







Plant 350 MTPD Caustic Soda Expansion	Client PACL	Contract Code PACL- 350 TPD EXPN	Document ID 0215-EQS-21-EC-0002	Contract No. 66- 0215-700
	Technical Specification for Plate Heat Exchanger 98% H2SO4 Cooler Item No. 21E05N			 PACL LIMITED
				Rev 00 Page 1 of 7



<p>tkIS India / Vendor</p> <p>Category Codes (Submission Purpose)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 For Approval <input type="checkbox"/> 2 For Review / Comments <input type="checkbox"/> 3 For Information <input type="checkbox"/> 4 For Engineering <input type="checkbox"/> 5 For Enquiry <input type="checkbox"/> 6 For Order Placement <input type="checkbox"/> 7 Final & Approved <input type="checkbox"/> 8 Released for Construction <hr/> <p>Acceptance Codes (Approval Codes)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 Approved <input type="checkbox"/> 2 Approved for Manufacturing / Fabrication with Comments as marked <input type="checkbox"/> 3 Not Approved / Resubmit <input type="checkbox"/> 4 Retained for Information / Records <input type="checkbox"/> 5 Reviewed <input type="checkbox"/> 6 Reviewed as Noted / Resubmit <p>Remarks for AC2 : This marked-up drawings is hereby approved for fabrication / manufacturing and shall be re-submitted after revision. This drawing should be revised only to the extent of tkIS India / Owner / Client comments. Any other changes made by you will not be considered unless clearly highlighted in covering letter asking for approval.</p> <p>This approval / review does not absolve the supplier from the full responsibility for design and fabrication.</p> <p>Date : ___/___/___ Name : _____</p>	<p>tkIS India / Owner / Client</p> <p>Category Codes (Submission Purpose)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 For Approval <input type="checkbox"/> 2 For Review / Comments <input type="checkbox"/> 3 For Information <input type="checkbox"/> 4 For Engineering <input checked="" type="checkbox"/> 5 For Enquiry <input type="checkbox"/> 6 For Order Placement <input type="checkbox"/> 7 Final & Approved <input type="checkbox"/> 8 Released for Construction <hr/> <p>Acceptance Codes (Approval Codes)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 Approved <input type="checkbox"/> 2 Approved for Manufacturing / Fabrication with Comments as marked <input type="checkbox"/> 3 Not Approved / Resubmit <input type="checkbox"/> 4 Retained for Information / Records <input type="checkbox"/> 5 Reviewed <input type="checkbox"/> 6 Reviewed as Noted / Resubmit <p>Date : ___/___/___ Name : _____</p>
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00		Issued For Enquiry	16.11.18	PRA	22.11.2018	SPT	23.11.2018	SKM		
Rev	Status	Description	Date	Prepared	Date	Checked	Date	Approved	AC	
					Barcode					Category Code

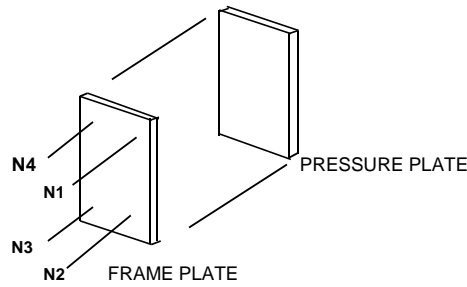
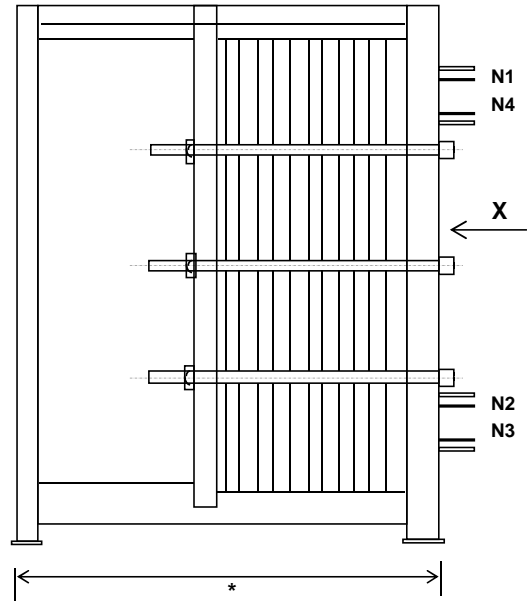
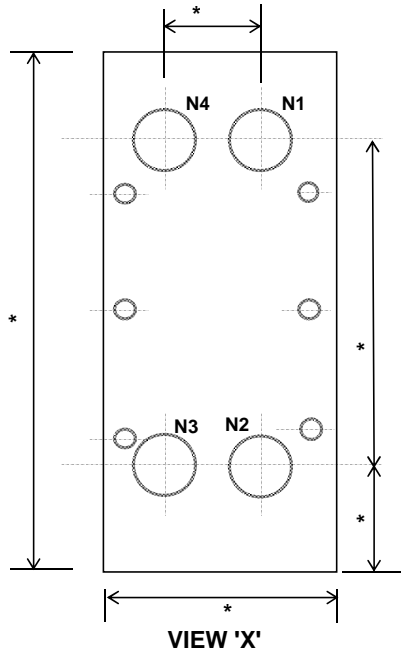
Plant 350 MTPD Caustic Soda Expansion		Client PACL		Contract Code PACL- 350 TPD EXPN		Document ID 0215-EQS-21-EC-0002		Contract No. 66- 0215-700			
		DATA SHEET FOR PLATE HEAT EXCHANGER						 PACL LIMITED			
		98% H2SO4 Cooler Item No. 21E05N									
		Rev 00		Page 2		of		7			
SN	Rev	Quantity (operation / stand-by)			1	13	Part		Material	Remarks	
1		Arrangement parallel			Series	Stand-by	14		Plates	HASTELLOY-C	
2		Surface area / exchanger (Eff./Total) m2 (Note-1)			*		15		End plate	SA 516 Gr.60/ 70	
3		Number of exchangers per unit			1		16		Frame	SA 516 Gr.60/ 70	
4		Number of plates, assemb. / max			*	*	17		Bolts / Nuts (Fluid 1)	SA 193 GR.B7 / 194 GR. 2H	With Cd
5		Min. plate thickness mm			0.6		18		Bolts / Nuts (Fluid 2)	SA 193 GR.B7 / 194 GR. 2H	electroplating
6		Type			Plate Type		19		Gaskets	VITON	
7		Material (process side)			HASTELLOY-C		20		Nozzle flanges fl.1	*	
8		Model No.			*		21		Nozzle flanges fl.2	*	
9		Supplier			*		22		Nozzle pipe fl.1	HASTELLOY-C LINED	
10		Weight, delivery kg			*		23		Nozzle pipe fl.2	AISI 316 LINED	
11		Weight with process fluid kg			*		24		Flanges acc. to	ASME B16.5, 150#	
12		Weight, water filled kg			*		25		Design code	ASME SEC-VIII, DIV.1	
26		Remarks:									
27		(*) - Data to be filled by Vendor									
28		INSULATION REQUIRED (Y/N) : N				INSPECTION BY : CLIENT / tkIS(India)					
29		Note 1 : Heat exchanger is to be designed for 10% excess area over dirty heat transfer coefficient.									
30											
31											
32											
33		Process fluid			Fluid 1			Fluid 2			
34					98% H2SO4			CHILLED WATER			
35		physical condition , in / out (S)olid, (L)iquid, (V)apour, (G)as			LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	
36		Class of hazard			Corrosive						
37		pH-value									
38		H2-part, press., in/put kg/cm2 a									
39		Design temperature °C			60			65			
40		Design pressure kg/cm2 g			6.0			6.0			
41		Test pressure kg/cm2 g			*			*			
42											
43		OPERATING CONDITIONS PER UNIT			Fluid 1			Fluid 2			
44					Inlet	Outlet	Inlet	Outlet			
45		Mass flow , total kg/h			252.50			733.5			
46		Mass flow , vapor / gas kg/h									
47		Mass flow, steam kg/h									
48		Mass flow, inerts kg/h									
49		Mass flow, liquid kg/h			252.50	252.50					
50		mass flow, water kg/h					733.5	733.5			
51		operating temperature °C			40.0	15.0	10.0	13.0			
52		Operating pressure kg/cm2 g			3.4		2.0				
53		LIQUID									
54		Density kg/m3			1815.0	1838.0	1000.0	1000.0			
55		Specific heat kcal/kg °C			0.3458	0.3485	1.00	1.00			
56		Thermal conductivity kcal/hr m °C			0.2964	0.2964	0.51	0.5110			
57		Dynamic viscosity cP			14.42	33.29	1.23	1.23			
58		Heat of evaporation kcal/kg °C									
59		Boiling point °C									
60		Solidification point °C									
61		STEAM / GAS									
62		Molar weight kg/kmol									
63		Density kg/m3									
64		Specific heat kcal/kg °C									
65		Thermal conductivity kcal/hr m °C									
66		Dynamic viscosity cP									
67		Condensation temperature °C									
68		Condensation enthalpy kca/kg									
69		Fouling factor hr m2 °C/kcal			0.000050		0.00015				
70		Velocity (mean) m/s			*		*				
71		Pressure drop , admissible / calculated kg/cm2			0.5/ *		0.5/ *				
72		Number of passes			*		*				
73		Corrected temperature difference °C			*						
74		Heat duty kcal/ hr			2200						
75		(Overall) Heat transf. coeff. , clean / dirty kcal/ hr m2 °C			*/ *						
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Plant 350 MTPD Caustic Soda Expansion	Client PACL	Contract Code PACL- 350 TPD EXPN	Document ID 0215-EQS-21-EC-0002	Contract No. 66- 0215-700
	PROCESS RELATED REMARKS			 PACL LIMITED
	98% H2SO4 Cooler Item No. 21E05N			

SN	Rev.	
1		1. Vendor to do thermal design of the exchanger.
2		
3		2. Exchanger shall not be dismantled after final hydrotest.
4		
5		3. Derusting and painting as per Manufacturer's standard. However vendor has to take prior approval of procedure & painting specification from tkIS(India)/Client.
6		
7		
8		4. Performance of heat exchanger shall be proved by vendor at site.
9		
10		5. Supply of foundation bolts, lifting lugs (in-built type) & earthing cleats shall be by vendor.
11		
12		6. Vendor to guarantee performance (i.e. thermal performance and pressure drop), suitability of materials offered (in fluid contact) and mechanical design of the unit. Performance test run shall be demonstrated at site for 72 hours. In case of any discrepancy during guarantee period, Vendor shall replace the defective parts or the whole heat exchanger free of cost in order to meet guaranteed performance.
13		
14		
15		
16		
17		7. In case of gasket failure, vendor shall replace full set of gaskets free of cost, during the period of 18 months from startup or 24 months from date of despatch whichever is earlier.
18		
19		
20		8. Friction type spanner shall be supplied by the vendor for tightening bolts.
21		
22		9. Extra length of the tightening stud shall be protected by providing suitable sleeve of PVC / rubber /any other suitable non-corrosive material
23		
24		
25		10. Following inspection / tests shall be carried out at the vendors works in the presence of tkIS(India) / client.
26		a) Material identification & checking of material test certificates.
27		b) Checking of X-ray report as applicable and verification of internal quality testing documents.
28		c) UT / DP test for weld joints.
29		d) Final hydrotest
30		e) Dimensional checking
31		f) Checking of plate thickness (0.6mm minimum).
32		
33		11. Rack of heat exchanger is designed for 20% extra plates (spare plates) minimum
34		
35		12. Commissioning spares to be supplied without any extra cost by vendor.
36		Commissioning spare parts:
37		a) Ring gasket for end plate : 1 set (100% per exchanger)(If applicable)
38		b) Flow gasket: 2% (atleast 5 nos. per exchanger)
39		c) Nuts & washers for tie rods: 2 nuts + 2 washers per exchanger
40		d) Gasket for start plate: min. 1 no. per exchanger
41		13. Spares for 2 years trouble free operation shall be quoted separately.
42		2 years operation spare parts:
43		a) Ring gasket for end plate : 1 set (100% per exchanger)(If applicable)
44		b) Flow gasket: 2% (atleast 5 nos. per exchanger)
45		c) Nuts & washers for tie rods: 2 nuts + 2 washers per exchanger
46		d) Gasket for start plate: min. 1 no. per exchanger
47		14. Personnel protection sheet of acrylic or other suitable material shall be provided for plates.
48		
49		15. Vendor to fill up data marked with "**"
50		
51		16. Minimum nozzle loads shall be considered as per API-662 Part1, Cl.7.7.10 Table 2.
52		Vendor shall check & incorporate revised loads if any during detail engineering without any extra cost if thicknesses are not changing.
53		
54		
55		17. The equipment shall be guaranteed for satisfactory performance as well as any sorts of manufacturing defects for a period of 18 months from the date of commissioning or 24 months from the date of last despatch, whichever is earlier.
56		
57		
58		
59		18. Supplies shall be carefully guaranteed against any manufacturing defect/ poor workmanship quality etc. for a period of 18 months from the date of commissioning or for 24 months from the date of delivery whichever is earlrier. During this period vendor will arrange to repair/ replace any defective part free of cost or replace complete set, if required.
60		
61		
62		
63		
64		19. Vendor shall provide all technical assistance for supervision of commissioning at free of cost.
65		
66		20. Vendor shall not use chinese made material or any part of the same.
67		
68		© thyssenkrupp Industrial Solutions (India) Private Limited 2018 FILE NAME :

Plant 350 MTPD Caustic Soda Expansion	Client PACL	Contract Code PACL- 350 TPD EXPN	Document ID 0215-EQS-21-EC-0002	Contract No. 66- 0215-700
	PRINCIPLE SKETCH 98% H2SO4 Cooler Item No. 21E05N			 PACL LIMITED Rev 00 Page 4 of 7



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
Notes:

- 1) Vendor confirmed data marked ' * ' & furnished in offer.
- 2) Nozzle orientation and Designation with Nozzle Symbol given by tkIS in the Sketch and nozzle table below shall be followed by vendor. Vendor considered same and provided the offer.
- 3) If vendor proposal consists of non standard flanges (Other than B16.5) for nozzles, vendor shall also supply companion flange, spool of appx.75mm of process suitable material with gaskets & fasteners including spares.
- 4) Vendor shall take necessary precautions while deciding nozzle sizes with respect to fouling of nozzle flanges with PHE supporting arrangements.

Nozzle symbol	Designation	DN	NB	Standard	Flange Type	Flange facing	Nozzle length	Remarks
N1	98% H2SO4 INLET	*	*	ASME B16.5	*	RF	*	
N2	98% H2SO4 OUTLET	*	*	ASME B16.5	*	RF	*	
N3	CHILLED WATER INLET	*	*	ASME B16.5	*	RF	*	
N4	CHILLED WATER OUTLET	*	*	ASME B16.5	*	RF	*	

Plant 350 MTPD Caustic Soda Expansion		Client PACL		Contract Code PACL- 350 TPD EXPN		Document ID 0215-EQS-21-EC-0002		Contract No. 66- 0215-700		
		INDEX OF APPLICABLE CODES AND STANDARDS 98% H2SO4 Cooler Item No. 21E05N						 PACL LIMITED		
								Rev	00	Page
1 DESIGN CODES										
1										
2	<input checked="" type="checkbox"/>	ASME Code Section VIII, Division 1 Edition 2017								
3		ASME Code Section VIII, Division 2 Edition 2017								
4		TEMA Standards, Class R, 2007- 9th Edition								
5		API 650, 12th Edition March 2013 with Addendum 2, January 2016								
6		API 620, 12th Edition October 2013 with Addendum 1, November 2014								
7	<input checked="" type="checkbox"/>	API 662 Part 1, 1st Edition February 2006 with Reaffirmed, February 2011								
8		EN 13121-3 : 2010A								
9		IBR 1950 with amendment Dec. 2008								
10	<input checked="" type="checkbox"/>	Manufacturer's Standards								
2 REFERENCE STANDARDS										
12		ESA 09 AU-ST-02(M)	Vessels & Equipment: Pressure Vessels General Specification							
13		UN 2000-01 Part 2(M)	Atmospheric vessels, general specification							
14		UN 2000-01 Part 3(M)	Vessels and equipment, field fabrication, general specification							
15		UN 2000-05 Part 1(M)	Saddle supports for horizontal steel vessels							
16		UN 2000-05 Part 4(M)	Supports For Vertical Steel Vessels; Skirt							
17		UN 2000-05 Part 5(M)	Supports For Vertical Steel Vessels; Legs							
18		UN 2000-05 Part 6	Supports For Vertical Steel Vessels; Brackets (Lugs)							
19		UN 2000-06 Part 2(M)	Clips for ladders, davits and platforms							
20		UN 2000-06 Part 3(M)	Clips for guide and support brackets for piping, type C							
21	<input checked="" type="checkbox"/>	UN 2000-09 Part 1(M)	Name plate for vessels							
22		UN 2000-09 Part 2(M)	Name plate for tanks							
23		UN 2000-11 Part 1(M)	Swivel devices for inspection openings							
24		UN 2002-01 Part 1	Vessels and equipment of glass fibre reinforced plastics; Technical delivery condition							
25		UN 2002-02 Part 1	Vessels and equipment of glass fibre reinforced plastics, with lining; Technical delivery condition							
26		UN 2002-03 Part 1	Vessels and equipment of glass fibre reinforced plastics; Typical configuration							
27		UN 2002-04	Transport and erection instructions for vessels and tanks of GRP							
28	<input checked="" type="checkbox"/>	UN 2003-01	Earthing connections for vessels and equipment							
29		UN 2004-05(M)	Internals; Vortex breakers, feed deflectors and ladder rungs							
30		UN 2004-06(M)	Insulation clips for vertical steel vessels							
31		UN 2100-01 Part 1	Tubular heat exchangers, general specification							
32		UN 2100-03(M)	Jack screw bosses at tube sheet for heat exchangers							
33		UN 5222-02 Part 1(M)	Fractionating Trays; General Specification							
34		UN 5222-02 Part 2(M)	Vessels, support grid							
35		UN 5222-02 Part 3(M)	Vessels, hold down grid							
36		UN V416-01 Part 1	Welding, welded joints for vessels and equipment, requirements							
37		UN V416-01 Part 2	Welding, welded joints for vessels and equipment, examples							
38		UN V416-02(M)	Vessels and equipment, tube-to-tubesheet joints							
39		UN V416-03 Part 1	Vessels and equipment, surface treatment of austenitic stainless steels after welding							
40		UN 2000-01 Part 1	Engineering of steel structures; design, fabrication, materials							
41										
42										
43										
44										
45										
46										
47										
48										
49										
50										
3 CLASSIFICATION GROUP and LEAKAGE CLASS										
52		Vessel	Group							
53		Heat Exchanger	Shell Side Group		Tube Side Group		Leakage class DK			
54		Not Applicable								
4 FATIGUE LOADING										
56		Design	No. of load cycles		from		kg/cm2 g	to		kg/cm2g
57	Remarks:									

Plant 350 MTPD Caustic Soda Expansion		Client PACL	Contract Code PACL- 350 TPD EXPN	Document ID 0215-EQS-21-EC-0002	Contract No. 66- 0215-700
		GENERAL REQUIREMENTS			 PACL LIMITED
		98% H2SO4 Cooler Item No. 21E05N			
1	General				
2	<input checked="" type="checkbox"/>	Stress analysis shall be performed by the manufacturer in accordance with design specifications			
3	<input checked="" type="checkbox"/>	Specified wall thicknesses are minimum values and shall be increased if required by stress calculation			
4	<input checked="" type="checkbox"/>	Nozzle necks shall be least DN 50/ 2". They shall be reduced to the required nominal flange size if necessary.			
5	<input checked="" type="checkbox"/>	Bolts and nuts for joints with tapped holes have to be supplied by the vessel manufacturer.			
6					
7	Supplies shall include the following items				
8	<input type="checkbox"/>	Base ring template			
9	<input type="checkbox"/>	Clips and pads for ladders and platforms			
10	<input type="checkbox"/>	Clips for davits			
11	<input type="checkbox"/>	Davits for manholes			
12	<input type="checkbox"/>	Clips and pads for pipe supports			
13	<input type="checkbox"/>	Supports for insulation			
14	<input type="checkbox"/>	Supports for fireproofing insulation acc. to UN 2000 - 05 part 4			
15	<input type="checkbox"/>	Additional 1 sets of gaskets for flanges with cover and blind flanges			
16	<input type="checkbox"/>	Additional 10% of bolts and nuts, as spare			
17	<input checked="" type="checkbox"/>	Lifting lugs for erection			
18	<input type="checkbox"/>	Lifting trunnions for erection			
19	<input checked="" type="checkbox"/>	2 separate earthing connections to be provided 180 degree apart resp. 1 per saddle, if not otherwise specified			
20	<input checked="" type="checkbox"/>	All internals			
21	<input type="checkbox"/>	Set of glasses and gaskets for water gauges			
22	<input type="checkbox"/>	Demister			
23	<input type="checkbox"/>	Platforms and ladders plus bolts and nuts, as spare			
24	<input checked="" type="checkbox"/>	Spare parts for 2 years to be quoted separately.			
25	<input type="checkbox"/>	Bolts, nuts and gaskets for connecting piping			
26	<input type="checkbox"/>	Test flange (quote separately)			
27	<input type="checkbox"/>	Lifting lugs on channels and bonnets			
28	<input checked="" type="checkbox"/>	Name plate			
29	<input checked="" type="checkbox"/>	Anchor Bolts			
30	<input checked="" type="checkbox"/>	For applicable standards see page ' index of applicable Codes and standards'			
31	<input checked="" type="checkbox"/>	Commissioning spare parts			
32					
33	Additional requirements for heat exchangers				
34	<input type="checkbox"/>	Tubes to be welded into tube sheet and tested according to UN V416 - 02 part 1, Leakage class			
35	<input type="checkbox"/>	Tubes to be expanded after welding			
36	<input type="checkbox"/>	Tubes to be fixed by expansion			
37	<input type="checkbox"/>	Expansion with grooves in tube sheet holes			
38	<input type="checkbox"/>	Tube bundle to be equipped with 2 slide rails			
39	<input type="checkbox"/>	Tube bundle to be equipped with sealing strips			
40	<input type="checkbox"/>	For stacked heat exchangers an experimental assembly and pressure test shall be performed			
41	<input type="checkbox"/>	Protection device for expansion bellows			
42					
43	<input type="checkbox"/>	Pulling Lugs for tube bundle			
44	<input type="checkbox"/>	Jackscrews and jack bosses according to UN 2100 - 03 part 2			
45	<input type="checkbox"/>	Tube holes in baffles and support plates to be max. 0.4 mm over outer diameter of tubes			
46	<input type="checkbox"/>	Holes' diameter in tube sheet according to standard fit			
47					
48					
49	Remarks:				

Plant 350 MTPD Caustic Soda Expansion	Client PACL	Contract Code PACL- 350 TPD EXPN	Document ID 0215-EQS-21-EC-0002	Contract No. 66- 0215-700		
	SUMMARY OF ENGINEERING AND FINAL DOCUMENTS			 PACL LIMITED		
	98% H2SO4 Cooler Item No. 21E05N				Rev 00 Page 7 of 7	
SN	The following engineering and final documents shall be furnished by the manufacturers :					
1	Version and delivery date shall be specified					
2						
3	1.0 For engineering and approval		Quantity			
4	Pos	Documents	Reproducible	Copy	Version	Delivery Dt
5	1	Assembly drawing - Arrangement drawing & QAP	1)	1 soft	II	B
6	2	Foundation plan - Load plan		1 soft	II	B
7	3	Workshop drawing with part list			II	
8	4	Engineering data and specifications (tkIS(India) DATA SHEETS FILLED)		1 soft	II	A, B
9	5	Piping plan or piping diagram / P&ID				
10	6	Electrical diagrams (MOTOR DRAWINGS), Instrument list (Make / Type)				
11	7	Delivery schedule for equipment		1 soft	II	D.1
12	8	Sketch for equipment transport				
13	9	Erection instructions				
14	10	Stress analysis (for information)				
15	11	Product catalogue, Instrument Specs. Including Instruments & G.A. for Panel.				
16	12	Reference list for similar equipment				
17	13	Documents bearing tkIS(India)/Client notes shall be resubmitted	As Indicated Above			C
18	2.0 SPARE PARTS					
19	1	Quotation for two years operation & commissioning spares		1 soft	II	A
20	2	Spare part list with itemized drawing or sketches		1 soft	II	B
21						
22	3.0 FINAL DOCUMENTS					
23	1	Final documents as listed under 1.0		4 Hard+3soft	II	 G
24	2	Instructions for operation and maintenance		4 Hard+3soft	II	
25	3	Erection instructions		4 Hard+3soft	II	
26	4	Table of lubricants and lubrication schedule				
27	5	Test certificates for explosion proof items of equipment				
28	6	Summary of antifriction bearings				
29	7	Stress analysis				
30	8	Exhaustive Component List				
31	9	Test Certificate of bought-out items				
32	10	Panel Wiring Diagram				
33	11					
34	12					
35	4.0 INSPECTION					
36	1	Shop inspection certificate		4 Hard+1soft	II	E
37	2	Inspection reports to DIN 50 049/3.1A-3.1C		4 Hard+1soft	II	E
38	3	Inspection reports issued by inspection authority such as TUV				
39	4	Inspection reports, stress-relieving diagrams, etc.				
40	5					
41	5.0 Explanation of figures listed in column version		Notes pertaining to column "delivery date"			
42	I	Lettering or wording in German	A To be submitted with quotation			
43			B 15 days after order placements			
44	II	Lettering or wording in English	C Two weeks after return of documents			
45			D One month after order placement, thereafter monthly			
46	III	Lettering or wording in German and English	E Not later than date of final inspection			
47			F One month after final inspection ; to be submitted with shipping documents if the equipment has to be shipped			
48	IV	Lettering or wording in German	G After final release, but not later than 4 weeks prior to final inspection			
49			1 soft copy to GNAL, 1 soft copy to tkIS(I)-HO, 1 soft copy to tkIS(I)- site			
50	6.0 REMARKS :					
51	1) Standard size DIN A4 and smaller on white sheets, larger sizes on reproducible					
52	NOTES :					
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