

References

1. Pollution of Groundwater: research paper. – Access mode: <http://www.waterencyclopedia.com/Oc-Po/Pollution-of-Groundwater.html>, free. Caption of title screen (date of review 20.10.2015)
2. Groundwater aquifers: research paper. - Texas Environmental Almanac, Chapter 2, Water Quality, Page 7. – Access mode: <http://www.texascenter.org/almanac/QUALITYCH2P7.HTML>, free. Caption of title screen (date of review 22.10.2015)
3. Ground-water quality of Texas-an overview of natural and man-affected conditions: research paper. – Texas water commission. - Access mode: [http://www.twdb.texas.gov/publications/reports/other\\_reports/doc/miscreport89-01/R89-01.pdf](http://www.twdb.texas.gov/publications/reports/other_reports/doc/miscreport89-01/R89-01.pdf), free. Caption of title screen (date of review 21.10.2015)
4. Scientific study confirms groundwater contamination by hydraulic fracturing: research paper. – Access mode: <http://www.wsws.org/en/articles/2013/07/09/frac-j09.html>, free. Caption of title screen (date of review 20.10.2015)

**ENVIRONMENTAL RESPONSIBILITIES OF SAKHALIN ENERGY IN OFFSHORE FIELD DEVELOPMENT AND EXPLORATION**

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Today, many onshore fields being depleted, the offshore petroleum projects are intensively implemented. Among most well-known projects are Sakhalin-1 (implemented by Exxon Neftegas Limited) and Sakhalin-2 (Sakhalin Energy).

The topicality of this paper is undisputable as environmental impact of petroleum production is among the crucial issues faced by oil and gas industry today. Sakhalin Energy implements its project with due regard for environmental sensitivities and the company itself is considered to be working on one of the most eco-friendly projects in Russia of the current time. Therefore, the experience of Sakhalin Energy in this sphere can be regarded as a model. The fundamental environmental strategies of the company being overviewed and analyzed, it is possible to identify the key factors providing mitigation of the negative environmental impacts.

In 2014, Sakhalin Energy was ranked second in the Russian Federation's first Environmental Responsibility Rating of Oil and Gas Companies. The company was recognized as the winner in two categories of the rating out of three: environmental management and information disclosure/transparency. The rating was launched by the World Wildlife Fund (WWF) of the Russian Federation and CREON Energy, the provider of advisory services to the fuel and energy industries, with the participation of the National Rating Agency [3]. The rating is aimed at promoting the efficient use of hydrocarbon resources, environmental protection, and socially responsible business administration. In total, 19 companies with leading positions in terms of the oil and natural gas production volume (over 1.5 million tonnes per year) took part in the Rating.

Sakhalin Energy exercises industrial environmental control of its assets to ensure the compliance with legislation on environmental protection, to observe established environmental regulations, and to provide the rational use of natural resources and fulfilment of the plans for minimizing the environmental impact [2].

The company exercises industrial environmental control in the following areas: air emissions control, water use and discharge control and waste management control. The company has developed and is implementing the Air Emissions and Energy Management Standard, Water Use Standard and Waste Management Standard.

Sakhalin Energy seeks to minimize environmental impact from air emissions. In order to reduce its emissions, Sakhalin Energy uses gas turbines equipped with low-NOx burners. A system of additional gas supply is used on flaring units to increase the gas turbulence, which facilitates the gas flaring in a soot-free mode. The company uses diesel fuel tanks equipped with fuel vapour recirculation system nozzles connecting the tank with the tanker. This leads to the reduction of volatile hydrocarbon emissions by 90% during the refuelling operations. In 2014, the total gross emissions decreased by 8% compared to 2013. This is primarily due to decreased volume of gas flared at the LNG Plant flare units and optimized use of HVAC systems at pipeline assets.

The company strives to reduce water consumption for production purposes and to minimize the environmental impact from wastewater discharge. In 2014, the total water intake level remained the same as in the previous year. The 2014 water intake limits were not exceeded by any of the units. In general, water disposal has reduced by 4%, mainly by the reduced utilisation of cooling water for equipment on the offshore platforms and decreased rainwater runoffs at the OPF during autumn. Environmental monitoring conducted in 2014 in the locations of Sakhalin Energy's production assets revealed no negative impact on water bodies.

In waste management, Sakhalin Energy is guided by the following principles: reducing the volume of generated waste and minimize the adverse environmental impact caused by waste; transferring hazard classes I-III waste to specialized organizations for recycling, reuse, and neutralization; disposing of hazard classes IV-V waste at municipal landfills arranged in accordance with the RF legislation and international provisions; and seeking economically efficient methods of recycling hazard classes IV-V waste in order to reduce the share of waste disposed of at municipal landfills. The company's main volume of waste is low-risk hazardous (hazard classes IV and V), which mainly consists of drilling waste and solid domestic waste [1].

Sakhalin Energy is committed to using materials and energy efficiently in providing products and services. To fulfil its commitment, the company implements the methods of efficient and lean production. The company's assets were built based on modern technologies and state-of-the-art oil and gas industry solutions. All the production assets have their own autonomous power supply sources. Process equipment, boiler units, and power plants run on gas. Diesel fuel is used only for assets standby power supply. Fuel with low sulphur content is preferred. The Yuzhno-Sakhalinsk and Korsakov infrastructure assets are power-supplied from the municipal electrical networks but generate their own energy for heat supply. The total energy consumption by Sakhalin Energy's assets amounted to 58.45 million GJ, of which 56.59 million GJ were generated from produced natural gas and 1.86 million GJ from purchased diesel fuel. 0.12 million GJ of electric power were purchased [4].

The company strives to reduce associated gas flaring volumes to the absolute minimum. Associated gas produced at PA-A, PA-B, and LUN-A platforms is transported via offshore pipelines to the onshore terminals. A part of the associated gas is used as fuel for production assets. Currently, the company does not re-inject associated gas into the reservoir. The actual associated gas utilization in 2014 was 94.9%. In order to minimize the gas flaring volumes, the company is constantly taking steps to minimize the consequences of unplanned shutdowns of production equipment.

For compliance with the requirements of the international and RF legislation, Sakhalin Energy performs environmental activities. Operating expenses for the environmental activities performed in 2014 amounted to RUB 4,440,886 thousand. The company's activities are regularly overseen by the federal and regional authorities, and in 2014, no significant violations of the environmental legislation resulting in a negative impact on the environment were identified.

In conclusion, the main trends in ensuring environmental safety by Sakhalin Energy comprise the control over air emissions, water use and discharge, as well as waste management. The standards develop by the company can be used as guidelines by other oil and gas enterprises operating on the territory of the RF.

#### References

1. Predlozheniya i zamechaniya k proektu GOSTa «Okhrana prirody. Gidrosfera. Pravila obrashcheniya s otkhodami bureniya i neftegazodobychi pri osvoenii morskikh mestorozhdeniy uglevodorodov». TINRO-Center, 1999.
2. Project "Sakhalin-2": experience of international company [Electronic resource]. URL: [www.wwf.ru/data/news/9056/prezentatsiya\\_bwn\\_training.pdf](http://www.wwf.ru/data/news/9056/prezentatsiya_bwn_training.pdf) (date of reference: 10.10.2015).
3. Sakhalin-2 [Electronic resource]. URL: <http://www.gazpromexport.ru/projects/2> (date of reference: 02.10.2015).
4. Sakhalin Energy. Sustainable development report [Electronic resource]. URL: [http://www.sakhalinenergy.com/media/user/otchety/sakhalin-2014\\_eng\\_28-05.pdf](http://www.sakhalinenergy.com/media/user/otchety/sakhalin-2014_eng_28-05.pdf) (date of reference: 13.10.2015)

#### ENVIRONMENTAL ISSUES IN MARINE OIL PIPELINE ENGINEERING

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The main focus of the current study is a thorough analysis of ecological issues related to oil marine transportation. Precisely, it examines the ecological risks that can easily occur during oil transportation.

Most oil fields are located far from the place of refining, i.e. refineries, and loading terminals or stations. Due to its fast and economic delivery, «black gold» is essential for the prosperity of the petroleum industry.

It is a commonly agreed fact that pipeline is the cheapest and the most environmentally safety way of oil transportation. It can be stated that transportation of oil through pipelines is a continuous and rather reliable process [1]. Oil moves inside at 3 m/s under due to pressure gradient maintained by pumps located in pump stations throughout the pipeline system. It is possible to lay pipeline on the seabed. It is obvious that it is rather complicated task in terms of technical support and financial costs. Underwater pipelines are usually used for oil transportation within a single oil complex. As oil pipelines are long-term projects, expensive to construct, and have fixed routes to follow, there is an alternative – transportation with vessels or tankers. Therefore, today offshore oil can be transported not only by marine pipelines, but also by various vessels or tankers. It is necessary to examine both ways of oil transportation and estimate the relevant environmental risks.