

FROM SPECIALIZATION TO UNIVERSAL APPLICATION

**ENERGAS gas treatment equipment
for the power supply complexes
for own needs of fields**



POWER SUPPLY COMPLEXES FOR OWN NEEDS OF FIELDS CREATE THE BASIS FOR THE DEVELOPMENT OF OIL AND GAS FIELDS, INCREASE ENERGY EFFICIENCY, PROFITABILITY AND ENVIRONMENTAL FRIENDLINESS OF HYDROCARBON PRODUCTION

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Projects of the ENERGAS Group are implemented at industrial facilities of various industries. Gas processing and gas supply systems of ENERGAS (photo above) based on booster compressor stations and block-type gas treatment confirmed their versatility, reliability and efficiency in the process of long-term operation of generating and gas transmission equipment.

The complex of engineering solutions is implemented in individual projects at large power plants, small power plants, APG

gathering and transportation facilities, autonomous power supply centers, gas turbine test benches, training centers for technical specialists.

For example, in the oil and gas industry, the gas treatment units of ENERGAS operate at special process facilities. These are: oil treatment plants (OTP); oil processing and pumping shops (OPPS); oil verification departments (OVD); booster pump stations (BPS); main transfer pumping stations (MTPS); preliminary water removal units (PWRU); central production facilities (CPF); central oil/gas gathering stations (COGGS); terminal separation units (TSU); condensate de-ethanization

units (CDU); condensate stabilization units (CSU); transportation systems of liquid hydrocarbons (TSLH); complex gas and condensate treatment plants (CGTP, CGCTP).

In this list, the special place is occupied by the fields' auxiliaries power supply complexes (FAPSC).

FAPSC AS A BASIS OF ENERGY EFFICIENCY

Many fields are equipped with their own generating facilities – power supply complexes based on GTPP or GTU-CHPP (GTU-TPP). Fuel for them is, as a rule, natural or associated petroleum gas gathered here.

In new projects, to ensure the uninterrupted and reliable operation of FAPSC, highly intelligent microprocessor-based process control systems and digital relay protection and automation devices are used that allow the control of fast processes without the operator's involvement, detect and disconnect the damaged equipment, keeping the serviceable one in operation.

In general, the creation of FAPSC serves to develop productive activities in the fields and allows the owner to solve a number of tasks on energy efficiency improvement, among which are:

- coverage of electrical loads in conditions of transmission constraints;
- generation of thermal power for various facilities of the fields;

- provision of process requirements for hot water and steam for injection into seams;
- reduction of energy consumption costs;
- reducing the company's dependence on tariff policy in the electricity market;
- growth in the volume of the rational use of associated petroleum gas.

EXPERIENCE THAT IS SOUGHT-FOR

ENERGAS has gained significant experience in the creation of modern FAPSC – in terms of treatment high-quality fuel and gas supply to generating equipment.

Individual design of process systems and packaged fuel gas

treatment units paves the necessary conditions for long-term joint operation with equipment of leading domestic and foreign manufacturers, among them: UEC-Gas Turbines and UEC-Saturn, UEC-Perm Motors and UEC-Aviadvigatel, Kazan and Ufa Motor-Building Production Associations, Nevsky Zavod, Russian Gas Turbines, Power Machines, Alstom, Turbomach, Centrax, Solar, Pratt & Whitney, Rolls-Royce, Kawasaki, Wartsila, Siemens, General Electric.

The Group's assets include the supply and commissioning of gas treatment systems for 21 power supply complexes built by LUKOIL, Surgutneftegas, Gazprom Neft, Rosneft, and others. To date, 3 such projects are being implemented. The list of own generating facilities equipped with ENERGAS equipment is presented in the table.

TABLE. Fields' auxiliaries power supply complexes (FAPSC) which equipped with gas treatment equipment of ENERGAS

Field	Region	FAPSC	FAPSC capacity	Power generating units / gas turbine units	Gas turbine equipment manufacturers
Gezh	Perm Territory	GTTP	4 MW	Ural-4000 / GTU-4P	UEC-Aviadvigatel
South-Nyuryskoye	Tyumen Region	GTTP	8 MW	Ural-4000 / GTU-4P	UEC-Aviadvigatel
Verh-Tarskoye	Novosibirsk Region	GTTP	10.4 MW	CX501-KB7 / 501-KB7	Centrax / Rolls-Royce
West-Chigorinskoye	Khanty-Mansi Autonomous Area	GTTP	12 MW	GTA-6RM	UEC-Gas Turbines
Tromyegan	Khanty-Mansi Autonomous Area	GTTP	12 MW	GTA-6RM	UEC-Gas Turbines
Igolsko-Talovoye	Tomsk Region	GTTP	12 MW	GTA-6RM	UEC-Gas Turbines
Konitlor	Khanty-Mansi Autonomous Area	GTTP	24 MW	GTES-12 / NK-16ST	Sumy NPO / KMPO
Verhnekolik-Egan	Khanty-Mansi Autonomous Area	GTTP	24 MW	CX501-KB7 / 501-KB7	Centrax / Rolls-Royce
West-Kamynskoye	Khanty-Mansi Autonomous Area	GTTP	24 MW	GTES-12 / NK-16ST	Sumy NPO / KMPO
Muryaun	Khanty-Mansi Autonomous Area	GTTP	24 MW	GTES-12 / NK-16ST	Sumy NPO / KMPO
North-Labatyugan	Khanty-Mansi Autonomous Area	GTTP No.1	24 MW	GTES-12 / NK-16ST	Sumy NPO / KMPO
Verhne-Nadymskoye	Yamal-Nenets Autonomous Area	GTTP	24 MW	GTA-6RM	UEC-Gas Turbines
Rogozhnikovskoye	Khanty-Mansi Autonomous Area	GTTP No.1	36 MW	GTES-12 / NK-16ST	Sumy NPO / KMPO
North-Labatyugan	Khanty-Mansi Autonomous Area	GTTP No.2	36 MW	GTES-12 / NK-16ST	Sumy NPO / KMPO
Rogozhnikovskoye	Khanty-Mansi Autonomous Area	GTTP No.2	36 MW	GTES-12 / NK-16ST	Sumy NPO / KMPO
Yukyaun	Khanty-Mansi Autonomous Area	GTTP	36 MW	GTES-12 / NK-16ST	Sumy NPO / KMPO
Tevlinsko-Russkinskoye	Khanty-Mansi Autonomous Area	GTTP	48 MW	EGES-12S-01 / GTU-12PG-2	UEC-Aviadvigatel
Vatyegan	Khanty-Mansi Autonomous Area	GTTP	72 MW	EGES-12S-01 / GTU-12PG-2	UEC-Aviadvigatel
Yarega	Komi Republic	GTU-CHPP	75 MW	GTES-25PA / GTE-25PA	UEC-Aviadvigatel
East-Messoyakha	Yamal-Nenets Autonomous Area	GTTP	84 MW	Titan 130	Solar Turbines Inc.
Usinsk	Komi Republic	GTU-CHPP	100 MW	GTES-25PA / GTE-25PA	UEC-Aviadvigatel
East-Urengoy area	Yamal-Nenets Autonomous Area	GTTP	105 MW	Titan 130	Solar Turbines Inc.
South-Khylchuyu	Nenets Autonomous Area	GTTP	125 MW	SGT-600	Siemens
Talakan	Republic of Sakha (Yakutia)	GTTP	144 MW	GTES-16 / NK-16ST	Sumy NPO / KMPO



PHOTO 1. GTPP of Vatyegan field operates on associated gas

As a part of FAPSC, 74 units operate (and 7 more units are being prepared for commissioning) for various purposes, versions and modifications, combined into "ENERGAS" complexes of the following types:

- fuel gas booster compressor station;
- multipackaged fuel gas treatment facility;
- fuel gas compressor facility;
- multifunctional gas treatment and gas supply system;
- hangar type gas treatment facility.

Such professional trust of the oil and gas community of the ENERGAS team is supported by its special gas treatment projects.

PROJECTS FOR FAPSC OPERATING ON ASSOCIATED GAS

BCS for the GTPP of Vatyegan field of the LUKOIL-West Siberia LLC

In May of this year the gas turbine power plant of the Vatyegan field (photo 1) passed 10-year boundary of uninterrupted operation. This is the first facility of the own generation of PJSC LUKOIL in the territory of West Siberia, it is also a successful pilot project on import substitution in the field of energy. Since the

commissioning in April 2008, a 72 MW GTPP has long been the largest power plant of the company's own needs.

The GTPP, built by LUKOIL-West Siberia LLC, uses associated petroleum gas as a fuel. The energy supply of the field is combined with the maximum recovery of APG. As a result, 1.4 billion cubic meters of associated gas was rationally used in 10 years.

The plant includes six power units of EGES-12S-01 with a capacity of

12 MW each. The power units are based on gas turbine units GTU-12PG-2 designed by JSC UEC-Aviadvigatel and manufactured by JSC UEC-Perm Motors.

In the design and construction there is realized a number of new design solutions. Among the features of the Vatyegan GTPP they can mark the following:

- turbine-generator and reduction valve are made on a single frame;
- there is used a separate turbine-generator protection unit;
- ACS of power units are combined into a common information network for remote control and operation control of all units;
- in each turbine room there are symmetrically placed two power units ("left" and "right" version).

The pairwise units placement in turbine rooms that is used here for the first time is further used in many of LUKOIL's own generation facilities.

Its own contribution to the reliability of GTPP-72 operation is made by the fuel gas booster compressor station of ENERGAS. Four hangar type units (photo 2) compress low-pressure (0.15 MPa) associated gas and feed it to turbines at a pressure of 2.7 MPa.



PHOTO 2. Compressor unit of intrashop version (on open frame)



PHOTO 3. East-Messoyakhskaya – the northernmost continental gas turbine power plant in Russia

The post-treatment of APG at the inlet to each compressor is carried out by highly efficient coalescing filters-scrubbers equipped with automatic condensate drainage system. The process scheme of the BCS also provides for a stable maintenance of the design gas feeding temperature to GTU.

The unit capacity of the compressor units is 12,800 m³/h; gas flow is controlled by a special two-level regulation system. Start of BCS was performed by specialists of ServicENERGAS LLC (companies group ENERGAS).

FGTF for the GTPP of East-Messoyakha field of the JSC Messoyakhaneftegaz (joint venture of Gazprom Neft and Rosneft)

The northernmost continental gas turbine power plant in Russia has been operating in the Yamal-Nenets Autonomous Area since September 2016. 84 MW GTPP (photo 3) supplies electricity and heat to the production and infrastructure facilities of the field.

The basis of the plant is six gas turbine units of type Titan 130 manufactured by Solar Turbines Inc. with a unit capacity of 14 MW. At the first stage GTPP operated on natural gas, and since May 2017 as a fuel for turbines there is used associated petroleum gas produced at the field.

This was made possible by commissioning a fuel gas treatment facility (FGTF), supplied by ENERGAS. FGTF (photo 4) provides the required quality of associated gas in accordance with the established parameters on purity, temperature, pressure and flow rate.

According to the project, process equipment is placed inside a separate capital building. To compress gas FGTF includes four booster compressor units. These CUs compress the low-pressure (0.2...0.45 MPa) APG to 2.95...3.05 MPa. The capacity of each unit is 9,000 m³/h.



PHOTO 4. Fuel gas treatment facility for the GTPP at Messoyakha

For gas purification high-efficiency filters-scrubbers are designed, which are located at the inlet to the CU and perform 2-step removal of liquid fractions and solid particles. The efficiency of the filter elements is 100% for contaminations larger than 20 microns and 97% for particles 5...20 microns in size.

At the discharge line of the CU there is built gas coolers so as to cool gas below the dew-point in order to separate condensate formed. Then the gas flows to the heaters, which maintain the design temperature of the fuel feeding to the turbines.

Each compressor unit is equipped with a two-level system of capacity control and automated control system. FGTF is additionally equipped with dew-point measurement system.

The whole cycle of pre-start works, including erection supervision, commissioning, individual testing and integrated verification as a part of GTPP, was performed by ServicENERGAS Company.

BCS for the GTPP of North-Labatyugan field of the OJSC Surgutneftegas

Pilot field exploitation began in 2004. Introducing innovative technologies of oil production, Surgutneftegas immediately



PHOTO 5. BCS of the hangar type as a part of GTPP-24 of the North-Labatyugan field



PHOTO 6. Compressor station supplies associated gas to turbines of GTPP-36 at the North Labatyugan

became concerned with the recovery of APG by generating electricity. The first GTPP with a capacity of 24 MW was commissioned here in 2007. The start-up in 2011 of the second phase – GTPP with a capacity of 36 MW – allowed to fully meeting the needs of the field.

GTPP-36, located at the site of booster pump station No.3, operates in a simple cycle. It consists of three power units produced by Sumy NPO. Each power unit is based on a gas turbine NK-16ST (KMPO) with a rated capacity of 12 MW and an efficiency of 29%.

The treatment of associated gas at this facility, as well as on GTPP-24, is carried out by BCS of the hangar type (photo 5, 6), commissioned by specialists of the ENERGAS Group. It consists of six compressor units, made based on screw oil-filled compressors. CU with unit capacity of 10,000 m³/h are located in two separate buildings.

The project is notable for the fact that BCS simultaneously solves different tasks:

- three CUs treat APG coming from the gas gathering facility, compress it to 2.7 MPa and feed it to GTPP-36 turbines;
- other three CUs inject associated gas into the pipeline for transportation to GTPP of other fields.

PROJECTS FOR FAPSC OPERATING ON NATURAL GAS

The possibilities of modern generating equipment allow power supply complexes to operate in a two-fuel mode. This is convenient and profitable, since initially the infrastructure of the fields, especially remote or inaccessible, is not sufficiently developed to supply GTPP or GTU-CHPP with its associated gas, and natural gas is temporarily used as the main fuel.

The field receives the necessary amounts of energy, and then at a certain stage of the development the correct transition of the power

supply complex to APG occurs. For example, the operation of the mentioned East-Messoyakha and Vatiegan GTPP was planned in such mode. In case of depletion of APG reserves, the station can again switch to natural gas fuel.

However, there are examples of the creation of FAPSC, where associated gas is not considered as fuel, and power units in a constant mode use only natural gas. This, for example, occurs when the demand for electricity and heat is high, and the amount of APG in the field is not sufficient for long-term operation or full-utilized capacity of turbines. Sometimes the problem is solved by laying the supply line with



PHOTO 7. Power supply complex "Yarega". As fuel for GTU-CHPP natural gas is used

associated gas from another field, but not always technically possible or economically profitable.

Gas treatment system for the power supply complex "Yarega" of the LUKOIL-Komi LLC

In September 2017 PJSC LUKOIL put into operation the next facility of its own generation in the Republic of Komi – the power supply complex "Yarega", built on the basis of GTU-CHPP (photo 7). LUKOIL-Energoengineering LLC developed the project and implemented it.

The new facility includes three gas turbine power units GTES-25PA produced by JSC UEC-Aviadvigatel with a total installed capacity of 75 MW. For issuance of the thermal power at the GTU-CHPP there are mounted three waste-heat boilers with total steam capacity of 121 t/h.

The start-up of the power supply complex provided the growing need for electricity and steam of strategic Yarega oil-and-titanium field, increased the efficiency of its development and reliability of energy supply.

The fuel for turbines of the GTU-CHPP is natural gas from Kurino-Patrakovskoye gas condensate field. Design gas parameters at the inlet into turbines (in terms of purity, temperature, pressure and flow) are provided by the multifunctional gas treatment system of ENERGAS (photo 8), which is composed of block-type gas treatment unit (BGTU), ACS of gas feeding as well as booster compressor station consisting of 4 units.

BGTU is a processing unit with maximum integration of the components on a single frame. Its main purpose is measurement of gas flow rate and gas filtration. BGTU is equipped with bilinear gas metering station (with ultrasonic flow meters) and filtration module.

The degree of gas purification is 100% for liquid fraction and 99.8% for solids of size larger than 10 microns. The content of mechanical impurities at the outlet is not more 0.001 g/m³.



PHOTO 8. Gas treatment system of ENERGAS at the Yarega oil-and-titanium field

Additional functionality is gas pressure stabilization. For this purpose BGTU is equipped with pressure reduction system. Contents of equipment also includes underground draining tank for gas condensate gathering; tank is equipped with a level sensor and a pump for condensate discharge. Capacity of BGTU is 15,780 kg/h.

Gas treatment unit is located at an open site (inside easy-to-assemble enclosure). Operation mode is automatic. After pretreatment, the gas flow is fed to the booster compressor station.

BCS compress gas up to operating pressure in the range of 4.5...5 MPa and feed it to the turbines of GTU-CHPP. It consists of four compressor units. Capacity of each CU is 7,890 kg/h.

Units are placed in separate block-modules of arctic type equipped with life support systems (heating, ventilation and lighting) and safety systems (fire detection and fire fighting, gas detection, alarm).

Modern gas treatment system was developed on special project. Coefficient of operational reliability is 0.98. Inside CU and BGTU there is provided open space for easy and comfortable access to all assemblies and components what allows possibility for year-round quality performing of service activities.

For efficient monitoring, management and safe operation of this process equipment there is responds completed two-level automated control system – ACS of gas feeding (ACS GF).

The main elements of the ACS GF are the following: local control systems of BCS and BGTU, control cabinet, the operator workstation, remote emergency shutdown. Internal and external connections are made using an Ethernet network as well as "S7-connection" and "Profibus" protocols.

Within the framework of a long-term agreement with the customer, the technical specialists of the ENERGAS Group carry out integrated maintenance of the gas treatment system, as well as the supply of components and consumables.

FGTF for the facilities of East-Urengoy licensed area of the JSC Rospan International (Rosneft)

The East-Urengoy licensed area is located in the Purovsky District of the Yamal-Nenets Autonomous Area. With the commissioning of this area, the annual volume of gas production by Rospan International will increase almost fivefold and reach a level of over 19 billion cubic meters.

In order of full development of the field, a complex gas and condensate treatment plant (CGCTP) is being set up here. The designed capacity of the facility in terms of the volume of natural gas treatment will be:

- 16.7 billion cubic meters of dry gas per year;
- up to 4.5 million tons of stable gas condensate;
- over 1 million tons of propane-butane fraction.

CGCTP is equipped with a multipackaged fuel gas treatment facility (FGTF) of ENERGAS.

This FGTF will perform filtering, metering, heating, reduction and in parallel mode will feed gas (with different parameters in terms of pressure, temperature and flow) to the facilities of main and auxiliary purposes. Among them there is a boiler house, technical propane-butane purification unit from methanol, a low-temperature separation unit, a methanol regeneration unit, intake flow lines, a flare unit, a booster compressor station of low-pressure gases, and a condensate stabilization unit.

The FGTF includes two fuel gas treatment modules (FGTM). Each module consists of separate block-boxes with equipment that are docked together in a single block-building with a common roof.



PHOTO 9. Fuel gas treatment modules No.1 for the facilities of CGCTP at the East Urengoy

FGTM-1 (photo 9) is the main; the range of its design capacity for gas is 93 ... 90,400 nm³/h. Fuel gas treatment module No.2 is standby; the installed capacity of FGTM-2 is 93 ... 32,612 nm³/h.

The equipment is fully automated; the local ACS of the two MPTGs are integrated with the upper level of the APCS. The fuel gas treatment facility was designed and manufactured taking into account the climatic conditions of the region and is designed for intensive operation mode.

Also, FGTF "ENERGAS" will supply fuel to a new auxiliaries gas turbine power plant, which under construction at the CGCTP site. 105 MW GTPP will provide electricity for the East-Urengoy area's facilities of production, processing and transportation of the oil, gas and gas condensate. The new power plant consists of seven gas turbine units of Titan 130 (Solar) with rated capacity of 15 MW each (photo 10).

Creation of energy autonomy of fields is a complex task, including development of standard technical solutions, analysis of technological risks and reliability level, introduction of highly efficient generating and process equipment.

Among such innovative engineering solutions are special gas treatment and gas supply projects of the ENERGAS Group. ●



PHOTO 10. Gas turbine units of Titan 130 produced by Solar

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