AAPG European Region Annual Conference
Paris-Malmaison, France
23-24 November 2009

RUSSIAN ARCTIC UNEXPLORED PETROLEUM POTENTIAL

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The Arctic continental shelf is believed to be the area with the highest potential for oil and gas as well as to non-traditional petroleum resources such as gas hydrates.
In the global picture of traditional hydrocarbon resources Arctic circumpolar region has ca. 23-25% of the world petroleum resources. Russian Arctic shelf has a territory of 6.2 million km^2 with 50% of it prospective for oil and gas. However, this area is barely explored and remains largely untested.
Estimates of hydrocarbon potential of the Arctic circumpolar region differ from country to country depending on data available, assumptions and classification but all agree that these resources are huge.
Gas hydrate resources of the Russian Arctic shelf accumulated under the sea bed are even higher, and their quantity is simply estimated as plenty. According to a forecast made by Yu. Makogon, by 2050 global methane production from gas hydrates can contribute as much as 16% of the total energy supply [2]. However, extensive research is required to develop technology for methane production from gas hydrates.

Challenges associated with the arctic resources development

Development of Arctic offshore fields is associated with numerous challenges, among which:

- Severe climate conditions
- Presence of ice
- High cost
- Long distance export of oil and gas – additional heavy cost
- Lack of technology, competence and experience in the arctic offshore field development
- Deficit of qualified personnel
- Environmental risks, not yet fully understood
- Energency response time

In addition to that, Russian arctic shelf is barely explored. Comparison with Norwegian continental shelf shows that the exploration coverage (in km of seismic lines per km^2) of the Russian northern seas is somewhat 20 times lower than that in Norway. The number of exploration wells is ca. 25 times lower than their number on the Norwegian continental shelf. However, exploration activities are necessary to convert enormous but yet hypothetical petroleum resources of the Russian Arctic to a reserve base that could be further developed and exploited.
Reserve replacement could be maintained by large scale projects in Russian new regions of oil and gas production – Eastern Siberia, Far East and Arctic Shelf. However, long distances to market and lack of infrastructure make these projects not so attractive for a business. Development of resources of the northern seas is additionally complicated by the lack of

technology and qualified personnel, operational and environmental challenges and even higher cost.
Recent estimates of the Russian Arctic Shelf development cost show the numbers close to $ 2.64 trillion, of which $ 680 million should be invested in geological prospecting [3]. Our estimation shows that development of the Russian Arctic shelf according to Norwegian environmental and technology standards would require ca. $ 100-120 billion per annum, or $ 4-5 trillion by 2050.
In order to fulfill this task a state (coordinated) exploration program is required. It is also obvious that deployment of such a big and challenging project requires a close cooperation of the international community.

More research, better decisions and novel technologies required

It is not only petroleum resources of the Arctic that are poorly explored. Our general knowledge of global ecosystems and an overall impact on them made by human activities is scarcely studied.
There is very little knowledge how human activities in offshore oil and gas resources development impact the climate change in a long-term perspective. Humans have matured enough now to say confidently that we know virtually nothing about an impact we generate on the Earth. This is especially important for vulnerable Arctic areas and northern seas.
Another important part of successful development of Arctic petroleum resources is skillful balancing of the needs of local stakeholders, business incentives, and the environment. Special attention and care should be paid for creating conditions for decent life of the indigenous people (Sami, Nenets, Inupiak).
This goal can be achieved only by continuous dialogue with stakeholders regarding their habitat and their active involvement in the development and the timeline planning.
Regarding technologies one must admit that there are more challenges than available solutions that can be readily suggested and deployed for efficient and cost-effective development of the Arctic.
In order to overcome these challenges new and environmentally friendly technologies for the Arctic conditions are required, among which most important, to our mind, are:

- Stringent environmental standards for operations, technology, materials and equipment used in the Arctic regions. Standards developed by ISO should be at least referenced to the opinion of local stakeholders. However, involvement of local stakeholders into a process of setting up the environmental standards seems more efficient
- Development of new materials, equipment, installations for the whole value chain (exploration, drilling, production, processing and transportation) that can be reliable in the Arctic conditions
- Safe operations in the Arctic with emphasis on evacuation of personnel in the ice-infested waters
- Technology being in a fast developing track doesn't often meet environmental standards (one example: there is still no solution for safe field development in shallow arctic waters)
- New solutions should be studied for the areas few hundred miles away from a shoreline. Waste management should be developed to a standard routine operation. Handling of produced and ballast water is still a big issue
- An international program on oil spill response in ice-infested waters should be initiated as soon as possible. This is one of the biggest challenges in safe operations in the Arctic. Establishment of international quick-reaction forces to combat oil spills

- Modeling and prediction of iceberg location and movement – an important element in safe development of the Arctic.
- Development of new (and environmentally friendly) exploration technology – according to standards/guidelines from co-existing industry sectors (fishing, hunting, etc.)
- New technology of offshore and coastal oil and gas field development – need for peaceful co-existence of different industry sectors.

Example from Snøhvit gas-condensate field on Norwegian continental shelf shows that nearly 18 years were spent on developing a new technology of hydrocarbon field development (so-called sub-sea production technology) before it was finally accepted by the fishing industry and approved by the state.

In 2007 a Norwegian state oil company Statoil set a very ambitious goal: by 2030 to excel technologies to such a level that to have the whole arctic offshore accessible for efficient and safe development. A previous record in developing technologies that can be "approved" by society for Snøhvit development gives a confidence that this new goal can also be achieved.

Role of international cooperation in offshore oil and gas field development

Development of oil and gas field in the arctic seas located few hundred miles from shoreline is, according to experts' opinion, the most challenging project in the world.

Global challenges and common goals advocate for a broad international cooperation in developing Arctic resources and coordination of all activities. Without international cooperation, coordination of all activities and use of modern and proven technologies for production of hydrocarbons, their transport, efficient safety and environmental protection tools realization of such project would be questionable.

It is important to outline that international cooperation on research and the knowledge transfer across the borders could actively be facilitated through the university cooperation.

There should be a well balanced proportion of studies related to fundamental research and immediate industrial needs. Knowledge and competence accumulated in different parts of the globe should be a subject of experience transfer through university international cooperation.

Internationalization of efforts in the development of arctic resources is the only way to do it in sustainable, cost-effective and efficient way.