Risk Analysis and Assessment for a Complex of Mooring Hydraulic Facilities of Offshore Oil and Gas Production Objects

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ABSTRACT
The risk analysis and assessment for mooring hydraulic facilities of offshore oil and gas production objects have been made in order to validate the normal level of safety of the facilities at the operation stage. Very intense loads of various types acting on the facilities are taken into account; seismic, ice, wave and thermal ones typical for the offshore zone of Sakhalin Island are the main of them. In addition, the risk of lean-on of vessels of different dead weight (including significant one) on the facilities has been analyzed in detail.

The results of the risk analysis allow validation of the scenarios of the most probable and the most severe failures at the mooring hydraulic facilities and quantitative estimation of the average annual probability (frequency) and damage from the failures.

The obtained values confirm that the risk of failure of the mooring hydraulic facilities at the operation stage is acceptable (tolerable).

KEY WORDS: Safety; risk; mooring hydraulic facilities; hazard analysis, failure scenario; damage.

INTRODUCTION
The Liquefied Natural Gas (LNG) plant which is a part of the complex of oil and gas production complex at Sakhalin shelf consists of two processing liquefying lines, gas storages (LNG terminal) and LNG loading objects.

The territory of LNG plant consists of five areas for managing main and auxiliary processes and accommodating services:

- main processing area in the center of the territory which consists of two processing lines for gas liquefying, a power station and general engineering facilities;
- LNG terminal at the south-west of the liquefying lines;
- trestle and LNG loading berth in the water 850 m to the south of the two LNG storage tanks, with two loading lines;
- area of administrative and repair services to the north of the general facilities and power units;
- flare facilities to the north of gas liquefying lines.

The hydraulic facilities of the special port of LNG plant include:

- Berth No. 1 for loading tankers with liquefied natural gas;
- Berth No. 2 – Tanker Loading Unit (TLU) for loading oil tankers;
- Berths No. 3 and 4 for handling of small port vessels.

The marine terrace in the area of the port is located at the southern end of intermountain degradation which narrows to the north-north-east of the bay. The cliff facing the coast has numerous landslides and subjected to intense sea impact during large tides and storms. The beach along the coast is 20 to 30 m wide.

The seabed relief in the bay is even, except for some specific relief forms, and has uniform inclination to the south, from 30 m depth to the south-east.

The climatic conditions of the area are harsh, depend on different thermal regimes of seas and currents washing the area and mountain relief of the majority of dry lands.

The natural conditions are divided in two seasons (monsoons): winter from October to March/April, when cold north winds dominate; and summer from May/June to September with relatively warm winds mostly from the south.

The climate is marine and humid, without strong frosts or heat, with short summer and long cold winter.

High seismic activity of the area of the facilities should be noted. The most recent damaging earthquakes were registered in 1964 in Nogliki area (8 points of Richter scale), in 1971 at Moneroon Island, in 1995 near Neftegorsk (7.2 points) and 2 August 2007 near Nevelsk (6.8 points).

The unique fish production value of the area should be also considered as special natural conditions. This area of Sakhalin shelf is one of the most important fish resources in Russia and requires that the hazardous impact of oil and gas production is made as low as possible.

The results of risk analysis for hydraulic facilities of Berth No. 1 are given below. The detailed risk analysis for hydraulic facilities of Berth