ipip S.A. — Tecnimont KT

VICTORIA PROJECT
Gas sweetening, C_2 Recovery & Fractionation Plant

BUSHEHR PETROCHEMICAL COMPANY

Document title:	DATA SHEET FOR AIR COOLERS							Think X perT
Document number:	Plant id.	Proj. no.	Unit	Disc.	Type	Seq.	Rev.	Page 1 of 2
	01	1010	120	PR	DSH	006	2	Phase: EBD

TKT Document number:	Project no.	Unit no.	Document code		Serial no.	Rev. no.
	K015	120	SP	0710	01	2

Service: AGRU LEAN AMINE AIR COOLER — Item: 01-120-AE-3 — MR:

Bay size (W x L): (11) x (11) m — No. of Bays / Item — Type Draft (Induced / Forced): (11)

Surface per item; Finned Tube: (11) m² ; Bare Tube: (11) m²

Heat Exchanged (16) (1): 32.74 MW — Effective MTD: (11) °C

Transfer Rate; Finned, Service: (11) ; Bare Tube, Service: (11) ; Clean: (11) W/m²°C

PERFORMANCE DATA - TUBE SIDE

			In	Out			In	Out
Fluid Name			LEAN AMINE					
Total Fluid	kg/h		1275914		Density	(Liq. / Vap.) kg/m³	989.9 /	1004.1 /
			In	Out	Spec. Heat	(Liq. / Vap.) kJ/kg°C	4.06 /	3.96 /
Temperature	°C		88	65	Therm. Cond.	(Liq. / Vap.) W/m°C	0.55 /	0.54 /
Vapour	kg/h	M.W.			Dew / Bubble Point	°C	/	
Liquid	kg/h		1275914	1275914	Latent Heat	kJ/kg		
Steam	kg/h				Inlet Oper. Press.	bar (g)	13.2	
Water	kg/h				Inter. Fouling Fact.	m²°C/W	0.0004 (3)	
Non Condens.	kg/h	M.W.			Pressure Drop	bar	Allow. 0.7	Calc. (11)
Viscosity	(Liq. / Vap.) cP		0.50 /	0.73 /	Pour Point	°C		

PERFORMANCE DATA - AIR SIDE (2)

Air Flowrate / Item: m³/h	Face Velocity: m/s	Temperature In: 50	°C
Air Flowrate / Fan: m³/h	Altitude a. s. l.: 32 m	Temperature Out:	°C
Actual Static Pressure: 990-1100 mbar(a)		Min. Temperature: 5	°C

DESIGN, MATERIALS AND CONSTRUCTION (6) (8) (12)

Design Pressure: 20 (15) bar (g)	Test Pressure: bar (g)	Design Temperature: 140 (9) °C

TUBE BUNDLE (11) (17)	HEADER	TUBE
Size: m x m — No. of Rows (11)	Type:	Material (6): SS 316L
No. per Bay: (11) — No. per Item (11)	Material: SS 316L	O.D. mm — Thk mm
Arrangement: (11)	No. of Passes — Slope %	No. per Bundle
Bundles (11) In Parallel — In Series	Corrosion Allowance: 1 mm	Length mm
Bays (11) In Parallel — In Series	Plug Design — Mater.	Pitch mm — Layout
Bundle Side Frame	Gasket Material	FIN

MISCELLANEA	Nozzles	No.	Ø in	Rating & Fac. #	
Structure (yes/no) — Ladder (yes/no)	Inlet	1	24 (5)	300 RF	Material
Louvres (auto/man) — Walkway (yes/no)	Outlet	1	24 (5)	300 RF	Type
Hood (yes/no) — Vibr. Switch (yes/no)	Code Req.				O.D. mm — No./m
					Stock Thick. mm

MECHANICAL EQUIPMENT (7) (14)

FAN (4)	DRIVER	SPEED REDUCER
No./bay (11) — kW / Fan — rpm	No./bay — kW /driver — rpm	No. / bay
Diameter m — Blades No.	Type	Type
Angle — Blade Material	Volt / Phase / Cycles / /	Speed Ratio
Pitch — (Adjustable or Auto Var.)	Enclosure	

CONTROLS

RECIRCULATION SYSTEM			STEAM COIL			
Type (Internal or External)			Press.: Inlet bar (g)	Design bar (g)	Test	bar (g)
Shutters (Manual or Automatic)			Design Temperature °C	Steam Quantity		kg/h
Actuator Air	Signal	Supply	Tube: No.	O.D. mm	Thk. mm	Length mm
Steam Coil	to kPa(g)	kPa(g)	Fin: Type	O.D. mm	No./m	
Auto-Fan	to kPa(g)	kPa(g)	Material: Tube	Fin	Code Req.	
Shutters	to kPa(g)	kPa(g)	Nozzles Ø: In — Out	in	Rating & Fac. #	
Control Action on Air Failure:	Fan Pitch	(Min or Max)	Louvres	(Open or Close)		

NOTES:

Rev.	Date	Description	Wrt	Verif	App	Aut
2	02/07/2012	RELEASED FOR DETAIL DESIGN	FFI	CMA	FAN	MDC
1	18/05/2012	RELEASED FOR EXTENDED BASIC	FFI	CMA	FAN	MDC
0	2/17/2012	ISSUE FOR BASIC DESIGN	dirita	MEA	FAN	MDC

PROCESS DEPARTMENT

Rev.	Date	Description	Wrt	Verif	App	Aut

ENGINEERING DEPARTMENT

ipip / Tecnimont KT	VICTORIA PROJECT Gas sweetening, C_2 Recovery & Fractionation Plant							BUSHEHR PETROCHEMICAL COMPANY	
Document title:	DATA SHEET FOR AIR COOLERS							*Think X perT*	
Document number:	Plant id.	Proj. no.	Unit	Disc.	Type	Seq.	Rev.	Page 2 of 2	
	01	1010	120	PR	DSH	006	2	Phase: EBD	

TKT Document number:	Project no.	Unit no.	Document code		Serial no.	Rev. no.
	K015	120	SP	0710	01	2

Service **AGRU LEAN AMINE AIR COOLER** Item **01-120-AE-3**

MR

NOTES:

1. 10% overdesign on duty to be provided.
2. For climatic conditions, site information, air design temperature refer to "Meteorological Condition and Site Data" Doc. N. 01_05-1010-000-PR-REP-002 latest revision.
3. Fouling factor for air side: 0.00035 m^2°C/W.
4. At least two fans shall be provided for each bay.
5. Connection sizes refer to inlet and outlet piping lines.
6. Amine service. Material shall comply with API 945 where applicable.
7. Temperature control by variable speed drivers on 50% of fans.
8. Number of bundles and relevant piping arrangement (vents, drains, isolation valves, etc) to be defined during Detailed Engineering.
9. Minimum Design Metal Temperature: 5 °C.
10. Recommendation for spare parts to be advised by Vendor.
11. By Vendor.
12. Construction according to: ASME Section VIII-DIV.1, API 661, local codes, laws and standards.
13. Noise Level: < 85 dbA at one metre from equipment (Annex 2A-1 Basis of Design). The noise level is usually limited to 75 decibels max. at 15.24 m from the fan and the blade tip speed is limited ("General Specification For Air Cooled Heat Exchangers" Doc. N. 01_05-1010-000-ME-SPF-005 latest version).
14. Number of motors and tag to be confirmed during detailed Engineering stage.
15. To be confirmed after AGRU Lean Amine Pumps Vendor selection (01-120-P-1 A/B).
16. Design case for this equipment: Winter Rich.
17. Give tube count of each pass when irregular.
18. Deleted

Pipe rack width = 10 m

Rev.	Date	Description	Wrt	Verif	App	Aut	Rev.	Date	Description	Wrt	Verif	App	Aut

PROCESS DEPARTMENT | ENGINEERING DEPARTMENT

Petropars Ltd. IOEC PPI PPI/IOEC/PPI CONSORTIUM	NATIONAL IRANIAN OIL COMPANY SOUTH PARS GAS FIELD DEVELOPMENT PHASE 19 ONSHORE FACILITIES	NIOC PARS OIL & GAS COMPANY
	DOCUMENT TITLE : PROCESS DATA SHEET FOR REFRIGERANT CONDENSER 147-A-101	Class :2
	DOCUMENT NUMBER: SPP-SP19-147-A-101	Rev.No :3

PROCESS DATA SHEET FOR AIR COOLED HEAT EXCHANGER

1	SERVICE	REFRIGERANT CONDENSER			ITEM	147-A-101				
2	DRAFT		BUNDLE SIZE	m	SECTION SIZE					m
3	NO. OF UNITS	1	BUNDLES PER UNIT		SECTION PER UNIT					
4	BUNDLES ARRANGEMENT				SECTION ARRANGEMENT					
5	SURFACE PER UNIT:		FINNED		m²	BARE TUBE				m²
6	**PERFORMANCE DATA OF ONE UNIT (CASE:SUMMER)**									
7	**TUBE SIDE**						**AIR SIDE**			
8	FLUID CIRCULATED			PROPANE (5)			INLET TEMPERATURE	(2)	°C	
9	FLUID QUANTITY , TOTAL		kg/h	172676 (3)			OUTLET TEMPERATURE		°C	
10				IN	OUT		AIR QUANTITY PER FAN		m³/h	
11	VAPOR	(MOL. WT.)	kg/h	172676 (3)			AIR QUANTITY PER UNIT		m³/h	
12	LIQUID		kg/h		172676 (3)		ALTITUDE	(2)	m	
13	STEAM		kg/h				MINIMUM TEMPERATURE	(2)	°C	
14	WATER		kg/h				STATIC PRESSURE	(2)	bar	
15	NON CONDENSABLE	(MOL. WT.)	kg/h			3	POWER PER UNIT		KW	
16	HYDROGEN VAPORS		kg/h				HEAT EXCHANGED	15404 (3)	KW	
17	TEMPERATURE		°C	86	60.3		OVER DESIGN 10% ON SURFACE (3)			
18	DENSITY AT T AND P	LIQ. / VAP.	kg/m³	43.45	431.32		MTD (CORRECTED)		°C	
19	VISCOSITY AT T AND P	LIQ. / VAP.	CP	0.01	0.065		TRANS. RATE FINNED		W/(m².°C)	
20	SPECIFIC HEAT	LIQ. / VAP.	KWH/(KG.°C)	6.92E-04	9.04E-04		TRANS. RATE BARE		W/(m².°C)	
21	THERMAL CONDUCTIVITY	LIQ. / VAP.	W/(m.°C)	0.025	0.0817		**DESIGN DATA**			
22	POUR POINT / FREEZING POINT		°C				DESIGN / TEST PRESS.	barg	28 (6) /	
23	LATENT HEAT		Kj/kg				DESIGN / MAX OPER.TEMP	°C	115 (6) /	
24	INLET PRESSURE		bara	22.2			MIN DESIGN TEMPERATE.	°C	-46	
25	PRESSURE DROP ALLOW. / CALCULATED		bar	0.7			AT PRESSURE OF	barg	28 (6)	
26	FOULING RESISTANCE		m².°C/W	0.00015			CORROSION ALLOWANCE	mm	3 (HEADER) (4)	
27	PARTICULAR SERVICE						CODE			
28	**CONSTRUCTION EACH BUNDLE (8,9)**									
29	TUBES			FINS			HEADERS			
30	MATERIAL	LTCS (4)		MATERIAL			MATERIAL	LTCS (4)	PLUG MAT.	
31	MAT. SPEC.			O.D.	mm		MAT. SPEC.		GASKETS	
32	O.D. mm	THK. mm		THK.	mm		TYPE	PLUG	PIPE INLET / OUT	18" / 16" in
33	LENGTH	mm		NO. / INCH			NO. PASSES		NOZZLE INLET	in
34	PITCH △	mm		TYPE			NO. ROWS		NOZZLE OUTLET	in
35	NO./BUNDLE						PLUG TYPE		RATING AND FACING	300# (4) RF
36	**CONSTRUCTION EACH SECTIONS**									
37	NO. ADJST. PITCH FANS	2		FAN DIAMETER	mm		DRIVER TYPE		VOLTS	
38	NO.OF VAR.PITCH FANS			FAN POWER	KW		DRIVER POWER	KW	PHASES	CYCLES
39	NO. OF BLADES			TIP SPEED	M/S		DRIVER SPEED (10)	RPM	AIR SIGNAL	barg
40	SHUTTERS			4WR² FAN	kg.m²		SPEED REDUCER		AIR SUPPLY PRESS.	barg
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PROCESS DATA SHEET FOR AIR COOLED HEAT EXCHANGER

NOTES

1) Minimum Turndown: 20%
2) Refer to "Basic Engineering Data for Onshore Facilities" - DB SP19 999 P332 204
3) 10% Overdesign on Duty and Flowrate Shall Be Considered by Air Cooler Vendor.
4) Data Should Be Finalized by Mechanical Department.
5) Commercial Propane - Expected Composition Is : C2: 0.06% vol , C3: 98.84% vol, C4:1.1% vol. Mass: 0.04%, 98.69%, 1.26%
6) Deleted. △3
7) To Be Confirmed After Depressurization Calculation.
8) Bundle to Be Self-draining (1% Slope)
9) 2" Vent to Be Provided at High Point.
10) No Variable Speed Driver. Two-speed Motors with Selector Provided on Local and in CCR.

Pipe rack width = 12 m

CHARACTERISTICS (1)(2)(3)(4)

Tube surface	m²	4810 (5)	Total developed surface	m²	(6)

Run case			Base case - EOR	
Tube Side			**Inlet**	**Outlet**
Fluid name			DIH overhead (HC)	
Fluid quantity, total		kg/h	335 160 (7)	
Vapor		kg/h	335 160	
Liquid		kg/h		335 160
Steam		kg/h		
Water		kg/h		
Non condensable (mole fraction on total inlet fluid)				
(8) Temperature		°C	75	50
Vapor (14)	Density (PT)	kg/m3	7.520	
	Viscosity	cP	0.0083	
	Molecular weight	kg/kmol	78.48	
	Specific heat	kJ/kg.°C	1.968	
	Thermal cond.	kW/m.°C	0.000019	
Liquid (14)	Density (PT)	kg/m3		607.3
	Viscosity	cP		0.20
	Specific heat	kJ/kg.°C		2.387
	Thermal cond.	kW/m.°C		0.000117
Latent heat		kJ/kg	(14)	
(8) Inlet pressure		bar g	1.7	
Pressure drop (allowable)		bar	0.4 (9)	
Fouling resistance		m².°C/kW	0.172	

Air Side			(1) (2) (3) (4)
Temperature	(in)	°C	36
Altitude		m	1362 m above sea level

Heat exchanged	MW	33.62 (10)
Transfer rate	kW/m².°C	(6)
Mean temperature difference	°C	(6)

GENERAL DESIGN INFORMATION

Note	Design conditions		
	Design pressure	bar g	3.8
	Temperature	°C	100
	Ext. Pressure		FV @ 75°C
	MDMT	°C	-25 (11)
Note	**Other operating conditions**		
	Pressure	bar g	
	Temperature	°C	
	Pressure	bar g	
	Temperature	°C	
	Pressure	bar g	
	Temperature	°C	

MATERIAL AND CORROSION ALLOWANCE

Note		Materials	Corr. Allow. mm
	Material induced by fluid characteristics	Low Temperature Carbon Steel	3

CONNECTIONS NOMENCLATURE

Note		
(12)	Line size (in/out) in	30" / 16"
(13)	Connections rating (in/out)	150 RF / 150 RF

NOTES

General note : Design conditions result from normal operation conditions. DETAIL ENGINEERING CONTRACTOR must check that results obtained with these conditions are adequate for all operating conditions.

(1) Forced draft type.
(2) Variable speed driver on 50% of the fans.
(3) Louvers on 50% of the fans.
(4) Non condensable vent. One per each bundle.
(5) Estimated bare tubes surface based on U = 410 W/m².°C and tube length of 30ft. To be confirmed by DETAIL ENGINEERING CONTRACTOR.
(6) By DETAIL ENGINEERING CONTRACTOR / Thermal rating specialist.
(7) Design flowrate = 402 192 kg/hr corresponding to 120% overdesign of the base case EOR flowrate.
(8) Normal operating conditions.
(9) Allowable pressure drop to be based on the design flowrate.
(10) Design duty: 36.98 MW corresponding to 110% overdesign of the indicated duty.
(11) Resulting from minimum ambient temperature.
(12) Diameter of the process line connected to the air cooler.
(13) Flange class is base on ASTM A350 Gr LF2 material.
(14) Refer to attached physical properties tables:
Base case EOR - Inlet Pressure
Base case EOR - Medium Pressure
Base case EOR - Outlet Pressure

Base case EOR – Inlet pressure	Mass flowrate kg/h	335 160

		BUB							
Temperature	°C	74.9	73.8	73.0	71.1	69.2	67.7	67.3	65.3
Pressure	bar g	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Enthalpy	MW	43.67	43.45	38.86	28.14	19.32	14.04	13.95	13.51
Spec. Enthalpy	kJ/kg	469.0	466.7	417.4	302.2	207.5	150.8	149.8	145.1
Wt pc vapor	%	100.00	100.00	84.00	47.04	17.30	0.00	0.00	0.00
Wt pc free water	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VAPOR									
Density	kg/m3	7.520	7.552	7.528	7.465	7.398			
Viscosity	cP	0.0083	0.0082	0.0082	0.0082	0.0082			
Thermal Cond.	kW/m.°C	0.000019	0.000019	0.000019	0.000019	0.000019			
Heat Capacity	kJ/kg.°C	1.968	1.963	1.960	1.952	1.944			
Spec. Enthalpy	kJ/kg	469.0	466.7	465.9	463.8	461.6			
Mol. Weight	kg/kmol	78.48	78.48	78.09	77.04	75.98			
LIQUID									
Density	kg/m3			587.4	587.3	587.2	587.3	587.8	590.1
Viscosity	cP			0.16	0.16	0.16	0.16	0.16	0.17
Thermal Cond.	kW/m.°C			0.000108	0.000109	0.000110	0.000110	0.000110	0.000111
Heat Capacity	kJ/kg.°C			2.484	2.480	2.476	2.472	2.470	2.461
Spec. Enthalpy	kJ/kg			163.2	158.7	154.3	150.8	149.8	145.1
Surf. Tension	dyn/cm			11.4	11.4	11.5	11.5	11.5	11.7
WATER									
Density	kg/m3								
Viscosity	cP								
Thermal Cond.	kW/m.°C								
Heat Capacity	kJ/kg.°C								
Spec. Enthalpy	kJ/kg								
Surf. Tension	dyn/cm								

Note : BUB=Bubble Point ; DEW=Dew Point ; WAT=Water Dew Point

Base case EOR – Inlet pressure	Mass flowrate	kg/h	335 160

Temperature	°C	63.4	61.5	59.6	57.7	55.7	53.8	51.9	50.0
Pressure	bar g	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Enthalpy	MW	13.07	12.63	12.19	11.76	11.33	10.90	10.47	10.04
Spec. Enthalpy	kJ/kg	140.4	135.7	131.0	126.3	121.7	117.1	112.4	107.9
Wt pc vapor	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wt pc free water	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VAPOR									
Density	kg/m3								
Viscosity	cP								
Thermal Cond.	kW/m.°C								
Heat Capacity	kJ/kg.°C								
Spec. Enthalpy	kJ/kg								
Mol. Weight	kg/kmol								
LIQUID									
Density	kg/m3	592.3	594.5	596.7	598.9	601.0	603.2	605.3	607.4
Viscosity	cP	0.17	0.17	0.18	0.18	0.18	0.19	0.19	0.20
Thermal Cond.	kW/m.°C	0.000112	0.000113	0.000113	0.000114	0.000115	0.000116	0.000116	0.000117
Heat Capacity	kJ/kg.°C	2.451	2.442	2.433	2.423	2.414	2.405	2.396	2.387
Spec. Enthalpy	kJ/kg	140.4	135.7	131.0	126.3	121.7	117.1	112.4	107.9
Surf. Tension	dyn/cm	11.9	12.1	12.3	12.5	12.7	12.9	13.1	13.3
WATER									
Density	kg/m3								
Viscosity	cP								
Thermal Cond.	kW/m.°C								
Heat Capacity	kJ/kg.°C								
Spec. Enthalpy	kJ/kg								
Surf. Tension	dyn/cm								

Note : BUB=Bubble Point ; DEW=Dew Point ; WAT=Water Dew Point

Base case EOR – Medium pressure	Mass flowrate kg/h	335 160

									BUB
Temperature	°C	74.5	72.6	70.8	70.7	68.8	66.9	65.1	64.7
Pressure	bar g	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Enthalpy	MW	43.67	43.32	43.00	42.38	31.24	21.83	14.54	13.35
Spec. Enthalpy	kJ/kg	469.0	465.3	461.9	455.2	335.6	234.5	156.2	143.4
Wt pc vapor	%	100.00	100.00	100.00	97.84	59.54	27.77	3.81	0.00
Wt pc free water	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VAPOR									
Density	kg/m3	6.898	6.944	6.989	6.986	6.929	6.869	6.806	
Viscosity	cP	0.0082	0.0082	0.0081	0.0081	0.0081	0.0081	0.0081	
Thermal Cond.	kW/m.°C	0.000019	0.000019	0.000019	0.000019	0.000019	0.000019	0.000018	
Heat Capacity	kJ/kg.°C	1.958	1.951	1.944	1.944	1.936	1.928	1.920	
Spec. Enthalpy	kJ/kg	469.0	465.3	461.9	461.8	459.7	457.7	455.6	
Mol. Weight	kg/kmol	78.48	78.48	78.48	78.43	77.40	76.36	75.29	
LIQUID									
Density	kg/m3				590.9	590.8	590.7	590.8	590.8
Viscosity	cP				0.17	0.17	0.17	0.17	0.17
Thermal Cond.	kW/m.°C				0.000109	0.000110	0.000111	0.000111	0.000111
Heat Capacity	kJ/kg.°C				2.471	2.467	2.463	2.458	2.457
Spec. Enthalpy	kJ/kg				157.4	153.0	148.6	144.3	143.4
Surf. Tension	dyn/cm				11.7	11.7	11.7	11.8	11.8
WATER									
Density	kg/m3								
Viscosity	cP								
Thermal Cond.	kW/m.°C								
Heat Capacity	kJ/kg.°C								
Spec. Enthalpy	kJ/kg								
Surf. Tension	dyn/cm								

Note : BUB=Bubble Point ; DEW=Dew Point ; WAT=Water Dew Point

Base case EOR – medium pressure	Mass flowrate kg/h	335 160

Temperature	°C	63.2	61.3	59.4	57.5	55.6	53.8	51.9	50.0
Pressure	bar g	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Enthalpy	MW	13.01	12.58	12.15	11.73	11.30	10.88	10.46	10.04
Spec. Enthalpy	kJ/kg	139.7	135.1	130.5	126.0	121.4	116.9	112.4	107.9
Wt pc vapor	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wt pc free water	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VAPOR									
Density	kg/m3								
Viscosity	cP								
Thermal Cond.	kW/m.°C								
Heat Capacity	kJ/kg.°C								
Spec. Enthalpy	kJ/kg								
Mol. Weight	kg/kmol								
LIQUID									
Density	kg/m3	592.5	594.7	596.9	599.0	601.1	603.2	605.3	607.3
Viscosity	cP	0.17	0.17	0.18	0.18	0.18	0.19	0.19	0.20
Thermal Cond.	kW/m.°C	0.000112	0.000113	0.000113	0.000114	0.000115	0.000116	0.000116	0.000117
Heat Capacity	kJ/kg.°C	2.450	2.441	2.432	2.423	2.414	2.405	2.396	2.387
Spec. Enthalpy	kJ/kg	139.7	135.1	130.5	126.0	121.4	116.9	112.4	107.9
Surf. Tension	dyn/cm	12.0	12.1	12.3	12.5	12.7	12.9	13.1	13.3
WATER									
Density	kg/m3								
Viscosity	cP								
Thermal Cond.	kW/m.°C								
Heat Capacity	kJ/kg.°C								
Spec. Enthalpy	kJ/kg								
Surf. Tension	dyn/cm								

Note : BUB=Bubble Point ; DEW=Dew Point ; WAT=Water Dew Point

Base case EOR – Outlet pressure	Mass flowrate kg/h	335 160

Temperature	°C	74.0	72.2	70.3	68.5	67.7	66.6	64.8	62.9
Pressure	bar g	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Enthalpy	MW	43.67	43.33	43.00	42.67	42.52	36.15	25.98	17.64
Spec. Enthalpy	kJ/kg	469.0	465.4	461.8	458.3	456.7	388.3	279.1	189.5
Wt pc vapor	%	100.00	100.00	100.00	100.00	100.00	78.18	43.77	16.16
Wt pc free water	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VAPOR									
Density	kg/m3	6.283	6.324	6.365	6.407	6.426	6.397	6.344	6.288
Viscosity	cP	0.0082	0.0082	0.0081	0.0081	0.0081	0.0081	0.0080	0.0080
Thermal Cond.	kW/m.°C	0.000019	0.000019	0.000019	0.000019	0.000018	0.000018	0.000018	0.000018
Heat Capacity	kJ/kg.°C	1.949	1.942	1.934	1.927	1.924	1.920	1.912	1.904
Spec. Enthalpy	kJ/kg	469.0	465.4	461.8	458.3	456.7	455.6	453.6	451.7
Mol. Weight	kg/kmol	78.48	78.48	78.48	78.48	78.48	77.92	76.89	75.84
LIQUID									
Density	kg/m3						594.6	594.4	594.4
Viscosity	cP						0.17	0.17	0.17
Thermal Cond.	kW/m.°C						0.000111	0.000111	0.000112
Heat Capacity	kJ/kg.°C						2.453	2.449	2.445
Spec. Enthalpy	kJ/kg						147.4	143.2	138.9
Surf. Tension	dyn/cm						12.0	12.0	12.1
WATER									
Density	kg/m3								
Viscosity	cP								
Thermal Cond.	kW/m.°C								
Heat Capacity	kJ/kg.°C								
Spec. Enthalpy	kJ/kg								
Surf. Tension	dyn/cm								

Note : BUB=Bubble Point ; DEW=Dew Point ; WAT=Water Dew Point

N.I.O.E.C.	National Iranian Oil Engineering & Construction Company	**Contract :** NIOEC/GC-GN/CON-BD 03-00				**REF. No.:** 1083-DS-E-6813			
	Shahriar Refinery Project	**DOCUMENT CODE**							PAGE 10 OF 10
NARGAN ENGINEERS & CONSTRUCTORS	**ISOMERIZATION UNIT**	PRJ.	UNIT	PHASE	DISC.	DOCTYPE	SER. NO	REV. NO	DATE
		1083	68	EB	PR	DS	E6813	0	14/11/08
KBC	Axens IFP Group Technologies	**Originator Job No.** 08-3199				**Originator Doc. No.** 08-3199 68 2AC E-6813-0			

Base case EOR – Outlet pressure	Mass flowrate kg/h	335 160

		BUB							
Temperature	°C	61.5	61.1	59.2	57.4	55.5	53.7	51.8	50.0
Pressure	bar g	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Enthalpy	MW	12.62	12.53	12.11	11.70	11.28	10.87	10.45	10.04
Spec. Enthalpy	kJ/kg	135.6	134.6	130.1	125.6	121.2	116.7	112.3	107.9
Wt pc vapor	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wt pc free water	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VAPOR									
Density	kg/m3								
Viscosity	cP								
Thermal Cond.	kW/m.°C								
Heat Capacity	kJ/kg.°C								
Spec. Enthalpy	kJ/kg								
Mol. Weight	kg/kmol								
LIQUID									
Density	kg/m3	594.5	594.9	597.0	599.1	601.2	603.2	605.3	607.3
Viscosity	cP	0.17	0.17	0.18	0.18	0.19	0.19	0.19	0.20
Thermal Cond.	kW/m.°C	0.000113	0.000113	0.000114	0.000114	0.000115	0.000116	0.000116	0.000117
Heat Capacity	kJ/kg.°C	2.442	2.440	2.431	2.422	2.414	2.405	2.396	2.387
Spec. Enthalpy	kJ/kg	135.6	134.6	130.1	125.6	121.2	116.7	112.3	107.9
Surf. Tension	dyn/cm	12.1	12.2	12.4	12.6	12.7	12.9	13.1	13.3
WATER									
Density	kg/m3								
Viscosity	cP								
Thermal Cond.	kW/m.°C								
Heat Capacity	kJ/kg.°C								
Spec. Enthalpy	kJ/kg								
Surf. Tension	dyn/cm								

Note : BUB=Bubble Point ; DEW=Dew Point ; WAT=Water Dew Point

BUSHEHR PETROCHEMICAL COMPLEX
OLEFIN PLANT

BUSHEHR PETROCHEMICAL COMPANY

Document Title: : Process Data Sheet for Quench Water Air Cooler

ThinkXperT

Contractor Document N°							Owner Document N°						
Project No.	Unit	Doc. Type	Material Code	Serial No.	Rev.	Page	Plant No	Project No.	Doc. Type	Material Code	Serial No.	Rev.	Page
N-270	10	PDS		AE-201	2	3/3	10	OL16	PDS		AE-201	2	3/3

Service: QUENCH WATER AIR COOLER — Item 10-AE-201

2 PID No: 10-OL16-PID-0021-20-03

Bay size (W×L),m: × No.of Bays/Item — Type Draught (Induced/Forced) **INDUCED**

Surface/item -Finned Tube, m^2: — Bare Tube, m^2:

Heat Exchanger 2.40 E+7 (2) (3) kcal/h — Effective MTD, °C:

Transfer Rate-Finned, kcal/h.m^2.°C: — Bare Tube,Service, kcal/h.m2.°C: — Clean, kcal/h.m2.°C:

PERFORMANCE DATA-TUBE SIDE

	In	Out
Fluid Name	QUENCH WATER (6)(7)(9)	
Total Fluid kg/h	1842000	
	In	Out
Temperature °C	78	65
Vapor kg/h M.W		
Liquid kg/h		
Steam kg/h		
Water kg/h	1842000	1842000
Non-Cond. Kg/h M.W		
Viscosity (Liq/Vap) cP	0.364 /	0.4426 /

		In	Out
Density (Liq/Vap)	kg/m^3	973 /	980.5/
Spec.Heat (Liq/Vap)	kcal/kg°C	1.003/	1.001/
Cond.(liq./Vap)	kcal m/h m^2°C	0.575/	0.566/
Dew/Bubble Point	°C	/	
Latent Heat	kcal/kg		
Inlet Oper.Press	bar(a)	7.1	
Inter.Fouling Fact	hm^2°C/kcal	0.0006	
Pressure Drop	Bar	Allow. 1	Calc.
Pour Point			

PERFORMANCE DATA-AIR SIDE

Air Flowrate/Item	Face Velocity	Temperature In 50 (5) °C
Air Flowrate/Fan	Altitude 20 m	Temperature out °C
Actual Static Pressure (4)		Min. Temperature 5 (5) °C

DESIGN,MATERIALS AND CONSTRUCTION

Design Pressure 12.6 (9) bar(g)	Test Pressure: bar(a)	Design Temperature: 5/120 °C
TUBE BUNDLE	HEADER	TUBE
Size (W×L), m No. of Tube Rows:	Type Removable Plate	Material CARBON STEEL
No./Bay: No. of bay/Items:	Material CARBON STEEL	O.D., mm: Thk, mm:
Arrangement	No. of Passes: (1) Slope %	No. of Tubes per Bundle:
Bundles In Parallel In Series	Corrosion Allowance: 3 mm	Length:
Bays In Parallel In Series	Plug Design Mater.	Pitch Layout
Bundle Side Frame	Gasket Material	FIN

MISCELLANEA	Nozzles	No.	Φ	Rating & Facing	
Structure(Yes/No) Ladder(Yes/No)	Inlet				Material:
Louvers(Auto/Man) Man Walkway(Yes/No)	Outlet				Type EXTRUDED
Hood(Yes/No) Vibr.Switch(Yes)	Code Req.				O.D., mm: Thk, mm:
					Stock Thick, mm:

MECHANICAL EQUIPMENT

FAN		DRIVER			SPEED REDUCER
No./Bay	Speed, rpm:	No./Bay	/Driver	rpm	No./Bay
Diameter	No. of Blades:	Type			Type
Angle	Blade Material	Volt/Phase/Cycles	/	/	Speed Ratio
Pitch(Adjustable or Auto Var.) 100% Adj		Enclosure			

CONTROL

RECIRCULATION SYSTEM		
Type(Internal or External)		
Shutters(Manual or Automatic)		
Actuator Air	Signal	Supply
Steam Coil	to	
Auto-Fan	to	
Shutters	to	

STEAM COIL			
Pressure Inlet	bar(a) Design	bar(a) Test	
Design Temperature	°C Steam Quantity	kg/h	
Tube: No. O.D	Thk.	kg/h	
Fin:Type	O.D		
Material:Tube	Fin	Code req.	
Nozzles:Φin	Out	Serie and Type	

Control action on Air Failure: — Fan Pitch (Min or Max): — Louvers(Open or Close):

NOTES:

1) Give tube count of each pass when irregular
2) 5% overdesign on duty should be considered by vendor.
3) Design case: 8 furnaces working+one in hot standby
4) Air barometric pressure (m bar): min 990/max 1100.
5) Outdoor relative humidity: at 48°C:65%,at 5°C:100%.
9)Non flammable
6) May contain some tar and coke particles. Characteristics of coke particles: 0.2 ppm weight, diameter: 0.5 mm maxi
7) The quench water carries 1%wt max. of gasoline component in dispersion.This composition is rich in aromatics.
8) ELECTRIC AREA CLASS: Zone 2, Gas Group IIB, Temp Class T3
9) Design pressure should be updated based on 10-P-201A/B/C Shut-off Pressure During Detail Engineering Design.