

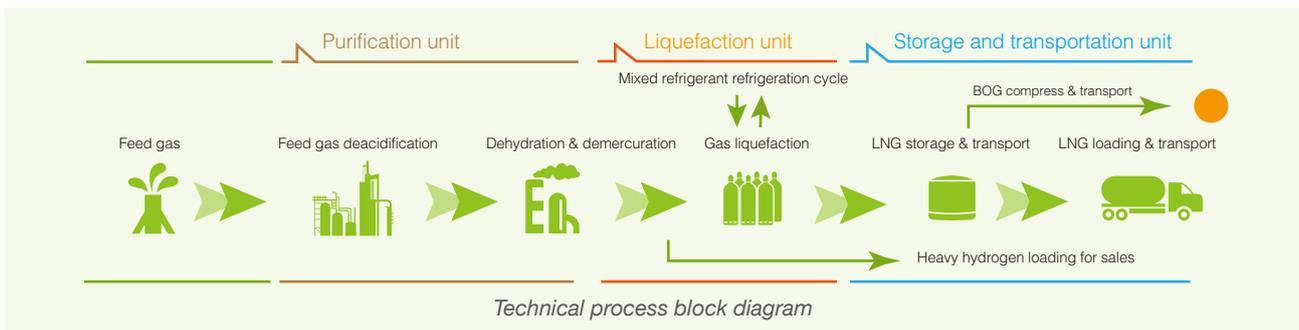
Tai'an 600 kt/a LNG Plant

Natural gas liquefaction technology and key equipment adopted at the Tai'an 600kt/a LNG plant are developed and manufactured under the leadership of "National Energy R&D Center for LNG Technology", which is built by CNPC affiliated China HuanQiu Contracting & Engineering Corporation (HQCEC) .

HQCEC has developed the dual-cycle mixed refrigerant liquefaction technology and the design and construction technologies for building 30,000-200,000m³ LNG storage tanks.

HQCEC is capable of delivering refrigerant compressor, BOG compressor, driving machine, cold box and other key equipment applied to large and medium-sized LNG projects, greatly reducing the procurement cost, manufacturing cycle and transportation time of the equipment.

Technology Plan and Features



Process description

Dual-cycle mixed refrigerant technology

- Suitable for natural gas liquefaction plants of all sizes;
- Wide adaptability of raw materials;
- High heat transfer efficiency, small temperature difference;
- Independent pre-cooling cycle and liquefaction cycle;
- Simple technical process, low investment, extensive sources of refrigerants, and low operating costs;
- Motor-driven refrigerant compressor, high energy efficiency, and long-term operating costs saved.

LNG storage tank

- Single-containment and dual-metal-wall tank, inner tank made of stainless steel, outer tank made of low-temperature carbon steel, expanded perlite for thermal insulation;
- LNG loading pumps, all process pipes and instrumentation interfaces are at the top of the tank, and there is no opening at the bottom or side walls of the tank, essentially avoiding any potential leakage and further enhancing the safety of the LNG storage tank;
- Monitoring and alarm instruments for LNG pressure, level, temperature, density; overpressure and undervoltage warning and protection facilities, and anti-roll facilities.

BOG compression system

- All the BOG produced from natural gas liquefaction, LNG storage tank and pipe heat leakage is recycled, avoiding BOG flaring;
- Low-temperature reciprocating compressors, flow rate control through gradual adjustment, control of compressor load through LNG tank pressure.



Acid gas removal through MDEA solvent absorption

- ▶ Mature technology, stable process, low corrosion of equipment and pipelines, and reliable system operation;
- ▶ Chemical absorption for feed gas deacidification, good absorption properties and high absorption efficiency;
- ▶ Low circulation volume of solvents, stable chemical properties of solvents, anti-foaming;
- ▶ Wide sources of solvent, low energy consumption for regeneration.

Dehydration through molecular sieve adsorption

- ▶ Simple and mature technological process, stable and reliable operation, no gas loss;
- ▶ Feed gas dehydration by physical adsorption: high adsorption load, high adsorption selectivity, stable adsorption performance, and suitable for deep dehydration;
- ▶ Long service life of molecular sieve, toxicity and pollution free, and low price.

Large-pore sulfur-loading aluminum oxide demercuration

- ▶ Mature technology, simple and reliable processes and equipment, and stable operation;
- ▶ Feed gas demercuration through chemical adsorption: stable adsorbents and wide sources of adsorbents;
- ▶ Adsorbent loading and unloading in air atmosphere, without the need of nitrogen protection, easy to operate;
- ▶ Large average pore diameter of adsorbents, effectively preventing hydrocarbon capillary condensation; hydrocarbon loss negligible.

Cold box (aluminum vacuum-brazed plate-fin heat exchanger)

- ▶ Compact, high heat transfer efficiency, light weight;
- ▶ Small cold loss, shaped through one manufacturing, short manufacturing cycle, mature manufacturing technology, and high manufacturing quality;
- ▶ Fast site installation, small land coverage, maintenance-free operation, stable and reliable operation;
- ▶ Particularly suitable for gas liquefaction plant with heat transfer of multi-strand fluids, low temperature difference of heat transfer, high energy efficiency, and low costs.

LNG loading pump and loading system

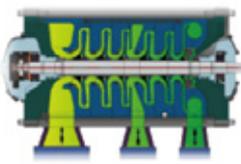
- ▶ Submersible centrifugal pumps installed in the tank, stable operation, high reliability, high efficiency, low failure rate, without the need of sealing system;
- ▶ Low requirements for operating liquid level, increasing the effective volume of the tank and overall operating flexibility of the device;
- ▶ Easy to start and stop, large operating range, especially suitable for loading of LNG tanker;
- ▶ Loading controlled through flow rate controller, highly operable.

Flare system

- ▶ Two flare systems: hot flare system and cold flare system, used for collection and treatment of the gas released during emergency operation;
- ▶ A low flow of nitrogen is continuously introduced to the end of the torch manifold to maintain slight positive pressure of the flare system;
- ▶ Both the hot flare system and cold flare system discharge flare gas only under accident conditions.

Key equipment made in China

High-power refrigerant compressor

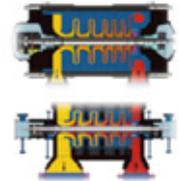


Program for MR1 compressor

Single cylinder and two sections
 Totally 6 impellers
 Shaft power: 11,532kW
 Rotational speed: 7,850rpm
 Model: 3BCL526

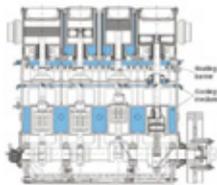
Program for MR2 compressor

Two cylinders and two sections
 Totally 11 impellers
 Shaft power: 16,465kW
 Rotational speed: 7,112rpm
 Model: MCL705+BCL526



20% of investment saved and 4 months of manufacturing cycle shortened

Low temperature BOG compressor



4-row labyrinth seal compressor

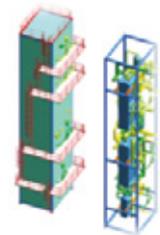
Flow rate: 6,046kg/h
 Suction pressure: 0.11MPa
 Discharge pressure: 1.8MPa
 Suction temperature: -110 °C to -161 °C
 Shaft power: 760kW

*40% of investment saved
 3 months of manufacturing cycle shortened*

Cold box

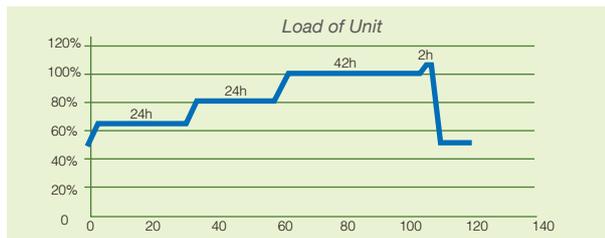
Aluminum plate-fin heat exchanger

Total heat load: 32.8MW
 Row A and Row B, manufactured and assembled in the factory, transported as a whole
 Dimension per row: 3.9×4.9×29.5m



*20% of investment saved
 3 months of manufacturing cycle shortened*

Performance Test



Process Performance Test Results

Product Quality Testing

	Index	Unit	Design value	Actual
1	Total sulfur	ppm	≤30	0.002
2	H ₂ S	ppm	≤3	0.036
3	CO ₂	ppm	≤50	0.114
4	H ₂ O	ppm	≤1	0.039
5	Benzene	ppm	≤5	0.63
6	Hg	ug/m ³	≤0.01	\

Test results of key localized equipment

Practical tests show that when the power load of the MR1 compressor power is 90% of the design value, the plant can reach full load; when the power load of the MR2 compressor power is 95.7% of the design value, the plant can reach full load. In addition, the requirements of the plant can be fully met. Its energy consumption is lower than the design value, and the plant has good mechanical properties. The BOG compressor works steadily when operating at full load, with an energy consumption level lower than the design value and integral mechanical properties. And all indexes meet design requirements. The test data of the LNG plate-fin heat exchanger meet design requirements, without any leakage. At 105% load, the unit runs steadily.