, hydrotesting pressure, etc.

4.3.3 Steam tracing isometrics:

This shall be produced from the relevant isometrics with details of steam tracing incorporated. However the bill of materials will be that for the steam tracing line.

- 4.4.0 PIPE SUPPORT PLAN
- 4.4.1 This drawing should indicate the location and type of all supports used and should also give the pipe support detail sheet number to be referred for getting details of the support.
- 4.5.0 PIPE SUPPORT DETAIL SHEETS
- 4.5.1 This detail sheet should give all the data required for the fabrication and erection of a particular pipe support.
- 4.6.0 LINE SCHEDULE
- 4.6.1 This document should give all line numbers, the detail of connecting equipment lines, operating conditions, service and insulation details.
- 4.7.0 VALVE SCHEDULE
- 4.7.1 This document should furnish tag numbers, type, pressure rating, size, material of construction and service of all valves.

5.0.0 GENERAL

- **5.1.0** All piping items shall be procured from the attached sub vendor list of approved vendors for indigenous vendors. For any deviation, prior approval from FEDO shall be obtained before placement of order.
- **5.2.0** Operating spares for valves, steam traps, strainers etc. for two years of trouble free service be included in the offer.
- **5.3.0** A layout shall be included in the package for reference.
- **5.4.0** Bypass, drain and vent connections for valves shall be as specified in MSS-SP 45.
- **5.5.0** Geared Operators for valves shall be provided as per the following table.

ANSI Rating	Valve Size
150 #	300 NB and over
300 #	200 NB and over
400 # & 600 #	150 NB and over
900 #	100 NB and over
1500 # & 2500 #	80 NB and Over

ENGINEERING SPECIFICATION			FABRICATION & ERECTION OF STEEL PIPING		25ES205 / 94 - R1		
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1.0.0	CONTENTS GENERAL FABRICATION WELDING HEAT TREATMENT THREADED AND FLANGED JOINTS PROTECTION & SIZE OF PREFABRICATED PIPE SPOOLS INSTALLATION OF PIPE SUPPORTS PIPING INSTALLATION TESTING AND INSPECTION PRESSURE TEST AND OTHERS				tion (color identification and die stamp) sh checked and recorded in the material le The materials shall be stored promptly and ly in the designated warehouse or storage		
2.0.0 3.0.0 4.0.0				2.1.2	 When the identification is inadequate, the material shall be marked according to the colour identification or an identification mark such as die stamp shall be applied before storing the material. Piping materials shall be issued only upor presentation of Material Issue Slips signed by the FEDO Engineer / Representaive. Piping materials shall be issued only against the relevant isometrics. Issued materials shall be indicated on the drawings or material use charts, etc., to prevention 		
5.0.0 6.0.0 7.0.0				2.1.3			
8.0.0 9.0.0 10.0.0				2.1.4			
11.0.0					duplication of issue Any surplus mater shall be returned p storage vard.	duplication of issues. Any surplus materials found on the job - site shall be returned promptly to the warehouse or storage vard.	
1.1.0 1.1.1	SCOPE This specifi ments for f piping (inclu	SCOPE This specification covers the general require- nents for fabrication and installation of steel piping (including carbon steels, low-alloy steels.			When more material is needed as a result of faulty fabrication or other similar reasons, the FEDO engineer shall promptly be in formed of the matter so that he can give further directions and advice.		
	and stainles and chemic	and stainless steels) within petroleum refineries and chemical plants.		2.1.7	Special precautions shall be taken to keep electrodes and gaskets dry during storage.		
1.1.2	When confli and the p specification	When conflict occurs between this specification and the piping drawings or the individual specification, the order of precedence shall be		2.2.0	PRECAUTIONS FABRICATION	FOR PREPARATION &	
1.2.0 1.2.1	piping drawings, individual specification, and this specification. REFERENCES The requirements contained in the latest edi- tions of the following standards shall form a part of this specification, in the manner and to the extent indicated herein: 1. Indian Boiler Regulation (IBR) 2. ANSLB2 1. Pipe Threads			2.2.1	 2.2.1 When the location of piping connections by field welding is not shown on the piping drawings consideration shall be given to preparation and fabrication of piping materials so that the field welding position is flat or horizontal as far as possible. 2.2.2 The minimum clearance between the edges of two adjacent welds shall exceed 25mm or 4 times the pipe nominal wall thickness whichever is greater. 2.2.3 When both welded pipes and piping components having a longitudi nal welded joint are joined at the end, in the girth butt welds the dimension between the longitudinal welded joints shall exceed 5 times the nominal pipe wal thickness of the thicker of those being joined. In unavoidable circumstances when the dimension is less than 5 times, both longitudina welded joints in the girth butt welds shall be examined by radiography over 100mm. In ad dition, Section 8.1 (14) shall be considered in the preparation and fabrication. 2.3.0 CUTTING 2.3.1 Pipes shall be marked accurately and then curaccording to the dimensions shown in the piping drawing or the dimensions shown in the piping drawing or the dimensions and for curved and multiple branch connections and for curved and multiple branch connections and for curved and multiple branch connections and for curved and multiple prace of pipe, the cutting shall be performed by using a template. 2.3.3 In principle, pipes shall be cut mechanically with a pipe cutter or a high speed cutter. When cutting ss pipe using a high speed cutter, and the preparation and high speed cutter. 		
	 ANSI / Petrole ASME, Section Radiog Section tions. 	I / ASME B31.3, Chemical Plant and bleum Refinery Piping E, Boiler and Pressure Vessel Code: ion V- Non-destructive Examination, tion VIII - Division 1, UW-51- ographic Examination of Welded Joint, ion IX- Welding and Brazing Qualifica- i.					
1.3.0 1.3.1	DEVIATIONS When piping cannot be fabricated and installed as shown on the piping drawings, or when it is deemed to be more appropriate to fabricate and to install the piping in a manner other than as shown on the drawings, the FEDO Engineer / Representative shall be consulted and the piping shall be fabricated and installed in ac-		2.3.0 2.3.1				
2.0.0	FABRICAT	Packages of piping materials delivered to the guantities, specifications, sizes, and identifica-					
2.1.1	Packages of jobsite shall quantities, s						
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abrasive wheel for stainless steel shall be used.

2.3.4 When pipe is of a large diameter, or when a pipe cutter or a high speed cutter cannot be used the following methods may be used.

a) Carbon Steel

Carbon steel pipe may be cut with automatic or manual oxygen- acetylene gas apparatus. However, base metal with a carbon content of more than 0.35% shall not be cut with oxygen-acetylene gas apparatus.

b) Low-alloy steel pipe

Only when unavoidable, low-alloy steel pipe may be cut with oxygen-acetylene gas apparatus pursuant to Subitem (a) above.

c) Stainless steel pipe

Only when unavoidable, stainless steel pipe may be cut by plasma arc cutting or arc air gouging. In this case, the pipe shall be coated with spatter deposit prevention paint to avoid adhesion of spatter.

2.4.0 END PREPARATION

- 2.4.1 Shape of Grooves
 - In principle, grooves for butt welding ends shall be shaped in accordance with ANSI B16.25 However, the grooves shall be in accordence with the approved Procedure Qalification Records(PQR).
 - Unless otherwise specified, the grooves shall be in accordance with the requirements shown in Table below which conform to ANSI B16.25.

PIPE WALL THICKNESS (t)	GROOVE	
3 mm or less (stainless steel) and 4mm or less (carbon steel and low alloy steel)	Square groove or slightly bevelled	
Over 4mm (but over 3mm for stainless steel) to 22mm	Single v groove asper figure 1a	
Over 22 mm	Double v groove as per figure 1b	

- 2.4.2 Shape of Internal Trimming and Misalignment
 - Radial misalignment at the joining ends of piping components shall be such that full penetration can be attained.
 - Where component ends have an internal misalignment over 1.6mm, the thicker component with the wall extending internally shall be trimmed internally to an angle less than 30°C as shown in Figure2. However, such trimming shall not result in a finished wall thickness less than the required minimum design thickness plus corrosion and erosion allowances.
- 2.4.3 End Preparation method

In principle, the end preparation shall be performed by machine. However, when the preparation is other than by machine, any cracks, flaws, burrs or oxidation scale (rust) shall be removed from the surface with a grinder.

2.4.4 Treatment after End Preparation

When carbon or low-alloy steel pipes and piping components with the ends prepared are to be stored for an extended period, a groove face rust preventive that will not damage the welding shall be applied to the ends (Appendix I). The rust preventive shall be removed prior to welding, as far as possible.

2.5.0 BENDING

- 2.5.1 In principle, ready-made elbows shall be used for bends of piping. However, when bends of a large radius are required due to fluid characteristics or plant performance, the pipe may be bent to shape. The procedure for bending shall be as follows:
 - . In principle, pipe shall be cold bent with a pipe bender. However, when the pipe bender cannot be used because of the large pipe diameter, the pipe may be bent by heating or by high frequency induction.Low-alloy and stainless steel pipes shall not be bent by heating.
 - 2. Pipe bends shall be made of one piece of pipe with no welds at the bend.
 - 3 The pipe shall be smooth on both the exterior and interior, and shall be bent so as not to form any cuts, cracks, wrinkles, dents, etc.
 - 4 Flattening of a bend shall not exceed the requirements shown in Section 2.8 figure 6.
 - 5 The minimum bending radius shall be greater than 1.5 times the nominal diameter of pipe, unless otherwise specified on the piping drawings or the individual specification.
 - 6 Low-alloy and stainless steel pipe shall be heat treated in accordance with the individual specification to relieve residual stress and work hardening of the bend. However, the heat treatment may not be applied to austenitic stainless pipe or to nickel-alloy steel pipe.
 - 7. For carbon steelpipe of 25 NB and smaller, steam tracing, or discharge-end piping of vents, drains, etc., the pipe may be bent to the required angle by heating with an oxygen-acetylene gas torch. However, precautions shall be taken to prevent damage to the pipe by overheating and to ensure that the roundness of the steel pipe is maintained.

2.6.0 MITRE BENDS

- 2.6.1 Unless otherwise specified, mitre bends shall be used for piping 350NB and larger. For piping of 300 NB and smaller, ready-made smooth elbows shall be used.
- 2.6.2 Mitre bends shall be fabricated as follows unless otherwise stated in the piping drawings or the individual drawings.
 - Mitre bends to be used at bends greater than 45^oC shall consist of not less than three segments. The minimum distance (I) between alternate segments of the mitre bend shall be 4 times the pipe nominal wall thickness or 25mm, whichever is greater (Figure3)




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- 2 The radius of the mitre bend shall be greater than the nominal diameter of the pipe.
- 3 The maximum mitre angle (ß of Figure 4) of each segment shall be as follows:

When design pressure is $\beta \leq 22^0 30'$ 8kgf / cm²G or less

When design pressure is 28 $~~:\beta \leq ~15^000^{\prime}$ kgf / cm 2 G or less

When design pressure ex- : $\beta \leq 11^0 15'$ ceeds 28 kgf / cm $^2 G$

- 4 The segments shall be neatly cut so that they will closely fit with each other when assembled. Cutting and end preparation of pipe shall be in accordance with the requirements (Sections 2.3 and 2.4)
- 5 When designing the shape of a groove, the mitre angle shall be considered and the shape of the groove shall be suitable for the welding process used.
- 6 When assembling the mitre bend, the segments shall be laid out and tack welded on a surface plate or other flat surface to keep the centers of the segments aligned.
- 7 After welding is completed, the interior of the pipe shall be inspected and any internal weld protrusions shall be removed.
- 8 Welding and heat treatment shall be performed in accordance with the requirements specified in Sections 3.0.0 and 4.0.0 of this specification.

2.7.0. BRANCH CONNECTIONS

- 2.7.1 Branch connections shall be fabricated by assembling the fittings that have dimensions and configurations shown in the piping drawings.Unless otherwise specified, branch connections shall be made in accordance with Figure 5 and as follows:
- 2.7.2 Branch connections, which are made by providing a hole in the main run pipe and inserting a branch pipe or a coupling, shall be as follows:
 - a The hole provided in the main run pipe shall conform to the requirements of Section 6.
 - b When the main run pipe is welded pipe, the welds of branch connections shall be made so as to avoid the welds of the main run pipe.
- 2.7.3 Branch connections shall be made by means of fully penetrated groove welds. The groove welds shall be made in accordance with the same welding procedure as for girth butt welds.
- 2.7.4 In no case shall scraps of metal resulting from making the hole be left inside the pipe.
- 2.7.5 When making branch connections, a jig or a metal fitting shall be attached to the main run pipe to prevent distortion of the main run pipe or bending of the branch pipe due to welding. The material of the metal fitting shall be similar to the main run pipe.
- 2.7.5 If reinforcement pads are used, unless otherwise specified, a 3.0mm dia vent hole shall be provided (at the side and not at the crotch) in the reinforcement pad to reveal leakage in the weld

between branch and main run, and to provide vent ing during welding and heat treatment operations. If the reinforcement pad is made in more than one piece, each piece shall be provided with a vent hole.

- 2.7.7 The material of reinforcement pads shall be the same as the main run pipe.
- 2.7.8 An examination of the welds joining reinforcement pad to the branch shall be made by FEDO Engineer/ representative before installing the reinforcement pad.

2.8.0 FABRICATION TOLERANCES

- 2.8.1 To avoid misalignment when joining a pipe or fitting to a pipe, the pipe or fitting shall be turned to check for any irregularities and shall be joined correctly.
- 2.8.2 Unless otherwise specified, tolerances for fabrication shall be in accordance with the requirements shown in Figure 6.

2.9.0 GALVANISED PIPING

2.9.1 Galvanised carbon steel piping shall be completly cold worked so as not to damage galvanised surfaces

3.0.0 WELDING SPECIFICATION

3.1.0 GENERAL

b.

- 3.1.1 This specification shall be adopted to all welded pipe joints of carbon steel, alloy steel and stainless steel piping system.
- 3.1.2 The welded pipe joints are defined as under:
 - 1. All line joints of the longitudinal and circumferential butt welded and socket welded type.
 - 2. Attachments of castings, forgings, flanges and other supporting attachments to pipes.
 - 3. Welded manifold headers and other sub assemblies
 - 4. Welded branch connections with or without reinforcement pads.
 - 5. Manufacture of welded / fabricated piping components.
 - 6. The attachment of smaller connections for vents, drains, drips and other instrument tappings.
- 3.1.3 All welding, and heat treatment, shall be in accordance with the applicable codes and specifications.
 - a. codes for petroleum ANSI B31.3 refinery piping
 - Welding Qualifications. ASME Sec. IX.
 - c. Code of procedure for metal arc welding of mild steel (structural work only)
 - d. The Indian Boiler Regula- IBR tions

All codes referred shall be the latest editions. In adition to the codes mentioned above, other relevant international codes such relating to the work, shall also be applicable. In case of conflicts between different codes or between codes

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and tender specifications the more stringent shall be applicable.

- 3.2.0 **INSPECTION & TESTING**
- 3.2.1 General
 - 1. The owner's inspector shall have free access to all concerned places, where the actual work is being performed. The contractor shall also provide the owner's inspector all means and facilities necessary for carrying out inspection.
 - The owner is entitled to depute his own 2. inspector to the field or shop where prefabrication and erection of pipe lines are being done with (but not limited to) the following functions
 - a. To check the quantity, consumables and welding equipments used on the job
 - b. To supervise welding procedure & welders performance qualification tests.
 - To ensure that only qualified welders are c. engaged for welding.
 - d. To check that shop / field welding is in conformity with the relevant specification and codes of practice followed in pipe line construction
 - e. To carry out Non Destructive Examination of welds
 - Contractor shall intimate sufficiently in ad-3. vance the commencement of qualification tests and welding work to enable the owner's inspector to be present to supervise them.
- 3.2.2 Welding procedure qualification

Welding procedure qualification shall be carried out in accordence with the job requirements and relevant requirements laid down in the standard ASME Sec. IX and other relevant applicable codes. The contractor shall submit the welding procedures in QW — 482 format given in ASME Sec. IX. immediately on receipt of work order. Owner's inspector will review, check and approve the welding procedure after conducting the necessary tests. It shall be the responsibility of the contractor to carry out the tests, at his costs. All the necessary arrangements for the procedure qualification i.e. supply of material for assembly welding consumables, welding equipments, preparation of test coupons, welding, heat treatment, machining of test specime, conducting N.D.T, mechanical & chemical test and maintaining qualification records, shall be by the contractor at his cost. He shall submit the test results to the Engineer-in-charge in QW-483 format given in ASME Sec. IX. for approval.

- 3.2.3 Welder's Qualification
 - Welder's qualification shall be in accord-1. ance with the relevent codes specified in scope of work. Owner's inspector shall witness the test and certify the qualification of each welder. Contractor shall submit the welder qualification report as per Format before the commencement of work. It shall be the responsibility of the contractor to carry out the qualification tests of welders.

For piping covered by Indian Boiler Regulations, welders with valid IBR certificate, qualified by Boiler Inspectors and acceptable to the local Boiler Authority shall only be employed.

- The welders shall always have in their pos-2. session the identification card as per Format and shall produce it whenever demanded by owner's Inspector. It shall be the responsibility of the contractor to issue the identity cards after duly certified by the Inspector.
- The identity card shall contain the following minimum details. 3.
 - a. Name of Contractor
 - b. Name of welder
 - Stamp No. c.
 - d. Address
 - Recent passport size photograph e.
 - f. Details of qualifications
 - Welding process and P numbers
 - ii Range of pipe diameters
 - Range of thickness iii
 - Welding positions iv
 - g. Date of qualification test
 - h. Period of validity
 - i.
 - Signature of manufacturer Signature of Engineer —in—charge
 - j.
- 4. No welder shall be permitted to work without the possession of identify card.
- If a welder is found to perform a type of welding or in a position for which he is not 5. qualified, he shall be debarred from doing any further work. All such welds so performed shall be cut and redone at the expense of the Contractor.
- Engineer-in-charge reserves the right to ask 6. the contractors to perform requalification test at their cost for welders whose workmanship technique etc. are found unsatisfactory during the execution of the job.
- SELECTION OF WELDING MATERIALS 3.3.0
- Selection of welding electrodes shall be as per 3.3.1 Appendix - II

Table - I : Selection of welding electrodes & rods for joining similar materials except Aluminium

Table - II : Selection of welding electrodes & rods for joining dissimilar materials except Aluminium

- 3.4.0 STORAGE AND ISSUE OF ELECTRODES
 - Electrodes shall be stored and issued as follows:
- Electrodes shall be stored indoors free from 3.4.1 moisture as far as possible.
- 3.4.2 Electrodes shall be dried in a heating cabinet in accordance with the manufacturer's recommendation before welding.
- Immediately after drying, electrode shall be 3.4.3 stored in a portable dryer, or in a heating cabinet at the following temperature, and shall then be used.

: 70 - 100⁰C a. Illumenite

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b. Others : 100 - 150⁰C

- 3.4.4 During welding, electrodes shall be kept in a portable dryer or equivalent. The electrodes shall not be laid down directly on the ground or any other damp places.
- 3.4.5 Electrodes exposed to the atmosphere for more than 4 hours shall be redried. However, only two redryings are permitted.
- 3.4.6 When the day's work has been completed, the electrodes shall be collected and stored in a heating cabinet at the temperature specified in 3.3.2 above.
- 3.4.7 Issue of electrodes shall be controlled by the assigned person.
- 3.5.0 SURROUNDING CONDITIONS FOR WELD-ING
- 3.5.1 Welding shall not be performed under the following climatic conditions.
 - 1. In the rain
 - 2. In winds of 8 m/s or more
 - 3. In snow

However, welding may be performed if the area is fully protected from the inclement weather.

- 3.5.2 When the item to be welded is wet with rain or covered with snow or ice, the snow or ice shall be removed and the surface dried completely before welding.
- 3.6.0 GENERAL FOR WELDING
- 3.6.1 Welding shall be performed in accordance with welding procedure specification (WPS), which has been approved by FEDO/Representative. Before welding, the WPS shall be prepared which has been qualified by the welding procedure qualification test based on the specification for welding procedure qualification, according to this specification and ASME Section IX.
- 3.6.2 As a general rule, welding for steel pipes shall be performed as follows.
 - The welding process used shall be SMAW, GTAW, or GMAW (MIG Welding). Any other welding process may be used only when approved by FEDO / Representative.
 - Preferably, the first layer of butt welded joint shall be made by GTAW. For the first layer on 3Cr. and higher low-alloy steel pipe, or stainless steel, GTAW shall be performed with back shielding gas such as argon.
 - 3. The surface to be welded shall be cleaned thoroughly and any paint, rust, scale, oil, dust, moisture, or any other foreign matter that would be detrimental shall be removed at least within the extent of 50mm from the groove end before welding.
 - 4. The welding position shall be performed in flat position as far as possible.
 - 5. Full consideration shall be given to the welding progression to keep distortion to a minimum.
 - 6. In multi-layer welding, before welding the following layer, the surface of each layer

shall be removed of any slag or other foreign matter with a chipping hammer, a grinder, or a wire brush. To prevent spatter adhering to the base metal, a spatter deposit prevention paint may be applied around the outside of the groove. Wire brushes and abrasive wheels shall be distinguished so that those for stainless steel shall not be confused with those for carbon steel or low-alloy steel. Moreover, any arc starts, craters, or inferior beads of each layer shall be removed before the welding is continued.

- 7. Peening on the welds is prohibited.
- Unless required, the external surfaces of welds shall not be finished with a grinder or any other tool. However, when finishing the end of weld beads with a grinder, special precautions shall be taken not to reduce the thickness of base metal by over grinding.
- 9. Arc strike shall not be generated on the pipe surface. Care shall be taken not to lay down the electrode holder or move it around by the electrode.
- 10. To prevent damage from sparks, care shall be taken to ground the welding equipment by strict use of ground clips and to ground each piece of material.
- 11. When welding galvanized steel, the coating shall be removed from the surface to be welded, 50mm on either side.
- 12. For the joints of P-Number 5 materials, when welding is unavoidably interrupted, postheating shall be applied and the welds shall be cooled gradually by the use of insulation or other suitable materials. (Para 4.3.0).
- 3.7.0 BUTT WELDS
- 3.7.1 When welding a pipe to a pipe, fitting, valve, etc., the components shall be placed on a revolv ing stand, aligned accurately within the tolerances specified in Section 2.8. of this specifica- tion by the use of tack weld pieces (fit-up pieces), lineup clamps, etc., and shall then be welded.
- 3.7.2 Backing rings shall not be used unless otherwise specified.
- 3.7.3 The number of tack welds made shall be the minimum required to secure the pipe, and a minimum of three shall be made for pipes of 50 NB and larger.
- 3.7.4 When tack weld pieces are used for pipe materials of stainless steel, the material of the pieces shall be similar to that of the pipe. When the pipe material is low-alloy steel, carbon steel may be used for the pieces unless otherwise specified. The welding for the tack weld pieces shall be performed with electrodes equivalent to those used for the base metal and shall be performed by a welder or welding operator qualified for fillet welds.
- 3.7.5 Tack welds, which are made directly at the root of the joint, shall be made by a qualified welder or welding operator specified in Section 3.2.3 and shall be made by the same welding procedure as the product welding. Tack welds that are cracked or not fused properly shall be removed.

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- 3.7.6 Pieces for tack welds shall be removed with a grinder. If a concave surface due to overgrinding, etc., is produced on the pipe, the repair welding shall be performed in accordance with WPS, which has been approved by FEDO Engineer / Representative. Any convex weld beads formed on the pipe surface shall be removed. When defects are found while removing tacks / cleats they shall be fully removed, repaired by welding, and a magnetic particle or liquid penetration examination shall be performed to confirm that there are no defects.
- 3.7.7. Internal weld protrusions of butt welds for orifice flanges shall be finished smoothly to the pipe inside diameters with a grinder.
- 3.7.8. The root pass of all buttwelds on pipe of size less than 50NB shall be made in GTAW grove only.
- 3.8.0 FILLET WELDS
- 3.8.1 Fillet welding shall be performed as follows:
 - 1. Fillet welds shall be multi-layered and of sufficient strength.
 - 2. Fillet welds shall be as shown in Figures 7A and 7B.
 - 3. Fillet welds for socket welding flanges shall be as shown in figure 7C.
 - 4. Fillet welds for socket welding components shall be as shown in figure 7D.
- 3.9.0 SEAL WELDS
- 3.9.1 Seal welding shall be performed as follows:
 - Threaded joints to be seal welded shall not be coated with a compound or covered with a seal. After any oil on the threads has been fully removed, the threads of joint shall be screwed in securely in accordance with Section 5-1.0, and shall then be welded.
 - 2. If threaded joints are seal welded, all exposed threads shall be covered by a seal weld.
 - Seal welding shall be performed by a qualified welder.
 - 4. Electrodes of 3.2 mm dia or less shall be used.
- 3.10.0 FLANGE ATTACHMENT WELDS

Flange attachment welding shall be performed as fol lows:

- 3.10.1 Unless otherwise shown on the drawings, in principle, flange bolt holes shall straddle the established centerlines. The only exception is at equipment flanges required for matching orientation.
- 3.10.2 When installing flanges, flange square or other jig shall be used, and the center line of the pipe and the perpendicular of the flange face shall be within the tolerances specified in Section 2.8.
- 3.10.3 Joining welding neck flanges to the pipe shall be performed in accordance with the requirements of Section 3.7.
- 3.10.4 Front welding shall be performed on slip-on flange joints except for pipes class less than 50NB (Figure 8). Care shall be taken so that the weld reinforcement does not protrude on to the

gasket contact face and that the gasket contact face is not damaged by welding. If the gasket contact face is damaged,or weld reinforcement protrudes onto the gasket contact face, such defects shall be removed by polishing the gasket contact face.

- 3.10.5 When welding flange joints, care shall be taken to handle the flanges carefully so that the gasket contact face will not be damaged. The gasket contact face shall not be in direct contact with the ground, and grounding shall not be taken directly from the gasket contact face.
- 3.10.6 In the case slip-on flanges which are to be heat treated, and also require to be front welded, they shall be provided with a 3mm dia vent hole at the hub as shown in FIG.8.

4.0.0 HEAT TREATMENT

4.1.0 PREHEATING

- 4.1.1 Unless otherwise specified, the preheating applies to gas cutting and welding (all welds including butt welds, fillet welds, socket welds, repair welds, tack welds, and seal welds of thread ed joints). Preheating shall be performed as follows:
 - 1. Materials to be pre heated and preheating temperature shall be in accordance with relevant codes as a rule, but for steam lines fallen under the purview of IBR, the same shall be followed.
 - 2. If the maximum specified carbon content is more than 0.38, or if the material is under a high degree of restraint (weld-all- around such as pipe shoe), carbon steel shall be preheated to a minimum of 80°C and maintained at that temperature for surface weld-ing.
 - 3. When welding dissimilar metals, unless otherwise specified, the preheating temperature shall be that for the higher grade steel
 - 4. The width of the heated circumferential band shall be 4 times the pipe nominal wall thickness or 100mm, whichever is greater, extending on both sides of the welds.
 - 5. Heat shall be applied by the use of a gas burner or a heating coil. The use of a gas burner for cutting shall not be permitted since it tends to heat locally.
- 4.1.6 Temperature measurements of preheating, interpass temperature, and postheating shall be performed by a temperature crayon (tempil stick), thermocouple temperature indicator, etc., and it shall be confirmed that the specified temperature is maintained.

4.2.0 INTERPASS TEMPERATURE

- 4.2.1 The following items shall be confirmed for interpass temperature:
 - Interpass temperature of the materials that require to be preheated shall be the same as the preheating temperature and shall be maintained until welding has been completed.
 - 2. Interpass temperature of austenitic stainless steel pipe shall not exceed 150⁰C.





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4.3.0 POSTHEATING

- 4.3.1 When postheating is required it shall be carried out for more than 30 minutes within the temperature range of 300 to 400°C, and the material shall be cooled gradually by the use of insulation, etc. However, when post weld heat treatment is performed immediately after welding, post heating is not necessary.
- 4.4.0 POST WELD HEAT TREATMENT

4.4.1 Procedure

Unless otherwise specified, post weld heat treatment shall be performed in accordance with the following procedure. However, post weld heat treatment for dissimilar metals shall be in accordance with the individual specification.

- The requirements for heat treatment shall be in accordance with applicable codes. But for steam lines IBR shall be followed. Heat treatment of welded joints between dissimilar ferritic metals shall be within the temperature ranges for the higher grade steel.
- All the machined surfaces shall be protected adequately by the use of paint or compound to prevent damage from scaling during heat treatment.
- In case of furnace heat treatment, all the pipes shall be supported properly during heat treatment to minimize warps and other distortions.
- 4. In principle, after heat treatment has been completed, neither rewelding nor reheating shall be performed. However, if rewelding is performed because of repairs, etc., heat treatment shall be performed again.
- 5. If welding is intrrupted before completion or the weldment is allowed to cool prior to heat treatment, adequate heat treatment or controlled rate of cooling shall be applied to ensure that no effects detrimental to the piping shall result. The pre-heat temperature in the welding must be applied before welding is resummed.
- 6. When heat treatment is performed, the holding temperature, holding time, rate of heating and cooling, and the hardness after heat treatment required shall be recorded and the records shall be submitted to FEDO Engineer / Representative.
- 7. The measurement of heat treatment temperature shall be performed by measuring the metal temperature by the use of a thermocouple, or by other suitable methods. However, when the heat treatment temperature is measured by the furnace temperature, the relation between the temperature of metal and furnace shall be considered.
- 8. A hardness test shall be performed in accordance with Section 9.4.0 to determine if the heat treatment has been performed satisfactorily.
- Throughout the cycle of heat treatment, the portion out side the heated band shall be suitably wrapped under insulation so as to avoid any harmful temperature gradient at

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the exposed surface of pipe. For this purpose temperature at the exposed surface of pipe should not be allowed to exceed 400° C.

- 10. All online pipe item (eg. Valves, Instruments etc.) within 500mm of the weld which is beingheat treated, shall be dismantled prior to commencement of heat treatment of weld.
- 11. The no. of thermocouples to be used for the monitoring of tempreature shall be as follows.(HAZ Heat Affected Zone)

DIA OF PIPE	NOS.	OrientatIO N ()	LOCATION
15NB & below	2	0 , 180	One on weld & one in HAZ
200 to 500 NB	3	0 ,120 , 240	one on weld & rest in HAZ on either side of weld
600 Nb & above	4	0, 90 180, 270	two on weld & rest in HAZ on either side of weld

4.4.2 Heating Methods

For heat treatment, application of heat in a furnace is preferable, however, heat may be applied locally by the following methods:

1. Heating by electrical resistance

This is a method where a programmed movable automatic heater applies heat by means of nickel-chrome wire applied around the welds. Special attention shall be given to the following items:

- a. Protective measures shall be taken to prevent damage to the pipe surface or injury to the workers due to a short circuit of the lead wire, and to prevent persons other than the operator entering the work area.
- b. The width to be heated shall extend 25mm beyond the edges of the weld on each side
- c. The width to be insulated shall extend at least 150mm on each side of the weld.
- d. The heating and cooling rates above 315⁰C shall be determined by the following formula, but in no case shall the rate exceed 220⁰C per hour.

$$\frac{25 \times 220}{\text{wall thickness (mm)}} (^{\circ}C/h)$$

- 2. Heating by gas burner
 - a. This is a method where heat is applied by a propane or butane gas burner. This method shall not be used unless specified by FEDO Engineer/ Representative.

5.0.0 THREADED AND FLANGED JOINTS

- 5.1.0 THREADED JOINTS
 - Threading of joints shall be as follows.
- 5.1.1 Taper pipe threads shall be as per ANSI B2.1,



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ANSI Standard Taper Pipe Thread (NPT).

- 5.1.2 Unless otherwise specified, when threading on pipes of NPS $1^{1}/_{2}$ or smaller, the pipe thickness shall be Schedule 80.
- 5.1.3 In principle, all threads shall be cut with a threading machine or lathe. When threading with hand dies such as an oster or reed type, a lubricant shall be used to avoid an irregularity of screw thread or scratches due to coarse machining.
- 5.1.4 All the threads shall be cleaned thoroughly.
- 5.1.5 In principle, teflon seal tape shall be used for threaded joints used in services of 150°C and lower. Once the joints are screwed, they shall not be unscrewed. Fillers such as hemp, jute, lead scraps, and white paint shall not be used.
- 5.1.6 Seal welding of threaded joints shall be in accordance with Section 3.9
- 5.1.7 In no case shall threaded joints be made with a length of engagement less than specified.
- 5.1.8 When pipe is screwed into a threaded flange, the pipe end shall not extend beyond the gasket contact face. If the pipe end protrudes even slightly, the pipe end shall be ground off with a grinder or a file so that the gasket contact face is not scratched.
- 5.1.9 When screwing a pipe into a threaded bronze valve, the pipe shall be gripped by a pipe vice and the valve shall be screwed on by clutching the end of the valve with a wrench. Threading and screwing shall be carried out carefully so that the pipe does not enter the valve too far and damage the valve due to the threads being overcut on the pipe.
- 5.1.10 Scraps of metal due to threading and oil used for cutting shall be removed before screwing on instrument air piping.
- 5.1.11 Any compound or lubricant used on the threads shall be suitable for the service conditions, and shall not react unfavourably with either the service fluid or piping material.
- 5.2.0 FLANGED JOINTS

Flanged joints shall be made as follows:

- 5.2.1 In principle, Class 125 and 250 flanges of valves and other equipment made of gray cast iron shall be of flat face with full contact area gaskets.
- 5.2.2 Steel to gray cast iron flanged joints shall be assembled with care to prevent damage to the cast iron flange.
- 5.2.3 Unless otherwise specified, gasket paste shall be applied uniformly on the gasket contact face of the flange when a metal jacketed gasket or a metal gasket is used. However, when the flange material is austenitic stainless steel, the use of gasket paste shall be approved by FEDO Engineer / Representative. As the choice of paste is limited by the fluid handled, the paste shall be suitable for the service fluid. The gasket paste shall be kept in a container with a lid and handled with care to prevent entry of sand, dust or other foreign matter.
- 5.2.4 For asbestos-sheet gasket, gasket paste may not be applied.
- 5.2.5 For spiral-wound gaskets or ring-joint gaskets, gasket paste shall not be applied.

5.2.6 The thread and bearing surfaces of bolts and nuts to be used on piping at temperatures of 250°C or higher shall be coated thinly and uniformly with a lubricant to prevent them becoming burnt and stuck.

- 5.2.7 Lubricant shall not be applied to machine bolts unless other wise specified.
- 5.2.8 Bolts shall be of material and length as specified. In principle, all the bolts shall extend 2 or 3 threads through their nuts.
- 5.2.9 Flanges shall be tightened with a wrench or spanner of the specified length and with a hammer if required, or with a torque wrench. Care shall be taken so that the bolt is not tightened excessively or unevenly.
- 5.2.10 As the tightening force varies according to the flanges, gaskets, and bolts used, the tightness shall be controlled with care. In particular, flanges of piping for low temperature and dangerous services shall be tightened only with a torque wrench. For large diameter bolts, the use of an impact wrench with torque control or a power machine (hydraulic torque wrench) is preferred.
- 5.2.11 Bolts of flanged joints shall be successively and evenly tightened in a symmetrical pattern (Appendix IV).
- 5.2.12 Cast iron flanges of equipment such as pumps, turbines, compressors, or other similar equipment shall be tightened carefully so that the flange does not break.
- 5.2.13 The flange clearance with connections of pumps, compressors, or other similar equipment, and ring-joint flanges shall be measured by the use of a clearance gauge and the parallelism shall be checked, and then the bolts shall be tightened evenly.
- 5.2.14 Ring-joint gaskets shall be ground with the groove of the flange for a tight fit prior to installation. The grinding shall be performed by using a compound (coarse, intermediate, or fine), and red paste shall be applied to confirm the roughness of the contact face between the ring and the groove of the flange. The paste shall be removed completely before the ring is installed.
- 5.2.15 If the gasket contact face of the flange is damaged, the defects shall be removed by polishing evenly the gasket contact face, or the flange shall be replaced.

6.0.0 PROTECTION OF PREFABRICATED PIPE SPOOLS AND SIZE

- 6.1.0 PROTECTION OF PREFABRICATED PIPE SPOOLS
- 6.1.1 All prefabricated pipe spools that have been inspected shall be protected as follows until they are installed in a plant.
 - 1. All dust, rust, weld slags, or other foreign matter in the pipe shall be removed carefully by brushing or by flushing with compressed air, or by other suitable means. After cleaning, all openings of austenitic stainless steel shall be blanked.
 - 2. Pipe spools to be stored temporarily shall be laid on suitable sleepers and not directly on the ground.



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- Pipe spools shall be marked with the area number (major divisions such as offsite, onsite), line number, and piece number. After cleaning the pipe spool surface and applying rust preven tive, it shall be marked clearly with paint by the use of a stencil. When specified, in showing the line number, etc., a color code identification or tag plate (die stamped to the sheet metal) for each area shall be made, and it shall be attached with coated iron wire. However, zinc coated iron wire shall not be used for austenitic stainless steel.
 If hydrostatic test is performed, the water
- 4. If hydrostatic test is performed, the water shall be removed completely.
- 6.1.2 When prefabricated pipe spools are to be stored for a long period of time or are to be shipped, the pipe interior shall be checked to see that it is clean, and the openings of pipe ends shall be protected as follows:
 - 1. When the pipe ends are prepared, the ends shall be coated with rust preventive (Appendix 1) and covered with a plastic cap, etc.
 - 2. When the pipe ends are flanged, the gasket contact face shall be coated with rust preventive and be protected with a wooden or plastic cover bolted on to the flange. In case of a wooden cover, poly ethylene or other suitable film shall be inserted between the flange and the cover.
 - 3. When the pipe ends are threaded, the threads shall be coated with rust preventive and threaded end connections shall be covered with wooden or plastic plugs or caps.
 - 4. When masking tape is intended to be used instead of the protection mentioned above, it shall be subject to FEDO Engineer's/Representative's approval.
- 6.1.3 However, austenitic stainless steel pipes and prefabricated pipe spools that may be affected by chlorine ions, shall be protected in accordance with the individual specification.
- 6.2.0 SIZE OF PREFABRICATED PIPE SPOOLS
- 6.2.1 The size of prefabricated pipe spools shall be determined by consideration of the conditions of transportation, etc. Consideration shall be given to the conditions of inland transportation, size of the carrier's hatch, means of transportation, traffic regulations in the country and the economy.
- 6.2.2 The standard size of a package to transport prefabricated pipe spools is limited to 2.5 meters width by 2.5 meters height by 13 meters length with a weight of 5 tons per package.

7.0.0 INSTALLATION OF PIPE SUPPORTS

- 7.1.0 PIPE SUPPORTS
- 7.1.1 Pipe supports whose materials & dimensions conform to fabrication drgs, shall be installed accurately at the positions shown on the drawings prior to piping installation. When installing the pipe supports, pay attention to the following:
 - 1. Each support shall be fabricated and assembled so that piping does not become disengaged from the support by movement of the piping itself due to operation.

- 2. Stanchions requiring foundations shall have anchor bolts of the correct size, position, projection, etc.
- 3. Before installing the supports, the finished conditions of the cut ends of all members and welded conditions shall be checked.
- 4. Pipe supports shall be made level and plumb to facilitate alignment during piping installation.
- 5. In principle, when the main run pipe is lowalloy steel or ss, either a pad plate or support members of the same material as the main run pipe shall be used, and carbon steel supports shall not be welded directly to these. In this case, when welding the pipe to the support, the same electrodes as applied to the pipe shall be used, and the qualified welder specified in Section 3.1.0 shall perform the welding in accordance with WPS. When the main run pipe requires heat treatment, the welds for attachment of pipe supports shall be heat treated if required,as per ANSI B31.3.
- 6. Welds for anchor supports shall be doublelayer welds to provide a bond of sufficient strength.
- 7. When welding dummy pipe to elbows, tees, etc., the welding shall not melt through to their interior.

7.2.0 SLIDING SUPPORTS

- 7.2.1 Sliding supports shall be assembled so that the expected movement of the supported piping due to thermal expansion and contraction or other design requirements is possible.
- 7.3.0 SPRING HANGERS
- 7.3.1 The lock-pin or preset-piece of spring hangers shall not be taken off until pressure testing and flushing have been completed, except only when a high temperature fluid such as flushing steam is streamed.
- 7.3.2 Adjustment of spring hangers shall be performed by taking off the lock-pin or preset-piece prior to ini tial operation. It shall be confirmed that spring hangers operate on the expected movement according to temperature increase in the initial operation.

7.4.0 ADDITIONAL SUPPORTS

7.4.1 If additional supports are required to prevent shaking of piping in the field, they shall be installed in accordance with the instructions of the FEDO Engineer's / Representative's Engineer in consideration of the effects due to thermal expansion of the piping.

7.5.0 INSULATION SUPPORTS

7.5.1 The configuration, material, and installation procedure of support rings for hot or cold insulation of vertical piping shall be in accordance with the individual specification.

8.0.0 PIPING INSTALLATION

8.1.0 GENERAL ITEMS FOR PIPING INSTALLA-TION

The general items for attention relating to piping installation shall be as follows:



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- 8.1.1 Pipes shall be stored in accordance with each category of material, and stacked on sleepers with wedges or stakes provided to prevent the stack from collapsing.
- 8.1.2 Before installation, pipe spools shall be checked with the piping drawings as to dimensions, material, class, etc. In principle, the installation of pipe spools shall start from elevated lines or larger size lines. The precedence for installation shall be determined after confirming that all equipment has been installed and aligned, and steel structures and pipe racks are ready for installation of the piping. The part which cannot be painted after piping installation shall be painted beforehand.
- 8.1.3 In principle, underground piping shall be installed before above ground piping.
- 8.1.4 Before installation, the pipe spool shall be suspended at one end by a crane, etc., and ham mered to remove the dust inside.
- 8.1.5 Supports such as stanchions shall be checked for the accuracy of position, dimensions, elevation, levelness and plumbness.
- 8.1.6 When temporary supports are installed unavoidably to the piping, welding shall not be performed on the main run pipe.
- 8.1.7 Temporary work for piping installation shall be planned in advance, and the necessary equipment and materials shall be selected and prepared in time with the schedule. Moreover, the scaffolding required for field connections shall be checked, and whether the required number of scaffold pipes and boards shall be sufficient.
- 8.1.8 Scaffolding shall be provided to permit safe operation, and the use of small size piping, pumps, instruments, etc., in lieu of scaffolding shall be prohibited. All scaffold boards shall be securely tied to the scaffold pipes or piping with metal connectors or iron wire.
- 8.1.9 The primary cards, cables, and grounding wires of all welding equipment shall be of sufficient size, and any conductors with damaged insulation shall not be used. They shall be inspected periodically.
- 8.1.10 Piping components such as pipe spools and valves shall be lifted with the designated wire rope slings, and the use of iron wire shall be prohibited.
- 8.1.11 Piping components shall be hauled by mechanical equipments as far as possible. Even for a short haul, the components shall be securely tied to prevent them from falling.
- 8.1.12 Piping requiring cold spring may become misaligned during field welding, therefore, the dimensions shall be checked thoroughly in accordance with the piping drawings. After it has been confirmed that guides and anchors have been installed at the specified location, the piping shall be installed. Furthermore, when there are flanged joints in the same direction requiring cold spring, a spacer with the same thickness as the dimension of cold spring shall be inserted between the flanges, and when the entire piping system has been assembled, the spacer shall be removed and the flange fastened.

- 8.1.13 Alignment tolerances of flange connections installed in piping shall be as per **Figure 9** (Page 28 of 28). However, alignment tolerances of pipe flanges for the rotational equipment nozzle shall be as per Section 8.3.0 (Item 6).
- 8.1.14 In principle, the longitudinal welded joint of welded pipe shall be located above the horizontal centerline, if the pipe is installed horizontally.
- 8.2.0 PIPING AROUND COLUMNS, DRUMS AND HEAT EXCHANGERS

The piping installation around columns, drums, and heat exchangers shall be as follows:

- 8.2.1 Piping for columns shall be installed in the order of the overhead line and the risers, and the installation of instrument take-off nozzles, supports, spring hangers, etc. The levelness and plumbness of piping shall be complete and true.
- 8.2.2 For piping installed at high elevations at the top of columns, drums, etc., assembly and nondestructive examination and pressure testing shall be performed on the ground, as far as possible, to minimize work at high elevations. When piping installation is unavoidably performed at high elevations, the area below shall be fenced in with a safety rope and "MEN AT WORK ABOVE" signs shall be posted.
- 8.2.3 When piping components are to be lifted into place at high elevations by means of large cranes, in advance, the work data such as the weight, position of center of gravity, reach of crane, crane boom length, and other vital data shall be ob tained, and they shall be studied sufficiently.
- 8.2.4 Temporary supports shall not be taken from the shell (body) of equipment.
- 8.2.5 After the pipe spool has been installed accurately to the nozzle of the equipment, field welding shall be performed. In such cases, blinds shall not be inserted for purposes of pressure testing, etc.
- 8.3.0 PIPING AROUND PUMPS AND COMPRES-SORS

The piping installation around pumps and compressors shall be as follows.

- 8.3.1 All piping except for the connections to the nozzle of rotating machinery shall be assembled on the ground.
- 8.3.2 Before installation of piping to rotating machinery, the required heat treatment, pressure test ing, interior cleaning, etc., shall be completed. Pressure testing shall not be performed by inserting the blinds directly between the nozzle of rotating machinery and the flange of the connected piping.
- 8.3.3 The protective cover placed on the nozzle of rotating machinery shall not be removed until the piping is to be connected.
- 8.3.4 The preset-piece of spring hangers shall be taken off and spring hangers shall be adjusted, so that piping is located accurately.
- 8.3.5 It shall be confirmed that alignment work of rotating machinery and measurement preparation for inspecting misalignment has been completed.



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- 8.3.6 Pipe flanges shall be aligned with all the nozzles of rotating machinery. The alignment shall be performed by the adjustment of pipe supports and flange connections. Unless otherwise speci fied, the misalignment between flanges shall be within the following permissible limits:
 - a. Flange face separation : ± 0.8mm (space for gasket)
 - b. Flange face parallelism : 0.2mm
 - c. Rotational offset : 0.8mm
 - d. horizontal and vertical bolt : 0.8mm hole offset
- 8.3.7 If the piping alignment specified in Item (6) above is not within the permissible limits, it shall be corrected. The correction of piping alignment or the adjustment work of supports shall be performed by dismantling piping from rotating machinery. Care shall be taken so that expansion or distortion due to welding, etc., does not have a detrimental influence on the rotating machinery.
- 8.3.8 When connecting piping to a rotating machine, if the machine misalignment is more than the values specified, alignment work of the machine and piping shall be performed again by dismantling the piping from the machine.
- 8.3.9 After piping is connected to rotating machinery, the rearrangement of pipe supports or retightening of flange bolts shall not be performed without permission.
- **8.4.0** PIPING AROUND FIRED HEATERS

Piping installation around fired heaters shall be as follows:

- 8.4.1 Since piping around the burner tends to become complicated, piping for one or two burners shall be installed first, and after confirming operability, clearance, safety, and other matters, other piping shall be installed.
- 8.4.2 Drain piping around the burner shall not be placed on the ground or in such a way as to obstruct passage of persons.
- 8.5.0 PIPING ON PIPE RACK

Piping installation on pipe rack shall be as follows:

- 8.5.1 Generally, since air cooled heat exchangers are placed on top of the pipe rack, and pumps are placed underneath, the precedence for installing piping shall be determined in consideration of the time of installing such equipment, the number of stages of the pipe rack itself, etc. In principle, piping installation will be performed from the bottom to the top level. When installing piping, a check shall be performed to ensure that the pipe rack beams have been painted.
- 8.5.2 Before connecting piping to other equipment, piping on pipe racks shall be laid down accurately in the places specified beforehand, and then slide shoes and stoppers shall be installed accurately in accordance with the drawings, so that baseline for dimensional adjustments in field installation may be made. However, elbows, tees, etc., required for take-off connections to outside the pipe rack may be left in place temporarily since it may be re quired to perform

adjustments.

- 8.5.3 After the pipe has been laid on the rack, the pipe shall be tied with wire to prevent it from falling off until the weld joints are made.
- 8.5.4 The pipe fittings and welded lines shall be installed so as not to be positioned on the beams.
- 8.6.0 OFFSITE PIPING

Installation of offsite piping shall be as follows:

- 8.6.1 Piping installation inside the dike shall be performed after a thorough study of the work schedule has been made, with consideration given to other related work such as the confirma tion of time of tank water filling and of access for handling materials.
- 8.6.2 Pipe sleepers and support footings inside the dike shall be installed after confirming that the levelness of the ground has not been disturbed by the water filling test of the tank.
- 8.6.3 Piping to be connected to the tank nozzle shall be installed after checking that the valve and accessories installed on the tank are in accordance with the specification.
- 8.6.4 Flexible hoses and expansion joints to the tank nozzle shall be installed accurately in accordance with the drawings.
- 8.6.5 When laying pipe on sleepers, the sleepers shall be checked to confirm that they are at the specified elevation, level in line, and painted.
- 8.6.6 Piping on pipe sleepers shall be laid on sleepers that have been marked off. Slide shoes and stoppers shall be installed accurately in accordance with the drawings. The pipe fittings and welded lines shall be installed so as not to be positioned on the sleepers.
- 8.6.7 For piping penetrating an oil dike, the flanged, threaded, or welded joints shall not be embedded in the dyke.
- 8.7.0 INSTALLATION OF VALVES

The installation of valves shall be as follows:

- 8.7.1 The valve shall be installed accurately so that its location and the orientation of the handle is in accordance with the piping drawings. However, when the orientation of the handle is deemed inappropriate from the viewpoint of operation or passage, the FEDO engineer shall be contacted for directions.
- 8.7.2 The valve shall be checked for its class, body materials, and trim materials to prevent any misuse.
- 8.7.3 Before installing the valve, the flange faces of the valve and the connected piping shall be checked to see that they are not damaged or dirty, and that they are parallel with each other.
- 8.7.4 Valves shall be installed in the closed position, except for plug valves and ball valves. After being installed, valves shall not be opened except for pressure testing. Especially, welding for installation of the butt weld and socket weld type valves shall be performed in the closed position, to prevent the valve seat being damaged.
- 8.7.5 For lubricant plug valves, the disc shall be left in the open position and the lubricant shall be replenished to prevent loss of the sealant.



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- 8.7.6 Globe valves, check valves, control valves, and other similar valves shall be installed in accord ance with the marked direc tion by checking the flow direction.
- 8.7.7 To prevent the stem threads from rusting, grease shall be applied prior to installation of the valve.
- 8.8.0 INSTALLATION OF SAFETY VALVES

The installation of safety valves shall be as follows:

- 8.8.1 Until line pressure testing has been completed, in principle, the safety valves shall not be in stalled with the piping. If safety valves are necessary to assemble the piping, a spool of the same face-to face dimension shall be fabricated and installed. For threaded safety valves, the piping shall be capped. However, the safety valve with test gag may be installed with piping and subjected to line pressure testing.
- 8.8.2 All safety valves shall be installed after the specified set pressure has been tested in the field.
- 8.8.3 The seal securing the cap to the safety valve body shall not be removed without FEDO / Representative's approval.
- 8.8.4 The safety valve with a lever shall be installed with the lever oriented as shown on the drawing.
- **8.9.0** Installation of expansion joints

The installation of expansion joints shall be as follows:

- 8.9.1 Expansion joints shall be installed accurately and shall be at the location and of the dimensions shown on the piping and detailed drawings, and in a manner so as not to be connected eccen tric with the pipe.
- 8.9.2 Expansion joints shall be installed after confirming that the line has been completely assembled with all anchors, guides, and stoppers installed in place as shown on the piping drawings.
- 8.9.3 Expansion joints shall be installed so that no stress except in the direction intended occurs.
- 8.9.4 After pressure testing and flushing, all shipping bolts and fixtures shall be removed and the joints shall be checked to ensure that nothing obstructs the expansion movement.
- 8.9.5 Prior to installation, expansion joints with inner sleeves shall be checked to ensure that the sleeve inlet (fixed) is on the upstream side.
- 8.9.6 Bellows of expansion joints shall be handled with utmost care, so that no objects will be dropped upon it.
- 8.9.7 Each expansion joint shall be blown free of dust / foreign matter with compressed air or shall be cleaned with a piece of cloth.
- 8.9.8 For handling and installation of expansion joints, great care shall be taken while aligning. An expansion joint shall never be slinged with bellows corrugations/external shrouds, tie-rods, angles etc.
- 8.9.9 An expansion joint shall preferably be slinged on the end pipes/flanges or on the middle pipe.
- 8.9.10 The pipe ends in which the expansion joint is to be installed shall be perfectlyaligned or shall

have specified lateral deflection as noted on the relevent drawings.

- 8.9.11 The pipe ends / flanges shall be spaced at a distance specified in the drawings.
- 8.9.12 The Expansion Joint shall be placed between the mating pipe ends/flanges and shall be tack welded/bolted. The mating pipes shall again be checked for correct alignment.
- 8.9.13 Butt welding shall be carried out at each end of the expansion joint. For flanged Expansion Joint, the mating flange shall be bolted.
- 8.9.14 After the Expansion Joint is installed the contractor shall ensure that the mating pipes and Expansion Joint are in correct alignment and that the pipes well supported and guided.
- 8.9.15 The Expansion Joint shall not have any lateral deflection. The contractor shall maintain parallelism of restraining rings or bellows convolutions.
- 8.10.0 INSTALLATION OF INSTRUMENTS
- 8.10.1 Kinds of instrument handled
 - 1. The following instruments shall be installed in the scope of piping installation work:
 - a. Flow meters to be installed directly on the line (area type, volume type, magnetic type, etc.).
 - b. Orifice flanges and orifice plates
 - c. Displacer type or ball float type level meters
 - d. Control / self control valves & safety valves
 - e. Other instruments installed directly on the line
 - 2. In addition, instruments up to the first valve or flange in the nozzle take-off connections for the instrument lead piping are included.
- 8.10.2 General Procedure : General installation procedure for instruments shall be as follows:
 - a. All instruments shall be checked as to instrument number and shall be installed true to level, plumbness, or the specified angle
 - The instruments and the associated piping (excluding instrument piping) shall be supported so that problems will not result due to distortion or vibration
 - c. It is preferred to have all the instruments installed after the interior of piping, columns and drums have been cleaned. When instruments are to be installed unavoidably during piping construction, measures shall be taken to prevent the instruments from being damaged and to prevent foreign matter from entering the instruments. Orifice plates shall be installed only after testing and flushing of pipes.
 - d. Flow control valves shall be installed after checking the flow direction mark.
- 8.10.3 Installation of Flow Meters : The installation of flow meters shall be as follows:
 - a. When installing orifice flanges, the straight lengths of pipe required upstream and downstream shall be checked to see that they comply with the piping drawings. In principle, the upstream straight pipe length shall be of one piece. When there is an unavoidable welded line in the length, the distance between the orifice and the weld



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line shall be not less than 14 times the pipe diameter. The straight lengths of pipe shall not be provided with a vent, drain, or other similar branch.

b. Jack screws for orifice flanges shall be installed so that they are 180^o apart from each other.

c. When taps are to be taken off from a pipe, the holes shall be drilled where shown on the drawings, the burrs removed and the holes made smooth. Sockets shall not be embedded in the pipe.

- d. The orientation for pressure differential taps shall be accurate as shown on the drawings
- e. Orifice plates shall not be installed until the pipe interior has been cleaned.
- f. When installing orifice plates, the orifice plate number and the flow direction shall be checked. In general, the handle is pointed upwards and the inlet die stamp mark end is pointed upstream.
- g. An orifice plate shall be installed with its center coinciding with the center of the pipe and with the gasket not protruding into the pipe.
- g. An orifice plate shall be installed with its center coinciding with the center of the pipe and with the gasket not protruding into the pipe.
- h. Installation of flow meters such as area type, column type, and magnetic type shall be in accord ance with the instructions of the FEDO Engineer.
- 8.10.4 Installation of Control Valves : The installation of control valves shall be as follows:
 - a. Control valves shall be installed by checking the flow direction and, except for special cases, with the diaphragm at the top in a vertical position.
 - b. To prevent internal and external damage and entry of foreign matter during construction, control valves shall be installed during the last stage after pressure testing and flushing of the line. In this case, a spool having the same face-to-face dimension as the control valve shall be inserted to keep the distance during construction. Further more, after the piping around the control valve has been installed, the dimensions shall be checked to confirm that the valve can be fit in place.
 - c. When installing control valves unavoidably during construction, a blind gasket, galvanized iron sheet, or other suitable material of the same thickness as the main gasket shall be inserted to prevent entry of foreign matter. During construction, control valves shall be covered with vinyl sheet or other suitable material, and care shall be taken not to damage the valves. During pressure testing and flushing of the line, the valve shall be removed and the end flanges of the valve shall be covered up.

9.0.0 INSPECTION AND TEST

9.1.0 DOCUMENTS

The Contractor shall submit the following inspection records for each items of test and inspection:

- 9.1.1 Non-destructive inspection
 - a. Record of radiographic inspection
 - b. Record of magnetic particle inspection
 - c. Record of liquid penetrant inspection
 - d. Record of ultrasonic inspection
 - e. Records of stress relieving
 - f. Records of hardness test
 - g. Records of hydrostatic & pneumatic pr. tests
- 9.1.2 Destructive inspection Record of welding procedure qualification test
- 9.1.3 Others specifically instructed Following are to be indicated on the test and
 - inspection record1. Name of customer
 - 2. Job number and name of work
 - 3. Name of contractor
 - 4. Line number
 - 5. Date of test and inspection
 - 6. Name(s) of attendant (FEDO, Customer, or third party)
- 9.2.0 ITEMS OF INSPECTION AND TEST
- 9.2.1 Prior to, during and after completion of the works, the following tests and inspections shall be performed.

ITEMS FOR INSPECTION AND TEST

PRIOR TO COMMENCING WORK

Checking materials	Legal qualification certificate
Welding proce- dure test	
Welder's techni- que qualification test	welder's techniqe qualifica- tion certificate
Welding rod check	
PRIOR TO WELDI	NG WORK
Edge preparation	Angle, Root opening, Thick- ness of land, Cleanliness
Shape of pipe end	Out of roundness, Thick- ness, Uneven thickness
Bending	Degree of flattening at bent part, Radius of curvature, Thickness reduction at bent part
Tack welding	Bevelled end misalignment, Root opening
Preheating	Method of preheating, Temperature of preheating, width of heating, Tempera- ture measurement, Heating temperature, Others



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PEC	IFICATION		STE	EL PIP	ING			P	AGE 18	OF 28				
_	Welding ro	Drying	temperature, Drying time	-	6	i L N	Inder cut lo under cut is a owed for piping o	l- : W of 12.5	/ithin 0.8mm 5% of thickn) or Jess				
-	DURING WE	UING WOR Weldir	ng parameters, Flow	-		C ti	old or high temp ure service.	era- whi	chever sma	ller				
	Welding cond	tion rate of ing m Cor	sealing gas, Protect- easure for welding, idition of ambient		7	Ċ	Over lap	: 1	.5mm or le	SS				
-	Ir	tor-layor tom		-	8	6 F	leight of reinforc	ement						
-	Re	-examination	of welder	-		Ν	Iominal Wall The	ζ.						
-	AFTER COM	PLETION OF	WELDING WORK	-		ι	Jp to 6.4mm	: 1	.6mm or le	SS				
	Visual an-	Inside s Outer s Ins	urface misalignment, urface misalignment, ide surface weld			C 1	Over 6.4mm up to 2.7mm	o ; 3	3.2mm or le	SS				
	pearance insp tion	bec-Unever height Overla	of leg length, Irregular of bead, Undercut, p, Bead centre shift,			0 2 (ver 12.7mm up 4.5mm)ver 24.5mm	to : 4	1.0mm or les	SS				
-	Non-destruct	ive Radiogr	welds	-		т	hroat thickness	:4 0f • 70⁰	4.8mm or le	SS				
-	inspection	M	agnétic particle	-		fi	llet welds	the	inner plate	or				
-	Stress reli	eving temperative	ature and method	-	040	Ne	n dootructivo	nonoction						
-				-	9.4.0		n-destructive	inspection	i Seball bo	performe				
-	WELDING W	ORK Dimens	ion, Condition of con-	-	5.4.1	ac	cording to the the next table	grade of (Pressur	inspection e classes	stipulate				
_	tion	to equipment, Visual erance inspection	-		an		Grad	de of Inspec	tion					
-		-		М	aterial	Ι	II	III						
-	Seal welding of threaded portion							Pressure classes - ANSI B16.5 (psig.)						
_	AFTER COMPLETION OF WORK		P											
	Completic	n of work w.r.	t piping drawings				Service	Less	400 lb -	2500 lb				
	Pi	neumatic pres		Carb	on	below 350°C	lb	1500 lb	above					
		Flushin	g		stee		Service temp.		150 lb -	1500 lb				
-		temporary su	pports / scafoldings	-			350°C or more	-	900 lb	above				
-		ppearance in	spection	-			llad Staal		150 lb -	1500 lb				
30				-		1-KI	lied Steel	-	900lb	above				
3.1	Following	shall be me	t checking visually	or in	<u>P - NO</u>	: 3,	4, 5							
-	using mea	suring instru	iment		C. C	· 0.5 r- M	Mo Steel o Steel	-	150 lb - 900 lb	1500 lb and above				
	misalignn	nent	. 1.5mm or less		<u>P - NO</u>	: 9				4500 "				
	2 Outer sur misalignn difference diameter	nent due to e of of thick-	: 3.0mm or less			3.5	Ni steel	-	150 lb - 900 lb	1500 lb and above				
	3 Inside su	face weld pro	otrusion		<u> - NU</u>	. 0	4040.0	Less	202.1	900 lb				
	Nominal Up to	Vall Thk. 6.4mm	: 1.6mm or less		Aus tenit stainle	- ic ess	A312 Gr. TP304	than 150 lb @	300 lb - 600 lb	above				
	Over 6 12	.4mm to 7mm	: 3.2mm or less		stee	el	Other than above	-	150 lb - 300 lb	and above				
	Over 12 25	2.7 up to 4mm	: 4.0mm or less		Note:	@ hig	When A312 oh temperature	Gr. TP30 service, t	4 is used he grade l	for cold of inspe				
	Over 2	25.4mm	: 4.8mm or less			tio lb.	n snall be app	iiea even	II IT IS NOT	above 15				
	4 Wave irre	gularity	; 2.5mm or less		9.4.2	lte	ms of non-des	tructive in:	spection a	nd numb				
	5 Irregular bead	neight of	: 2.0mm or less		of samples for the random inspection as follows:					n shall b				
	FACT EN	GINEER	ING AND DESI	[GN O]	RGANIS	SAT	ΓΙΟΝ							

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ITEM OF INSPECTION R - Radiographic Inspection M - Magnetic particle Inspection L - Liquid PenetrantInspection									
			O	oject of	inspecti	on			
	Mat	erial	Peri phery	Noz- zle (1)	Soc ket	Non pres- sure part			
GRA	DE - I								
	Carbon	Less than 150 Ib	3 %						
R	steel	Over 150 Ib to 300 Ib	10 %	-	-	-			
	A312 Gr	. TP304	10 %						
GRA	DE - II			1					
R	All ma	terials	20 %	-	-	-			
	Carbo	n steel	-						
M (3)	C-0.5 N Cr-Mo s Al-killeo 3.5-Ni s).5 Mo steel Mo steel killed steel 5-Ni steel	10,%	10 %	10 %	10 % (4)			
L (3)	Auste stainles Non-ferro	enitic ss steel us metals	(2)						
GRA	DE - III			r					
R	All ma	terials	100 %	-	-	-			
M (3)	All materia for auster less steel rous m non-magn	als except hitic stain- , non-fer- etals & letic metal	20 %	100 %	100 %	20 % (4)			
L (3)	Auste Stainles Non-ferro	enitic ss steel ous metal				~ /			

Notes

- (1) In "nozzle welding", welded parts of reinforcing plate and slip-on flange are included.
- (2) This inspection shall be performed for the welded parts other than those to which radiographic inspection was applied.
- (3) Either magnetic particle inspection or liquid penetrant inspection shall be performed.
- (4) This inspection shall be performed for Cr-Mo steel (A335 Gr. P5 or over grade) and 3.5Ni steel.

Remarks

- Radiographic inspection for peripheral joint shall be performed for pipes of nominal diameter of 2" or more having the same condition.
- 2. Number of random sampling test shall be at least one, when less than one is obtained in percentage of sampling
- Number of photographs to be taken for one peripheral joint at radiographic inspection shall be as follows:

PIPE SIZE NB	NO. OF PHOTOGRAPHS
50 to 80	150 x 2 sheets
100 to 150	300 x 3 sheets

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200 to 300	300 x 4 sheets
350 to 400	300 x 5 sheets
450	300 x 6 sheets
500	300 x 7 sheets
600	300 x 8 sheets
650 & above	With film overlap of 25mm or more, no of photographs shall be equivalent to peripheral length of the pipe

9.4.3 Radiographic examination

Unless otherwise specified, radiographic examination shall be as follows:

- 1. Radiographic inspection shall be performed in accordance with Article 2, Section V of the ASME Boiler and pressure vessel code.
- 2. The welds to be examined shall be selected based on the number of work products of each welder and welding operator engaged in all welding operations. A minimum of one weld per sample shall be examined.
- 3. All welded joints in a designated lot of piping shall be radiographed over the complete circumference.
- 4. When a random type examination reveals a defect, additional examination shall be performed in accordance with the requirements of appendix IV.
- 5. The radiation source shall, in principle, be x-ray or Gama-ray.
- 6. Film such as Sakura RR, Fuji #100, Kodak AA, or Equivalent shall be used.
- 7. Identification mark as shown in **Figure 10** (Page 28 of 28) shall be marked on every radiograph, and radiographs of repair weld shall be marked with repair mark (R).
- The image quality indicator (IQI) specified in B UB-51, ASME Section VIII, Division 1, or equivallent shall be used.
- Limitations on imperfection shall be in accordance with ANSI B31.3 TABLE 327.4.1 (A) for the degree of radiography involved.
- 9.4.4 Magnetic Particle/Liquid Penetrant Examination

- Liquid penetrant inspection shall be performed in accordance with Article 6, section V of ASME Boiler and pressure vessel code.
- 2. Limitations on imperfection shall be in accordance with ANSI B31.3 Table 327.4.1 (A)
- 3. The weld surface, to which liquid penetrant or maganetic particle examination is applied, shall be finished smoothly with a grinder as necessary.
- 4. If a defect is found in welds, the defect shall be removed, and liquid penetrant examination or maganitic particle examination shall be performed again to confirm that no more defects exist., and then rewelding shall be performed. After rewelding has been completed, liquid penetrant examination or maganetic particle examination shall be



Liquid penetrant or magnatic particle examination shall be as follows:

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Any harmful flaw on the flange face, inner

Shape and size of branches and other at-

tachment shall comply with drawings.

Inspection shall be performed visually and

touching by hand to confirm that no rust, slag,

spatter, sand, or other foreign matters are left. Inspector must confirm whether sufficient flush-

10.1.1 Prior to initial operation, the installed piping shall be pressure tested under witness of FEDO En-

10.1.2 Prior to the pressure test, a line check shall be performed based on P&I diagrams and the piping draw ings, in accordance with the instructions of the FEDO Engineer/ Representative.

10.1.3 Types of pressure test are as follows, however the test shall be performed in accordance with

Hydraulic test (using water or other liquids)

2. Removal of spatter and slag

and outer surface of pipe.

As-erected condition

9.7.0 Inspection for treatment of pipe inside

10.0.0 PRESSURE TEST AND OTHERS

gineer/ Representative.

the individual specification:

Pressure tests

Pneumatic test

test shall be retested.

Overall air tightness test

10.1.4 Before filling it with the test fluid, the entire line to be pressure tested shall be examined in the manner described in Section 9.0.0, and any

10.1.5 In principle, piping shall be pressure tested at a metal temperature not less than 2^oC. However, carbon and alloy-steel piping exceeding 25mm

10.1.6 The following equipment and instruments shall not be connected to the piping before comple-

discs and pressure relief valves.

temperature not less than 16°C.

bines, and compressors.

tion of the pressure test:

faults shall be repaired. The piping affected by any repairs or additions made after the pressure

in thickness shall be pressure tested at a

Rotating machinery such as pumps, tur-

Pressure relieving devices, such as rupture

Equipment that has a castable or lining

Piping which is normally open to the atmos-

phere such as drains, vents, and discharge

piping from pressure relieving devices.

2. Leak test

ing was performed.

3.

4.

5.

10.1.0 GENERAL

1.

1.

2.

3.

4.

5.

9.7.1

performed again to confirm that the rewelds are sound.

- Magnetic particle inspection shall be performed in accordance with Article 7, Section V of the ASME Boiler & pressure vessel code
- b. Limitations on imperfection shall be in accordance with ANSI B31.3 Table 327.4.1 (A)

9.5.0 HARDNESS TEST

- 9.5.1 After stress relieving (SR) is performed, hardness shall be tested as follows:
 - 1. If SR is performed by heat coil, the hardness test shall be carried out for all welds.
 - 2. If SR is performed in furnace, hardness test shall be performed for 10% of all welds (at least one-when 10% of all is less than one)
 - 3. Point to be tested shall be finished flat with file before the test.
 - 4. The hardness points shall be tested to weld and to heat affected zone. Hardness test of the heat affected zone shall be made at a point as near as practicable to the edge of the weld. When dissimilar materials are welded, both heat affected zones shall be tested.
- 9.5.2 Hardness limit is given in following table (Hardness In Brinell Max.)

P-No.	MATERIAL	HB (MAX)
P-3	A335 Gr.P1 (STPA12)	225
P-4	A335 Gr.P12 (STPA22) A335 Gr. P11 (STPA23)	225
P-5	A335 Gr. P22 (STPA24) A335 Gr. P5 (STPA25)	241

9.6.0 PRODUCT INSPECTION

Inspection for the finished product shall be performed as follows:

- 9.6.1 Dimension: Right angle, perpendicularity, parallelness, dimension, etc. shall be measured visually and by measuring tools and checked against the drawings. Dimensional tolerances are as follows:
 - 1. Length + 0; -3.2mm or less
 - Inclination of flange surface: less than 0.5° against the surface perpendicular to the axis of pipe. (but, not to exceed 2mm at outside circumference of flange).
 - 3. Perpendicularity of vertical line: 2/1000 or less.
 - 4. Horizontality: 2/1000 or less
 - 5. Misalignment between flange center and pipe center: 1.6mm or less
 - 6. Shift of bolt hole center: 1.0mm or less.
- 9.6.2 Inspection of connection to equipment: For those pipings which are connected with pump, compressor, turbine, etc., the above dimensional tolerance shall be submitted by the tolerances required by each of such machinery.
- 9.6.3 Appearance inspection:
 - 1. Correction for jig mark.

6. Any other designated equipment.

10.2.0 TEST FLUID

material.

Instruments.

Test fluid shall be as follows:

10.2.1 In principle, the fluid for hydrostatic testing shall be fresh water. Unless otherwise specified, the



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chlorine ion concentration in the fluid used for austenitic stainless steel piping shall not exceed 30 ppm. After completion of the test, the water shall be drained immediately, and the interior of the pipe shall be dried by an air blower, etc.

- 10.2.2 For piping systems having strong acids and So2 where water may become corrosive, or piping systems operated at a temperature of 0^oC or less, kerosene or similar light oils (with a flash point not less than 50^oC) or air is preferred as the test fluid.
- 10.2.3 The air to be used for pneumatic testing shall be compressed air from a portable compressor. However, for instrument air lines or where specifically specified, oil-free dry compressed air or inert gas shall be used. For high pressure piping (not less than 100 kgf/cm²G), the use of inert gas is preferable. When pneumatic testing is performed by the use of an air compressor, precautions against combustion shall be taken by blowing clean the oil separator thoroughly so that no lubricant enters the air.
- **10.3.0** TEST PREPARATION

The preparation for pressure test shall be as follows:

- 10.3.1 All joints (including welds) are to be left uninsulated and exposed for examination during the test. However, joints previously tested in accordance with this standard may be insulated.
- 10.3.2 When filling water into piping that is designated for vapor, gas, etc., not filled with water during operation, temporary supports or other reinforcements shall be provided beforehand.
- 10.3.3 Special fittings in piping components, such as expansion joints, filters, and flame arrestors, shall be disconnected from the piping.
- 10.3.4 Equipment which is not to be subjected to the pressure test shall be either disconnected from the piping or isolated by blinds or other means during the test.
- 10.3.5 If a pressure test is to be maintained for a certain period and the test liquid in the system is subject to thermal expansion, precautions shall be taken to avoid excessive pressure. In particu lar, for hydrostatic testing, care shall be taken to ensure that the water will not be subject to thermal expansion so that the piping is not damaged during the test.
- **10.4.0** TEST PRESSURE
- 10.4.1 Hydraulic Testing of Internally Pressured Piping
 - 1. The test pressure for piping subject to internal pressure shall be as follows:
 - a. Not less than 1.5 times design pressure
 - For a design temperature above the test temperature, the minimum test pressure shall be calculated by the following formula.

 $P_T = \frac{1.5PS_T}{S}$

Where

P_T= minimum hydrostatic pressure in kgf/cm2 G

P = internal design pressure in kgf/cm² G

S_T= allowable stress in kgf/cm² at test temperature

S = allowable stress in kgf/cm² at design temperature

- 3. If the test pressure as defined in Item (2) above produces a stress in excess of the yield strength at the test temperature, the test pressure may be reduced to the maximum pressure that will not exceed the yield strength at test temperature.
- 10.4.2 Hydrostatic testing piping with vessels as a system
 - Where the test pressure of piping attached to a vessel is the same as or less than the test pressure for the vessel, the piping may be tested with the vessel at the test pressure of the piping. However, the test pressure shall be controlled carefully so as not to exceed the test pressure of the vessel.
 - 2. Where the test pressure of piping exceeds the vessel test pressure, the piping shall be tested by isolating it from the vessel.
- 10.4.3 Hydrostatic testing of externally pressured piping : The test pressure for piping subjected to external pressure shall be as follows:
 - Lines in external pressure service shall be subjected to an internal test pressure of 1.5 times the external differential design pressure, but not less than a pressure of1.0 kg/cm²G (15 psig).
 - b. In jacketed lines, the internal line shall be pressure tested on the basis of the internal or external design pressure, which ever is critical. The jacket shall be pressure tested on the basis of the jacket design pressure unless otherwise specified.
- 10.4.4 Pneumatic testing
 - In principle, pressure tests shall be performed hydraulically, however, when it is inappropriate to fill piping with water, the test may be performed with air or inert gas. The test pressure shall be 1.1 times the design pressure.
 - Any pneumatic test shall include a preliminary check at not more than 1.75 kgf / cm²G (25 psig) pressure. The pressure shall be increased gradually in steps providing sufficient time to check for leaks.

10.5.0 TESTING METHOD

The method of pressure testing shall be in accordance with the instructions of FEDO. However, the general method by using water shall be as follows:

- 10.5.1 In principle, pressure tests shall be performed for each piping system. However, when design conditions do not permit testing in such a manner, the system may be tested in sections.
- 10.5.2 Test blinds shall have a handle extending out from the flange. The handle shall be painted in red, to ensure removal of blind after testing.
- 10.5.3 Installation and removal of blinds shall be performed in accordance with the instructions of



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FEDO. The number or all the blinds used and the location of the insertion shall be recorded at all times.

- 10.5.4 Test pressure gauges with graduations up to two times the prescribed test pressure shall be provided. All the pressure gauges shall be certified by the national authority, and the calibrations shall be checked by periodic inspections.
- 10.5.5 Two or more pressure gauges shall be installed so that they are easily observed. When the piping system to be tested extends from a low to a high level, pressure gauges shall be installed at both the lowest and the highest points.
- 10.5.6 For each piping system, an outlet for discharging the pressure in case of emergency shall be designated and marked to that effect.
- 10.5.7 During pressure testing of piping, operation of valves shall be prohibited and the valves shall be marked to that effect.
- 10.5.8 Prior to pressure testing, it shall be confirmed that a strainer is provided at a designated location to remove foreign matter.
- 10.5.9 Vents on piping subjected to hydrostatic testing shall be opened to remove the air when filling the piping with water.
- 10.5.10 Prior to hydrostatic testing, the piping shall be checked to confirm that it is free from air pockets and if necessary, temporary vents shall be provided to eliminate the air pockets until testing is completed.
- 10.5.11 For piping systems with a check valve, the pressure shall be applied from upstream of the valve. If this is impractical, the check valve shall either be reversed or shut off with blinds. However, when reversed, the valve shall be reinstalled correctly after testing.
- 10.5.12 When the test pressure is not less than 50 kgf / cm²G, pressure shall be increased gradually.
- 10.5.13 The test pressure during a pressure increase shall be read by the pressure gauge installed at the lowest point of the piping in consideration of the water head pressure.
- 10.5.14 The check for any leaks during the pressure test shall be performed after the prescribed pressure is maintained for a time not less than 10 minutes. All connections and all welded joints shall be inspected thoroughly.
- 10.5.15 After the completion of pressure testing, the water shall be drained immediately from the line to prevent the piping system from being damaged by freezing or thermal expansion. Also to prevent vacuum forming in the piping, the vents shall be opened when the water is being drained.
- 10.5.16 On completion of pressure testing, the line shall be checked to see that no residual pressure is present, and the line shall be drained. All blinds shall be removed.
- 10.5.17 Short pieces of pipe, which must be removed for installing blind plates and blind flanges, shall be tested separately.
- 10.5.18 All valves, orifice plates, expansion joints, short pieces of pipe, and other items removed or installed for the test, shall be reinstalled with the prescribed gaskets in the correct position.

10.6.0 REPAIR OF DEFECTS

The repair of defects found during test and inspection of piping systems shall be as follows. In principle, the repair shall be performed under witness of FEDO after the approval of the FEDO Engineer has been given.

- 10.6.1 Repair of welds
 - a. Repair welding shall be performed after the pressure and liquid remaining in the pipe have been removed.
 - b. The defects to be repair welded shall be removed completley with a grinder, etc.
 - c. The welding, the heat treatment, and the test and inspection shall be the same as required for the initial welding, and performed in accordance with the applicable provisions of this specification.
 - d. In principle, repair welding of the same portion shall not be performed more than twice.
- 10.6.2 Repair of Threaded Joints

All defective threaded joints shall be replaced with complete new ones.

10.6.3 Repair of Flange Joints

All defective flange joints shall be replaced with complete new ones, except those which can be repaired in accordance with Section 5.2 (15).

- 10.7.0 FLUSHING AND CLEANING
- 10.7.1 Selection of cleaning method
 - Cleaning method shall be selected in the following methods considering kind of fluid, pipe material and condition of internal surface of piping to be cleaned. Cleaning method and extend of cleaning shall be as per specific Project Requirements.
 - a. Water Flushing
 - b. Air Blowing
 - c. Steam Blowing
 - d. Acid Cleaning
 - e. Oil Cleaning
 - f. Others
- 10.7.2 Procedure of cleaning in general
 - 1. Cleaning of fabricated pipings

Inside surface and face of weld of fabricated piping shall be made free from slag, chamfer, scale and other foreign matter, with grinder, chisel, wire brush, etc., and be airblown. After completion of air blowing and checking, ends of the piping shall be covered with vinyl or veneer cap, etc. till the installation in the field.

2. Temporary Strainers

Temporary strainers shall be used as follows:

- a. After installation of piping, and before commencement of flushing/cleaning.
- The temporary strainers shall be installed at pump suction piping, upstream of control valve and other locations as specified.



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- c. Mark plate shall be attached to the temporary strainers to distinguish from other strainers.
- d. After a constant period of initial operation, all temporary strainers shall be removed, cleaned and reinstalled.

10.8.0 WATER FLUSHING

- 10.8.1 Cleaning method by water
 - As a rule, pure water, service water, steam condensate, industrial water, etc. shall be used. If there is any requirement about the quality of water to be used, it shall be observed.
 - 2. After flushing, drying by compressed air or natural drying shall be carried out. Drying by superheated steam shall be carried out with agreement between Customer and FEDO.
 - Flushing shall be performed till the water becomes free from foreign matter, scale, etc. This shall be decided by observing turbidity of water taken out (into beaker or cup).
 - 4. Water flushing shall be performed by the method of running by pressurised water and hammering, or rapid draining with water filled. Hammering shall, however, not be performed for austenitic stainless steel pipe, copper pipe, aluminum pipe.
 - 5. The primary cleaning shall be performed for each assembled piping system including the equipment.
 - 6. Where instruments are included in piping system to be cleaned, the instruments shall, as a rule, be disconnected and spool pipe (distance piece) shall be inserted instead.
 - 7. When cleaning is carried out in the condition that control valve is connected, the procedure shall be as follows:
 - a. Disconnect companion flange at upstream side of the control valve and cover opening of the control valve.
 - b. Clean the piping of upstream side.
 - c. Connect the control valve and the piping of upstream side after cleaning.
 - d. Close the control valve, open by-pass valve, and then clean the piping of down stream side. Where the by-pass valve is not installed, the temperory strainer having austenitic stainless steel screen of No. 50 specified in ASTM E-11 shall be inserted.
- 10.8.2 Air blowing
 - 1. Air blowing shall be performed by the method of blowing by pressurized air and hammering. Hammering shall, however, not be performed for austenitic stainless steel pipe, copper pipe and aluminum pipe.
 - Blowing shall be performed till there remains no scale in the piping. FEDO personnel in charge shall make judgement of whether the result of the cleaning is statis-

factory or not

- 3. The primary cleaning shall be performed for each assembled piping. The secondary cleaning shall, as a rule, be performed for piping from eqpt. to adjacent eqpt. Whether or not the equipment is included shall be determined considering shape, internal construction & packing of the eqpt. and according to overall cleaning planning.
- 10.8.3 Steam blowing
 - Execution of steam blowing Steam blowing shall be executed after completion of pressure test and insulation work.
 - 2. Preparation of steam blowing
 - a. Temporary piping work, countermeasure for safety & confirmation of preparation shall be done according to blowing plan.
 - b. Support shall be attached to exhaust piping to prevent accident caused by the reaction force during blowing.
 - 3. Procedure of steam blowing
 - a. Warm up the piping with cooperation by operator
 - b. Check expansion joints, spring hangers, etc., for expected thermal expansion.
 - c. Steam blowing shall be performed at the temperature near to the operating temperature, considering operating condition of boiler.
 - d. To remove the scale effectively by temperature change, it is required to perform flushing and cooling cyclically, having temperature difference as large as possible between the flushing and cooling.
 - 4. Judgement criteria of steam blowing
 - a. Judgement on result of steam blowing shall generally be done by checking color or quantity of foreign material present in the drain sampled.
 - b. If necessary, especially for suction line of steam turbine etc., result of flushing shall be judged by observing whether scratch was produced or not on the test piece inserted in the line.
- 10.8.4 Acid cleaning
 - 1. Applicable piping of acid cleaning
 - Unless otherwise specified in specific job requirements, acid cleaning shall apply to oil piping system of rotating machinery.

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 Cleaning method by acid As a rule, acid cleaning procedure shall be as follows:

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- a. Ten-percent hydrochloric acid solution or Ten-percent sulphuric acid solution with temperature 30 to 40^{0} C shall be used, and piping shall be pickled in the acid solution for 1 to 6 hours.
- After pickling, the piping shall be washed sufficiently to remove the acid solution by water.
- c. And the piping shall be rinsed for neutralization of the acid solution by sodium hydroxide solution, followed by water flushing.
- d. The piping shall be well dried by superhaeted steam or dry air and the inside of pipes given a coat of the oil of the same quality as specified to be used in the oil piping.
- **Remarks:** Oil piping of stainless steel shall not be acid cleaned.
- 10.8.5 Oil cleaning
 - 1. Applicable piping of oil cleaning
 - Oil cleaning shall apply to the oil piping system after the acid cleaning specified in par. 10.8.4 has been performed.
 - 2. Cleaning method by oil

The procedure shall be as follows:

- Oil to be used shall have good quality suitable for the machinery, and shall be completly replaced with the specified oil after cleaning.
- b. The cleaning shall be performed by the method of circulation of the oil and hammering. Hammering shall, not be performed for copper pipe.
- c. After completion of cleaning, it shall be checked that no foreign matter is present in temporary strainer screen of No.200 specified in ASTM E- 11 for oil pipings of centrifugal compressor, and screen of No.100 specified in ASTM E-11 for other oil pipings.
- 10.8.6 Other cleaning method
 - Cleaning method by pig or cushion ball Cleaning by the use of pig or cushion ball shall confirm to specific job requirements.
 - 2. Cleaning method by sodium hydroxide
 - Cleaning by sodium hydroxide solution shall conform to specific job requirements.
 - Special cleaning Special Cleaning, if specified for special piping components or systems, shall conform to specific job requirements.
- **10.9.0** Overall airtightness test
- 10.9.1 When specified, an overall airtightness test shall be performed for the piping of process line by the use of air or inert gas after completion of flushing.

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10.10.0 Disposition

10.10.1 All construction equipment used for the piping work, and all surplus, scrap and debris shall be disposed of in accordance with the instructions of the FEDO Engineer.

10.11.0 Test record

10.11.1 All inspection and test results shall be made into re cords in accordance with the instructions of FEDO. The records shall be submitted for approval to FEDO.

11.0.0 APPENDICES

11.1.0 The following Appendices shall form a part of this manual:

TITLE	REFER TO:
Grove face Rust Preventive	APPENDIX I
Selection of welding electrodes	APPENDIX II
Procedure for Flange Bolt up	APPENDIX III
Additional Random Type	APPENDIX IV

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<u>APPENDIX – I</u>

GROOVE FACE RUST PREVENTIVE

Features of Product

- 1. As rust preventive applied to the groove face, in general, deoxialuminite is used as it is not detrimental to the weld. Deoxialuminite is the brand name of a product of Special Chemical Co., Ltd.of USA. This was first produced in Japan by Nippon Oil & Fats Co., Ltd. and is sold under the brand name of Tasteto Silver.
- 2. The composition of the product is 40% resin, 50% solvent, 5% pigment, etc., and the percentage of resin in the compound is high to reduce the amount of gas produced during welding.
- 3. This product is recommended for both marine and overland transportation. The thickness of the applied product shall not be more than 30 microns.
- 4. The adherent durability is not more than three months.

Directions for Use

- 5. Before applying the rust preventive, it shall be confirmed that the groove face is clean.
- 6. After the rust preventive has been applied, welding shall not be performed within two weeks.
- 7. In principle, the application shall be sprayed by maintaining a distance not less than 30 cm from the spray nozzle to the object. Unless otherwise specified, the product shall not be applied with a brush.

<u>APPENDIX — II</u>

SELECTION OF WELDING ELECTRODES & RODS

Table - I : Selection of welding electrodes & rods for joining similar materials except Aluminium Table - II : Selection of welding electrodes & rods for joining disimilar materials except Aluminium

(Tables overleaf)

APPENDIX — III

PROCEDURE FOR FLANGE BOLT UP Confirmation Prior to Bolt Up

The following items shall be confirmed prior to bolt up:

- 1. The gasket has been inserted and centered.
- 2. Bolts and nuts have been lubricated.
- 3. Bolts have been inserted and are finger tight.
- 4. There are at least two threads extending beyond the nut on either side.

Procedure for Bolt Up

Procedure for flange bolt up shall be as follows

- 5. Hand tighten bolts with a short wrench by the procedure shown in Figure 11.
- 6. Tighten bolts a second time with a spanner wrench and light hammer (about 1 kg), again by the procedure shown in Figure 11.
- 7. Continue tightening gradually by the procedure shown in Figure 11, using a heavy hammer (about 2 kg) until bolts are completely drawn tight. This may take two or three additional rounds by the same procedure.
- 8. For bolts larger than 25mm in diameter, a final round or two with a heavier hammer (about 3.5 kg) is recommended to reach the correct bolt tension.

Precautions

Special precautions shall be taken for the following items for bolt up:

- 9. Never draw up tight on one or two bolts only. This will cause local gasket crushing or pinching, which will result in leaks.
- 10. After each round of tightening, the alignment may be checked by measuring the distance between flange faces.
- 11. The bolts should be gradually and evenly tightened with a wrench and hammer until the hammer begins to "bounce" with a distinct ring.

<u>APPENDIX – IV</u>

ADDITIONAL RANDOM TYPE EXAMINATION FOR WELD DEFECTS

(Taken from ANSI / ASME B31.3b-1982, 336.5)

When the required examination of a spot or random type reveals a defect requiring repair, two additional examinations of the same type shall be made on the same kind of item (if of a weld, others by the same welder or welding operator). If the second group of items examined is acceptable, all items represented by these additional examinations shall be accepted.

For each of the second group of items which reveals defects requiring repair, two additional items shall be examined. If all of the third groups of items examined are acceptable, the items requiring repair shall be repaired or replaced to meet the requirements of the code, and all items represented by the examined items shall be accepted.

If any of the third group of items examined reveal defects requiring repair, all comparable items may be replaced or they shall fully examined and repaired as necessary to meet applicable quality requirements.



ENG	INEERING	G FABRIC	ATION &	FRECTION OF	25E	S205 / 94 - R1				
SPEC	CIFICATIO	N I / DITE	STEEL	PIPING	PA	GE 26 OF 28				
	TABLE - I	SELECTION OF WELDING	ELECTRODE	S & RODS FOR SIMILAR MAT	ERIALS EXCEP	T ALUMINIUM				
MATL.		BASE	COV	ERED ELECTRODES	WELD	WELDING RODS				
NO.		MATERIAL	AWS SPEC	PREFERRED ELECTRODE	AWS SPEC.	CLASSIFICATION				
1		UTS UNDER 60,000psi	A 5.1	E6010/E6013 (1)	(2) (3) (4)	—				
2	carbon steel	UTS 60,000psi & above	A 5.1	E6010/ E7018 (1)	(2) (3) (4)	—				
2a		A333 Gr - 1	A 5.1	E7018 -1(5)	(5)					
3	с	arbon-molybdenum	A 5.5	E70XX-A1	(2) (3) (4)	—				
4		2 ¹ / ₄ nickel	A 5.5	E80XXC1	(2)	—				
5		3 ¹ / ₂ nickel	A 5.5	E80XX-C2	(2)	—				
6		9 nickel	A 5.11	ENi Cr Fe - 3	A5.14	ER Ni Cr -3				
7		¹ / ₂ Cr- ¹ / ₂ Mo	A 5.5	E8015-B2L	(2)	0.05C max.				
8		1Cr-1/2Mo	A 5.5	E8015-B2L	(2)	0.05C max.				
9	low	1 ¹ / ₄ Cr- ¹ / ₂ Mo	A 5.5	E8015-B2L	(2)	0.05C max.				
10	chromium ferrtic	2 ¹ / ₄ Cr–1Mo	A 5.5	E9015-B3L (0.05C max.)	(2)	0.05C max.				
11	steels	5Cr-1/2Mo	5Cr ⁻¹ / ₂ Mo A 5.4 E502-I5 (0.05C		A5.9	ER502(0.05C max)				
12		7Cr-1/2Mo	A 5.4	E7Cr-I5 (0.05C max.)	(2)	(0.05C max.)				
13		9Cr–1Mo	A 5.4	E505-I5 (0.05C max.)	A5.9	ER505(0.05C max)				
14		AISI Type405	A 5.4	E410-I5 (0.05C max.)	A5.9	ER410(0.05C max)				
15	ferrtic	AISI Type 410S	A 5.4	E410-I5 (0.05C max.)	A5.9	ER410(0.05Cmax)				
16	stainless	AISI Type410	A 5.4	E410-I5 (0.05C max.)	A5.9	ER410(0.05C max)				
17		AISI Type430	A 5.4	E430-I5	A5.9	ER430				
18		AISI Types 304&304H	A 5.4	A 5.4 E308-I5 or 16		ER308				
19		AISI Type 304L	A 5.4	E308L-I5 or 16	A5.9	ER308L				
20		AISI Types321&321H	A 5.4	E347-I5 or 16	A5.9	ER347				
21		AISI Types 347 & 347H	A 5.4	E347-I5 or 16	A5.9	ER347				
22	stainless	AISI Types 316 & 316H	A 5.4	E316-I5 or E 16 -8 -2	A5.9	ER316				
23	Sleeis	AISI Type 316L	A 5.4	E316L-I5 or 16	A5.9	ER316L				
24		AISI Type309	A 5.4	E309-I5 or 16	A5.9	ER309				
25		AISI Type310	A 5.4	E310-I5 or 16	A5.9	ER310				
26		Incoloy(32Ni46Fe20Cr)	A 5.11	ENi Cr Fe-2	A5.14	ERNiCr -3				
27		AluminiumBronze	A 5.6	ECu Al-A1	A5.7	RCu Al-A2				
28		Phosphor Bronze	A 5.6	ECuSn-C	A5.7	RCuSn-A				
29		Copper	A 5.6	ECu	A5.7	RCu				
30	non–	67Ni-30Cu Monel	A 5.11	ENiCu-4	A5.14	ERNiCu-7				
31	ferrous metals &	Hastalloy(60Ni-28Mo-5Fe)	A 5.11	ENiMo - 1	A5.14	ERNiMo-4				
32	alloys	Inconel(75Ni 15Cr8Fe)	A 5.11	ENiCrFe -1	A5.14	ERNiCrFe-5				
33		70Cu-30Ni	A 5.6	ECuNi	A5.7	RCuNi				
34		Nickel	A 5.11	ENi-1	A5.14	ERNi-3				
35		20Cr-29Ni-2 ¹ / ₂ Mo-3Cu	-	Alloy 20 Cb - 3	_	Alloy 20Cb3				

Notes:

(1) For materials Nos.1 and 2 (Carbon steel) where SMAW is followed, the root run shall be with E 6010 electrodes.

(2) Where no AWS specification exists for base wire, it is acceptable to use wire or rods of the same nominal composition as the base material with substantially neutral flux or inert gas, provided they have been qualified in the procedure test.

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(3) MIG wire shall conform to AWS A5.18 and A5.20

(4) SAW wire and flux shall conform to AWS A5.17

(5) The root run of butt welds for material No. 2a shall be made in GTAW process using ER70S - 2 wires.

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	TABLE II — SELECTION OF WELDING ELECTRODES & RODS FOR WELDING DISSIMILAR MATERIALS EX- CEPT ALUMINIUM																									
Lower	Higher base material number																									
mat'l No.	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	35
1	А	А	А	А	А	В	В	В	В	В	В	В	В	В	В	В	С	С	С	С	С	С	D	D	Е	С
2		А	А	А	А	В	В	В	В	В	В	В	В	В	В	В	С	С	С	С	С	С	D	D	Е	С
3			@	@	@	В	В	В	В	В	В	В	В	В	В	В	С	С	С	С	С	С	D	D	Е	С
4				А	А	@	@	@	@	@	@	@	@	@	@	@	С	С	С	С	С	С	D	D	Е	@
5					А	@	@	@	@	@	@	@	@	@	@	@	С	С	С	С	С	С	D	@	Е	@
6						@	@	@	@	@	@	@	@	@	@	@	Е	Е	Е	Е	Е	Е	Е	@	Е	@
7							А	А	А	А	А	А	А	А	А	А	С	С	С	С	С	С	D	Е	С	@
8								А	А	А	А	А	А	А	А	Α	С	С	С	С	С	С	D	Е	С	@
9									А	А	А	А	А	А	А	А	С	С	С	С	С	С	D	Е	С	@
10										А	А	А	А	А	А	А	С	С	С	С	С	С	D	Е	С	@
11											А	А	А	А	А	Α	С	С	С	С	С	С	D	Е	С	@
12												А	А	А	А	А	С	С	С	С	С	С	D	Е	@	@
13													А	Α	А	Α	С	С	С	С	С	С	D	Е	@	@
14														А	А	Α	С	С	С	С	С	С	D	Е	@	@
15															А	Α	С	С	С	С	С	С	D	Е	@	@
16																Α	С	С	С	С	С	С	D	Е	@	@
17																	С	С	С	С	С	С	D	E	@	@
18																		A	A	A	A	A	A	A _	A _	С
19																			F	F	F	A	F	F	F	C
20																				A	A	A	A	A	A	C
21																					A	A	A	A	A	C
22																						A	A	A	A	C
23																							A	A	A	C
24																								С	E	C
25	E C							C																		
26	6 C							С																		

DESCRIPTION OF CODE LETTERS IN ABOVE TABLE

- A As specified in table I for material corresponding to either the higher or lower base material number
- B ASME SFA-5.5, E8015-82L electrode
- C ASME SFA-5.4, E309 electrode. Acceptable alternatives shall be as specified in table I for the higher base material number
- D As specify in table I for the material with the higher base material number
- E ASME SFA-5.11, ENiCrFe-2 electrode and ASME SFA-5.4. ERNiCr-3 rods shall be used where design temperature exceeds 1000⁰F (538⁰C). ASME SFA-5.4, E310 electrodes are to be used where service temperatures are below 1000⁰F (538⁰C) and expected to be relatively constant after start up. All rods, excluding alternatives shall require written approval from designated authority.
- F ASME SFA-5.4, E308 electrode or as specified in table I for the material with the higher base material number

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@ Welding of these material combinations are not permitted without written approval from designated authority.



CONTENTS

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- 2.0.0 REFERENCE
- **3.0.0** COMPLETENESS OF CONTRACT
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- 5.0.0 STANDARDS & REGULATI 6.0.0 SERVICE CONDITIONS
- 7.0.0 EARTHING
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- **9.0.0** NAME PLATES
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- 17.0.0 TESTS
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- **19.0.0** INSTRUCTIONS TO THE BIDDER

1.0.0 SCOPE

1.1.0 This specification covers the general requirements for supply and installation of all electrical items as applicable.

2.0.0 REFERENCE

- 2.1.0 The following documents shall be read in conjunction with this specification:
- 2.1.1 Data sheet of General Requirements for Electrics.
- 2.1.2 Engineering specifications, Data sheets and Technical Particulars of individual equipment / items.
- 2.1.3 Scope of work, Scope of Inspection and Tests, Special requirements of the project, Vendor Data Requirements, etc attached with the Technical Procurement Specifications.

3.0.0 COMPLETENESS OF CONTRACT

3.1.0 The electrics supplied / installed shall be complete with all accessories for the safe, smooth and efficient operation of the system. Such parts shall be deemed to be within the scope of this specification whether specifically mentioned or not.

4.0.0 COMPONENTS AND CONSTRUCTION

4.1.0 Each and every component shall be of reputed make and be of proven design for best performance, reliability and durability. They shall be brand new. Workman ship shall be of the highest grade and the entire construction shall be in accordance with the best modern engineering practice.

5.0.0 STANDARDS & REGULATIONS

5.1.0 All electrical equipment / installations shall fully comply with the requirements laid down in the following rules / regulations / acts / standards / codes as amended up to date.

 PRPD.:
 CHKD.:
 APPRD.:
 ISSUED ON SEPT 2014

 FACT ENGINEERING AND DESIGN ORGANISATION
 ISSUED ON SEPT 2014

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- 5.1.1 Indian Electricity Rules.
- 5.1.2 Indian Electricity Act.
- 5.1.3 Indian Electricity Supply Act.
- 5.1.4 Indian Factories Act.
- 5.1.5 Fire Insurance Act.
- 5.1.6 Petroleum Rules.
- 5.1.7 OISD Standards.
- 5.1.8 Pollution control norms as per Environmental Regulations.
- 5.1.9 Standards / regulations of statutory bodies applicable for the place of installation.
- 5.1.10 Relevant Indian / International standards and in their absence, the standards of the country of manufacture.
- 5.2.0 Vendor shall furnish all necessary assistance & documents for obtaining approval from statutory bodies. Making whatever additions/ modifications considered necessary by the Electrical Inspectorate and other authorities to bring the equipment / installation in conformity with the above rules, Regulations, acts and standards shall be in the scope of the vendor.
- 5.3.0 All equipment shall be of tropical design according to relevant Indian / International Standards.
- 5.4.0 All electrics shall be suitable for the hazardous / non-hazardous area involved and /or specified. Electrics suitable for the hazardous area involved shall be selected as per the relevant Indian Standards and shall be of proven design approved by CIMFR / relevant statutory bodies. In such cases copies of relevant certificates shall be furnished for Purchaser's approval.

6.0.0 SERVICE CONDITIONS

6.1.0 All equipment shall be suitable for the service conditions specified in the **Data sheet of General Requirements for Electrics** attached.

7.0.0 EARTHING

7.1.0 Duplicate earthing terminals, suitable for terminating earthing conductors of sizes indicated in the data sheets of individual equipment, shall be provided on the body of the equipment apart from those, if any, provided inside the terminal boxes.

8.0.0 POWER SUPPLY DETAILS

- 8.1.0 The equipment shall be suitable for the power system details furnished in the **Data sheet** of **General Requirements for Electrics** unless otherwise specified in the data sheets of individual equipment.
- 8.2.0 The equipment shall perform satisfactorily even with variation in supply voltage and frequency as detailed in the data sheets. The equipment shall operate at the specified rating without exceeding the permissible temperature rise as per the relevant I.S. in spite of the variation in supply voltage and frequency.



9.0.0 NAME PLATES

9.1.0 Necessary nameplates, conforming to standards, giving relevant details of the equipment, shall be provided on individual equipment. Any additional details shall also be indicated in the nameplate, if so specified in the specifications / data sheets of individual equipment.

10.0.0 PAINTING

- 10.1.0 Unless otherwise specified in the specifications / data sheets of individual equipment / items, painting procedure described in this clause shall be adopted.
- 10.2.0 All exposed metal parts shall be subjected to at least the following pretreatment before painting to suit the material and environment involved.
- 10.2.1 De-greasing.
- 10.2.2 Rust removing.
- 10.2.3 Phosphating/ equivalent chemical treatment.
- 10.2.4 Giving two coats of corrosion resistant primer suitable for final coating.
- 10.3.0 Two coats of anticorrosive painting shall be given after the above process so as to render the materials suitable for the highly corrosive environment specified.
- 10.4.0 Final Colour and finish of the equipment shall be Dark Admiralty Grey (shade no: 632) as per IS: 5 unless otherwise specified in the data sheet for individual equipment/item.
- 10.5.0 Vendor shall furnish detailed painting procedure proposed, along with the bid.

11.0.0 INTER-CHANGEABILITY

11.1.0 All similar parts shall be inter-changeable with each other.

12.0.0 DANGER NOTICE PLATES

12.1.0 Danger Notice plates conforming to IS: 2551 and other statutory requirements shall be affixed on equipment wherever required.

13.0.0 TOOLS AND APPLIANCES

- 13.1.0 The vendor shall supply one set of special tools and appliances that may be required for carrying out the maintenance, special inspection etc. of the equipment offered, without any extra cost.
- 13.2.0 Vendor shall also furnish list of tools and appliances required for the maintenance of different equipments.

14.0.0 SERVICES OF MANUFACTURERS' TECHNICAL EXPERTS

14.1.0 Services of the manufacturer's technical experts shall be made available to the Purchaser, if found necessary, during erection, testing, and commissioning and during the guarantee period.

15.0.0 TRAINING

15.1.0 The vendor shall render all facilities free of cost for imparting training to purchaser's technical personnel at manufacturer's works, if required, for the proper assembly, installation, testing, commissioning, operation and maintenance of the equipment supplied. The travel and living expenses of the personnel deputed for training will be borne by the Purchaser.



16.0.0 PERFORMANCE OF EQUIPMENT

16.1.0 Duly filled in **Technical Particulars** of individual equipment / item shall be furnished as per formats attached. Performance figures of the equipment as per **Technical Particulars** furnished along with the offer shall be guaranteed.

17.0.0 TESTS

17.1.0 All the tests specified in **Scope of Inspection & Tests** attached along with the **Technical Procurement Specification** shall be performed.

18.0.0 DOCUMENTS

18.1.0 Drawings and documents shall be furnished as per Vendor Data Requirements (VDR) attached with Technical Procurement Specification.

19.0.0 INSTRUCTIONS TO THE BIDDER

- 19.1.0 All the drawings and documents as per Vendor Data Requirements shall be furnished along with the offer. Offers without these details will be treated as incomplete and are liable for rejection.
- 19.2.0 In the absence of clearly spelt-out item wise deviations from purchaser's specification, it will be presumed that the equipment offered are in conformity with the specification.
- 19.3.0 The Vendor shall supply all equipments and items of make specified in the vendor list attached with the specification. The Vendor shall obtain Purchaser's approval before placement of purchase order for electrical items / components wherever makes are not specified in the respective data sheets.



CONTENTS

- 1.0.0 SCOPE
- 2.0.0 REFERENCES
- 3.0.0 STANDARDS
- 4.0.0 GENERAL REQUIREMENTS
- 5.0.0 STARTING CURRENT AND TORQUE
- 6.0.0 NUMBER OF STARTS
- 7.0.0 INSULATION
- 8.0.0 CONSTRUCTION
- 9.0.0 VENTILATION
- **10.0.0** BEARINGS AND LUBRICATION
- **11.0.0** WEATHER-PROOFING
- 12.0.0 TERMINAL BOXES AND TERMINATIONS
- 13.0.0 EARTHING
- 14.0.0 NAME PLATES
- 15.0.0 LIFTING FACILITIES
- 16.0.0 COUPLINGS
- 17.0.0 ANTICONDENSATION HEATERS
- 18.0.0 PROTECTION
- 19.0.0 RECIPROCATING COMPRESSOR FACTOR
- 20.0.0 MOTOR SUPPLIED AND ORDERED ALONG WITH THE DRIVEN MACHINE
- 21.0.0 ADDITIONAL ACCESSORIES / REQUIREMENTS
- 22.0.0 DESPATCH

1.0.0 SCOPE

1.1.0 This specification covers the general requirements for design, manufacture, testing and supply of medium voltage induction motors.

2.0.0 REFERENCE

- **2.1.0** The following documents shall be read in conjunction with this specification.
- 2.1.1 Engineering specification and Data Sheet of General requirements for electrics
- 2.1.2 Data sheet of Medium Voltage Induction Motors
- 2.1.3 Technical particulars of Medium Voltage Induction Motors

3.0.0 STANDARDS

3.1.0 All motors shall comply, wherever applicable, with the latest issues of the following Indian Standards and other relevant standards.

PRPD.:		CHKD.:	APPRD. :	ISSUED ON SEPT 2014					
	IS: 2223	Dimensions of flange	mounted AC Induction M	otors					
		test and marking for type of protection "n"							
	IS/IEC60079-15	Electrical apparatus f	or explosive gas atmosph	eres: part 15-construction					
	IS/IEC60079-7	enclosures "p" Electrical apparatus f	or explosive gas atmosph	eres: part 7-Increased safety"e"					
	IS/IEC60079-2	enclosures "d" Electrical apparatus f	or explosive gas atmosph	eres: part 2-Pressurized					
	IS/IEC60079-1	requirements Electrical apparatus f	or explosive gas atmosph	eres: part 1-Flame proof					
	IS/IEC60079-0	Electrical apparatus f	or explosive gas atmosph	eres: part 0-General					
	IS: 1271	Classification of insul	ating materials						
	IS: 1231	Dimensions of 3 phase	se foot mounted Induction	Motors					
	IS: 325	3 Phase Induction Mo	otors						



ENGINEERING	MEDIUM VOLTAGE INDUCTION MOTORS	13ES910/14		
SPECIFICATION	MEDIUM VOLTAGE INDUCTION MOTORS	Page 2 of 6		
IS: 2253	Designations for types of construction and mounting arrangements of rotating electrical machines			
IS: 2254	Dimensions of vertical shaft motors for pumps			
IS: 4029	IS: 4029 Guide for testing three phase induction motors			
IS: 4691	IS: 4691 Degrees of protection provided by enclosure for rotating electrical machinery			
IS: 4722 Rotating electrical machines				
IS: 4728 Terminal markings and direction of rotation for rotating electrical machinery				
IS: 4889	IS: 4889 Methods of determination of efficiency of rotating electrical machines			
IS: 6362	IS: 6362 Designation of methods of cooling of rotating electrical machines			
IS: 6381	IS: 6381 Construction and testing of electrical apparatus with type of protection"e"			
IS: 7389	IS: 7389 Pressurized enclosures of electrical apparatus for use in explosive atmospheres			
IS: 8789	IS: 8789 Values of performance characteristics for 3 phase induction motors			
IS: 1206	IS: 12065 Permissible limits of noise levels for rotating electrical machines IS: 12075 Mechanical vibration of rotating electrical machines with shaft heights from 56 & higher measurement, evaluation and limits of vibration severity			
IS: 1207				
IS: 1261	5 Energy efficient motors			

4.0.0 GENERAL REQUIREMENTS

- **4.1.0** All machines shall be continuous maximum rated (Class S1 as per IS:325) under the operating conditions specified in the data sheet, and shall be suitably protected for operation under the service conditions stated in data sheet.
- **4.2.0** Motors for hazardous areas shall be of a design for which approval has been obtained from the Central Mining and Research Institute (CMRI), Dhanbad, for use in the particular hazardous area specified. All motors approved as above, shall have a separate nameplate carrying the details of such approval, fixed on the body adjacent to the main nameplate. The approval / certification shall be latest/relevant.
- **4.3.0** The motor coupled to its driven machine shall start and operate successfully under full load even if the voltage at the motor terminals is lowered to 80% of rated voltage for 30 seconds.
- **4.4.0** Critical speeds should be either well below or well above the normal running speeds of the motor.
- **4.5.0** Slip at rated load shall not exceed 3% at rated voltage and frequency.
- **4.6.0** The motors shall be liberally designed as regards their pullout torque, pullout voltage and their ability to ride through voltage dips during system disturbances. They should, if required, be suitable for automatic restart under full load after a momentary lack of supply voltage, with the possibility of the restored supply voltage being out of phase with respect to the motor residual voltage. The extent to which the motor has to withstand out of phase residual voltage (in percentage) shall be as specified in the data sheet.

5.0.0 STARTING CURRENT AND TORQUE

- **5.1.0** All motors are envisaged to be started direct on line across full line voltage unless otherwise specified in the data sheet. The rotor shall be squirrel cage type unless otherwise specified in the data sheet. The rotor shall be dynamically balanced with fan and half key on the rotor shaft.
- **5.2.0** The starting characteristics of the machine shall be carefully selected as to:
- 5.2.1 Satisfy the torque requirements of driven machine, even where reduced voltage starting is specified in the data sheet.
- 5.2.2 Have starting time which is less than locked rotor withstand time (hot) of the motor by at least two seconds, at the rated conditions of voltage and frequency specified, with driven machine coupled.
- 5.2.3 Ensure that starting current is not normally more than 600% of full load current at the rated voltage and frequency (subject to IS tolerance) unless otherwise specified in the data sheet.



ENGINEERING SPECIFICATION			13ES910/14		
		MEDIUM VOLTAGE INDUCTION MOTORS	Page 3 of 6		
5.2.4	Ensure that accelerating torque is not too large to cause stressing of the transmission e the driven machine				
5.2.5	Ensure that motor is suitable for starting at 80% of the rated voltage against torque speec characteristics of the driven equipment.				
6.0.0	NUMBER OF STARTS				
6.1.0	The motor shall be suitable for the number of starts specified in the data sheet. If nothing is specified in data sheet, then the motor should be suitable for Direct-on-line starting with minimum number of starts stated below: a) Three successive cold starts b) Two successive hot starts c) Four uniformly spaced starts per hour				
7.0.0	INSULA	TION			
7.1.0	Insulatio	n class shall be class F with temperature rise limited to class B			
7.2.0	Motor winding shall be done using copper conductor only				
7.3.0	The winding shall be tropicalised.				
7.4.0	All windings shall be treated with humidity, acid and alkali resisting protective coating like epoxy gel to withstand service conditions in an industrial atmosphere described in data sheet.				
8.0.0	CONSTRUCTION				
8.1.0	The motor shall be able to withstand the corrosive atmosphere mentioned in data sheet. External screws and bolts shall be protected particularly against corrosion by passivation.				
8.2.0	The enclosure shall be provided with the required degree of protection, viz IP 55 (Indoor) / IPW5 (Outdoor) / Flameproof / Flameproof weatherproof, etc. as specified in the data sheet.				
8.3.0	Vibration	and noise levels shall not exceed those given in the relevant IS.			
8.4.0	Motor frame sizes shall be in accordance with IEC recommendation in the absence of Indian Standards. For a particular motor, required frame sizes as per IS / IEC or higher frame size sha only be supplied.				
8.5.0	The shaft shall be generously proportioned for transmitting continuous full load torque and any specified overload or duty, which may be created by the driven machine. In designing the moto shaft and bearing systems, the manufacturer shall take full account of the characteristics, thrust shaft system and bearing system of the driven machine and also the type of coupling proposed, so as to give a completely satisfactory shaft and bearing system.				
8.6.0	The motors shall be suitable for connecting capacitor at the motor terminals, if required in data sheet. Rating of capacitor shall be as indicated in the data sheet. If there is any limitation inadequacy with regard to the rating of the capacitor that can be connected to the motor, the findings shall be clearly substantiated in the Technical Particulars.				
8.7.0	Condens whereve	sate drains shall be provided where water may collect. Drain holes shall a r required.	also be provided,		

- **8.8.0** Foundation rails if any, foundation bolts, nuts; washers, etc. shall be supplied.
- **8.9.0** All motors shall be capable of standing idle for long periods without damage to the bearings.



9.0.0 VENTILATION

- 9.1.0 Motors shall be self-ventilated.
- **9.2.0** Materials of construction of fans, tubes, etc. used shall be suitable for the environment specified in the data sheet.
- **9.3.0** Motors shall be bi-directional, i.e. suitable for rotation in clockwise and anti-clockwise directions.

10.0.0 BEARINGS AND LUBRICATION

- **10.1.0** The bearings shall be of reputed manufacturer and of a type interchangeable with bearings from other makes.
- **10.2.0** The method and type of lubrication shall be selected by the manufacturer and shall be suitable for the rating (kW), speed and duty involved.
- **10.3.0** Excess grease escape devices shall be provided.
- **10.4.0** Grease migration to winding shall be prevented.
- **10.5.0** Necessary grease nipples for online lubrication from outside shall be provided for both Drive End and Non-Drive End bearings. Whenever grease nipples are provided, these shall be associated, where necessary, with appropriately located relief devices to ensure passage of grease through the bearings.
- **10.6.0** Name and grade of lubricant shall be given in the motor nameplate.
- **10.7.0** Lubrication schedule for the motors shall be indicated in the nameplate or shall be furnished separately in the maintenance manual.
- **10.8.0** Details of bearing shall be furnished in the test certificates, to facilitate ordering of spares.

11.0.0 WEATHERPROOFING

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11.1.0 If Outdoor service is specified in the data sheet, the motors shall be suitable for operation in direct sun and rain, without further protection (like canopy, hood, etc.) from weather. However, vertical motors shall be provided with a hood over the fan cover, as an integral part of the motor.

12.0.0 TERMINAL BOXES AND TERMINATIONS

- **12.1.0** The motors shall be complete with compression type cable glands suitable for the armoured PVC /XLPE main power cables, as specified in the data sheet.
- **12.2.0** All the six winding ends shall be brought out and marked to one terminal box for power supply connections.
- **12.3.0** The terminal boxes shall be suitable for the system fault level for 0.25 seconds or as indicated in data sheet. The terminal boxes shall be amply sized to accommodate the cable sizes specified in data sheet. The terminal box shall be provided with pressure relief device if necessary.
- **12.4.0** It shall be possible to rotate the terminal box in steps of 90 degrees to enable cable entry from any direction.
- **12.5.0** Live terminals shall be insulated from the frame with material resistant to tracking.



- Page 5 of 6
- **12.6.0** Flameproof double compression type cable glands shall be provided for flameproof motors approved by CMRI, Dhanbad.
- **12.7.0** For anti-condensation heater, thermistor, etc. separate terminal boxes shall be provided, with cable glands, suitable for the cable sizes specified in data sheet. These terminal boxes shall be flame proof for flameproof motors.
- **12.8.0** Main terminal box shall be located on the right hand side of the motor, when viewed form its drive end, unless otherwise specified in the data sheet.
- **12.9.0** In case star delta starting is envisaged / capacitors are to be connected to the motor terminals, the terminal box shall be of special design by which sufficient creepage space between terminals is available. The terminal box shall be provided with two / three sets of cable glands as specified in the Data Sheet.

13.0.0 EARTHING

13.1.0 All motors shall have two suitable earth studs, capable of withstanding the fault level, integral to the motor frame for motor earthing. The studs should be adequate for accepting lug of the earthing conductor size specified in the data sheet.

14.0.0 NAME PLATES

- **14.1.0** Two stainless steel nameplates shall be supplied and fastened by SS fasteners. In addition to the data required to be furnished on the name plate as per IS, locked rotor current, temperature rise, type of enclosure, direction of rotation (if unidirectional), weight, grade of lubricant, bearing sizes and ambient temperature for which the motor is designed shall also be indicated.
- **14.2.0** A stainless steel warning label with indelible red inscription shall be provided on the motor to indicate that isolation of main power supply alone is not sufficient and that space heater supply shall also be isolated before carrying out any work on the motor.

15.0.0 LIFTING FACILITIES

15.1.0 Provision for lifting the motor shall be provided on the motor.

16.0.0 COUPLINGS

16.1.0 The motor shall be supplied with bare, single shaft extension and key. The couplings shall be supplied and fitted by the driven machine supplier.

17.0.0 ANTICONDENSATION HEATERS

17.1.0 The motors of rating 37 KW and above shall be provided with anti condensation heaters to prevent condensation when the motor is kept idle for long periods. The anti-condensation heaters shall be rated for single phase 240 V, 50 Hz. power supply, unless otherwise specified in the data sheet.

18.0.0 PROTECTION

18.1.0 Embedded temperature detectors or thermistors, hot air thermostats, etc. shall be provided in the motor if specified in the data sheet. Where thermistors are provided, thermistor control relay shall be supplied loose in a suitable weatherproof enclosure of cast aluminium.

19.0.0 RECIPROCATING COMPRESSOR FACTOR

19.1.0 Supplier of motors for driving reciprocating compressors shall liaise with the purchaser and the compressor manufacturer to ensure that the compressor factor chosen is sufficient to have a satisfactory degree of current pulsations.



20.0.0 MOTOR SUPPLIED ALONG WITH THE DRIVEN MACHINE

- **20.1.0** When a motor is supplied as a combined unit with the driven machine, the driven machine supplier shall ensure proper co ordination in the selection of motor and its characteristics. The driven machine supplier is also responsible for the suitability of the motor for the equipment and shall guarantee a reasonable defect liability period.
- **20.2.0** The driven machine supplier shall also ensure the correctness of the motor test certificates, suitability of couplings etc.

21.0.0 ADDITIONAL ACCESSORIES / REQUIREMENTS

- **21.1.0** The motors shall be provided with additional accessories / requirements, if any, specified in the data sheet
- **21.2.0** Where any special requirement such as degree of protection to enclosures, thermal cutout, special cable boxes, extra starting torque, supply of half coupling, etc. are specified, these details shall be clearly recorded in the test certificates or in an attached supplement.

22.0.0 DESPATCH

22.1.0 Before despatch, opening in the motor like cable entry should be sealed to prevent entry of moisture and dust during transit and storage.



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TPS NO. 32679-02-PS-001				
ITE	EM : MEDIUM VOLTAGE INDUCTION MOTORS			
EQ	PT. NOS.: AS PER DATA SHEETS ATTACHED			
The	e following inspection and test shall be conducted and record	ls submitted		
SI. No.	Description	Ins./test Reqd.	Witness Reqd.	Remarks
1.0	Physical verification for conformity with P.O. specifications and approved drawings	Reqd		
2.0	Routine test (as per IS), including the following:			
2.1	Insulation resistance test	Reqd		
2.2	High voltage test	Reqd		
2.3	No load running test	Reqd		
2.4	Locked rotor test	Reqd		
2.5	Reduced voltage running test at no load	Reqd		
2.6	Open circuit voltage ratio test	-		
2.7	Testing of accessories / auxiliaries for correct functioning	Reqd		

FACT ENGINEERING AND DESIGN ORGANISATION							
RFV	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED		
0	21-10-'20	Original Issue	SM	IK	IK		
	ECHNICAL MANDATOD V SDADES			32679-02-PS-001-SPR(M)			
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SPEC	CIFICATION	MANDATOR I SPARES		PAGE1 (OF1 R1		
SI. No.		Description	Quantity	Unit Price	Total Price		
1.	Ware house TPS	e stand by burner along with its pilot as per	1 Set				
2.	Burner Tip	(1no / Burner)	2 No's				
3.	GASKETS		200%				
4.	BOLTS, NU (Minimum 2	TS, WASHERS, CLAMPS 2 Nos. each)	100%				
	Above sp Mating Fla	ares shall be applicable for all the anges including Blind Flanges.					
5.	REFRACTOI (If applicab	RY BRICKS OF EACH SIZE AND MATERIAL (e).	10%				
1	14.01.21	For Enquiry	LÄ	JF.	ÄÄN		
0	17-09-20	For Client Review	7K.	<i>ዒ፻</i> ኇ	ÄÄN		
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED		
F.	ACT ENG	INEERING AND DESIGN ORGAN	ISATION		FEDO		

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TECHNICAL PROCUREMENT		RECOMMENDED SPARES FOR 2	MENDED SPARES FOR 2 YEARS OF		
SPEC	CIFICATION	NORMAL OPERATION (MECHA	NICAL)	PAGE1 (OF1 R1
SI. No.		Description	Quantity	Unit Price	Total Price
	Vendor shal the Doc. Sp	I furnish list of recommended spares for two ecial Requirements of The Project (Process 8	years of norma Combustion E	l operation as quipments)	depicted in
1					
2					
3					
4					
				1	
		1			
1	14 01 21	Ear Enquiny	T 2	sF.	7 7.AN
0	17-09-20	For Client Review	st.	<u> </u>	AAN
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
F	ACT ENG	INEERING AND DESIGN ORGAN	ISATION		FEDO

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TECHNICAL PROCUREMENT SPECIFICATION

SPARES (INSTRUMENTATION)

32679-14-PS-001 SPR INST

PAGE 1 OF 2

R1

SI. I	No.		Description	Quantity	Unit price	Total price	
Α.	S	pare	es For Thermal Oil Heater (F5902)				
1.	B	MS I	PLC				
a.	C	PU		1 No.			
b.	Po	owei	r supply	1 No.			
C.	AI	I Cai	rd	1 No.			
d.	A	0 Ca	ard	1 No.			
e.	D	DI Card		1 No.			
f.	D	DO Card		1 No.			
2.	0	N-O	FF VALVE SPARES				
a.	So	Solenoid valve		1 No.			
b.	Ai	Air filter regulator		1 No.			
C.	Li	Limit switch (On and Off)		1 Set.			
d.	Pi ty	Piston O ring, Packing etc (For each size/ type)		1 Set.			
3.	Fl	LAM	IE SCANNER (UV Type) - Full unit	1 No.			
4.	PI	IL01	ΓIGNITOR (Full unit)	1 No.			
5.	L	OCA	L PANEL SPARES				
a.	Pt	Pushbuttons (Of each type and colour)		10% or Min 2 No. whichever is higher			
b.	. Lamps/ indicators (of each type a		s/ indicators (of each type and colour)	10% or Min 2 No. whichever is higher			
C.	Relays (Of each type and rating)		10% or Min 2 No.				
		<u> </u>	1				
1	14/10/2	20	FOR ENQUIRY	DCK	DPV	MS	
0	28/09/	20	FOR COMMENTS	DCK	DPV	MS	
REV.	DAT	E	DESCRIPTION	PREPARED	CHECKED	APPROVED	
	FACT ENGINEERING AND DESIGN ORGANISATION						

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TECHNICAL PROCUREMENT SPECIFICATION

SPARES (INSTRUMENTATION)

32679-14-PS-001 SPR INST

R1

PAGE 2 OF 2

SI. No.	Description	Quantity	Unit	Total price
		whichever		
		is higher		
		10% or Min		
d	Fuses (each type and rating)	2 No.		
u.		whichever		
		is higher		
		10% or Min		
		1 No.		
е.		whichever		
		is higher		
f.	Annunciator cards/Lamps	10%		

Notes:

- 1. The above indicated spares are loose items to be handed over to client at the end of project.
- 2. Next rounded figure to be considered wherever % is specified (Example: For total 11 nos. instruments with 10% spares basis, 2 Nos. spares shall be provided)
- 3. Wherever complete instrument/set is considered as spare, spare quantity shall never exceed ordered/ purchased quantity (for example, if ordered quantity is 1 and mandatory spare philosophy is 20% or min 2, in such cases mandatory spares quantity shall be 1 and not 2)

1	14/10/20	FOR ENQUIRY	DCK	DPV	MS
0	28/09/20	FOR COMMENTS	DCK	DPV	MS
REV.	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED

TECHNICAL PROCUREMENT		SUB VENDOR LIST	32679-02-PS-001 SV(MECH)							
SPECIFIC	CATION	(Mechanical)		PAGE	1 0	F 1	R	1		
SL. NO.		Vendor Name								
I	BURNERS									
1	 a. Airoil- b. Airoil- c. Itochu d. J N M e. The V f. Incorr g. Ador h. Coen i. Johr j. Heat K. Nipport BLOWEF a. ARF b. FLA c. H S d. ACC e. BAT f. BHA g. DM' h. ANE i. PAT j. MAC K. EMI L M L M PLA N PRC 	Flarregas Ltd., Dorset. Flarregas (India) Pvt Ltd., Indrad. Corporation., Mumbai. arshall Pvt Ltd., Pune. /esman engineering co Ltd., Kolkata. oorated engineersLtd., Vadodara. Fechnologies Ltd., Pune. Bharat Limited., Mumbai. zinc company Ltd., England. t Technology International HT., Italy. on National Airoil Burner Co., Tokyo. 25 - CENTRIFUGAL ENGINEERING LTD,CHENNAI KT INDIA LTD, CHENNAI EQUIPMENT PVT LTD,MUMBAI EEL LTD, KOCHI LIBOI ENVIRONMENTAL ENGINEERING, MUMB/ RAT HEAVY ELECTRICALS LTD, CHENNAI V CORPORATION, TOKYO PREW YULE & COMPANY LIMITED, KOLKATA ELS AIRTEMP (INDIA) LTD, MUMBAI CNEIL AND MAGOR LTD, CHENNAI PIRE ENGINEERING CORPORATION, MUMBAI DALMIA & CO LTD, KOLKATA STO CHEM FABRICATION (I) PVT LTD, MUMBAI	AI							
	NOTE:- A	s per FACT Corporate vendor list.								
1	14.01.3	For Enquiry	LA	SK		A	AN			
0	17.09.2	0 For Client Review	SK	GPO	G	A	AN			
REV.NO.	DATE	DESCRIPTION	REPARED	CHEC	KED	APP	ROV	'ED		
	FAC	Γ ENGINEERING AND DESIGN ORGANISAT	TION			FR	D	0		

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DATA
SHEET

The	The make of instrumentation items shall be as per the following list.								
					NERAL INSTRU	JMENTS CONSORTIUM			
PRESSURE & DIFFERENTIAL				b. HG	b. H GURU INSTRUMENTS (SI) P LTD				
	PRESSURE & DIFFERENTIAL PRESSURE GAUGES				c. MANOMETER (INDIA) PVT LTD				
	PRESSURE	GAUGES		d. OD	IN INDIA PRIVA	ATE LIMITED			
				e. PRI	e. PREMIER INSTRUMENTS & CONTROLS LTD				
				f. BLU	JE BELLS CON	TROL SYSTEMS PVT LTD			
				a. DEI	TON CABLES	LTD.			
				b. BR	DOKS CABLE \	VORKS LTD.			
				c. KEI	INDUSTRIES I	_TD.			
				d. AS	SOCIATED CAE	BLES PVT LTD, MUMBAI			
	CABLES			e. GE	NERAL INSTRU	JMENTS CONSORTIUM			
				f. UN	VERSAL CABL	ES LTD.			
				g. то:	g. TOSHNIWAL CABLES				
				h. AS	h. ASSOCIATED FLEXIBLES & WIRES PVT LTD.				
				a. BAI	a. BALIGA LIGHTING EQUIPMENTS PVT LTD				
				b. CR	b. CROMPTON GREAVES LTD				
				c. EX-	c. EX-PROTECTA				
	JUNCTION B	OX		d. FLE	d. FLEXPRO ELECTRICALS PVT LTD				
				e. FLA	e. FLAMEPROOF EQUIPMENTS PVT LTD				
				f. FLA	f. FLAMEPACK (MANIPAL)				
				g. ALS	g. ALSTOM T&D INDIA LIMITED				
				a. BLU	a. BLUE STAR LTD				
	CABLE TRAY	/		b. FAC	b. FACT ENGINEERING WORKS				
				c. WA	VES ELECTRO	NICS PVT LTD			
					PROJECT	CONVERSION OF BURNERS TO RLNG AT FACT-UC			
					PROJECT	RLNG burner for Thermal Oil Heater (F 5902)			
2	29/07/21	DCK	DPV	MS	CLIENT	M/s FACT			
1	12/01/21			MS MS	P.O. NO				
RE\	/ DATE	PRPD	CHKD	APPRD	VENDOR				

DATA	SUB VENDOR LIST		32679-14-PS-001 SV I	NST		
SHEET			PAGE 2 OF 4	R2		
		d.	ALWAYE ENGINEERIN	GWORKS		
			INDIANA GRATINGS P	VT LTD		
		f.	STEELITE ENGINEERI	NG LTD		
		g.	ACME (ASSOCIATED C	CHEMICAL &		
		h.	AM-TECH ENGINEERIN	NG SERVICES		
		i.	VENUS STEEL PRODU	ICTS		
		j.	VINAY STEEL SYSTEM	IS		
		k.	INDUSTRIAL ANCILLA	RIES		
		١.	RITE PRODUCTS			
		m.	CHELUR CORPORATIO	N		
		n.	SIGMA INSTRUMENTS	COMPANY		
		a.	FCG FLAMEPROOF C	ONTROL GEARS PVT.		
		b. FLEXPRO ELECTRICAL PVT LTD				
CABLE (SI AND	с.	EXPROTECTA			
	d	d. BALIGA LIGHTING EQUIPMENTS PVT LTD				
		e.	MULTI PRESSINGS			
		a.	CEAG FLAMEPROOF	CONTROL GEARS(P) LT	D	
		a.	HONEYWELL AUTOM	ATION INDIA LTD.		
FLAME S	SENSORS/SCANNERS	b.	DURAG			
		c.	FIREYE			
		d.	ABB LTD.			
		a.	FIREYE			
		b.	DURAG			
PILOT B	URNER/IGNITOR	C.	AIR OIL FLARE GAS F	Pvt Ltd		
		d.	FORNEY			
		e.	LUCENT			
			LAMTECH			
LIMIT SV	VITCHES/ PROXIMITY	a.	HONEYWELL AUTOM	ATION INDIA LTD.		
SWITCE	S	b.	PEPPERL + FUCHS IN	IDIA PVT LTD.		
		С.	ABB LTD.			
CONTRO	DL VALVES	a. h	MIL CONTROLS LID.	סד		
		υ.		_ I <i>U</i> .		

FACT ENGINEERING AND ORGANISATION

Since 1

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14FT703A/15

DATA SHEET				32679-14-PS-001 SV	INST			
		308 VE	SUB VENDOR LIST		PAGE 3 OF 4	R2		
			C.	FLOWSERVE INDIA C	ONTROLS (P) LTD.			
			d.	FORBES MARSHALL	ARCA PVT LTD.			
			e.	EMERSON PROCESS LTD.	MANAGEMENT CHENN	AI		
			f.	DEMBLA VALVES (P)	LTD.			
			g.	DRESSER VALVE IND	DIA PVT LTD.			
			h.	KOSO INDIA PRIVATE	LTD			
			a.	ASCO NUMATICS (INI	DIA) PVT LTD.			
	SOLENC	DID VALVE	b.	ROTEX MANUFACTU	RES & ENGG PVT LTD.			
			c.	FESTO CONTROLS L	TD.			
			a.	INSTRUMENTATION I	_TD.			
			b.	MIL CONTROLS LTD.				
			c.	EMERSON PROCESS LTD.	MANAGEMENT CHENN	AI		
				d. DRESSER VALVE INDIA PVT LTD.				
	ON-OFF	VALVE – SOLENOID TED	e.	FLOWSERVE INDIA C	ONTROLS (P) LTD.			
			f.	KOSO INDIA PRIVATE	LTD.			
			g.	VIRGO VALVES & CO	NTROLS PRIVATE LTD.			
			h.	VAAS INDUSTRIES (P) LTD.			
			i.	TYCO VALVES & CON	ITROLS (I) P LTD.			
			j.	ARCA CONTROLS LT	D.			
			a.	DRESSER VALVE IND	DIA PVT LTD.			
	SELF AC	TUATED PRESSURE	b.	EMERSON PROCESS LTD.	MANAGEMENT CHENN	AI		
			c.	NIRMAL INDUSTRIAL	CONTROL PVT LTD.			
			d.	SAMSON CONTROLS	PVT LTD.			
			a.	ROCKWELL (ALLEN B	BRADLEY)			
			b.	SIEMENS LTD.				
			C.	HONEYWELL AUTOM	ATION INDIA LTD.			
	PLC		d.	SCHNEIDER ELECTR	IC SYSTEMS INDIA			
			e.	OMRON.				
			f.	ABB LTD.				
			a)	SWITZER INSTRUMEN	T LTD.			
	PRESSUR	RE SWITCHES	b)	INDFOS INDUSTRIES L	.TD.			
			c)	DANFOSS				
	ELECTRC (PRESSU	NIC TRANSMITTERS RE & TEMPERATURE) –	a)	SIEMENS LTD				
	F	ACT ENGINEERING A	ND C	ORGANISATION		$\mathbf{O}(0)$		

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DATA SHEET					32679-14-PS-001 SV	INST
		SUB VENDOR LIST			PAGE 4 OF 4	R2
	SMART T	YPE	b) c) d) e)	YOKOGAWA INDIA LTE EMERSON PROCESS MA LTD. ABB LTD. HONEYWELL AUTOMAT). ANAGEMENT (INDIA) PVT FION INDIA LTD	
	RELAYS /	AND TIMERS	a) b) c)	OMRON HONEYWELL AUTOMAT OEN INDIA LTD.	TION INDIA LTD.	

TECHNICAL 32679-03-PS-001SV (PIP) PROCUREMENT SUB VENDOR LIST SPECIFICATION (PIPING) Page 1 of 6 R 0 1.0 GASKETS (i) GASKET METALLIC a) IGP Engineers Pvt. Limited, India b) Madras Industrial Products, India c) Starflex Sealing India Pvt Ltd, India d) Teekay Metaflex Pvt Ltd, India e) Unique Industrial Packing, India (ii) GASKET NON METALLIC a) Champion Jointing Ltd, India b) IGP Engineers Pvt. Limited, India c) Madras Industrial Products, India d) Starflex Sealing India Pvt Ltd, India e) Unique Industrial Packing, India 2.0 **FLANGES** a) Abasi Engineering Works, India b) Britex Engineering Works, India c) CD Engineering Co.,India d) CD Industries (Ghaziabad), India e) Chaudhry Hammer Works Ltd, India f) Golden Iron & Steel Works, India g) J K Forging, India JAV Forgings (P) Ltd, India h) M.S. Fitting (P) Ltd,India i) Metal Forging Pvt Ltd,India j) Punjab Steel Works (THE), India k) JTG KΚ 0 21-09-20 First Issue KR REV.NO. DATE DESCRIPTION PREPARED CHECKED **APPROVED**

FACT ENGINEERING AND DESIGN ORGANISATION

FEDO

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3.0 PIPES

(i) PIPE - CARBON STEEL (SEAMLESS)

- a) BHEL (Trichy), India
- b) Heavy Metal & Tubes Limited (Mehsana), India
- c) ISMT Ltd Ahmedngr, India
- d) ISMT Ltd Baramati, India
- e) Jindal Saw Ltd (Nashik Works), India
- f) Mahalaxmi Seamless Limited,India
- g) Maharashtra Seamless Ltd,India
- h) Sainest Tubes Pvt Ltd, India

(ii) PIPE - CARBON STEEL (WELDED)

- a) Jindal Saw Ltd (Kosi Works), India
- b) Lalit Profiles & Steel Industries Ltd,India
- c) MAN Industries (I) Ltd,India
- d) Mukat Pipes Ltd, India
- e) Mukat Tanks & Vessels Ltd, India
- f) Ratnamani Metals & Tubes Ltd,India
- g) Surindra Engineering Co Ltd (Mumbai), India

(ii) PIPE - STAINLESS STEEL (SEAMLESS & WELDED)

- a) Remi Edelstahl Tubulars Ltd.
- b) Ratnamani Metals & Tubes Ltd.
- c) Royal Metal & Engg. Co.
- d) Bhandari Steels Pvt.Ltd.
- e) Nippon Metal Industry Co.
- f) Sanghvi Matals
- g) Metallica Metals (India)

	SUB VENDOR LIST	32679-03-PS-001SV (PIP)							
SPECIFICATION	(PIPING)	Page 3 of 6	R 0						
h) Choudha	h) Choudhary Metal Distributors								
i) All India N	letal Corporation								
j) Venus Tra	ding Corporation								
4.0 FITTINGS	FITTINGS								
a) CSA Fitti	a) CSA Fittings, India								
b) EBY Indu	stries, India								
c) EFTEN E	ngineers Pvt Ltd, India								
d) Gujarat Ir	fra Pipes Pvt Ltd, India								
e) M.S. Fitti	ngs Mfg Co Pvt Ltd, India								
f) Sidharth &	Gautam Engineers, India								
g) Teekay T	g) Teekay Tubes Pvt Ltd, India								
h) Tube Pro	h) Tube Products Incorporate, India								
5.0 VALVES									

(i) CS BALL VALVES (LP/MP service - Class 150, 300, 600 & 800)

NO.	VENDOR NAME	REMARKS
a)	Belgaum Aqua Valves Pvt. Ltd, India	Not recommended for Class600
b)	Flow Chem Industries, India	For Class600, recommended upto 350NB
c)	Larsen & Turbo Ltd, India	
d)	Microfinish Valves Pvt Limited, India	
e)	Weir BDK, India	Not recommended for Class600
f)	Virgo Engineers Limited, India	

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TECHNICAL PROCUREMENT SPECIFICATION

SUB VENDOR LIST (PIPING)

32679-03-PS-001SV (PIP)

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R 0

(i) CS BUTTERFLY VALVES (LP service - Class 150 & 300)

NO.	VENDOR NAME	REMARKS
a)	Advance Valve Pvt Ltd, India	
b)	BDK Process Controls Pvt Ltd, India	
c)	Crane Process Flow, India	
d)	Fouress (BLR Work), India	
e)	Instrumentation Ltd (Palghat), India	
f)	Intervalve (India) Ltd, India	
g)	Larsen & Turbo Ltd, India	
h)	Leader Valves Ltd, India	
i)	Tyco Valves & Controls Pvt Ltd, India	
j)	Weir BDK, India	
k)	Virgo Engineers Limited, India	

(i) CS GATE, GLOBE AND CHECK VALVES (LP/MP service-Class150, 300, 600 & 800)

NO.	VENDOR NAME	REMARKS
a)	Weir BDK, India	For Class600, recommended only upto 300NB
b)	BHEL (Trichy),India	
c)	KSB Pumps Ltd (Coimbatore), India	
d)	Larsen & Turbo Ltd, India	
e)	Leader Valves Ltd, India	
f)	Niton Valve Industries Pvt Ltd, India	
g)	NSSL Ltd, India	
h)	Oswal Industries Ltd, India	
i)	Petrochemical Engineering, India	Not recommended for Class600
j)	Shalimar Valves Pvt Ltd, India	Not recommended for Class600
k)	Steel Strong Valves India Pvt Ltd, India	For Class600, recommended only upto 300NB



		SUB VENDOR LIST	32679-03-PS-001SV (PIP)			
ŝ	SPECIFICATION	(PIPING)	Page 5 of 6	R 0		
6.0	BUTTERFLY	VALVES				
	a) M/s Advan	ce Valves				
	b) Fouress					
	c) Instrument	ation				
	d) Crane					
	e) L & T					
	f) Intervalve					
	g) Tyco					
7.0	STRAINER /	FILTER				
	a) M/s Gujara	it Otofilt				
	b) Grand Prix	Engineers				
	c) Filtration E	ngineers				
	d) Ultra Filter					
	e) Multitex					
	f) Spirax Mars	shall				
	g) Bombay C	hemical				
8.0	MISLLANEO	US ITEMS				
	(i) HOSE RUBBE	R (STEAM/ GAS/ AIR/ WATER/ CHEM.)				
	a) Gaytri Indu	strial Corporation, India				
	b) Presidency	/ Rubber Mills Pvt Ltd, India				
	c) Royal India	a Corporation (Nasik Works), India				
	d) Soni Rubb	er Products Ltd, India				
	e) Sridhar Ru	bber Products Pvt Ltd, India				
	FACT ENGI	NEERING AND DESIGN ORGANISATION		EDO		

Page 6 of 6 F

- d) INSAP Flexibles & Engineers Pvt Ltd, India
- e) Senior India Private Limited, India

c) Gaytri Industrial Corporation, India

a) Aeroflex Industries Pvt Ltd, India

b) Bengal Industries Pvt Ltd, India

(iii) FASTENERS

a) AEP Company, India

(ii) HOSE METALLIC FLEXIBLE SS

- b) Boltmaster India Pvt Ltd , India
- c) Fasteners & Allied Products Pvt Ltd, India
- d) Hardwin Fasteners Pvt Ltd, India
- e) J.J. Industries, India
- f) Multi Fasteners Pvt Ltd, India
- g) Nexo Industries, India
- h) Pacific Forging & Fasteners Pvt Ltd, India
- i) Pioneer Nuts & Bolts Pvt Ltd, India
- j) Precision Auto Engineers, India
- k) Precision Engg. Industries, India
- I) President Engineering Works, India
- m) Sandeep Engineering Works, India



PROCUREMENT
SPECIFICATION

00FT014/94

COMPLIANCE STATEMENT

32679-02-PS-001 CS PAGE 1 OF 1 R0

TPS NO. 32679 -02-PS-001

We state that our Enquiry No	Quotation Nois inis inexcept for the deviations lister	n full compliance with the documents issued against the ad below.								
	LIST OF DEVI	ATIONS								
SI. No.	Description	Reasons for Deviation								
Name of vendor:		.								
FACT F	NGINEERING AND DESIGN OF									



.

						-	PARTS LIST	r _			N.
		ITEM	QTY	-		DESC	CRIPTION		PA	RT NO	MATERIAL
	P	1	1	BL	JRNER	TILE SET	(AC-135)		DA	-121	60% AL203
	Ð	2	1	OII	L TILE	ASSEMBL	Y (121440)		JA	-215	60% AL203
		3	1	PL	ENUM /	ASSEMBL	Y		JD	-245	-//-
		4	1	DA	MPER A	ASSEMBLY	Y		JD-	-246-1	-//-
	\triangle	5	1	OI	L TIP (763)			EA	-055	310 S.S.
	$\langle R \rangle$	6	1	CE	B OIL G	UN RECE	IVER ASSEMB	LY	RB	-007	-//-
	-	7	1	OI	L GUN	GUIDE T	JBE			2"	C.S.
1.1	(R)	8	1	CE	3 OIL G	UN INSE	RT ASSEMBLY		RE	-008	-//-
	Ä	84	1	AT	OMIZER	(#7)			EA	-018	BRASS
	Š	88	1	ΔΤ	OMIZER	SPUD (#7)		FA	-015	BRASS
	U	00	1				π·)		FA	-012	A-126 CL 30
		9	-				6" (0)			/9"#	
\sim	-	10	1	PA	ACKING	ROPE (1	B LG.)		<u> </u>	/0 0	GSK. MAIL
ம	$\langle R \rangle$	11	1	PI	-HS-1	-EF PILO	JI ASSEMBLY			-414	-//-
		12	1	All	R CONT	ROL POS	SITION PLATE		EA	-266	ALUM.
		13	1 ·	All	R CONT	ROL HAN	IDLE		JA	-193	-//-
	\triangle	14	1	CH	HOKE P	LATE			EA	-780	A-569/570
P	$\langle R \rangle$	15	1	1"	SWIVE	L SCANN	ER ASSEMBLY		XA	-053	-//-
	P	16	3	2"	SIGHT	& LIGHT	TING PORT		XA	-054	-//-
		17	1	1	/2" FLA	NGE NIP	PLE ASSEMBL	Y	JA	-127	-//-
		18	1	C	OUPLING	;			1/:	2" NPT	A-105
		19	2	PI	PE CAP				3/-	4" NPT	MALL.
		20	1	т	IBING G	ASKET (8 FT)			-//-	CSK MAT'I
		20	-			LATE CAS			1	-400	OSK. MATL
		21	2		HUKE P	LATE MOU		r		701	GSK. MATL
		22		PI		ATE MOU	NTING GASKET	1		4-321	GSK. MAIL
	Δ	23	1	D	AMPER	ASSEMBL	Ŷ		JD-	-246-2	_//_
		(<u>P</u>) =	RECO	MM	ENDED	SPARE P	ARTS				
		$\langle R \rangle =$	REFE	REN	ICE DRA	WINGS :	B-RB-007	OIL GUN	REC	EIVER	ASS'Y,
] .		B-RE	8-008	OIL	GUN I	NSERT A	SS'Y, B-UA-4	414 PT-	HS-	1-EF F	PILOT ASS'Y,
		B-XA	-053	SW	IVEL SC	ANNER A	SS'Y				
		TAG	NO's. :	RE	3-345-	1 BURNE	R ASS'Y; DA-	-121-1	BUR	NER TIL	E SET;
		RB-3	345-20	о ті	JBING (ASKET					
					1	PURCH	ASED SPAR	E PAR	TS -	5	
		ТА	G NO	× .	OTY		DESCRIPT				
			17007	-	4		(763)				
		5	13227-	<u>+</u>	-	AC 135	DUDNED THE	SET			
		SP-	13227-	-2		AC-135	BURNER HLE				
		SP-	13227-	-3	1	121440	OIL TILE ASSE	MBLT			
		SP-1	13227-	-4	5 SETS	OIL GUN	GASKET				
		SP-	13227-	-5	1	PILOT TI	ASSEMBLY				
		SP-	13227-	-6	1	PX-1 PI	LOT MIXER				
						-AC	CESSORY P	PARTS -			
		TA	G NO.		QTY		DESCRIPT	ΓΙΟΝ		_	
	•	ACC-	-13227-	-1	1	AUXILIAR	Y OIL GUN (T.	AG #2 0	IL G	UN)	
		ACC-	-13227-	-2	2 SETS	FLEX HO	SES 2 M LG.	ONE EN	ID 1	/2" M.I	N.P.T.
	-	·				OTHER E	ND 1/2" R.F.	W.N. 150	o# (SS 304	•)
		-		_	-NFT	HEAT	RELEASE F	PER BL	IRN	ER	
		-					OIL GUN #1	OIL GU	N #	2	
		M		1 ()	M Koo	I/HR) ·	.94	A .47	7		
				. (*	M Koc	/HR) ·	75	A 37	5	1	
					AM Kog	//IIC) ·	32	A 18	8	10111	
		N				<u>, , , , , , , , , , , , , , , , , , , </u>	.52		0	-	
			LHV	/ (r	(cai/kg):	14.08	14 992	27		
			API GH	<i>.</i> :			14.08	14.0	55		
		DRA	FT LOS	S :	100mn	n W.C. 🤇	94 MM Kc	al/HR 20	J% X	SAIR	₩ 45°C.
		FOR	OPER/	ATIN	IG PRES	SURES S	SEE CAPACITY	CURVE	: C	C-RB-	345-0
		PILO	T OPER	RAT	ING PR	ESSURE	: 10 PSIG (L	_PG)			
		REV.	NO.3:								
		REV.	NO.2:								wit PEr
	1	REV.	NO.1:	AS	NOTED	PER C	USTOMER COM	MENTS E	зн с	JJUL02	WWH RFC
	1	JOB	SITE: I	NDL	A			FLEV		N: 12.8	M ASL
20 A.		P O	NO ·	MM	14/723	4		5.0	NO	: 1322	7
		75500	NO	MIN,	4/125	Tuerd.	FEDO		110.	. 1022	
EPED).	22151 E	ARROW, OK	REET 74014	61	USER:	000 175 0	ONUM		DRAWN:	DATE:
7IN	IC	PHONE:(918) 258-80 918) 251-55	551 19	49		CWR-135 OIL BURNER ASSE	MBLY		BH	17MAY02
	-	solee@20			V	т	HERMAL OIL H	HEATER		WWH	RFC
	-	PROPRIE INFORMA	TARY DATA IS	ED HE	REIN AND IS			RED)		SCALE:	REV:
		INFORMA	TION IS SUBM		IN CONFID-	FOR:		/		DRAWING	NUMBER:
		AND ALL	RIGHTS OF	DESIGN	OR INVENTION	В	HARAT HEAVY	PLATE		B-I	RB-345
		OR USE	IS PROHIBITE	DBY	LAW.	1					

ANNEXURE 2 Control Valves Specification Sheet

F	FISHER Control Valves Specification Sheet									
Cu: Co Cu: Iter Taç	stomer: FACT htact: stomer Reference: n: 16 Rev: gs: FPV 5960	Qty: 1	Emers Conta Sales Quote Date L	son Prod ct: Bije Office F : 875H- _ast Mo	cess sh.N Refer KG- difie	Managemer rence: 2025 1 1 20207-000 d: 29/10/201	nt Chenna 532 547 / FA 2	i Ltd Lead ⁻ CT Rev: C	Гіте:)R	
Sei	vice Description: Thermal Oil I	Furnace								
1	Fluid: RLNG						Crit. Pre	es. PC:		
	SERVICE CONDITIONS	Units:	N	lor.Flov	v	Max F	low			
2	Mass flow rate (w)	kg/h	1	100.000)	110.	000			
3	Inlet Pressure (P1)	kg/cm2g		4.000		4.0	00			
4	Temperature (T1)	kg/cm2g		3.000		30.0	00			
6	M / Gg	M		18.260		18.2	60			
7	Specific heats ratio (gamma)			1.400		1.4	00			
8	Dynamic Viscosity (Mu)	сР		0.013		0.0	13			
9	Sizing Coefficient (Cv)			4.474		4.9	21			
10	(Allowed (Coloulated)	% Open		69.32		/1.3	80	1		,
12	(Allowed / Calculated)	dB(A)		/54		/5/	4	1		1
					52		Type:	Spring & I)ianhraci	n
13	Size Schedule In:	1 in. SCH 80			54	Mfa/Model	rype.	Fisher/667	, ,	
14	Size, Schedule Out:	1 in, SCH 80			55	Size:	34	Eff Area:	69 ir	12
15	Insulation:				56	On/Off:		Modulating	:	
16	VALVE BODY/BONNET	Туре:	Globe		57	Spring Action	on: Dov	vn,Close		
17	Size: NPS 1	ANSI	CL300		58	Max Allow F	Press:	70 psig		
18	Max Press/Temp:	6 Kg/Cm2g/3 Fisher/E7	aeg C		59 60		ress: r Supply I	Drossuro		
20	Body/Bonnet Matl	WCC Steel			61	Max.	i Suppiy i	Min [.]		
21	Liner Matl/ID:				62	Bench Rand	ae:	8-32 psi		
22	End Connection In:	CL300 RF FI	g		63	Act Orienta	ion:	•		
23	End Connection Out:	CL300 RF FI	g		64	Handwheel	Туре:	Side Mour	nted	
24	Flg Face Finish:	125-250 AAF	H		65	Air Failure \	/alve: Cl	ose Set a	at:	
25	End Ext/Mati:	lln			66	Input Signal		1 to 20 m/	do	
20	BONNET Type	Plain			68 6	POSITIONER	R Type:	SMART	u u u u u u u u u u u u u u u u u u u	
28	Lub-Iso Valve: No	Lube:	No		69	Mfg/Model:	Fisl	her/DVC6200/Adva	nced-AD	
29	Packing Material:	Single PTFE			70	Incr Signal	Output:			
30	Packing Type:	V-Ring Sprir	g type		71	Gauges:	0-6	0 psig/0-4 bar By-	Pass: N	Α
31	Bolting:B7/2H	0.000			72	Cam Chara	cteristic:	Linear		
32	Size: 3/4 Inch	Travel	3/4 Inch		13					
34	Characteristic:	Micro-Form	(Ea Pct)		74	Type:		Otv:		
35	Balanced/Unbalanced:	Unbalanced			75	Mfg/Model:				
36	Rated Cv: 8.84 FI:	0.97	(t: 0.919	•	76	Contacts/Ra	ating:			
37	Material:	S31600 SST	(PTFE Sea	at)	77	Actuation P	oints:			
38	Seat Material:	531600 SST			78					
39 40	Stem Material	S31600 SST			79ľ	Mfg/Model·	Fiel	her/67CFR		
41	Stem size:3/8Inch				80	Set Pressur	e:	35 psia		
42	Yoke boss size:2 1/8 Inch				81	Filter:	Yes	Gauges:	Yes	
	SPECIAL ACCESS.				82		_	-		
43	NEC Class: Grou	p: [Div:		83	ESTS Hydr	o Press:		4	
44	3/8 UD SS3161 UDINGS&Fitti	ngs -5wagelo	К		84 85	ANSI/FCI L	eak Class	: ANSI CL V	1	
40					86					
47	Spares: One set of Packing.	Gasket			Rev	Date		Revision	Oria	qqA
48	Plug stem Assy,Retainer and	d seat ring							5	1-1-
49	shall be loose supplied alon	g with valve								
		-								
50	Paint Grey, Actuator Yellow	-								

FISHER

Customer: FACI		Emerson Process Mana	gement Chennai Lt	d	
Contact:		Contact: Bijesh.N			
Customer Reference:	0.4	Sales Office Reference:	20251532	Lea	d lime:
Item: 16 Rev:	Qty: 1	Quote: 875H-KG-12020 20251532	7-0001547 / 875H-	Rev	COR
Tags: FPV 5960		Date Last Modified: 29/1	0/2012		
Description: NPS 1 EZ 667 Size 34 DVC	6200 SS 67	7CF Series Acc Special F	Product Process L	evel 3	
Service Description: Thermal Oil Euroa	60				
Sizing Type: Gas	Turbulent	Solving for: Cv		rodynamic	Flow is Mass
Variable Name		Min Elow		Nor Elow	1 1000 15 101255
	Units	MIII:FIOW	IVIAX FIOW	NOL-FIOW	
			BLNG	BLNG	
Inlet Pressure (P1)	ka/cm2a		4 000	4 000	
Outlet Pressure (P2)	kg/cm2g		3 800	3 800	
Temperature (T1)	dea C		30,000	30,000	
Mass Flow Bate Gas (w)	ka/h		110 000	100.000	
Pressure Drop Batio Factor (Xt)	Ng/II		0.603	0.603	
Pressure Becovery Factor (FI)			0.970	0.970	
Valve Style Modifier (Ed)			0.290	0.290	
Atmospheric Pressure	psi		14.690	14.690	
Dynamic Viscosity (Mu)	cP		0.013	0.013	
Specific heats ratio (gamma)	•		1.400	1.400	
Molecular weight /Specific gravity	м		18.260	18.260	
Inlet Compressibility Factor (71)			1.000	1.000	
Pipe Size Up	in		1	1	
Pipe Schedule Up			80	80	
Pipe Size Down	in		1	1	
Pipe Schedule Down			80	80	
Nominal Valve Diameter (dv)	in		1.000	1.000	
Aerodynamic Distance (Rn)	m		1.000	1.000	
, , ,					
Sizing Coefficient (Cv)			4.921	4.474	
dP Choked	kg/cm2		3.035	3.035	
dP/P1 Valve	-		0.040	0.040	
NOISE CALCULATION					
Valve/Trim		C	alobe/Angle	Globe/Angle	
Whisper III Trim Level					
LpAeTrim1m	dB(A)		54	54	
LpAeOutlet1m	dB(A)		< 50	< 50	
LpAeValve1m	dB(A)		54	54	
LpAeValveRn	dB(A)		54	54	
	0		0 700	0 700	
Valve Outlet Area (Ao)	in2		0.790	0.790	
	Mach		0.042	0.038	
	Mach		0.040	0.036	
	mach		0.044	0.040	
	m/s		18.411	16./3/	
	m/s		1/.45/	15.8/0	
	m/s		19.1/3	17.430	
	m/s		439.730	439.730	
	m/s		439.730	439.730	
UZ FIPE	m/s		439.730	439.730	





										SCALE	
										DATE	15 [.]
										DRAWN	
	2		AS BUILT			PAS	KRD	КРМ	03-07-14	CHECKED	
	1		GOOD FOR CONSTRUCTI	ON		TKA	KRD	КАК	01-03-12	DESIGNED	
	NO	ZONE		PARTICULARS		REVISED	CHECKED	APPROVED	DATE	CHECKED	
				REVISION						APPROVED	
}			7	6	5				4		









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Reviewed by BHPV

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TECHNICA	I. SPECIFICA	TION]
DEL		BCB-725 -665	c
3			
IY (M/Scc)	TT /100/ T-4		
TEST BLOC	K (10% Exira) 0.88	
UP.POINT (I	Normal)	0.65	
OP.POINT (Minimum)	0.20	H
d to be Develop	ed Pressure (mmwc)	11
TEST BLOC	K (15 % Extra	a) 172.5	
OP.POINT (Normal)	· 100	6
OP.POINT (Minimum)	15	
	;) 		
IEST BLOC	<u>к</u>	10330	' H
OP.PUINT (Normal)	10330	
OP.POINT (Minimun)	10330	
e Pressure (mm	wc)		,
TEST BLOC	Ж	10502	.5
OP.POINT(I	Normal)	10430	
OP.POINT(I	Minimum)	10345	i L
TDIOC	Temp C?	density (K	(g/m3)
T BLOCK	45	1.077	
OINT (Normal) 38	1.112	
POINT (Minimu	m) 19	1.198	1
EED (RPM)		1430	
CONSUMPTIC	ON AT DESIG	IN (kw)	
TEST BLOC	CK .	1.88	П
OP.POINT ((Normal)	1.2	
OP.POINT	(Minimum)	0.8	
EFFICIENCY	(%)		
TEST BLO	CK	80	
OP.POINT	(Normal)	40	
OP.POINT	(Minimum)	05	
MOTOR CAPA	CITY(KW/P	OLE) 3.7/4	
FRAME SIZE		IR1	2
LOAD ON EA	CH BOLT	65 kg	3
AIC LOAD ON	EACH BOLT	100 1	123
	OTY	1 NO	
TRACTOR OF	~ * * 7 & % Y YY TY Y * 4		
, WEIGHT OF I	AN WITH M	UTUR 600	kgs
, WEIGHT OF I	AN with out	MOTOR 527]	Kgs -
IPELLER SIZE		Ø66:	5 mm
TATIOTTA T	EANG /		
DOR 63. BOILDING 404.4	J FANS (11 Inna balal cedidika).	NDIA) 600 035.	
DATTAL	PROUBCT M/s FA	CT (PD)HEATER	
TATINAM	P.O No. MM/4/723-	43001/CS91/33312181	DT.9-7-2002.
My DATE	PROJECTION		BCALE
\$/03/3%2 12/09/3%2			NTS
	DRO Ne.		REV.
T	IF-F-	100-00/2K2	C