GEOLOGY

A gas attack:

Development of methane hydrate reserves requires extra caution

The first experiment of recovering gas from an offshore methane hydrate deposit has been recognized as successful despite high production costs. This tremendous source of energy, however, may hide a peril of a global scope if the climate keeps getting warmer in Arctic.

Full speed ahead

The Natural Resource and Energy Agency in Tokyo announced it was launching a full-fledged surveying effort to assess the size of methane hydrate reserves in the Sea of Japan. A seismic vessel left port from the city of Joetsu, Niigata Prefecture on June 8. As part of the three-year survey, the vessel will also head to waters off the Noto Peninsula in Ishikawa Prefecture.

After narrowing down areas that appear to be promising, the government plans to conduct drilling for methane hydrate in fiscal 2014 from next April. It also intends to survey waters off Akita and Yamagata prefectures in 2014-2015, as well as off Hokkaido.

The National Institute of Advanced Industrial Science and Technology and Meiji University participate in the survey. The government has assigned $105 mln to the effort after Japan National Oil Gas and Metals Corporation (JOGMEC) reported success in its experiment of extracting methane from an offshore hydrate deposit.

The experiment, conducted with technical assistance of Baker Hughes and participation of an Australian company, Farley Riggs, targeted a deposit in the Nankai Depression some 60 km from the Atsumi Peninsula at the sea depth of 1,000 m. A well, drilled to 300 m under the seabed, yielded a stable gas flow for the whole period of tests, which lasted ten days.

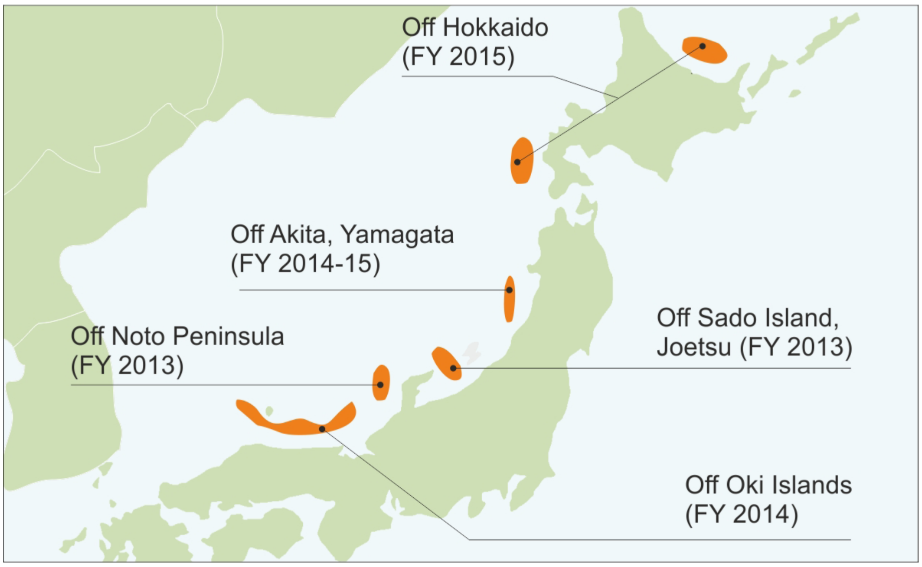
'This operation went long enough to prove that there is potentially a very commercial proposal,' Farley Riggs managing director Chris Riggs told the media. 'The Pacific ring area is laden with hydrate. Japan alone has potentially 100 years of gas, and that's a conservative estimate.'

Global importance

Japan, fully dependent on LNG import, associates great expectations with the hydrate program. One cubic meter of snow-like methane hydrate contains about 164 cubic meters of gas, and the volume of such reserves along the coast of Japan is tentatively estimated at 50 trillion cubic meters. Baker Hughes experts believe that the Nankai Depression alone may hold over 1,100 bcm of methane.

Geologists claim that global methane hydrate resources under the sea bottom and in permafrost onshore may amount to 250 trillion cubic meters, double the size of energy that can be extracted from all oil, gas and coal on Earth. Commercial use of these resources can change the energy patterns dramatically and cause political 'earthquakes'. Such coun-

Surveys for methane hydrate reserves in the Sea of Japan



Source: The Asahi Shimbun

Phase 3

The new three-year effort of offshore methane hydrate exploration is Phase 3 of a comprehensive program launched in Japan in 2001. It goes ahead while Phase 2 is still underway.

Phase 2, scheduled for 2009-2016, is being implemented by the MH21 consortium formed by JOGMEC, National Advanced Industrial Science and Technology Institute (AIST) and Japanese Engineering Achievements Association (ENAA). At a later stage, JAPEX joined the pool. The official aim of the program is to create a technology base by 2018 for commercial development of Japanese offshore methane hydrate reserves.

The consortium stated that Phase 1 was a success in 2001-2008. It included a preliminary assessment of hydrate resources, laying principles of reservoir modeling, and field tests of various technologies. Seismic surveys of 2001-2004 identified hydrate accumulation zones on the continental shelf.

If everything goes according to the original plan, commercial development of hydrate reserves close to Japanese coastline will begin in 2018.

tries as Japan and India will become energy independent, and Russia, along with other gas exporters, will find itself in the ranks of international losers.

RusEnergy has learned from experts involved in the experiment that production costs for hydrate-derived methane are triple the current cost of importing LNG to Japan. (And according to Canada's Geology Commission estimate made in 2009, development of methane hydrate reserves could be economical at the price of gas at over $10 per 1,000 cubic feet, that is, $350 per 1,000 cubic meters.

'It just seems to be a great gap in the costs,' an economic expert of Gazprom told RusEnergy. 'But we deal with the Japanese. Their rapidly advancing technologies and their laborious attitude will close down the gap very soon. It may happen in five years or so.'

Low pressure

Baker Hughes Inc. designed the completion system under contract to Japan Drilling Co. Ltd., to lower pressure in the reservoir enough to break down the hydrate to methane and water, control sand during production, and acquire large amounts of downhole data for reservoir modeling. The company provided a system that included qualification testing of standard products, a gravel-packed lower completion, the ESP system, a custom-designed dual-string production packer, real-time electronic pressure-temperature and memory gauges, and a distributed temperature-sensing fiber-optic monitoring system.

With direct access to the methane hydrate deposits, surrounding water was pumped out of the way and a pipe was placed above the hydrate. This effectively lowered the pressure above the hydrate and allowed the gas to escape upwards toward the ship. The gas was then tested on a burner on board the ship that caused a pair of propellers to spin upon successful extraction.

Actually, four wells were drilled at the Nankai Depression: one for producing gas and three for controlling possible structural and environmental effects. The extra cautionary measures were necessary in view of insufficient knowledge about the behavior of hydrate reservoirs. There was a danger of sagging seabed and landslides, which could provoke tectonic effects—and cause uncontrolled methane release in the atmosphere.

The first experiment ended without incidents but geologists and climate scientists insist that the danger remains.

Permafrost is thawing

Methane hydrate reserves were formed by a combination of low temperature and high pressure. Melting can be provoked by either decompression or heating. A massive release of methane in the air could result in a catastrophe. Molecule per molecule, methane is 22 times more potent as a greenhouse gas than carbon dioxide on a 100-year timescale, and 105 times more potent on a 20-year timescale. If just one percent of the permafrost carbon released over a short time period is methane, it will have the same greenhouse impact as the 99 percent that is released as carbon dioxide.

AQUA satellite measurements made by NASA from January 2009 to January 2013 show steadily increasing Arctic methane emissions. To keep hydrate stable under the regular atmospheric pressure, the temperature must be below −80°C, but Arctic is experiencing a warmth wave. According to NASA, methane levels in the area increase by about 10-20 ppb (particles per billion) each year.

The US National Snow and Ice Data Center estimates that there are 1,400 Gt of carbon locked in Arctic permafrost alone. This volume compares to the 880 Gt of carbon already put into the atmosphere via human greenhouse gas emissions. Arctic methane hydrates compose at least another 1,000 G1 of carbon. So for even a fraction of this carbon to be released would result in a substantial addition to human-caused warming.

Vaporizing Arctic

The so-called Yedoma landscape of east Siberian sub-Arctic plains is already recognized as one of the main sources of methane emissions in the atmosphere. The annual emissions are estimated at 4 Mt. Anton Vaks at the Oxford University predicts that the permafrost meltdown and methane release from Yedoma may become irreversible if the annual average air temperature in Arctic increases by 1.5°C.

Worried by the scope of the peril, experts of NESA have launched a new program, Carbon in Arctic Reservoirs Vulnerability Experiment (CARVE). CARVE is testing hypotheses that Arctic carbon reservoirs are vulnerable to climate warming, while delivering the first direct measurements and detailed regional maps of Arctic carbon dioxide and methane sources and demonstrating new remote sensing and modeling capabilities. About two dozen scientists from 12 institutions are participating. Last year they witnessed 'large, regional-scale episodic bursts of higher-than-normal carbon dioxide and methane in interior Alaska and across the North Slope during the spring thaw'.

Such vulnerable zones, the US researchers say, exist along Russia's Arctic coastline. The most extensive permafrost melting and methane release may occur in the East Siberia Sea—exactly where Gazprom wants to operate in an alliance with Rosneft. The thawing permafrost in the area could make the operations somewhat unpredictable.