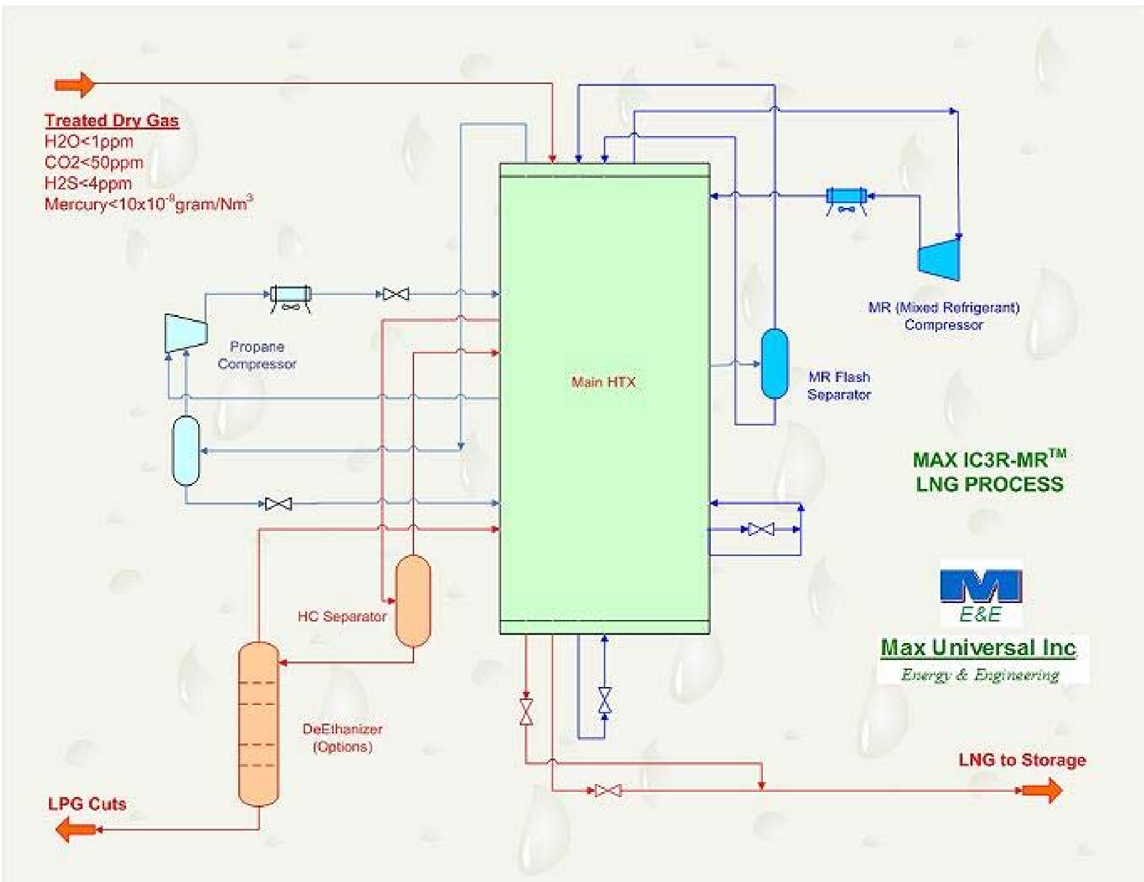
Max Universal's Proprietary LNG Process

美国顶值国际LNG专有工艺

Max IC3R-MR™
(Integrated Propane & Mixed Refrigerant Refrigeration)
（整合丙烷-混合冷剂制冷）

LNG Process
液化天然气工艺



1. **Features of the Process** 工艺特点

- Specially designed for small-scale (2 x 10^4 Nm^3/day to 150 x 10^4 Nm^3/day) natural gas liquefaction plants and peak shaving plants.

  专为小型 (2 x 10^4 Nm^3/day to 150 x 10^4 Nm^3/day) 天然气液化工厂和调峰工厂设计。

- Advanced refrigeration design to minimize energy consumption. Refrigeration energy consumption of 0.15 - 0.18 hp/lb LNG (9.5 – 12.0 kW/ton-day LNG) compared to the reported design refrigerant energy consumption of 0.18-0.25 hp/lb LNG (12.2 – 16.8 kW/ton-day LNG) for the existing MR LNG processes.

  优化之制冷设计降低了能耗。工艺设计制冷能耗仅为 0.15 – 0.18 hp/lb LNG (9.5 – 12.0 kW/ton-day LNG) 。较报道地现有MR工艺之制冷能耗 0.18-0.25 hp/lb LNG (12.2 – 16.8 kW/ton-day LNG) 大大降低。

- Integrating propane refrigeration cycle into main heat exchanger makes the process more suitable to large range of feed gas composition fluctuations, and changes in ambient conditions.

  将丙烷制冷循环结合进主换热器使得此工艺更适用于天然气组成波动及环境气温之变化。

- The mixed refrigerant is a mixture of nitrogen and hydrocarbons ranging from methane to butanes, which makes minimal temperature approach in the main heat exchanger and achieves high refrigeration efficiency.

  混合冷剂由氮气，甲烷，已烷(或已烯)，丙烷，及丁烷混合而成，使得主换热器达到最小之冷热流接近温度，并因此获得极高之制冷效率。

- The unique design of the main heat exchanger and heavies separation makes the process more efficiently and easily handle different gas from lean pipeline gas to rich gas with significant heavies content.

  主换热器及重组份分离器之独特设计使得该工艺更有效及更容易地处理从较贫的管道气到含有极多重组份的富气。

- With the integration of propane refrigeration and mixed refrigerant refrigeration, the process offers turndown ability while maintaining operating efficiency. By adjusting the operation parameters of the two refrigeration systems, the process can be run at less than 20 percent of design capacity while making specification LNG.

  此整合工艺设计使得工厂在小处理量运行时仍能保持之制冷效率。通过调整两制冷循环的操作参数组合可以使得工厂之最小处理量达到设计能力的20%而仍能生产合格的LNG产品。

- The process system is designed to contain the refrigerant during extended shutdown periods. Even the low-pressure suction portion of the system is designed for settle out pressure of the system. This design aspect minimizes refrigerant venting and makeup and allows rapid startup after a system shutdown. The typical time required for initial startup of the liquefaction plant is three to six hours. After a short shutdown, normal operation can be obtained within an hour.

  此工艺系统设计时考虑在工厂停产期间仍保持制冷剂而非放空。这将大大降低制冷剂之损失及充装需求，因此也使得工厂停车后能迅速再启动。工厂首

次热起动的时间一般为三到六小时。短时停车再起动一般一小时内即刻达到正常状态。

- Use of a single brazed aluminum plate fin heat exchanger is another key to process simplicity and ease of startup and operation.

  采用单一铝制板翅式换热器是该工艺得以简单化的另一关键，这也使得工厂的起动和操作更加容易。

- Employing proven process equipment such as brazed aluminum plate fin heat exchanger and electric motor driven centrifugal refrigerant compressors provides a desired long-term operational reliability.

  采用诸如铝制板翅式换热器和电机驱动离心式制冷压缩机等成熟工艺设备，使得该工艺工厂具有理想的长周期运转可靠性。

- The refrigeration system maximum operation pressure is less than 350 psig, which requires only ANSI 300 system design pressure and therefore reduce the cost.

  该制冷系统的最高工作压力小于350PSIG，系统设计压力仅须ANSI300，因此可使工厂投资得以降低。

- A deethanizer can be installed to provide LPG and heavy hydrocarbon cuts. This is as an option design.

  作为可选项，该工艺可以安装脱已烷塔以回收LPG及重组份。

2. **Plant Composite** 工厂之组成

- Feed gas compression system if gas available pressure is less than 800 psig (5.5MPa.G).

  原料气压缩机(当原料气压力小于800 psig (5.5MPa.G)时需要安装)。

- Amine unit (MDEA) to remove CO_2 to less than 50 –100 ppm(v) and H_2S to 4ppm(v).

  胺(MDEA)脱碳脱硫装置，以脱除CO2至小于50PPM(V)，H2S至小于4PPM(V) 。

- Molecular sieve system (two tower system) to remove water to less than 1ppm(v) and mercury content to less than 10 nanogram/Nm^3.

  分子筛脱水系统(双塔系统)，以将水含量脱至小于1PPM(V)并同时将水银脱至 10 nanogram/Nm^3

- Propane refrigeration compressor (motor driven centrifugal type).

  丙烷制冷压缩机(电机驱动离心式)。

- Mixed refrigerant compressor (motor driven centrifugal type).

  混合冷剂制冷压缩机(电机驱动离心式)。

- Main heat exchanger (brazed aluminum plate fin type).

  主换热器(铝制板翅式)

- Optional installation of deethanizer for recovery of LPG cut.

  脱已烷塔以回收LPG (此为可选项)。

- Optional installation of power generation system if electricity is not available.

  发电机系统(此为可选项，当无电力供应时)。

3. Typical Plant Design Parameters 典型工厂设计参数

Typical plant design parameters with the following treated dry gas composition are shown in table-1.

表-1中列出是据以下天然气组成而设计之典型工厂主要参数。

Components 组份	Mole %
Nitrogen 氮气	0.3068
Oxygen 氧气	0.0000
CO2二氧化碳	0.0050
H2S 硫化氢	0.0004
Methane 甲烷	82.6152
Ethane 已烷	12.6279

Propane 丙烷	3.8866
i-Butane 异丁烷	0.1804
n-Butane 正丁烷	0.3101
i-Pentane 异午烷	0.0261
n-Pentane 正午烷	0.0273
n-Hexane 已烷	0.0142

Table-1: Typical Plant Design Parameters 表-1：典型工厂设计参数

Feed Gas Rate 原料气流量	Nm^3/day 标方/日	5 x 10^4	10 x 10^4	15 x 10^4	20 x 10^4	25 x 10^4	30 x 10^4	40 x 10^4	50 x 10^4
LNG Product LNG 产量	Tons/day 顿/日	42.7	85.5	128.2	170.9	213.6	256.4	341.8	427.3
Feed Gas Compression Power (Note 1) 原料气压缩机功率（注-1）	KW 千瓦	317	634	951	1,268	1,585	1,902	2,536	3,170
Refrigeration Compressor Power 制冷压缩机功率	KW 千瓦	432	864	1,296	1,728	2,161	2,593	3,457	4,321
Others 其它功率	KW 千瓦	37	75	112	149	186	224	298	373
Total Plant Power without Feed Gas Compression 不包括原料气压缩时之全部功率	KW 千瓦	469	939	1,408	1,877	2,347	2,816	3,755	4,694
Total Plant Power with Feed Gas Compression 包括原料气压缩时之全部功率	KW 千瓦	786	1,573	2,359	3,145	3,932	4,718	6,291	7,864

Note 1: Assumed feed gas pressure =0.2MPa.G
注-1：假设原料气压力=0.2MPa.G