LNG PLANT
Preliminary Design Specification
60X10^{4}Nm3/d (421 T/d)

Contents

1 GENERAL

This 60 X 10^4 Nm3/d LNG plant is based on process design and equipment structure design, it considers sufficiently the plant safety, reliability and advancement, meanwhile it is easy to operate and maintain so that it operates steady in a long term.

2 DESIGN CONDITION

2.1 Feed Gas Component

2.1.1 Inlet flow rate of Feed gas 660,000Nm3/d

2.1.2 Inlet pressure of Feed gas 56bara.

2.1.3 Inlet temperature of Feed gas ~40℃

2.1.4 Raw Natural Gas & Feed Gas Component:

Component	Percent of component（mol%）		Remarks
	Raw Natural Gas	Feed Gas (Decarburization natural gas)	
CO2	19.8701	0.0027 (≤50ppm)	
CH4	68.1405	84.8821	
C2H6	4.4000	5.4894	
C3H8	1.4100	1.7618	
i-C4	0.1997	0.2503	
n-C4	0.1198	0.1502	
i-C5	0.0300	0.0376	
n-C5	0.1198	0.1501	
C6	0.1000	0.1251	
C7	0.0400	0.0501	
C8	0.0300	0.0376	
N2	5.5400	6.9198	
water	/	0.1433 (saturation)	
Methyl cyclopentane			Undetected
Benzene			Undetected

Component	Percent of component（mol%）		Remarks
	Raw Natural Gas	Feed Gas (Decarburization natural gas)	
Cyclohexane			Undetected
Methyl cyclohexane			Undetected
Toluene			Undetected
E-Benzene			Undetected
p-Xylene			Undetected
m-Xylene			Undetected
o-Xylene			Undetected
Mercury			Undetected
O2			Undetected
H2S			Undetected

2.2 NATURAL CONDITION ONSITE

Site Conditions

No.	Condition	Unit	Data
2.2.1	Ambient Temperature		
	Minimum Extremely Highest Temperature	℃	55-60
	Maximum Lowest Highest Temperature	℃	0-5
	Average Annual temperature	℃	35
	Average Temperature during the hottest months (July)	℃	50-55
	Average Temperature in the Coldest month (January)	℃	5
	Average maximum temperature in the hottest month (July)	℃	60
	Average minimum temperature in the coldest month (January)	℃	0
	Lowest one day mean ambient temperature (LODMT)	℃	-2
2.2.2	Humidity		
	Average Relative Humidity in the hottest month (July, Aug.)	%	69
	Average Relative Humidity in the coldest month (Dec., Jan..)	%	54
	Average Annual Relative Humidity	%	51
	Minimum Relative Humidity	%	38

No.	Condition	Unit	Data
	Maximum Relative Humidity	%	99
2.2.3	Barometric Pressure		
	Average Annual Barometric Pressure	kPa	98.451
	Annual Barometric Pressure in Winter	kPa	98.42
	Annual Barometric Pressure in Summer	kPa	101.612
2.2.4	Rainfall & Snowfall		
	Average Yearly Rainfall	mm	160 mm
	Maximum Yearly Rainfall	mm	507 mm
	Minimum Yearly Rainfall	mm	15 mm
	Maximum 24h Rainfall	mm	10 mm
	Maximum 1h Rainfall	mm	1 mm
	Maximum 30min Rainfall	mm	0.5 mm
	Maximum 10min Rainfall	mm	0.2 mm
	Maximum Snowfall Depth	mm	NA
	Snow load for design	N/m2	NA
2.2.5	Wind Direction & Speed		
	Average annual wind speed	m/s	12.5
	Average winter wind speed	m/s	8
	Average summer wind speed	m/s	11.5
	Maximum wind speed for 30 years	m/s	10.12
	Prevailing wind direction		NE
2.2.6	Geological Data		
	Maximum Soil Frozen Depth	m	NA
	Bearing Capacity of Soil	kPa	27.50 ton/m2
2.2.7	Basic Seismic Intensity Earthquake		
	Basic seismic intensity design	Degree	6.3
	Peak Acceleration of Ground Motion	g	0.300-0.600
2.2.8	Water Conditions		
	Highest Flood Stage of 100 Years	m	NA
	Highest Flood Stage of 50 Years	m	NA

No.	Condition	Unit	Data
	Highest Flood Stage	m	NA
2.2.9	Weather phenomena		
	Annual average water evaporate value on the ground	mm	368.3
	Average ground temperature in hottest month	℃	32
	Extreme maximum ground temperature	℃	2
	Annual average lighting attack		9-15
2.2.10	Altitude above sea level	m	242

2.3 UTILITY CONDITION

2.3.1 Circulation Water

The quality of circulating cooling water must meet GB50050 "Code for Design of Industrial Recirculation Cooling Water Treatment", whose basic requirements are as follows:

The supply water temperature circulation cooling water	32℃ The
return water temperature circulation cooling water	40℃
Feeding water pressure	≥3.5barg
Return water pressure	≥2.0 barg

2.3.2 POWER SUPPLY

High voltage power supply	11KV±5%, 50HZ±0.5HZ, 3-phase, 3-wire system, neutral point is non-earthed
Low voltage power supply	380/220V, 50HZ±0.5HZ、3-phase, 4-wire, neutral point is earthed.
Frequency	50±0.5Hz

2.3.3 INSTRUMENT AIR

The quality of instrumental air meets standards of SH/T3020-2001 "Code for design of instrument gas supply for petrochemical enterprises". Instrumental air requires as follows:

Instrument Air Pressure	5-7barg
Dew point	-40℃

2.3.4 NITROGEN UNIT

Nitrogen pressure	6barg
Purity of Nitrogen	≥99.99 %
O2 content	≤100ppm
CO2 contentCO2	≤30ppm
Water content	≤-70℃（dew point）

For safety, 20m3 LN tank and 600Nm3/h evaporator should be equipped.

2.3.5 HOT OIL HEATING UNIT

Hot oil temperature：	260~280℃.
Heating load	~1000kW.
Pressure of hot oil：	~5barg.

2.3.6 Requirements Of Explosion Proof

Compressor house: II district, dIICT4 or eIIT3。

3 PLANT PERFORMANCE DATA

3.1 Product Field：

Plant Design Capacity： 600,000Nm3/d LNG
LNG storage pressure LNG：1.12~1.18bara；
LNG storage temp.: Saturation temperature in the storage pressure.

3.2 The LNG liquefaction plant will operate at least 8000 hours per year.

3.3 **The plant shall be designed for minimum operating life of 15 years.**

3.4 The range of plant capacity:

The range of operation capacity is 60~100% of design capacity per hour; if under 60~80% of design capacity; the process control is not very accurate because of uneven distribution in plate-fin heat exchanger

4 PROCESS

4.1 Process Introduction

The feed gas from acid remove system comes into decarburization cooler (E0201) after filtering and measuring, and cooled down to ambient temperature, and then enters into decarburization separator. After removing free water, the gas goes into Dehydration tower (A0201A/B/C） via control valve FV0201

The gas comes into dehydration tower from its top; after adsorption and dehydration by the layer of molecular sieve bed, it comes out from its bottom, where the water content in dry natural gas is not higher than 1ppmV; the dry natural gas then goes into mercury-removal unit to get rid of mercury, after that, the mercury content is not higher than 0.01μg/Nm^3; and then the natural gas comes into dust filters, and eventually goes into cryogenic liquefaction unit

There are 3 sets of dehydration tower, during specific adsorption intervals, the first tower adsorps for removing water, the second is in pre-adsorption which adsorps water in regeneration gas; the third is in regeneration statement which is heated and then cooled down to adsorp water in molecular sieve; after 1st tower is in saturation, it is switched to the statement of 2nd tower; the saturated tower continually is heated and cooled; these 3 tower is switched in above way.

The regeneration gas drawn before pressure control valve comes topdown through pre-adsopted tower, where gas is fully dried and comes into regeneration-gas heater (E0203） to reach 220～250℃; the heat and dry gas gets bottomup through the heating and regenerating tower to adsorp the water in molecular sieve; the wet regeneration gas

goes into cooler（E0202） to the ambient temperature, and then gets into separator（ S0201） to adsorb the condensate water which is drained by level control valve

The gas from top separator（S0201） and the natural gas after pressure control valve come into tower in adsorption statement; After heating, the bypass heater of regeneration gas, which is not in operates, the dry gas goes through regeneration tower in the same way, which makes tower in cooling stage

The natural gas from dehydration unit comes into cold box of cryogenic liquefaction unit for heat exchanging in liquid heat exchanger （E0401A/B/C） with reflux medium to a specific temperature, and then comes out of E0401A/B/C; after it gets into cryogenic separator （S0401）, the gas goes back to E0402A/B/C to be cooled and condensed and goes out of the bottom liquid exchanger (E0401A/B/C);

After throttling, the gas comes into LNG flash drum, at the bottom of which LNG product gets from cold box and into LNG tank; the liquid heavy hydrocarbon from bottom separator（S0401） goes into exchanger (E0403) to exchange heat, and then goes into ethan tower condenser(E0501) to be cold sources to condense the gas from top deethanizer(T0501), meanwhile the former gas itself is cooled and evaporated partly; the heavy hydrocarbon from condenser of deethanizer comes into deethanizer for rectification;

There is a reboiler on bottom of deenthanizer which is for evaporating the liquid on bottom deenthanizer by conduction oil; after rectification in deenthanizer, the rich-methane-and- ethane-gas is produced on top, the rich gas is pushed into deethanizer condenser for cooling down, after that the gas liquid goes into separator on top deethanizer to separate liquid to be reflux liquid and separate gas to be exchanged heat in heavy hydrocarbon exchanger; and then it goes into liquid exchanger （E0402A/B/C） to be condensed and liquefied , eventfully throttled into LNG flash drum （S0402）

The liquid from bottom deenthanizer is throttled into debutanizer(T0502) to be distilled; there is a condenser on top debutanizer with cold resources: circulation water; there is a reboiler on bottom debutanizer with heat resources: conduction oil; after distillation, the

rich -propane-and-butane gas on top debutanizer is produced, the rich gas is condensed to be liquid by condenser(E0503); some of the liquid is to be reflux liquid; other liquid is cooled to ambient temperature by LPG cooler to LPG tank(S0504); some liquid from bottom debutanizer is cooled by gasoline cooler to gasoline tank （S0503）as the product

The residual gas from LNG flash drum gets back to liquid heat exchanger for reheating to ambient temperature, and then goes out of cold box for BOG compressor, after compression, it is sent to fuel gas unit

Most refrigerant is supplied by MRC unit; the mixed refrigerant is compressed by compressor(C0601), after cooling down, it is sent to outlet separator of compressor for getting gas MRC and liquid MRC; they are separately goes into channels of liquid exchanger, the liquid MRC is cooled to -60℃, after throttling and decompressing, it returns to exchanger（E0401A/B/C）; the gas MRC is cooled down in exchanger (E0401A/B/C、 E0402A/B/C）, after throttling and decompressing, it comes into bottom exchanger for bottom-up evaporation, and then mixed with reflux MRC liquid to go out of cold box; they returns to outlet of compressor for the next compressing and refrigeration

5 Unit instruction

5.1 ONE FILTERING AND MEASURING UNIT

5.1.1 Function

The main function are as follows：

(a) Filter impurity in feed gas, especially during plant startup stage, in which there are some residual impurities in previous equipment and pipes

(b) emergency cut-off and pressure regulation when coming into liquefaction unit

(c) detect feed gas temperature, pressure and flow rate

5.1.2 Design Data

volume	66X104Nm3/d（under 60°F、101.325kPa condition）
inlet pressure	55.0barg
inlet temperature	40℃

5.1.3 Main Equipment

(a): Canal type filter is for clearing impurities of feed gas to cold box
(b)：Interlock cut-off valve is for stop the feed gas supply to cold box
(c)：Pressure regulator is to adjust pressure to liquefaction unit
(d)：Flow measuring instruments is to measure feed gas volume

Flow measuring instruments is to measure fuel gas volume

5.1.4 MAIN CONTROL POINTS：

（a）：Pressure indication, control, alarm and local indication for feed gas (b)：Temperature indication, local indication
(c)：Analyzing sample point for feed gas；(d)：Flow indication and accumulation for feed gas (e)：Flow indication and accumulation for fuel gas
(f)：Interlock cut-off valve and interlock the following unit

5.2 ONE DEHYDRATION UNIT

5.2.1 Function

It causes big problem if there is water in feed gas: water and natural gas forms hydrate to block the pipes and affect liquefaction; due to low temperature of natural gas, the existing water leads equipment freezing and blocking, that's the reason why to remove water

Due to low temperature liquefaction, it requires deep dehydration, therefore, we adopts molecular sieve method, which molecular sieve have strong choosing and adsorption ability, high adsorption under less water and low pressure; that's the reason why we use 3A molecular sieve to be absorbent

It includes 3 same dehydration tower for water adsorption, and adopts temperature swing adsorption method to regenerate molecular sieve

5.2.2 Design Data

Feed gas volume	66X104Nm3/d

Adsorption pressure	~54barg
Adsorption temperature	~41℃
Regeneration ability	~54.5barg
Regeneration temperature	180~200℃
Heat resources	conduction oil
Inlet temperature	~260℃
H2O content after treatment	≤1ppm(V)

5.2.3 MAIN EQUIPMENT

(a) Decarburization cooler is for cooling down gas from decarburization unit to ambient temperature

(b) Decarbonation separator is for separating the free water in natural gas

(c) Dehydration tower is for adsorbing water in natural gas

(d) Regeneration gas heater is reheating generation gas

(e) Regeneration gas cooler is to cool down regeneration gas

(f) Regeneration gas separator is to separate free water in regeneration gas Switch valves is to switch among dry, heating and cold purge

(g)Regulating valves of regeneration gas is to adjust gas to specific pressure

(h) Conduction oil regulator is to adjust regeneration gas temperature

(i) Level regulator for decarbonation separator is to ensure the level stably

(j) Level regulator for regeneration gas separator is to ensure the level stably

(k) Emergency cut-off valve on bottom decarbonation separator is to cut drainage lines if necessary to ensure safety

(l) Emergency cut-off valve on bottom regeneration gas separator is to cut drainage lines if necessary to ensure safety

5.2.4 Key control points：

(a)：Adsorption tower pressure indication, alarm and local indication A0201A/B/C

(b)：Adsorption tower inlet and outlet temperature indication, alarm and local indication A0201A/B/C

(c)： Conduction oil inlet temperature indication, pressure indication and alarm

(d) ： Regeneration gas flow indication, regulation; heater outlet temperature

indication, regulation and alarm

(e)：Natural gas from decarbonation cooler: temperature indication, alarm (f)：Natural gas from regeneration gas cooler: temperature indication, alarm (g)：Decarbonation separator: level indication, control, alarm and local indication

(h)： Regeneration gas separator: level indication, control, alarm and local indication

(i)：Programmable control of switch valves

5.3 MERCURY REMOVAL UNIT

5.3.1 Function

There is a terrible results if mercury exists in natural gas: under cryogenic condition, the mercury leads to Al equipment, pipes and valves corrosion to effect plant operation; according to the technique data from customer, there is no mercury in natural gas, but for safety, the mercury-removal unit is set and the catalyst is used for removal which ensure the mercury contents is not higher than0.01μg/Nm3

There is a filter in mercury removal unit to filter the impurity and keep it from cold box

5.3.2 Design Data

Processed gas	~66X104Nm3/d
Adsorption pressure	53.5barg
Adsorption temperature	43℃
It is designed on base of max. mercury contents	0.5μg/Nm3
Hg contents after treatment	≤0.01μg/Nm3

5.3.3 Main Equipment

a) 2 sets mercury removal units for switching in turn；
b)2 sets dust filter for switching in turn；

5.3.4 Key control points：

(a)：Filter outlet: pressure differential indication and alarm (b)：Filter local pressure indication；

(c)：Mercury removal unit : local pressure indication

5.4 1 Set Cryogenic Liquefaction Unit

5.4.1 Function

It adopts MRC process without pre-cooling system; cool and condense the natural gas by refrigeration system; separate heavy hydrocarbon to distillation system, after remove the heavy hydrocarbon, natural gas is liquefied further to get LNG product

5.4.2 Design Data

Processed gas	66X104Nm3/d
Incoming pressure	52.5barg
Liquefaction temperature	-163℃
LNG product	60X10^4Nm3/d

5.4.3 MAIN EQUIPMENT ：

(a) 4 sets main heat exchanger is for liquid heat exchanger

b) 1 set heat exchanger of heavy hydrocarbon is for heat exchanging between heavy hydrocarbon and uncondensed gas in deethanizer tower

(c) 1 set cryogenic separator is for separating heavy hydrocarbon in natural gas

(d) 1 set LNG flash drum is for separating gas and liquid of natural gas

(e) 2 sets upper part of MRC flash drum is for separating gas and liquid of MRC liquid

(f) 2 sets lower part of MRC flash drum is for separating gas and liquid of MRC liquid

(g) 1 set cryogenic residual separator is for heating drainage liquid

(h) 1 set N2 heater including 2 pcs is for heating nitrogen to reheat liquid coldbox

5.4.4 Key control points：

（a）: MRC gas channel for upper part of liquid heat exchanger: resistance indication and alarm

（b）: MRC liquid channel for upper part of liquid heat exchanger: resistance indication and alarm

（c）: Feed gas channel for upper part of liquid heat exchanger: resistance indication

and alarm

（d）:MRC gas flow into liquid exchanger indication, control and alarm; MRC liquid flow into liquid exchanger indication, control and alarm

（e）: Feed gas out of upper liquid exchanger: temperature indication

（f）: LNG flash drum: level indication, control and alarm

（g）: LNG flash drum: pressure indication, control and alarm

（h）: Cryogenic separator: level indication, control and alarm

（i）:Cryogenic separator: pressure indication and alarm

（j）: Main heat exchanger: LNG level indication, control and alarm

（k）MRC liquid out of liquid exchanger: temperature indication

（l）: LNG out of cold box: temperature indication and alarm, flow accumulated indication

（m）: MRC residual gas out of cold box: temperature indication, alrm and interlock

（n）: Fluid in and out of cold box: temperature and pressure indication ; sampling and analyzing

（o）:Interlock is mainly for temperature signal connecting reflux liquid out of liquid exchanger with MRC compressor stop

（p):Outlet of N2 heater: temperature control

（q): Residual evaporator: temperature indication

5.5 1 SET LPG STORAGE UNIT

5.5.1 Function

Due to the multi-content liquid, including methane, ethane, propane, butane and C+5 from cryogenic separator, it separates methane and ethane from above multi-content liquid according to different boiling points, and then take it to cryogenic liquefaction unit to produce LNG, most of propane, butane to produce LPG, others to gasoline product

5.5.2 Design data

Processed gas	14400Nm3/d
Pressure	22.barg
Temperature	-78℃
LPG field	32m3/d (it depends on feed gas composition, if

composition Changes, LPG field changes correspondingly

LPG Storage pressure	~14.3barg
Gasoline field	12.62m3/d (it depends on feed gas Composition, if composition changes, LPG field changes correspondingly
Gasoline storage pressure	~4.2barg

5.5.3 MAIN EQUIPMENT:

a) 1 set deethanizer is to separate most methane and ethane in feed gas
b) 1 set deethanizer cooler is to keep gas except methane and ethane condensing on top deethanizer
c) 1 set deethanizer reboiler is to heat liquid on bottom deethanizer to produce upstream for deethanization
d) 1 debutanizer is for separating propane and butane in feed gas
e) 1 debutanizer condenser isto condensate gas on top debutanizer
f) 1 set debutanizer reboiler is to heat liquid on bottom deethanizer to produce upstream for debutanization
g) 1 set debutanizer separator is to use for flash gas out of debutanizer to make liquid and gas separate
h) 1 set LPG cooler is for LPG cooling
i) 1 set gasoline cooleris to cool gasoline
j) 1 set LPG tank is to store LPG product
k) 1 set gasoline tank is to store gasoline

5.5.4 Key Control Point

(a）：Deethanizer & debutanizer pressure indication, control and alarm (b）：Deethanizer & debutanizer resistance indication and alarm

(c）：Deethanizer & debutanizer: level indication, control, alarm and interlock

(d) ：Deethanizer & debutanizer: level indication

(e): Deethanizer & debutanizer: temperature indication, control and alarm

(f): LPG product flow indication, control and alarm

(g)：Conduction oil of reboiler in Deethanizer & debutanizer: temperature, pressure indication and alarm

(h)：3-phase separator level indication, control and alarm

(i)：LPG &gasoline tank: level indication, alarm and local level indication

(j) LPG &gasoline tank: pressure indication, alarm and local pressure indication

(k) LPG &gasoline unloading pump: start and stop, interlock control

5.6 1 SET MRC MIXTURE AND COMPRESSION UNIT

5.6.1 Function

The mixed refrigerant is made of pure natural gas, C2H4、C3H8、N2、C4H10、and C5H12

It uses compression refrigeration cycling with steam, and supply all kinds of temperature cold energy to natural gas liquefaction

5.6.2 Design data

Compressed gas volume MRC	89000Nm3/h（ 60°F、101.325kPa）
Compression type	centrifugal and drygas seal
Suction pressure	2.29barg
Suction temperature	~39℃
Discharge pressure	34.6barg（at flange in outlet of last stage cooler)
Discharge temperature	≤43℃（at flange in outlet of last stage cooler

It adopts reflux regulation at outlet to make regulation range between 75~102%

5.6.3 Main Equipment

(a) Ethane tank including an evaporator is to supply ethane for MRC mixture

(b)Propane tank including a dryer is to supply Propane for MRC mixture

(c)Propane unloading pump

(d) Butane tank including a dryer is to supply butane for MRC mixture

(e) Butane unloading pump

(f) C5 tank including a dryer is to supply C5 for MRC mixture

(g) C5 unloading pump

(h) MRC surge drum is to mix MRC and surge at MRC inlet MRC

(i) 1 MRC compressor MRC

(j) 1 MRC separator is for separating gas and liquid after compression and cooling down

(k) 1 liquid collection drum is to collect liquid from MRC intercooler

(l) 2 liquid recycle pump, one for work, the other for backup, push liquid in liquid collection drum into MRC separator

5.6.4 MAIN CONTROL POINT

(a) : Purified natural gas: pressure indication, temperature indication and alarm; flow indication, accumulation and control

(b) : Ethane tank: pressure indication; level indication, alarm and interlock (c) : Ethane out of evaporator: pressure indication, temperature indication, alarm; flow indication, accumulation and control

(d) : Propane tank: pressure indication and set local pressure

(e) : Propane unloading pump shutdown; Propane unloading pump pipeline: local pressure; Propane tank: level indication, alarm and interlock and set local level; temperature out of propane dryer: temperature indication; flow indication, accumulation and control

(f) : Butane tank: pressure indication and set local pressure; butane tank: level indication, alarm and interlock and set local level; butane unloading pump shutdown; butane unloading pump pipeline: local pressure; temperature out of butane dryer: temperature indication; flow indication, accumulation and control

(g) : C5 tank: pressure indication and set local pressure; C5 tank: level indication, alarm and interlock and set local level; C5 unloading pump shutdown; C5 unloading pump pipeline: local pressure; temperature out of C5 dryer: temperature indication; flow indication, accumulation and control

(h) : N2 flow indication for MRC mixture: flow indication, accumulation and control; temperature and pressure indication

(i) : MRC from cold box: temperature, pressure ,flow and content analyzing indication and alarm

(j) : MRC surge drum: level indication alarm and set local level; MRC separrtor :

pressure indication, alarm and interlock; level indication, control, alarm and interlock; temperature indication, alarm interlock and set local level; MRC compressor shutdown and interlock;

(k)：Liquid collection drum: level indication, control, alarm and interlock; pressure indication, control, alarm

(l)：interlock is mainly for LNG tank level, feeding liquid signal and MRC compressor shutdown; reflux liquid out of liquid exchanger :temperature signal and MRC compressor stop; feed gas analyzing signal with MRC compressor stop

5.7 1 Set Fuel Gas Unit

5.7.1 Function

It supplies fuel gas with proper temperature, flow and pressure to conduction oil unit to heating oil

5.7.2 Design Data

There are 2 ways for fuel originals, one is from feed gas into LNG plant, which is used during plant startup and special stage; the other is from BOG compressor which is used in normal operation;

Max. flow into fuel unit BOG	1950Nm^3/h（in 60°F、101.325kPa）
Inlet pressure BOG	2.8barg
Feed gas flow	1950Nm^3/h（in 60°F、101.325kPa）
Feed gas pressure	2.8barg

5.7.3 Key Equipment

1 set surge drum is for balancing fuel gas

5.7.4 MAIN CONTROL POINTS:

(a)：Fuel surge drum: pressure indication, control and alarm

(b)：Bottom fuel surge drum: level indication, control and alarm; local level indication

5.8 1 Set Conduction Oil Unit

5.8.1 Function

Heat conduction oil and supply heat resources for regeneration gas, reboiler of dethanizer and debutanizer and cryogenic residual separator by flame BOG fuel or feed gas; the heated oil comes firstly into regeneration gas for heat exchanging, then reboiler of debutanizer, after cooling down, mixes with mid-temperature cycling pump and comes into reboiler of deethanizer, and then some oil from reboiler goes into mid-temperature cycling pump, other oil goes back to inlet of conduction oil cycling unit

5.8.2 Design Data

Outlet temperature	260~280℃
Heat loading	~1000kW
Outlet pressure	~5barg
Inlet pressure	~3.0barg
Normal fuel gas （BOG）	1300Nm^3/h（in 60°F、101.325kPa）
Fuel gas in startup	800Nm^3/h（in 60°F、101.325kPa）
Inlet pressure	2.6barg

5.8.3 Main Equipment

(a)1 set fuel machines to flame fuel gas

(b) 1 set organic oven is for heating conduction oil

(c) 2 sets cycling pumps of conduction oil is to make oil cycle, one for work, the other for backup

(d) 2 sets mid-temperature cycling pump is make mid-temperature oil cycle, one for work, the other for backup

(e) 1 set make-up pump of conduction oil

(f) 1 set oil tank of conduction oil

(g) 1 set expansion slot

(h) 1 set air pre-heater

(i)1 set blower

5.8.4 Main Control Points:

(a）：fuel gas pressure control；

(b）：fuel machine: temperature indication and control

(c）：outlet of conduction oil: temperature indication and control
(d)：outlet of cycling pump: pressure
(e): outlet of mid-temperature cycling pump: pressure
(f): oil tank level; expansion slot level

5.9 1 Set Instrument Air Unit

5.9.1 Function

It supplies proper instrument air

5.9.2 Design Data

pressure	5~7barg
temperature	40℃≤45
dew point	-40℃
Max. flow	400Nm3/h

5.9.3 Main Equipment

a)2 sets compressor, 1 for work 1for backup；
b)1set instrument air surge drum；
c)1 set regeneration dryer without heat；

5.9.4 Key Points：

(a）：Bottom surge drum of instrument air: level indication and control (b）：Bottom surge drum of instrument air: pressure indication and control (c）：outlet of instruments air: temperature indication
(d)：inlet of instruments air: temperature indication

5.10 1 set N2 unit

5.10.1 Function

It supplies N2 for MRC unit: supply protection gas or replacement gas during commissioning and operation; there is a PSA plant with 1 set LIN evaporation device for backup

5.10.2 Design data

N2 pressure	6barg
N2 purity	≥99.99 %
O2 content	≤100ppm
CO2 contentCO2	≤30ppm
Water content	≤-70℃（露点 dew point）
Normal N2 flow	150NM3/h
Max. N2 flow	600NM3/h

5.10.3

(a) LIN tank including an evaporator is to supply make-up N2

(b) PSA N2 production unit is to supply N2 in normal operation

(c)1 set N2 surge drum

5.10.4 Key points：

(a） LIN tank: pressure indication and alarm ;
(b） LIN tank: level indication and alarm ;
(c） N2 surge drum: pressure indication, alarm and control, set local indication (d） temperature indication into N2 surge drum

5.11 BOG unit

5.11.1 Function

Make BOG gas from LNG tank and liquid cold box to be fuel gas

5.11.2 Design data

Discharge gas BOG	1850Nm3/h
Suction pressure BOG	5~20kPa.G
Discharge pressure BOG	285kPa.G

5.11.3 Main equipment

(a) 2 set BOG compressor , 1 for work 1 for backup

(b) 1 BOG heater

(c) 1 set heating surge drum

5.11.4 Main points

(a）：BOG from cold box: pressure indication and alarm (b）：BOG from cold box: flow indication and accumulation

(c): BOG from cold box: temperature indication (d)：BOG from tank: pressure indication and alarm

(e)：BOG from tank: flow indication and alarm

(f)：BOG from tank: temperature indication

(g)：BOG into surge drum: temperature indication and alarm (h)：BOG into surge drum: pressure indication control and alarm

(i): BOG compressor stop and startup indication

(j）：BOG outlet: pressure indication and alarm BOG (k）BOG outlet :temperature indication and alarm BOG

6 Consumption of water, power and perlite：

6.1 power consumption

The power consumption is as follows:

Electrical Equipment			Shaft Power kW	Motor Power (kW)	Electrical Specification	Quan.
Tag.No.	Name	Electrical Position				
H0401A/B	Nitrogen heater	Electrical heating tube		2×20	415V、50Hz	2PCS One is for use, the other for backup
P0501A/B	Natual gasoline loading pump	motor		2×37	415V、50Hz	2PCS
P0502A/B	LPG loading pump	motor		2×37	415V、50Hz	2PCS
C0601	MRC compressor	Main drive motor	8592	9800	11kV、50Hz	1PCS

Electrical Equipment			Shaft Power kW	Motor Power (kW)	Electrical Specification	Quan.
Tag.No.	**Name**	**Electrical Position**				
	Main and auxiliary pump	motor		2×30	415V、50Hz	2PCS
	Electrical heater			2×17.5	415V、50Hz	2PCS
	Electric instrument control			3	240V、50Hz	1PCS
	Smoke exhaust fan	motor		2	415V、50Hz	1PCS
	Condense space heater			2	240V、50Hz	1PCS
	Turning gear			2	415V、50Hz	1PCS
P0601	Pentane unloading pump	motor		37	415V、50Hz	1PCS
P0602	Butane unloading pump	motor		37	415V、50Hz	1PCS
P0603	Propane unloading pump	motor		37	415V、50Hz	1PCS
P0604A/B	MRC liquid recovery pump	motor		2×75	415V、50Hz	Every set(s);2PCS One is for use, the other for backup
P0800A/B	Middle Temperature Hot oil pump	motor		2×30	415V、50Hz	Every set(s);2PCS One is for use, the other for backup
P0801A/B	High Temperature Hot oil pump	motor		2×45	415V、50Hz	Every set(s);2PCS

Electrical Equipment			Shaft Power kW	Motor Power (kW)	Electrical Specification	Quan.
Tag.No.	Name	Electrical Position				
						One is for use, the other for backup
P0802	Supplement oil pump	motor		0.75	415V、50Hz	1PCS
F 0801	Air Blower	motor		15	415V、50Hz	1PCS
C0901A/B	Air compressor	motor		2×37	415V、50Hz	Every set(s);2PCS One is for use, the other for backup
C1001	Air compressor (For PSA N2-producing system)	motor		90	415V、50Hz	1PCS
A1001	N2-producing system	motor		3.5	415V、50Hz	1PCS
C1101A/B	BOG compressor	motor		2×160	415V、50Hz	Every set(s);2PCS One is for use, the other for backup
	Power consumption of Instrumental controlling			20		
Total				11026.25		

6.2 Water consumption

The water consumption is as follows, but the final power consumption of compressor is based on the final doc. supplied by compressor supplier

Consumption of Circulating Cooling Water

Tag.No.	Item	Consumption （m3/h）	Remarks
E0201	Decarbonization Gas Cooler	35	
E0202	Regeneration Gas Cooler	37	
C0601	MRC Compressor	1995	
C1101A/B	BOG Compressor	10	
E0503	Deethanizer condenser	4	
E0505	LPG Cooler	9	
E0506	Light Oil Cooler	5	
	Total	2095	

6.3 Instrument air and its consumption

It meets requirements of SH/T3020-2001

pressure	0.5～0.7MPa.G
temperature	≤40℃
dew point	≤-40℃
instrument air	300Nm3/h

6.4 N2 requirements and its consumption

O2 consumption	≤100ppm
CO2 content	≤30ppm
Water content	≤1ppm
N2 pressure	0.40~0.70MPa
Consumption	150Nm^3/h

6.5 Perlite consumption, including make-up perlite: ～ 650m^3

6.6 mineral cotton consumption: ～ 2m^3