DRILLING CUTTINGS RE-INJECTION TECHNOLOGY

SAKHALIN-2 PROJECT
Sakhalin-2 Project

Development of Lunskoye and Piltun-Astokhskoye oil and gas fields offshore Sakhalin northeast

Main infrastructure facilities:
- Three offshore platforms;
- Onshore Processing Facility;
- Pipeline system: from offshore platforms in the north to Aniva Bay in the south (onshore – 1,600 km, offshore – 300 km);
- Russia’s first liquefied natural gas plant; and
- Oil and LNG export terminals.

Natural features of Sakhalin Island:
- Rugged terrain, seismic activity, tectonic faults
- Monsoon climate, long-lasting winter season
- Protected species of plants, land and marine animals, rich and numerous biological resources.

Drilling cuttings and produced water re-injection is carried out in order to minimize impact on the environment in accordance with company policy and commitments.
Offshore Platforms and Drilling Cuttings Management

Offshore drilling platforms


— **Piltun-Astokhskoye-B (PA-B):** Drilling operations since April 2008, oil production started on 23 December, 2008; and


Existing drilling waste management technologies:

— Treatment and discharge to the marine environment. Environment protection restrictions: only extracted material (water-based drilled cuttings) without any chemical additives can be discharged into the sea;

— Removal to the shore and transfer to licensed organizations. Limitations: no industrial waste landfills on Sakhalin, no efficient processing and recycling technologies, the final product has limited use. Increased transportation and handling risks; and

— Re-injection. Geological and technological restrictions: injection within a mining allotment, no fault or well path crossings, limited volumes and injection pressure (well structural integrity).
Drilling Cuttings Preparation and Injection

The system of drilling cuttings preparation and injection to a disposal well ensures:

— Drilled cuttings collection during hole-making for a subsequent casing;
— Rock grinding to 300 μm;
— Separation;
— Provision of required flow properties to drilled cuttings (density, viscosity, solids suspension);
— Drilling cuttings transportation by high-pressure pumps;
— Over-pressurization for hydraulic fracturing; and
— Re-injection of drilled cuttings, produced and marine waters and others technological fluids through a CRI well.
Drilling Cuttings Disposal

— Slurry is injected to clay beds located more than 1000 m deep. The presence of sand formations above and below the clay interval restricts vertical single fracture propagation due to fluid flow to sand layers;

— Batched slurry injection (8 to 1,600 m$^3$) with interruption intervals sufficient for complete fracture closure leads to formation of a localized area, consisting of numerous short bottomhole fractures;

— Produced fractures do not reach the faults, paths of neighboring wells and productive formations and do not stretch beyond the mining allotment for drilling cuttings disposal;

— Drilling cuttings injection does not affect the field development; and

— In case of geological or technical complications, drilling of back-up disposal wells is planned.
Drilling Cuttings Composition and Licensing

Sakhalin Energy drilling cuttings disposal activities following environmental legislation:

- Waste hazard class (IV) was determined, and a passport was obtained, according to which the cuttings consists of water (47-50%), drilled solids (20-25% - silicium, calcium, aluminum, potassium, magnesium and other oxides), petroleum hydrocarbon products (6-7%), viscosifiers (7-9% - greases, oils, spirits, sugars, tannines);

- The company obtained mining licenses and mining allotment certificates for construction and operation of subsurface facilities not related to mineral resource extraction for the purposes of pilot and subsequent industrial drilling cuttings and production water disposal at Lunskoye (ШОМ 13802 3Э, 2006) and Piltun-Astokhskoye (ШОМ 14370 3Э, ШОМ 14118 3Э 2007) fields;

- According to the RF legislation, Sakhalin Energy drilling cuttings disposal facilities are registered with SRWDS; and

- Waste Management license obtained.
Industrial and Environmental Safety

— Technical projects for subsurface facility construction and operation and group well design received positive expert opinions and were approved by the RF supervisory authorities;

— Geological reports on drilling cuttings and production water pilot injection were approved by the State Reserves Committee of the Federal Subsoil Management Agency;

— Geological monitoring programs for drilling cuttings and production water injection include:
  • Regular slurry sampling and measurement of its properties against specified values;
  • Continuous measurements and recording of wellhead, annulus pressures, slurry injection rates and amounts;
  • Alarm system warning about approaching working injection parameters the maximum permissible values;
  • Use of geophysical and hydrodynamic control techniques enabling determination of intake formation properties and actual waste injection intervals;
  • Live simulation model of the drilling cuttings disposal area for capacity assessment and injection volume updating; and

— Monitoring programs of marine biota and its habitat.
References to the Best Available Technologies

— Drilling cuttings re-injection during offshore oil and gas field development is an advanced and environmentally benign technology, enabling waste isolation in deep underground layers;

— Technology of deep-well drilling cuttings re-injection was tested and has been implemented for 8 years not only at fields of Sakhalin-2 project, but also at Sakhalin-1 project fields;

— The current RF waste management legislation needs harmonization and unambiguous interpretation of waste disposal provisions; and

— According to Decree of the RF Government No.1458 as of 23.12.2014 “On procedures for determination of the best available technology …”, the Federal Agency for Technical Regulation started collecting relevant information for this register. Based on an official inquiry and according to an established form (questionnaire) the company forwarded the technology summary to FSFI “Sakhalin Standardization and Metrology Centre” in February 2015.
Thank you for your attention!

Any questions?