

INNOVATIVE TECHNOLOGIES FOR REDUCING OF ANTHROPOGENIC IMPACT ON THE ENVIRONMENT

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Gazprom dobycha Urengoy Company develops on an industrial scale fields unique on its natural gas, gas condensate and oil reserves on the territory of Yamalo-Nenets autonomous okrug: such as Urengoy (including Urengoy and Yen-Yakha areas), Severo-Urengoy field, Severo-Samburg field, Pestsy field, Yuzhno-Pestsy field and Vostochno-Padinsky area.

Currently hydrocarbon products are being produced from more than two thousand wells of the operating well stock as deep as 1000 to 4000 meters. Hydrocarbons raw materials are transported to the complex gas, condensate and oil treatment facilities over the pipelines with a total length of over 1700 km.

22 complex gas treatment facilities, 2 oil treatment facilities and 34 units of booster stations (DKS) with a total capacity of over 1,700 MW treat hydrocarbons raw materials produced from the bowels of Big Urengoy.

Since the beginning of the group fields development Gazprom dobycha Urengoy LLC produced more than 6.5 trillion cubic meters of gas, 140 million tons of gas condensate and 14 million tons of oil.

At present Urengoy oil, gas, condensate field (hereinafter referred to as UNGKM) is in the stage of production decline, which is characterized by a number of problems in the process of production, treatment for transport of hydrocarbons and associated with a reduction of the energy potential of deposit, the significant inflow of formation water into wells and other factors.

Due to the changing conditions of field operation, throughout the design-time specialists of the company together with research and design institutes carry out systematic operations to improve the efficiency of the extraction, treatment for transport of hydrocarbons, special attention is given to introduction of innovations and modernization of equipment that reduce the anthropogenic impact on the environment. Thus reduction of anthropogenic impact on the environment is one of the priorities of Gazprom dobycha Urengoy LLC (hereinafter referred to as Company).

The most important activities to reduce emissions of air pollutants are:

- improved methods of gas-hydrodynamic research (DDA) with the use of the new generation of instrument systems, which reduce the amount and time of research;
 - installation of concentric tubing in wells;
 - creation of the two-stage pressure system for Valanginian gas gathering and treatment, which allows to reduce the number of wells and pipes purges;
 - joint compression of Cenomanian and Valanginian gas that optimizes the operating modes and loading of disengaged Cenomanian compressor stations capacities (hereinafter referred to as DKS);

- joint operation of several UKPGs with preliminary treatment and compression of gas in a single compression stage in one facility and final treatment of gas from several fields at the head facility thus reducing the amount of fuel gas combustion at DKS;
- commissioning of booster stations for utilization of associated petroleum gas NP-1,2.

Protection of atmospheric air

Specialists of Gazprom dobycha Urengoy LLC jointly with Ufa State Technical University and Gubkin Russian State University of Oil and Gas have developed new technological methods of gas-hydrodynamic research using new generation of devices. These methods allowed for 10-15% decrease of research amount due to obtaining the necessary geological and technical information in the course of wells' operation. Implementation of these technological methods and devices has led to a decrease in emissions of combustion products by 30 000 tons.

At present maintenance of the Cenomanian horizon wells equipped with the tubing pipes of DN 168 mm, is complicated due to accumulation of water on the bottom of the well, which leads to a well shut down and as a result, irreversible loss of gas during blowdown and flare for putting the wells back into operation.

Operation of these wells is possible due to reduction of the tubing diameter or equipping wells with the concentric tubing. A feature of this technological method implementation at Urengoy field was the descent of central tubing with the inner diameter of 49 mm into the main tubing DN 168 mm without shutting down the well. Activities on equipping the well were performed within 6 days, after which the well was put back into operation without further lengthy work on mastering and the concomitant loss of gas, which is typical when the well is shut down. Well operation under control of an automated system have completely excluded technological blowdown and flaring because of water accumulation in the well.

In connection with the reduction of reservoir pressure gas gathering design scheme had ceased to provide the necessary conditions for the sustainable exploitation of gas and gas condensate wells and gas gathering pipelines. Frequent stops of wells due to accumulation of fluids downhole necessitated systematic purges what was connected with air pollution by combustion products. In order to reduce emissions into the atmosphere and efficient use of reservoir energy a part of the condensate wells with low pressure at the wellhead, which does not allow wells to work under the design gathering scheme was incorporated into a separate two-stage-pressurized gathering and treatment system of gas condensate. Implementation of this proposal had provided a stable operation of more than 120 low-producing wells and wet wells. In the result, the annual reduction in the loss of hydrocarbons was achieved, which corresponds to a reduction in greenhouse gas emissions by 2 000 tons (Fig. 1).

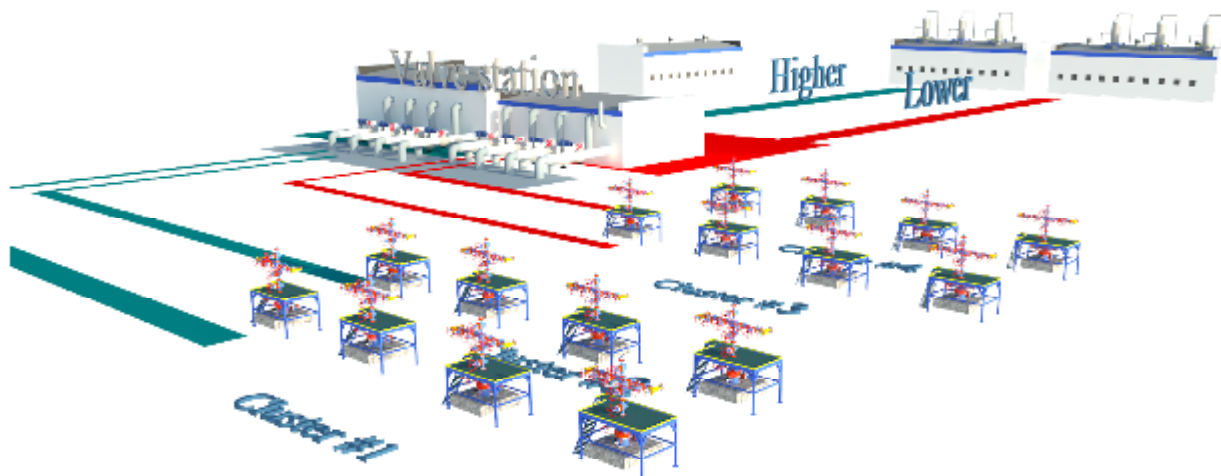


Fig. 1 – Two-stage-pressurized gas gathering and treatment system

Reduction of volumes of Cenomanian gas production resulted in lower loading of DKS on Cenomanian facilities and as a consequence, the deterioration of their energy efficiency and increase of specific amounts of fuel gas combustion. At the same time with a decrease in reservoir pressure in the Valanginian deposits it is necessary to compress the gas. For the operating conditions of Urengoy oil gas condensate field a rational way to increase energy efficiency of the Cenomanian DKS was developed and introduced.

Solution of the problem is seen as loading Cenomanian DKS compressors with gas produced from the Valanginian deposits. Gazprom dobycha Urengoy LLC carried out connecting of 4 Valanginian UKPGs to Cenomanian DKS, what led to the reduction of harmful air pollutants emissions by 6 500 tons per year (Fig. 2).

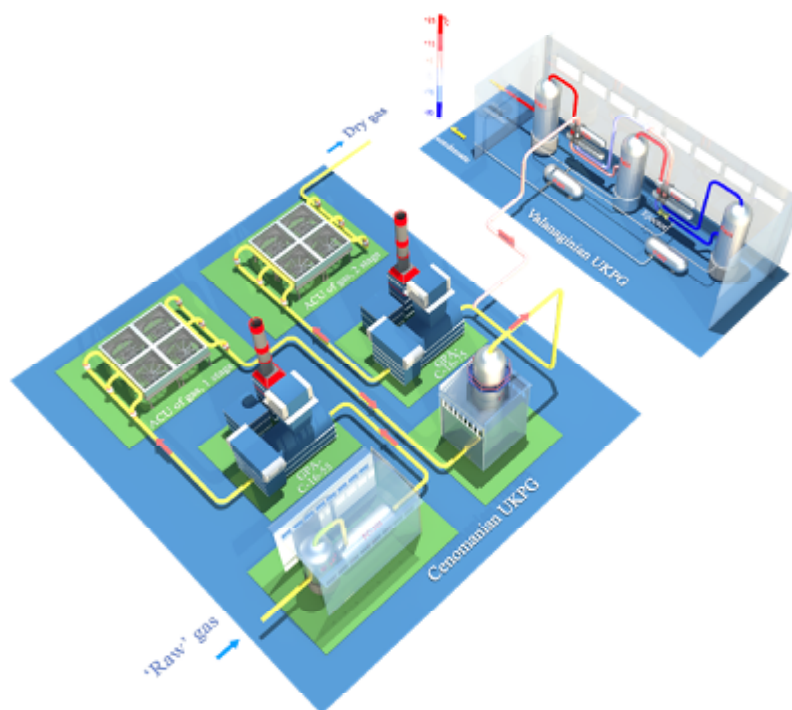


Fig. 2 – Technological method of treatment and joint compression of Cenomanian and Valanginian gas

To ensure the efficient gathering, treatment of gas and operability of gas boosters Company implements the scheme of joint operation of several UKPGs. In accordance with the amendments to the Design of further development of Cenomanian deposits of Big Urengoy it is planned to unite facilities in 4 groups:

- UKPG-1, 3 and 4 (UKPG-4 leading);
- UKPG -5, 6 and 7 (UKPG -7 leading);
- UKPG -8, 9 and 10 (UKPG -8 leading);
- UKPG -12 and 13 (UKPG -12 leading).

In order to determine the principal possibility for the joint operation of facilities under the scheme and evaluate its effectiveness specialists of the Company in 2006 conducted tests of joint operation of the two groups of Cenomanian facilities: UKPG-1,3,4 and UKPG-11,12,13. Gas preliminary dried and compressed at the first stages of UKPG-1,3 and UKPG-11,13, was led to the leading UKPG-4 and 12, where it was final-dried and fed to the second stage of compression before supplying into the interfiled pipeline.

The test results confirmed the effectiveness of unification schemes. Its implementation allows for optimization of equipment loading on field facilities and

improving the operational reliability of DKS. In addition it ensures the required quality of gas.

Redistribution of booster capacities and gas flows allowed, on the one hand, to ensure the required degree of compression, to reduce the negative impact on the atmospheric air and, on the other hand, to optimize the load of compressor equipment, thus reducing the specific consumption of fuel gas by 10-40% compared with the specific consumption of fuel in case of separate facilities operation (Fig. 3).

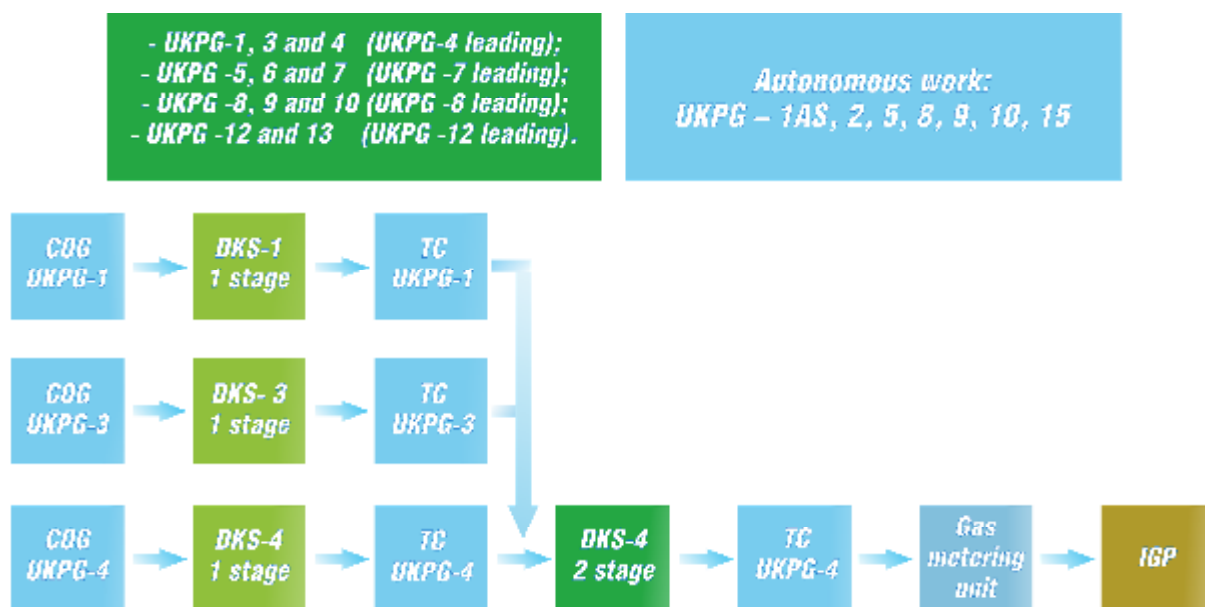


Fig. 3 – Unification of UKPGs into groups

Commissioning of two compressor stations for disposal of low pressure associated petroleum gas (APG) with APG utilization factor 98%, the development and introduction of innovative technologies, optimization of equipment operation and other activities allowed the Company to reduce pollutant emissions by more than three times (by 115 000 tons) (Fig.4).

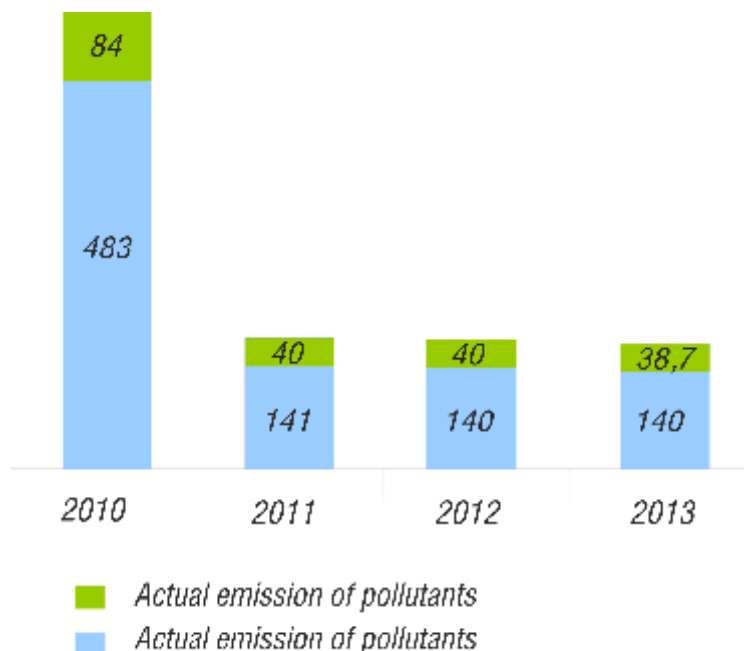


Fig.4 Dynamics of emission pollutants into the atmospheric air by Gazprom dobycha Urengoy LLC in 2010–2013 (thsd. t).

Protection of water resources

An equally important issue is the protection of water basin, as industrial wastewater generated during production and treatment of hydrocarbon raw materials contain such environmentally hazardous chemicals as oil products, diethylene glycol and methanol.

To reduce the anthropogenic impact on the water basin the following activities were successfully implemented:

- reducing the concentration of pollutants in wastewater;
- environmentally safe disposal of industrial and domestic wastewater into the deep laying lost circulation horizon.

In the process of industrial and economic activities of commercial facilities of Gazprom dobycha Urengoy LLC wastewater is produced, environmentally safe disposal of which is one of the most important tasks.

This problem is solved by creating a technological method of industrial wastewater recycling in the Urengoy specialized dumping ground, which is a complex of surface and underground facilities designed for accommodation of specially prepared industrial and domestic wastewater (Fig. 4).

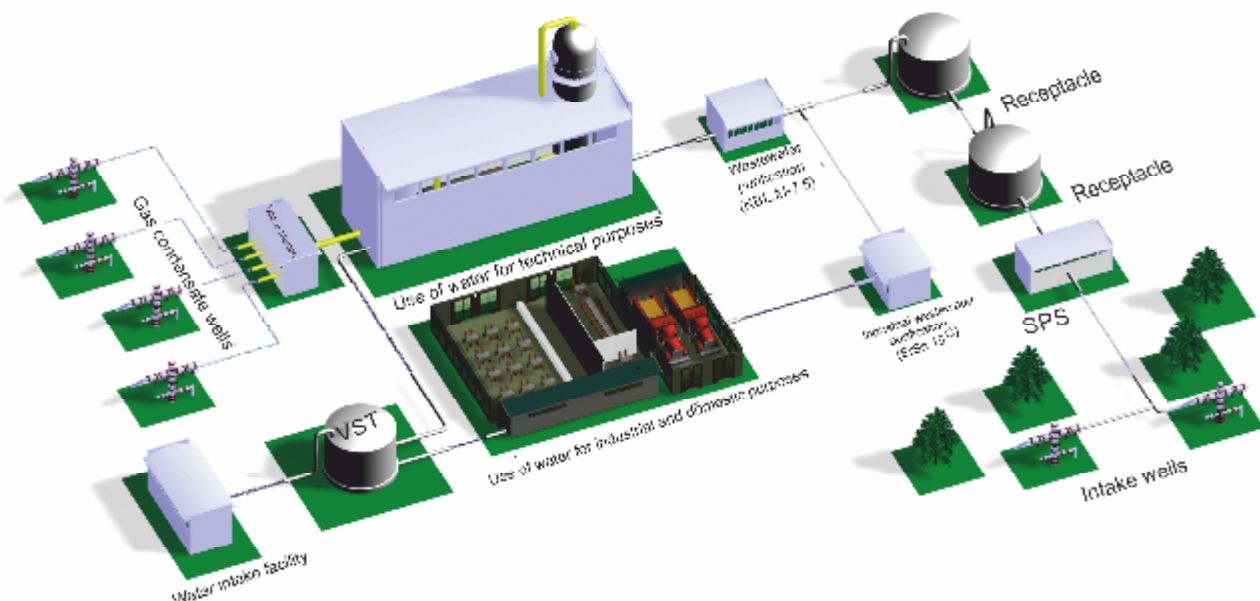


Fig. 5 Wastewater recycling scheme at UNGKM

One of the environmentally friendly way of wastewater disposing is pumping wastewater to the depths of 1300-1400 m below the gas reservoir in the Cenomanian horizon containing saline water not suitable for domestic water supply. Implemented by the Company innovative solutions for simultaneous injection of industrial and domestic wastewater provided an environmentally safe method of wastewater disposal amounting to more than 1 million cum/year.

Implemented by the Company innovative solutions for simultaneous injection of industrial and domestic wastewater ensure an environmentally safe disposal of industrial wastewater, which allows for complete elimination of the negative impact on the environment.

Events in the field of environmental protection and the promotion of environmental activities

In order to reduce the impact of Company's operating activities on the environment planned events are held in this field. 2013 only Gazprom dobycha Urengoy LLC executed more than 60 event list items on the protection of atmospheric air, water basin, soil, subsoil, as well as reconstruction of the objects intended for nature protection purposes. On the program for environmental protection and rational use of natural resources, dislocated soil reclamation with the use of biotechnological methods Gazprom dobycha Urengoy LLC in 2013 spent more than 200 million rubles.

The Company has conducted systematic ecological monitoring in three dimensions: it is air protection, water protection, protection of soil and snow.

In laboratories, the Company annually performs more than 16,000 instrumental measurements for harmful substances content in industrial emissions, atmospheric air and approximately 100,000 chemical analyzes of drinking water, wastewater, treated wastewater and surface water bodies, soil and snow cover on 40 indicators and components. This allows for recording and accumulation of information for analysis, based on which we can conclude about the number and extent of the impact on the environment and take timely environmental management action.

Gazprom dobycha Urengoy LLC conducts environment conservation measures aimed not only at reducing the negative impact of production facilities on the environment, but also on the maintenance of the specially protected natural territories and awareness-raising activities in the field of environmental protection.

The company pays special attention to ecological education of personnel in order to enhance accountability and professionalism of its employees, public awareness about the environmental performance of the Company.

Gazprom dobycha Urengoy LLC confidently holds the leading position in the field of environmental activities, receiving well-deserved recognition of their achievements at Yamal and in Russia. Measures implemented by the Company, demonstrate an active responsible approach of the Company in the face of the future generation for the preservation of the fragile nature of the Far North. Ongoing projects attract the attention of the townspeople to problems of environmental protection.

Convincing recognition of our effective approach to solving problems in the field of natural resources rational use and reduction of the negative impact on the environment is certification of the system of environmental management for compliance with ISO 14001 international standard.

Systematic and large-scale activities implemented by Gazprom dobycha Urengoy LLC on the introduction of advanced technological methods, environmental protection and production/environmental monitoring help to reduce energy consumption, to assess the real environmental situation on territory and to take the necessary measures to reduce the anthropogenic impact on fragile ecosystem of the Far North.