طرح نگهداشت و افزایش تولید 27 مخزن

BASIS OF PROCESS DESIGN FOR GAS DEHYDRATION PACKAGE

نگهداشت و افزایش تولید میدان نفتی بینک

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1. INTRODUCTION

Binak oilfield in Bushehr province is a part of the southern oilfields of Iran, is located 20 km northwest of Genaveh city.

With the aim of increasing production of oil from Binak oilfield, an EPC/EPD Project has been defined by NIOC/NISOC and awarded to Petro Iran Development Company (PEDCO). Also, PEDCO (as General Contractor) has assigned the EPC-packages of the Project to "Hirgan Energy - Design and Inspection" JV. As a part of the Project, a New Gas Compressor Station (adjacent to existing Binak GCS) shall be constructed to gather of 15 MMSCFD (approx.) associated gases and compress & transfer them to Siahmakan GIS.

2. SCOPE

The scope of this document is to summarize general project information, site conditions and the engineering data requirements needed for design of project. Additional requirements and data shall be derived from design criteria for each trade of engineering.

EQUIPMENT LIST

Item	Tag Number	Description
1	C-100	Glycol gas Contactor (Dehydration Column)
2	E-300	Dehydrated Gas/Lean Glycol Heat Exchanger
3	E-100	Re-Flux Condenser
4	V-120	Glycol Flash Drum
5	F-100 A/B	Particle Glycol Filter
6	F-200 A/B	Carbon Glycol Filter
7	E-200	Lean/Rich Glycol Exchanger
8	C-200	Glycol Regeneration Still Column
9	R-100	Glycol Regeneration Re-Boiler
10	V-130	Glycol Surge Drum
11	P-100 A/B	Lean Glycol Circulation Pump

3. NORMATIVE REFERENCES

3.1. REFERENCE DOCUMENTS

- BK-GCS-PEDCO-120-PR-SP-0001-D05 “Duty Specification for Gas Dehydration Package (PK-2101)”.
- BK-GNRAL-PEDCO-000-PR-DB-0001 “Process Basis of Design”
- BK-GNRAL-PEDCO-000-PR-DC-0001 “Process Design Criteria”

4. ABBREVIATIONS

Abbreviation	Description
NISOC	National Iranian South Oil Company
API	American Petroleum Institute
IPS	Iranian Petroleum Standard
ASME	American Society of Mechanical Engineers
BBL	US Barrel
MMSCFD	Million Standard Cubic Foot per Day
STBOD	Standard Barrel Oil per Day
P&ID	Piping & Instrumentation Diagram
PFD	Process Flow Diagram
PPM	Part per million

5. GENERAL DATA

5.1. SITE LOCATION

Binak oilfield in Bushehr province is a part of the southern oilfields of Iran, located 25 km northwest of Genaveh city.

Longitude: 50°; 35’

Latitude: 29°; 73’

Elevation from sea level for Binak New GCS: ≈ 12.5 m.

5.2. FEED SPECIFICATION

Table 1-1: New Oil Production Wells Location and Coordination

Case	Unit	Summer Case	Winter Case
Vapor Frac on a Mole Basis		1	1
Temperature	C	59.89	60
Pressure	Bar-g	53.9	53.9
Design Temperature	C	130	130
Design Pressure	Bar-g	62	62
Molar Flow	kgmole/h	702.4	703.7
Mass Flow	kg/h	17252.5	15170.9
Heat Flow	kW	-17478.8	-16496.2
Component	Molar component fraction Component		
H2O		0.0045	0.0036
CO2		0.0318	0.0252
H2S		0.0544	0.0471
Methane		0.6427	0.7398
Ethane		0.1383	0.1142
Propane		0.0778	0.0474
i-Butane		0.0084	0.0039
n-Butane		0.0187	0.0081
I-Pentane		0.0070	0.0031
N-Pentane		0.0038	0.0014
n-Hexane		0.0066	0.0022
n-Heptane		0.0020	0.0005
n-Octane		0.0006	0.0001
n-Nonane		0.0003	0.0001
n-Decane		0.0001	0.0000
Nitrogen		0.0030	0.0031

Vapor Phase Property			
Phase – Molar Flow	Khmole/h	702.4	703.7
Phase – Mass Flow	Kg/h	17252.5	15170.9
Phase – Heat Flow	KW	-17478.8	-16496.2
Phase Mass Heat Capacity	Kj/Kg-C	2.4	2.4
Phase Actual gas Flow	Act_m3/h	291.59	308.15
Phase Std Gas Flow	Std_m3/h	16608.28	16639.38
Phase Molecular Weight		24.56	24.56
Phase Mass Density	Kg/m3	59.17	49.23
Phase Viscosity	cP	0.01	0.01
Phase Cp/Cv		1.46	1.43
Phase Z Factor		0.82	0.87

5.3. ENVIRONMENTAL DATA

Followings are the climatic and Site conditions of the Binak Oilfield CGS:

Table 6-3: Site Condition of Ramshir Production Unit

Air Temperature	Maximum recorded temperature	+ 50 °C
	Minimum recorded temperature	+ 5 °C
	Maximum steel surface temperature exposed to sun	85 °C
Soil Temperature	Soil Temperature in Winter	15.6 °C
	Soil Temperature in Summer	32.2 °C
Humidity	Maximum Design relative humidity	100 %
	Minimum Design relative humidity	0 %
Wind	Maximum wind velocity for Structure Calculation	120 (km/hr)
	Average wind velocity for Thermal Calculation	5 (m/s)
Wind	Flare Thermal Radiation	10 (m/s)
	Prevailing wind direction	NW to SE
Heat Flux	Solar Radiation Heat Flux	1010 W/m^2
Earthquake	Seismic zone	0.3 g

5.4. PRODUCT SPECIFICATION

Vendor is required to guarantees below water content in outgoing dry gas. The maximum concentration of water in the dry gas at the outlet of the gas dehydration package calculated based on Dew Point equal to 5 °C (determined according to 10 degrees distance from minimum operating temperature) and the result is that 11.63 Ib/MMSCF in winter case and 11.43 Ib/MMSCF in summer case.

Moreover, 99.5% of all liquid droplets of 1 micron diameter and larger will be removed from the dehydrated gas stream.

5.5. CONTROL SYSTEM

Packaged control type C is requested as per BK-GNRAL-PEDCO-000-IN-SP-0004. Unit shall be fully controlled (monitoring and control functions and safety) by the UCP and ESD/BMS systems (ESD/BMS shall be PLC base, Full redundant, SIL3). Two control systems (UCP+ ESD/BMS) located in control Room for this package will be supplied. LCP is required for monitor/control commands such as burner control command. UCP and ESD/BMS logic shall be provided to be implemented in DCS and ESD. The package is equipped with its instruments, wired by means of appropriate cables and cable routing. The cables are connected to the junction boxes located at the skid edge battery limits or at edge of base plate. All controls are incorporated into the UCP and ESD/BMS by the system Vendors.

5.6. TURN DOWN RATIO

Sour gas dehydration package shall be designed in order to treat 35% of its normal capacity.

5.7. QUALIFICATIONS.

5.7.1. STILL COLUMN OVERHEAD PRESSURE

The Still Column Overhead will operate at 0.2 bar g maximum, based on the maximum back pressure in the LP Flare System during Normal operation. During Case “Block Outlet PSV 2111/2112” the still column overhead pressure reach 0.5 Bar g and package capacity is 50%.

5.7.2. LEAN GLYCOL PURITY

Based on the required Dry Gas Dew Point (+ 5 °C), the lean glycol optimal purity is 99.7 % wt (i.e. maximum water content 0.3 % wt, on a glycol/water binary system basis).

5.7.3. LEAN GLYCOL FLOW RATE

The optimal lean Glycol Flow rate has been set at 775 kg/h, corresponding to a TEG / Water pickup ratio of about 13.7 TEG kg per kg of removed water.

Make-up flow rate is equal to 8.46 kg/day while leakage and spillage are excluded.

5.7.4. REGENERATION SECTION CONFIGURATION

The lean glycol purity of 99.7 % wt can be achieved with one theoretical stripping section stage. Therefore, a dedicated stripping column has been deemed not necessary. The lean glycol purity can be reached by injecting the stripping gas directly inside the surge drum by means an adequate diffuser device.

Moreover, a separated surge drum is no required. The regeneration is performed in a single vessel divided in two compartments: the first compartment is the reboiler section, where the firetube and smoke tube are located, and where a purity of about 98.8 % wt can be reached at the boiling temperature of 204 °C. A weir separates this compartment by means the downstream surge drum section, where the stripping gas is injected through a sparger, achieving the final purity of 99.7 % wt.

From surge drum, the lean glycol flows by gravity to the glycol/glycol heat exchanger, and then to the circulation pumps.

5.7.5. GLYCOL/GLYCOL HEAT EXCHANGER HAIRPIN TYPE SELECTION

Considering the low flow rate and the high required temperature approach, a longitudinal finned double pipe hairpin type heat exchanger has been selected both for glycol/glycol heat exchanger and for glycol/dry gas heat exchanger. The advantages of this exchanger type can be summarized as follows:

- Provides pure counter current flow allowing temperature crossing and close temperature approach.
- Doesn't require expansion joint even with wide temperature differentials.
- At low flow rates, provides a more efficient thermal design.
- Easy maintenance with removable bundle option.
- Annular side low pressure drop.

In case of glycol/glycol exchanger, the lean glycol has been selected to flow annular side (matching the low pressure drop requirement to assure the NPSH of glycol circulation pumps). In case of dry gas/lean glycol exchanger, the dry gas flows in the inner pipe, resulting in a more effective thermal design.

5.7.6. EXCHANGERS FOULING FACTOR.

According to the Project Specification BK-GNRAL-PEDCO-000-PR-DC-0001 "Process Design Criteria", the following fouling factors will be assumed in thermal sizing of heat exchangers:

- Glycol side (lean & rich): 0.0004 m^2 K / W (0.000465 m^2 h K / kcal)
- Dry Gas side: 0.0002 m^2 K /W (0.000233 m^2 h K / kcal)

5.7.7. GLYCOL CIRCULATION PUMP SELECTION

Reciprocating pump type has been selected for the glycol recirculation pumps.

To control the flow rate to the contactor, a recycle line from the pumps' discharge line (downstream the dry gas/glycol exchanger), routing the excess of glycol flow rate back to the pumps' suction, will be provided. On the recycle line, a suitable flow control valve will be provided.

The line starts from downstream the dry gas/glycol exchanger to recycle back cold glycol, taking the advantage of lowering the glycol temperature at pump suction, increasing a bit the pumps' NPSH available.

5.7.8. OVERDESIGN MARGIN / HOLD UP TIME.

According to the Project Specification BK-GNRAL-PEDCO-000-PR-DC-0001 “Process Design Criteria”, the following design margin will be considered in the equipment sizing:

- Glycol contactor: 10 % on flow rate
- Reciprocating pumps: 15 % on flow rate
- Heat exchangers: 10 % on duty and flow rate
- Reboiler: 10 % on duty

Hold-up Time:

- Contactor: 15 minutes hold up time between LSL and LAH
- Surge Drum: 20 minutes from LAL and HLL (minimum)
- Flash Drum: 30 minutes residence time in separation section
- Flash Drum: 10 minutes hold up time between LSL and LAH (glycol compartment)

5.7.9. FUEL GAS / STRIPPING GAS CONDITIONS AND COMPOSITION

Table 5-1-1: Fuel Gas (Summer)

	Unit	
Inlet Operating Temperature (normal)	°C	37
Inlet Operating Pressure (normal)	Bar-g	4.9
Design Temperature	C	85
Design Pressure	Bar-g	9

Component	Molar Fraction
H2O	0.0103
CO2	0.0316
H2S	0.0541
Methane	0.6389
Ethane	0.1375
Propane	0.0773
i-Butane	0.0084
n-Butane	0.0186
I-Pentane	0.0070
N-Pentane	0.0038
n-Hexane	0.0065
n-Heptane	0.0020
n-Octane	0.0006
n-Nonane	0.0003
n-Decane	0.0001
Nitrogen	0.0030

Table 5-1-2: Fuel Gas (Winter)

	Unit	
Inlet Operating Temperature (normal)	°C	19
Inlet Operating Pressure (normal)	Bar-g	4.9
Design Temperature	C	85
Design Pressure	Bar-g	9

Component	Molar Fraction
H2O	0.0036
CO2	0.0252
H2S	0.0471
Methane	0.7398
Ethane	0.1142
Propane	0.0474
i-Butane	0.0039
n-Butane	0.0081
I-Pentane	0.0031
N-Pentane	0.0014
n-Hexane	0.0022
n-Heptane	0.0005
n-Octane	0.0001
n-Nonane	0.0001
Nitrogen	0.0031

5.7.10. PUMPS' NPSH

According to the Project Specification BK-GNRAL-PEDCO-000-PR-DC-0001 "Process Design Criteria", the calculated NPSH available for the pump shall be at least 1 m higher than the NPSH required by the pumps (based on the manufacturer's indication). In determining the NPSH available, a loss of 0.61 m shall be associated to any permanent strainer on the pumps' suction line.

5.7.11. GLYCOL FILTERS

The package includes:

- N. 2 x 100 % rich glycol mechanical filters (cartridge type) for the removal of solid particles impurities
- N. 2 x 10 % rich glycol carbon filter, sized for 20 % of total flow rate (minimum), for removal of glycol thermal degradation products or other organic impurities, to avoid their accumulation in the glycol circuit along the time.
- Deleted

5.7.12. REBOILER FIRETUBE & EFFICIENCY.

Reboiler firetube shall be sized to limit the heat flux within a maximum of 14.000 kcal/m^2 h (as average value on the heat transfer surface). The heat density (as heat flux through the firetube section) shall not exceed 6.000 Btu/h inch^2.

The Firetube heating efficiency shall be not below 70%, determined as the process duty (including 10% design margin) divided by burner duty.

The main burner (one burner) will be installed inside a firetube 10" size (254 mm ID). The burner type shall be Natural draft. The operation range shall be 25% to 125% of max duty. Air excess shall be 5% min to 15% maximum. The burner supply will include the following ancillary items, as minimum:

- Pilot burner
- UV flame detector
- Air Blower (only for firetube/smoke-tube purging during startup sequence) (excluded from MFS scope)
- Flame arrestor on air intake duct
- BMS (start-up and shutdown operation will be done from local panel).