

REFRIGERATED GAS PROCESSING UNIT

SPECIFICATION SHEET

MODEL: 3M-40-GL

NOMINAL GAS CAPACITY 1 TO 3 MMSCFD

CHILLER DUTY, BTUH 460,000

WORKING PRESSURE 1000 PSIG

DESIGN PROCESS TEMP, °F -20

**THIS UNIT TO BE MOUNTED ON A STRUCTURAL STEEL SKID
AND CAN BE MOUNTED ON A DROP DECK TRAILER.**

REFRIGERATION: 2-75 HP Carlyle refrigeration compressors w/air condensing and oil cooling, electric motor Drives, 480 v, 3 ph. Freon 507A or 404A refrigerant will be used. All mounted in an enclosure with one end of the enclosure used to house the motor controls and the PLC controller. Air cooled refrigerant condenser mounted and refrigerant oil cooler located on top of cargo enclosure. The entire refrigeration system will be pumped down to remove any water and filled with nitrogen pumped down again. The system will then be filled with refrigerant. Initial charge of refrigerant to be supplied with the unit.

HEATING SYSTEM: 1.4 mmbtuh natural gas fired heater, emersion firetube design w/Maxon forced air burner. Firetube design for Low NOX burner . Heater to be designed as a glycol concentrator unit.

DEHYDRATION: Ethylene glycol injection designed for 5% water pickup with , 150,000 Btuh

PROCESS TRAIN:	Consist of Free water knockout, gas/liquid separator, hydrocarbon liquid/glycol separator, Gas/Gas exchanger, gas chiller, all rated at 1000 psig working press. Gas/Gas exchanger is sized to the same surface area as the gas chiller so unit can be used on leaner gas streams. Gas chiller is sized to refrigeration capacity.
STABILIZER TOWER:	Cold feed stabilizer, packed column design with reboiler, glycol heated to produce up to 20,000 GPD of deethanized product (5% ethane), 500 psi working pressure, 0.82 MMbtu/h reboiler, product cooled by process gas exchanger.
INSTRUMENTATION:	
REFRIGERATION	PLC control on process and compressor units with capacity control, safety controls, chiller controlled by superheat controller, suction scrubber with oil siphon and DX type economizer.
HEATER	Fuel train with dual shutoff valves, temp control and high temp shutdown, low glycol level shutdown, and flame failure/pilot prover circuit/shutdown, fuel gas regulation
PROCESS	Locally mounted pneumatic level controls, pressure controls and temperature controls. Compressed air with refrigerated dryer used for instrument operation. Process variables and conditions will be transmitted to the PLC in the refrigeration enclosure for operator control. Remote monitoring can be done through MODBUS/TCP.
PUMPS	Glycol circulation pump 60 gpm for stabilizer reboiler heating Glycol injection Milton Roy or Neptune 1500# design, Glycol design rate 2 gpm.

ELECTRICAL

Instrument air compressor with refrigerated dryer for instrument air supply. All electrical panels for PLC control, refrigeration system, instrument air system and plant pumps will be located on the refrigeration skid in a non classified area. A LEL detector will be supplied with the unit and connected to the PLC control and emergency shutdown system. Electrical requirements will be 200 amp service, 480 V, 3 ph, 60 Hz.

EXHIBIT B

1-3 MMcfd Single Skid MRU/Stabilizer Design Basis Memorandum Rev 0



General Project Description:

This project envisions a single skid mounted Mechanical Refrigeration Unit (MRU) with a JT valve to achieve -20 degrees Fahrenheit and a stabilizer capable of producing a product containing less than 5 mol percent ethane content while maximizing propane recovery to at least 65-70 mol percent. The single skid MRU/JT/stabilizer (the "Plant") shall be mounted on a flat bed trailer with a maximum length of 53 feet. The MRU will utilize either Freon 404A or 507A refrigerant. Ethylene Glycol injection will be used to effectively dehydrate the gas to prevent freezing in the process. An on skid regeneration system will be used and sized so hot glycol may be utilized as a heat medium for the stabilizer. The stabilizer tower will be able to be disassembled and reassembled without the need of an off skid crane with provisions to lay down and secure for transportation a portion of the stabilizer tower.

Design Standards & Guidelines:

- ☒ Piping - ASME B31.3
- ☒ Pressure Vessels - ASME Section VIII
- ☒ Heat Exchangers - ASME Section VIII and TEMA C
- ☒ Painting and Insulation - Glycol Specialists Standards
- ☒ Electrical - RP 500A, NEC and Glycol Specialists Standards

Plant Operating and Ambient Conditions:

Inlet pressure: min 450 psig, max 850 psig

Outlet Residue Gas Pressure: 75 psig max, 40 psig minimum

Max Flow rate: 3 mmcfd (rich case)

Volume Free Water: per simulation run

Inlet Gas Dehydrated: ☐ Yes ☒ No

Potential contaminates: Free water, compressor lube oil

Piping Grade: Grade B or as needed for the application

Wall Thickness: as needed for the application

Corrosion Allowance: 1/16"

MAOP: 1000 psig Process Train
500 psig Stabilizer system

Inlet Gas Temp: 40 F minimum, 95 F maximum

Gas Composition Outlet: per simulation

Ambient Temperature extremes: - 40 F min, 100 F max

Max Wind Design: 100 MPH

Snowfall: 36"

Rainfall: 15"

Gas Composition Inlet Range and recoveries:

Component	Rich Case, %	*Rich Case Recoveries, %	Lean Case, %	*Lean Case Recoveries, %
Methane, C1	57.5	1.85	69.0	1.0
Ethane, C2	18.7	6.17	11.2	6.5
Propane, C3	10.2	72.5	9.1	65.0
Butanes, n&iC4	5.9	88.9-92.3	4.8	85-89.5
Pentanes+, C5+	5.7	99	2.4	99
Nitrogen, N	1.6		1.0	
Carbon Dioxide, CO2	0.5		2.5	

*Recovery of product as NGL as a percentage of inlet rate by component

Dehydrator Design & Operating Conditions:

Chemical: Ethylene Glycol Injection and Regeneration

Gas Water Content Inlet Range: Saturated at minimum pressure max temperature

Gas Water Content Outlet Range: per simulation

Supplemental dehydration: MeOH injection

Refrigeration Compressor Design:

Screw type refrigeration compressor

Manufacturer: Carlyle or equivalent

Condenser with Oil Cooler

Manufacturer: Gunther or Equivalent

Other Major Facilities and Equipment Required:

☒ Inlet free water knockout

☐ Inlet Filter Separator

☒ Outlet, fuel simplex orifice meter with Total Flow measurement and Product out meter

☒ Enclosure over MCC/PLC

☒ Stabilizer Tower

☒ Ethylene Glycol Reboiler/Process Heater

☒ Cold Separator

☒ Gas/Gas Exchanger/Chiller

☒ Refrigeration System

☒ Air compressor/dryer

☒ PLC with touch screen

Operations and Design Philosophy and Standards:

It is NOT the intent of following discussion to be all inclusive in terms of design and functionality of the Plant. It is Recapture Solutions' (the "Company") desire to take full

advantage of the knowledge, skill and ability of Vendor to supply a fully functioning Plant in accordance with operating and design conditions contained in this document. Therefore, the purpose of this section is to identify certain aspects of the Plant that should be taken into consideration, and should be a part of, the Vendor's design.

Electrical

- Electrical Design of the skids will be Class I, Div II, Group where appropriate
 - Design of building air exchange will need support this classification, if required
- Skid and buildings will be designed with appropriate separation and barriers to provide for the MCC building to be unclassified.
- All motors shall be 480 VAC, three phase
- All motors above 5 hp shall have soft starts
- Main disconnect and associated breakers will be provided for easy connection from the power source. Use quick connect connectors
- Conduit shall be run on skid in manner to avoid tripping hazards and shall be in common conduit runs where possible.
- Lights will be either 240 VAC or 120 VAC
- At least 3 - 120 VAC receptacles in MCC building
- There will be two external lights mounted on the MCC Building that can be positioned as needed.
- Transformer(s) will be supplied to reduce voltage as needed for the application
- PLC, Instrumentation, Solenoids, etc. will be 24 V DC
- 24 V DC power supply/rectifier will need to be designed to support 24 V power needs c/w battery back up (upon loss of AC power) for 120 minutes
- Gas detection and flame detection inside buildings

Mechanical

- Plant will be mounted on a single skid that will then be mounted on a trailer
- Trailer will be supplied by COMPANY
- Plant will ESD on gas detection, Plant air failure, and other causes as determined in the HAZOP.
- Plant air will be by a screw type air compressor with air dryer. Plant air will be supplemented with a Nitrogen "6 pack"
- Piping shall be evaluated for potential freezing of internal product and heat traced and insulated as appropriate
- Piping shall be designed for -40 F
- Trailer shall be designed for a 6 point manual leveling system to remove weight from trailer tires/axle - supplied by COMPANY

- All inlet and outlet connections shall be conveniently located in a common area
- Type of connection will be selected during detail design
- Insulation and heat tracing shall be shown on the P&ID drawings.
- Heat Tracing will be of the type with an indicator light when operational
- All relief valves shall be vented locally and shall be set up with rupture disks and testing ports.

Building:

- Plant enclosures (of any type) will be sloped type roofs with sealed penetrations for electrical conduit
- For MCC enclosure, access will be through a 36" door farthest from the process
- The enclosure will contain the motor starters, PLC, transformer and control panel. The enclosure shall have a catalytic type heater.

Instrumentation and Control

In general, the plant will have only a few critical control loops, mostly associated with the refrigeration compressors, condenser, ESD blowdown valve, burner management on the glycol reboiler, and other process functions. The PLC will monitor some critical parameters for alarm and call out purposes.

- The PLC will monitor Glycol Regen temperature and glycol flow rate
- Plant will have satellite system for monitoring, alarms and callouts - provided by COMPANY
- PLC will utilize MODBUS/TCP protocol
- The outlet meter gas and product meters will have a YZ or equivalent continuous sampler for monitoring quality

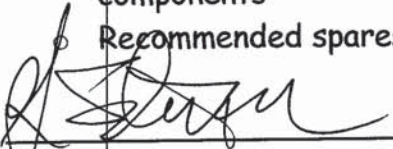
Commercial terms:

Vendor shall provide the following information in their quote:

- Lump sum price for Plant
- Statement of regulations, industry practices, and other specification for the Plant that will be followed
- Delivery date of Plant
- Proposed milestone payment schedule
- Project Schedule
- Major Equipment List
- PFD/P&ID
- WinSim Process runs showing process expectations at major equipment throughout the Plant for rich and lean compositions and at min and max inlet and ambient conditions.
- General Arrangement Drawing of Plant

- Process performance and warranty information (process performance shall be defined as achieving a specified performance parameter at consistent run rate for 24 continuous hours)
- List of Deliverables with Plant (schedule to be determined) which should include the following as a minimum
 - Engineering Documents and Drawings: As-Built P&ID, As-Built GA Drawing, Weight and Dimensions, Control Narrative, PLC Program file, HAZOP participation, Operations Manual, Process Description, One Line Electrical Drawing, Termination Drawing, Power Take off, Cause and Effect Diagram, Relief Valve sizing
 - Quality Documents: Certified Welding Procedure, Welding Certifications for welders, Material certifications, Strength Test
 - Metal preparation and Paint Specifications
 - Job Books to include cut sheets and warranty information for all components
 - Recommended spares for commissioning and running spares

By


(Signature)

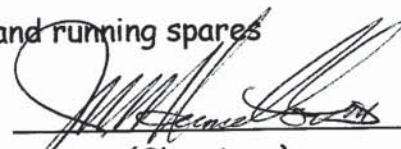
Title

President EVP

Date

9-14-2014

By


(Signature)

Title

President

Date

Sept 14, 2014

EXHIBIT C

STREAM SUMMARY

Stream Number	1	2	3	4	5
Stream Name	Strm 1	Strm 2	Strm 3	Strm 4	Strm 5
Thermo Method Option	GLOBAL	GLOBAL	GLOBAL	GLOBAL	GLOBAL
Vapor Fraction	0.8691141	1	0	1	0.7935889
Temperature	95	-20	-20	26.98499	55.52606
Pressure	psia	458.50038	458.50038	314.696	461.15835
Enthalpy	Btu/hr	-181057.155	-1076859.2	-37151.168	-588497.189
Entropy	Btu/hr/R	-1677.50096	-2282.76027	-337.28928	-2293.94461
Vapor Density	lb/ft3	2.13373	2.22808	1.80823	2.14683
Liquid 1 Density	lb/ft3	33.30649	32.66498	33.14494	33.14494
Liquid 1 Specific Gravity	60F@STP	0.5656038	0.4829087	0.5381028	0.5381028
Vapor Cp	Btu/lbmol/R	12.92305	11.082	12.83454	12.08914
Vapor Cv	Btu/lbmol/R	9.49293	7.08819	9.05009	8.51613
Liquid 1 Cp	Btu/lbmol/R	34.90651	24.50841	30.87095	30.87095
Vapor Viscosity	cP	0.0121308	0.0102874	0.0101818	0.0114852
Liquid 1 Viscosity	cP	0.1540517	0.1568702	0.1550958	0.1550958
Vapor Thermal Conductivity	Btu/hr/ft/R	0.0194763	0.0174303	0.0154114	0.018616
Liquid 1 Thermal Conductivity	Btu/hr/ft/R	0.0622842	0.0747038	0.0658835	0.0658835
Vapor Flowrate	MMSCF/day@STP	2.60734	1.78154	0.6331514	2.38077
Liquid 1 Flowrate	gal/min@STP	8.71567	23.04523	13.00277	13.00277
Liquid 2 Flowrate	gal/min				
Molecular Weight		28.296	41.611	25.2668	28.296
Molar Flowrate	lbmol/hr	329.3953	133.7852	69.519	329.3953
Mass Flowrate	lb/hr	9320.5834	5566.9422	1756.5231	9320.5834
Note: All Liquid 1 Phase calculations exclude Free Water					
Molar Flowrate By Component					
47 : OXYGEN	lbmol/hr	0	0	0	0
46 : NITROGEN	lbmol/hr	5.27033	0.243296	0.243296	5.27033
49 : CARBON DIOXIDE	lbmol/hr	1.64698	0.599603	0.599601	1.64698
2 : METHANE	lbmol/hr	189.402	30.8213	30.8213	189.402
3 : ETHANE	lbmol/hr	61.5969	36.2333	32.4316	61.5969
4 : PROPANE	lbmol/hr	33.5983	28.875	4.50622	33.5983
5 : I-BUTANE	lbmol/hr	6.25851	5.91292	0.3486	6.25851
6 : N-BUTANE	lbmol/hr	12.8464	12.3698	0.507662	12.8464

7 : I-PENTANE	lbmol/hr	0	0	0	0	0	0
8 : N-PENTANE	lbmol/hr	0	0	0	0	0	0
10 : N-HEXANE	lbmol/hr	18.7755	0.045485	18.73	0.060798	18.7755	
11 : N-HEPTANE	lbmol/hr	0	0	0	0	0	
12 : N-OCTANE	lbmol/hr	0	0	0	0	0	
1256 : R-507	lbmol/hr	0	0	0	0	0	
3103 : ETHYLENE GLYCOL	lbmol/hr	0	0	0	0	0	
62 : WATER	lbmol/hr	0	0	0	0	0	
Total	lbmol/hr	329.395	195.61	133.785	69.519	329.395	

Molar Composition By Component

47 : OXYGEN	molar %	0	0	0	0	0	
46 : NITROGEN	molar %	1.600003036	2.56992485	0.181855963	0.349970512	1.600003036	
49 : CARBON DIOXIDE	molar %	0.500001518	0.535437861	0.448184027	0.862499461	0.500001518	
2 : METHANE	molar %	57.49996205	81.0699862	23.037934	44.33507386	57.49996205	
3 : ETHANE	molar %	18.70001063	12.96641276	27.08323056	46.65141904	18.70001063	
4 : PROPANE	molar %	10.20000304	2.414687388	21.58313712	6.481997727	10.20000304	
5 : I-BUTANE	molar %	1.900001518	0.176673994	4.419718205	0.501445648	1.900001518	
6 : N-BUTANE	molar %	3.899998482	0.243657277	9.246029077	0.730249284	3.899998482	
7 : I-PENTANE	molar %	0	0	0	0	0	
8 : N-PENTANE	molar %	0	0	0	0	0	
10 : N-HEXANE	molar %	5.699995446	0.023252901	14.00007475	0.087455228	5.699995446	
11 : N-HEPTANE	molar %	0	0	0	0	0	
12 : N-OCTANE	molar %	0	0	0	0	0	
1256 : R-507	molar %	0	0	0	0	0	
3103 : ETHYLENE GLYCOL	molar %	0	0	0	0	0	
62 : WATER	molar %	0	0	0	0	0	
Total	molar %	100	100	100	100	100	

6	7	8	9	10	11	12	13
Strm 6	Strm 7	Strm 8	Strm 9	Strm 10	Strm 11	Strm 12	Strm 13
GLOBAL	GLOBAL	GLOBAL	GLOBAL	GLOBAL	GLOBAL	GLOBAL	GLOBAL
0.6243547	1	0	0.0944388	0	0	0.3406123	1
-10	85.10113	201.53781	-29.25309	100	60	-31.44563	-19.08933
458.50038	114.03914	319.696	318.50038	319.696	200	25	23.91197
-1168207.38	113292.571	-231030.245	-1076859.2	-489138.998	-675543.687	-675543.687	-95831.3617
-3495.47657	-404.83336	-413.53566	-2268.57338	-836.10779	-1728.05544	-1654.50709	-296.09295
2.20724	0.4150739		1.52378			0.5631842	0.5206627
32.74452		29.23196	34.05856	34.36606	68.08466	79.39753	
0.4899539		0.5759119	0.4935622	0.5759119	1.0472	1.0472	
11.14915	10.15083		10.34121			16.26248	16.38962
7.23589	7.94714		7.01589			13.94164	14.11034
25.24117		44.55709	24.86477	35.85563	34.87149	28.71644	
0.010444	0.0112939		0.0096763			0.0093184	0.0096042
0.1565888		0.0927961	0.1845101	0.1566229	0.1360262	0.2482112	
0.0175629	0.0185889		0.0161656			0.005257	0.0054647
0.0733822		0.0489592	0.0780666	0.0608712	0.0428237	0.0586937	
1.87306	2.41469		0.1150701			0.3136663	0.9208895
21.61699		13.22653	21.55773	13.22653	19.08979	12.58757	
28.296	20.7829	59.2911	41.611	59.2911	98.9	98.9	98.9
329.3953	265.1291	64.2662	133.7852	64.2662	101.1122	101.1122	101.1122
9320.5834	5510.1643	3810.4164	5566.9422	3810.4164	10000	10000	10000
0	0	0	0	0	0	0	0
5.27033	5.27033	4.832E-18	0.243296	4.832E-18	0	0	0
1.64698	1.64697	0.000002277	0.599603	0.000002277	0	0	0
189.402	189.402	3.507E-09	30.8213	3.507E-09	0	0	0
61.5969	57.7951	3.8018	36.2333	3.8018	0	0	0
33.5983	9.22959	24.3687	28.875	24.3687	0	0	0
6.25851	0.694192	5.56432	5.91292	5.56432	0	0	0
12.8464	0.98428	11.8621	12.3698	11.8621	0	0	0

[illegible]

GLOBAL
1201.53781
319.696
253380.702
123.87532
2.7953327.00036
21.52705

0.0114362

0.0173122

0.9847589

47.1301
108.125
5095.944

0

1.188E-16
0.00001874
4.306E-08
18.6208
60.1303
8.29157
14.7563

0
0
6.32604

○

C

Q

108.125

Q

1.09873E-16

1.73318E-05

3.98243E-08

17.22154913

55.61183815

7.668504046

13.64744509

2

CC

5.850672832

050

CC

CC

00

○ ○

88

100