

**REP HOLDING
INNOVATIVE
EQUIPMENT**

for LNG projects

REP Holding



JSC "REP HOLDING" IS A LEADING RUSSIAN POWER ENGINEERING HOLDING, DESIGNER, MANUFACTURER, SUPPLIER OF POWER GENERATION EQUIPMENT OF NEW GENERATION .

It carries out engineering developments, manufacturing and package supplies of power generation and electrical equipment for the gas, oil, metallurgical and chemical industries, for power engineering and integrated power grid.

The supplied equipment is widely used for upgrading the gas transportation system, in the construction of up-to-date power units and power plants, for small-scale power generation, in the LNG market and in some other industries.

REP Holding incorporates a large industrial enterprise of Saint-Petersburg - Nevskiy Zavod. It provides strong foundation for engineering and production of high quality competitive products. REP Holding also includes its own Engineering Center which carries out R&D activities and innovative development.

Since 2019 REP Holding is incorporated in Gazprom Energoholding Group.

PRODUCTS

- new generation gas-pumping units rated at 16, 22/25, 32 MW;
- steam turbine units rated from 6 up to 25 MW;
- complete electrically driven gas-pumping units rated at 4,0; 6,3; 10,5; 12,5 MW;
- centrifugal and axial compressors with a capacity of up to 32 MW;
- power generating units based on steam and gas turbines with a capacity of up to 32 MW;
- variable frequency electric drives up to 100 MW;
- systems for complete integrated automation of industrial facilities.

COMPETITIVE ADVANTAGES

- research and development potential, application of unique design and technological solutions;
- advanced engineering and manufacturing capabilities;
- successful experience in localizing advanced foreign technologies;
- production of advanced energy-saving equipment in compliance with the requirements of API standards;
- integrated production management system;
- full production cycle from design to service maintenance;
- high reliability and operational availability of the units;
- highly automatized manufacturing techniques;
- unique environmental performance of the equipment.

Equipment for LNG projects

MIXED REFRIGERANT COMPRESSOR UNIT

REP Holding mixed refrigerant compressor units are being used in natural gas liquefaction process. Each unit represents a gas turbine driven centrifugal compressor, equipped with required auxiliary systems located inside the individual hangar type shelter with associated block-containers.

COMPRESSOR

REP Holding designed and manufactured Russia's first ever K905-71-1C centrifugal compressor for refrigerant cycle in 2017. The machine was built for Vysotsk LNG Project.

The current solution plays the strategic role in further development of local compressor manufacturing for natural gas liquefaction and medium-tonnage LNG production in Russia.

Design features

- Two sections compressor with «barrel» type casing;
- 7 compression stages: 4 - in the first section, 3 - in the second section;
- Dry gas dynamic seals;
- Roll-out device, tool set.



The compressor includes high-tech flow passage components such as integrally-machined axial-radial impellers with spatial blades.

REP Holding was the only company in Russia to master production technology of current components and widely uses them in its novel solutions.

K905-71-1C compressor advantages

- Reduced operational costs and quantity of additional equipment;
- Operational life increase and design reliability improvement by using single piece produced part (weld and riveting free);
- 2-4% stage efficiency increase by 3D flow passage design;
- Standardized assemblies and components;
- Capacity range and pressure load extension;
- Weight and dimension parameters decrease.



The mixed refrigerant compressor was successfully tested at Nevskiy facility and confirmed contractual specifications.

REP Holding became Russia's first and world's third manufacturer of this type of compressor equipment. Mixed refrigerant compressor manufacturing for medium-tonnage LNG production mastered by REP Holding will help to create Russian natural gas liquefaction technology, increase a share of local high-tech equipment application in large-capacity plants construction, and reduce the dependence on foreign service programs.

K905-71-1C Compressor technical characteristics

Parameter	The 1st section	The 2nd section
Volume efficiency, related to 0°C and 0.1013 MPa, ths. nm ³ /h	147,000	134,492
Weight efficiency, kg/h	216600	192816
Volume efficiency, related to the initial conditions, m ³ /h	54146	8077
Initial gas pressure (abs.), on the inlet, bars	3,0	17,7
Final gas pressure (abs.), on the exhaust, bars	18,2	51,0
Pressure index	6,067	2,881
Inlet gas temperature, °C	33,0	35,0
Polytropic efficiency, not less than	0,825	0,805
Power, consumed on the turbine coupling, MW, not more	17,230	
Rotor speed, rpm	6200	



T25 GTU

Mixed refrigerant compressor is driven by GTU rated at 22/25MW.

Vysotsk LNG terminal will be the first Russian project where T25 GTU production is going to be localized at REP Holding site under Solar Turbines license agreement.

T25 is a high-tech simple cycle industrial gas turbine unit. GT features highest economic efficiency within current power class and low level of harmful emissions.

The turbine high reliability is a result of technologies application and up-to-date design approach to gas turbine engine design.



Basic parameters:

- Rate shaft power - 22,4 MW;
- Efficiency - 40%;
- Flow rate of the exhaust gases - 68,24 kg/s;
- Temperature of the exhaust gases - 465°C;
- Compression index - 24;
- Flowrate of the fuel gas ($Q_{ph} = 50\,000\text{ J/kg}$) - 1,11 kg/s;
- Rated speed of output shaft - 6300 rpm;
- Emission NO_x, ppm ≤ 25.

Gas turbine unit features the best mechanical efficiency [40%] within its power range, high economic effectiveness in various operating modes and has a long service life (200 k hours).

GT engine operational replacement is carried out by lateral roll-out on the support frame.

GT engine features an extended 40 to 100% load operating range.

The acceptable gas calorific value range makes it possible to use all LNG produced utilization gases (boil off gas generated during LNG heating, refrigeration unit purge gas, etc.) as GT engine fuel.

T25 advantages when LNG production

- Recourse conservation;
- Reliability, availability, maintainability (RAM);
- Remote monitoring availability;
- Modern automatic control system, possibility of synchronization with the terminal operating mode;
- Environmental friendliness.

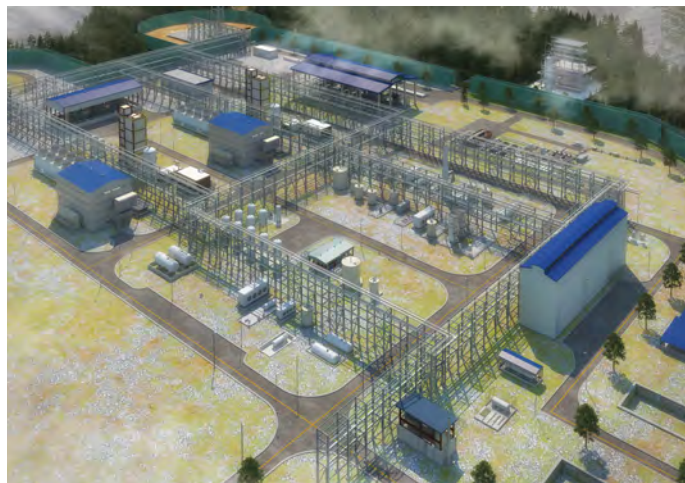


Vysotsk LNG Project

REP Holding is a supplier of two mixed refrigerant compressor units as part of the current Project. The equipment will play a key role in LNG production within Vysotsk port area.

In addition to the basic technological equipment REP Holding will supply the set of auxiliary systems to support life, operation and serviceability of the units. Mixed refrigerant compressors will operate on two independent natural gas liquefaction lines in closed refrigerant cycle of equal capacity - 330,000 tons of LNG per year.

The terminal will be commissioned as an integrated technological plant with a capacity of 660 k tons of LNG per year. Liquefied gas will be supplied to the consumers of the North-West region of Russia.



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