ECONOMIC FACTORS OF PROSPECTING AND EXPLORATION DEVELOPMENT ON THE RUSSIAN ARCTIC SHELF

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ABSTRACT

The oil and gas of the Russian Arctic shelf is one of the most important sources of the country's hydrocarbon raw materials. However, despite the sharp activation of geological exploration in Russia in 2012 - 2014, the geological study of the Arctic shelf remains extremely low. At present, the absolute majority of license areas of the shelf are distributed between PJSC Gazprom and PJSC Rosneft. The article notes that the lack of access to the shelf for other Russian and foreign companies can significantly slow down the process of its geological study. Also, as a shortcoming of the offshore licensing strategy adopted in Russia, the focus is on local licensing areas and the absence of the possibility of studying regional patterns. In the context of economic sanctions, an important problem is the almost absolute dependence of the geological exploration process on the shelf on imported equipment and technologies. It was noted that the existing fleet of domestic offshore drilling rigs is not able to fulfill the license obligations of Gazprom and Rosneft. In this regard, it was noted that the most important condition for successful offshore exploration is the availability of a production base and domestic technologies for offshore exploratory drilling. It is established that with the current trends in hydrocarbon sales markets, the cost-effective development of shelf deposits is problematic. It is concluded that the program for studying and developing the shelf should be adjusted in favor of financing the most promising projects in coastal and transit areas near production areas with developed infrastructure. The main points of the strategy for the development of the Arctic shelf zone in addition to the development of hydrocarbon reserves are highlighted: the development of alternative energy, the revival of the reliable hydrometeorological services, the increase in cargo transportation along the Northern Sea Route, and the exploration and development of ore deposits in the region.

Keywords: Arctic shelf, geological exploration, seismic exploration, licensing, profitability.

INTRODUCTION

Currently, one of the most important factors that may lead to a reduction in oil and gas production in Russia is the depletion of well-established deposits. Newly developed fields are usually located in hard-to-reach areas with a harsh climate, characterized by complex mining and geological output conditions. Continuing advancement of world innovative technologies today allows for the cost-effective

developing hard-to-recover oil and gas reserves, but Russia faces a serious lag in the technical and technological support for the exploration and extraction of these resources.

We believe that in the current environment of low prices and excess supply of hydrocarbons, high-cost Russian oil and gas will be uncompetitive in the world market, which is one of the major reasons for the reduction in hydrocarbon production.

PROBLEM STATEMENT

All sources of hydrocarbon raw materials available in Russia can be divided into three groups [1]:

1. Oil and gas from traditional deposits in long-established fields.

2. Hard-to-recover reserves, including shale oil and gas.

3. Hydrocarbons of the Arctic shelf.

The reserves of the first group are concentrated in the old fields with developed infrastructure and therefore these are the most attractive ones. The development of these reserves is likely to provide a significant part of the capital cost savings. However, the evidence from practice suggests that geological exploration in these areas is ineffective, since they lead to the discovery of relatively small deposits with reserves not exceeding 1 million tons, while costs for their implementation are high. For example, small deposits discovered in Western Siberia were not profitable even at oil prices over $ 100 per barrel. Nevertheless, the development of small deposits in the old oil and gas bearing areas has been implementing through the introduction of new methods to increase the production capacity of reservoirs, as well as due to the devaluation of the ruble in 2014-2015. However, it is no longer possible to maintain production at the same high level.

Reserves of oil fields that are relatively unfavorable for extraction in terms of geological conditions of occurrence and (or) physical properties of oil are considered hard-to-recover. Extraction of such reserves requires considerable expenditures of material, labor and financial resources, employment of non-traditional technologies, special equipment, reagents and materials. According to experts, more than 60% of the explored oil reserves are hard-to-recover [3], most of them currently being of insufficient investment attractiveness for oil companies.

The largest source of alternative oil reserves in the country is the Bazhenov Formation – the rock horizon in the central part of the Western Siberia at a depth of 2 to 3 thous. m. The deposits of the Bazhenov Formation spread over an area of about 1 million square km, contain shale oil with a bed formation thickness of 10 to 100 m. The resources of the formation are estimated at 100-170 billion tons. [5]. It should be emphasized that the production of Bazhenov oil today is no more than 0.7 to 1 million tons per year. This is mainly due to the fact that thin and

almost impenetrable shale rock beds do not allow oil to be pumped out using traditional methods, and there are practically no new economically viable technologies for developing such reserves in Russia. In order to solve this problem in 2017, the Ministry of Energy of Russia initiated a special national project. The goal of this project is to create technologies for precise localization of reserves, optimize drilling, and study the effectiveness of thermochemical methods of impact on the reservoir by integrating the technological and scientific potential of PAO Gazprom Neft, leading research centers, oilfield services companies, and manufacturers of the equipment. The project implementation should render the reserves of the Bazhenov Formation ready for industrial development; and reduce the cost of oil production from the Bazhenov reservoirs as low as possible. However, it must be emphasized that it is scientific organizations that were almost only ones to confirm their participation in the project. Oil companies currently prefer to develop the Bazhenov Formation independently, without placing this task in the priority category. The lack of interest of Russian vertically integrated oil companies in pooling efforts for the most effective implementation of the national project to develop the Bazhenov Formation can be attributed to uncertainty of the legal status of these works.

Based on the foregoing, it can be concluded that the first and second group of hydrocarbon sources will not be able to maintain the output at the achieved level, i.e. 500 million tons of oil and 600 billion cubic meter of gas per annum [4].

RESEARCH QUESTIONS

Let us describe the situation that has developed to date in the field of geological exploration on the Arctic shelf.

It should be noted that despite the surge in geological exploration in Russia in 2012-2014, the Arctic shelf has been studied insufficiently as compared, e.g. with the shelf of Norway or with the shelf of the American part of the Chukchi Sea.

Exploration volumes increased significantly due to the assignment of 93 license areas to the largest oil and gas producing companies, PAO Gazprom Neft (38 sites) and PAO Rosneft (55 sites). The companies carry out the drilling of additional exploration wells, as well as geophysical activities (in particular, 2D and 3D seismic surveys).

The distribution of the most attractive offshore areas between the two largest players in the oil and gas market has entailed a controversial situation. On the one hand, the lack of access to the shelf for other Russian and foreign companies can dramatically slow down the process of geological survey. On the other hand, the need to fulfill license commitment compels Gazprom and Rosneft to carry out geological exploration following the established schedule of work.

Note also that the current scheme for the distribution of licenses for the development of offshore fields does not allow the use of multiclient surveying or some other tools in geophysical operations. This tool is widely used in world practice and implies that service companies independently select shelf areas,

conduct geological exploration at their own peril and risk, and then repeatedly sell the information developed to all those concerned. Implementation of this scheme by the Ministry of Natural Resources of Russia would allow receiving information on earth depth at minimal costs for the state budget and the companies. A common world practice involves the development of complex fields using efforts of several companies to reduce risks. When entering the project, the partners are required to purchase the survey findings to estimate the amount of reserves and their own risks. At the same time, the key resource user will compensate for a part of the expenses incurred, while the service company will make a profit.

Furthermore, the concentration of activities on local licensed areas and the lack of the possibility of studying regional trends are on the downside of the current Russian system of licensing on the shelf. To address this issue, public funding or joint research by Russian and foreign companies is necessary.

The foregoing allows for the conclusion that it is necessary to revise the existing shelf licensing procedure.

A particularly pressing issue in studying the depths of the Arctic shelf is the almost absolute dependence of the geological prospecting process (mainly, of geophysical research) on imported equipment and technologies.

One of the principal methods of geophysical activities on the shelf is seismic exploration, which makes it possible to evaluate the structure of the earth depth and locate probable places of occurrence of hydrocarbons on the basis of dynamic interpretation based on the anomalies of the reflected signal. Alongside the widely used 2D and 3D seismic survey techniques, broadband seismic methods are rapidly developing today, which are significantly more informative, with comparable operational costs.

The broadband seismic techniques have been developed exclusively by foreign companies: CGS (Broadseis technology), PGS (GeoStreamer technology), Sercel (Sentiel technology), Western Geco (Izometrix technology), etc. Among these technologies, GeoStreamer is the undisputed leader in broadband marine seismic surveys both in productivity of offshore operations, and in geological performance. Because of the economic sanctions, these companies actually left the Russian market

Today, the Russian service companies can employ none of the said technologies. In addition, it should be emphasized that Russian marine geophysical companies such as OAO MAGE (Marine Arctic Geosurvey Expedition), OAO DMNG (Sakhalin Geophysical Company, Dalmorneftegeophysica), OAO SMNG (Sevmorneftegeophysica) are not equipped with modern specialized vessels for 3D seismic exploration. As a result, current 3D seismic operations on the Russian shelf are lagging behind the world level by more than 15 years [4]. This means that only foreign contractors can perform high-tech 3D work. Due to the imposed sanctions, most foreign contractors cannot operate as before.

Another complicating factor is the inability to conduct 3D seismic survey by specialized vessels in ice, as there is a risk of cutting the outboard equipment by ice. As the case stands, in the Eastern Arctic, only 2D seismic survey is possible during the ice-free period, which lasts only 1.5-2 months in these arctic surroundings.

Availability of a reliable production base and advanced technologies for exploratory and, subsequently, operational offshore drilling is key to successful exploration on the shelf. However, it should be noted that the Russian-owned fleet of domestic drilling rigs is not in a position to fulfill the license commitments undertaken by PAO Gazprom or PAO Rosneft in the offshore areas [1].

An important factor limiting intensive shelf development is the issue of environmental protection. The spills of oil have a negative impact on all participants of the Arctic food chains. Some Arctic faunal forms are particularly sensitive to oil spills, since pollution with oil and oil products will degrade fur and feathers heat-insulating properties. Today, there are no reliable technologies for eliminating such accidents in the world in the presence of ice cover. This problem is extremely urgent for polar water areas, where mitigation of accidents is complicated not only by the presence of a thick ice cover, but also by the polar night, low temperatures, strong winds, and lack of infrastructure.

In the event that all license commitments have been delivered on the offshore fields, significant volumes of oil and gas will enter the market. Let us consider the possibilities of effective sales of this hydrocarbon raw material.

In recent years, the competition for oil and gas markets has seriously worsened. According to initial forecasts, a portion of the gas from offshore fields, in particular Shtokman field, liquefied on the shore of the Kola Bay was to enter the US market. However, the development of shale gas reserves, as well as the discovery of new deposits in favorable economic and geographical conditions, let the US abandon imports.

The aggravation of the geopolitical situation and the deterioration of diplomatic relations with Europe compel Russia to turn to the market of the Asia-Pacific region, which is located in close proximity to the Russian offshore projects Sakhalin-1 and Sakhalin-2.

Today, the Sakhalin shelf projects based on the production sharing agreement (PSA) are rather effective. Implementation of the projects has become quite profitable for the state budget due to the main investments within the PSA made by foreign participants. Thanks to the implementation of these projects, high-technology industrial and social infrastructure facilities have been created in the Sakhalin Region. The products of the gas liquefaction plant located in the region are sold to Japan, Korea and China.

In contrast, offshore projects in the Barents Sea, where the PSA scheme is not applied, have not become effective even given the substantial government investments for their implementation.

Increased oil production in the US is certain to have global consequences, since it is the United States and China that are the main consumers of hydrocarbons in the world. There is a high probability that the surplus of hydrocarbons produced in other countries and not in demand by America will enter the world market to lower the price of oil. In addition, it should be borne in mind that significant volumes of oil and gas are concentrated in Iran, Iraq, and Libya, which for political reasons are currently unable to supply in full. Consequently, a shortage of hydrocarbons in the world market is very unlikely. In periods of surplus, producers with a lower production cost are found in a more favorable situation, meanwhile, the production costs of Russian hydrocarbon raw materials rather high. Moreover, the cost of delivery of the hydrocarbons produced to the consumer in Russia is a multiple of what is recorded in the Middle East. In this situation, with a decrease in world prices for hydrocarbons, the companies operating on the shelf face extremely high risk of losses.

Consequently, we may conclude that implementation of costly offshore projects can be frozen before the market conditions are optimized. Therefore, it is advisable to adjust the program of study and development of the shelf in favor of funding the most promising projects in coastal and transit areas near production areas with highly-developed infrastructure.

It should be emphasized that the Arctic zone is a very important region for Russia not only in economic terms, but also geopolitically, therefore the need for its development cannot be attributed to high hydrocarbon potential only. The main directions of the development strategy of the Arctic zone in addition to the development of offshore projects can be stated as follows.

1. In the Arctic zone, the use of alternative energy, especially for energy supply to small settlements located at considerable distances from infrastructure facilities, can become extremely popular. Laying pipelines or power lines in these territories is economically inexpedient. In our opinion, the use of the following energy sources is possible:

- wind energy, due to an exceptional potential the Arctic region holds. To successfully unlock the potential, it would be required to adapt the wind generators designed for Europe to the harsh climatic conditions of the North;

- solar energy, which can be successfully used in the conditions of the polar day, also provided that the existing equipment is adapted to the local climate;

- gas hydrates, often located in the Arctic near the surface.

2. Reliable hydrometeorological support. Currently, the equipment used for meteorological observations is obsolete, the number of observation points reduced significantly. It is against this background that the meteorologists' performance and the accuracy of forecasts lag behind current requirements.

3. Increased cargo transportation along the Northern Sea Route, which is the shortest sea route between Europe and Asia. It passes through the seas of the Arctic Ocean (Kara, Laptev, East-Siberian and Chukchi) and has a length of about

2,500 nautical miles. The average duration of passage of the Northern Sea Route is 10.6 days [2]. Transportation of equipment for the development of Arctic deposits and the need for subsequent export of extracted raw materials will require a complex infrastructure for the delivery and storage of oil fuels. An alternative is the integration of Arctic LNG projects into transport and energy schemes of existing projects.

The role of the Arctic region as a transport corridor is currently increasing due to the reduced ice cover in some areas of the Arctic Ocean. In this regard, it becomes possible to consider the Arctic zone of Russia as an important transport route that can connect Europe and Asia. The main advantages of the Northern Sea Route are no piracy in the region and cutting time of transportation. For example, it is possible to carry cargo from Norway to Japan up to 21 days faster than through the Suez Canal [2].

An additional advantage of the Northern Sea Route is a possibility to bunker vessels with natural gas from onshore or offshore fields almost throughout its entire length. This circumstance can also contribute to improving the competitiveness of the NSR.

4. Exploration and development of ore deposits in the Arctic zone. First of all, these are potential ore deposits in the north of the Eastern Siberia, which reserves can be used for the subsequent manufacture of solar batteries, as well as for the long-term storage of the accumulated energy.

CONCLUSION

In view of the foregoing, the following conclusions can be made.

1. Additional exploration of hydrocarbon reserves in well-established fields discover small deposits, which development is not cost-effective, even with oil prices exceeding $100 per barrel, because of high production costs. More than 60% of the explored oil reserves in Russia are hard-to-recover, thus having no investment appeal for domestic oil companies. To develop the deposits of the Bazhenov Formation, the largest source of shale oil in Russia, a national project of the Ministry of Energy has been initiated. However, today the large Russian vertically integrated oil companies show no interest in joining efforts to implement the project. Thus, hydrocarbons from traditional deposits, as well as hard-to-recover reserves, cannot serve as a reliable base for maintaining oil and gas production at the existing level.

2. The Russian Arctic shelf accommodates significant reserves of oil and gas; however, the shelf deposits are extremely understudied in geological terms. The pace of study and development of the Russian Arctic shelf has seriously slowed down due to the imposing of economic sanctions. At present, geological survey of the shelf almost absolutely depends on foreign technology and technology. There is a significant lag in the technical and technological security of seismic and drilling operations on the shelf as compared with the world practice.

3. The shelf development is limited by the environmental issue, as currently there are no reliable technologies for liquidating oil spills in ice conditions in the world.

4. Compliance with the license commitment of PAO Gazprom and PAO Rosneft in all offshore licensed areas under the current licensing system, given low oil prices, may lead to excessive exploration of potentially unclaimed hydrocarbon reserves.

Large-scale development of offshore fields in the Arctic region can be suspended for economic, technological and environmental reasons.

6. The Arctic zone can be developed in alternative directions not related to the extraction of hydrocarbon raw materials.

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