

DRILLING CUTTINGS RE-INJECTION TECHNOLOGY

SAKHALIN-2 PROJECT

TO BE THE PREMIER ENERGY
SOURCE FOR ASIA-PACIFIC

БЫТЬ ВЕДУЩИМ ИСТОЧНИКОМ ЭНЕРГИИ
ДЛЯ АЗИАТСКО-ТИХООКЕАНСКОГО РЕГИОНА



Sakhalin-2 Project

Development of Lunskeye 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-A (PA-A/ Molikpaq):** Phase 1 – oil production since 1999, upgrade in 2004-2007;
- **Piltun-Astokhskoye-B (PA-B):** Drilling operations since April 2008, oil production started on 23 December, 2008; and
- **Lunskoye-A (LUN-A):** Drilling operations since 7 May, 2007, gas production started on 10 February, 2009.

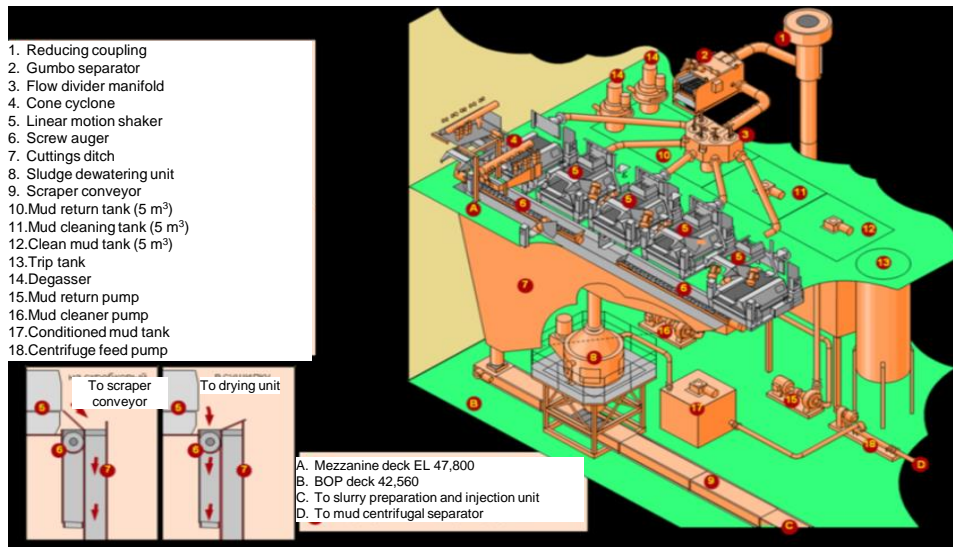
Existing drilling waste management technologies:

- 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

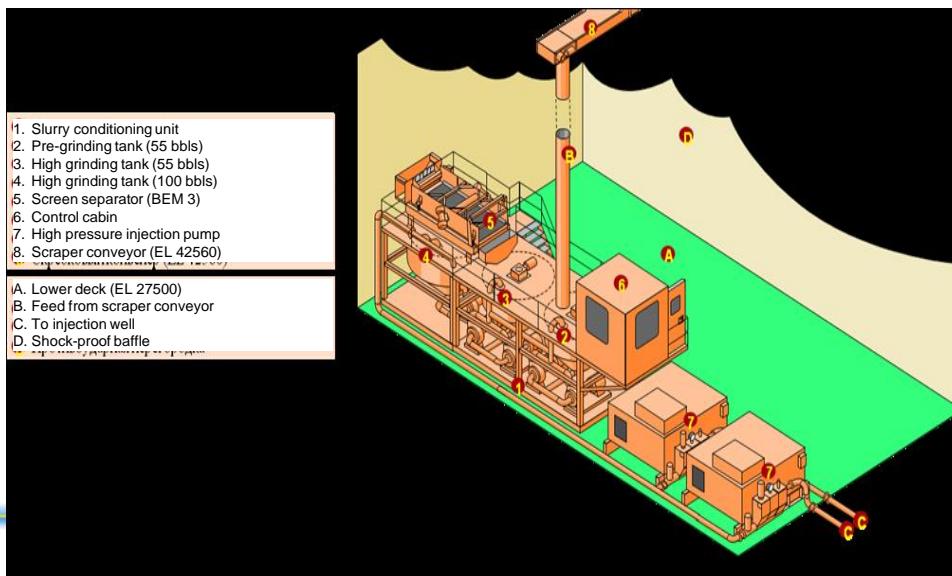
Process flow diagram of cuttings separation and transportation



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

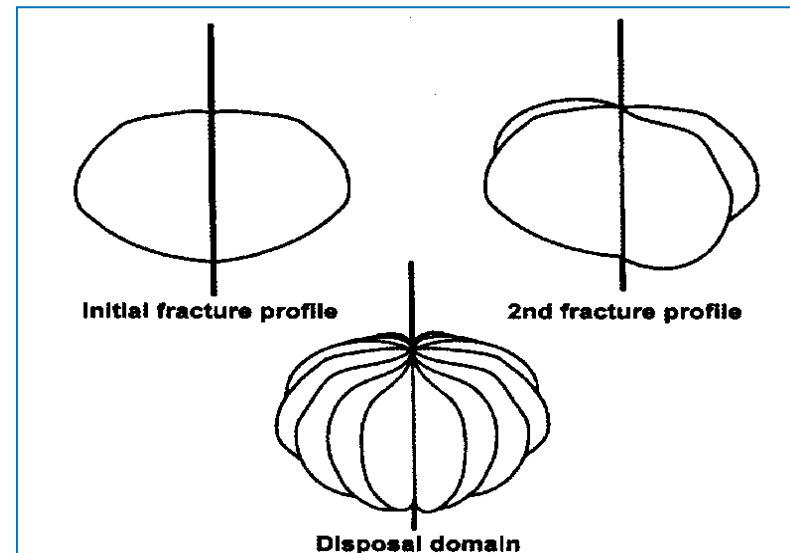
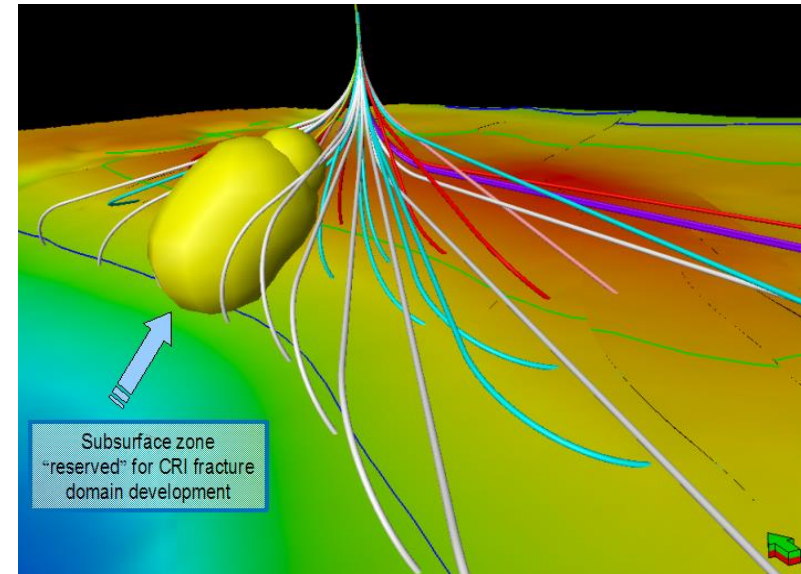
- Drilled cuttings collection during hole-making for a subsequent casing;
- Rock grinding to 300 µm;
- Separation;
- Provision of required flow properties to drilled cuttings (density, viscosity, solids suspension);
- Drilling cuttings transportation by high-pressure pumps;
- Over-pressurization for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

Cuttings preparation and reinjection package



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 m³) 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 Lunskeye (ШОМ 13802 ЗЭ, 2006) and Piltun-Astokhskoye (ШОМ 14370 ЗЭ, ШОМ 14118 ЗЭ 2007) fields;
- According to the RF legislation, Sakhalin Energy drilling cuttings disposal facilities are registered with SRWDS; and
- Waste Management license obtained.

Утверждена
постановлением Правительства
Российской Федерации
от 16 августа 2013 г. №8712

УТВЕРЖДАЮ
Начальник Управления по взаимодействию
с государственными органами власти и контролю
Филиала компании «Сакхалин Энерджи»
Инвестмент Компани Лтд»
С.Г. Литвинов
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2014 г.

М.П.

ПАСПОРТ ОТХОДОВ I-IV КЛАССОВ ОПАСНОСТИ

составлен на **2 91 100 00 00 0**
Отходы при бурении, связанном с добычей сырой нефти, природного (попутного)
газа и газового конденсата / Бурильные отходы и попутные воды, размещаемые в
глубоких горизонтах недр

(указывается вид отходов, код и наименование по федеральному классификационному каталогу отходов)

образованный в процессе деятельности индивидуального предпринимателя или юридического лица
в результате бурения скважины, выбуривания породы путем разрушения горных пород и
выноса их на поверхность из створа скважины
(указывается наименование технологического процесса, в результате которого образован отход, или процесса, в результате которого
отход (продукция) утратил свои потребительские свойства, с указанием наименования исходного товара)

состоящий из Вода - 46,88%; Нефтепродукты (суммарно, кроме бензина) - 6,6%; Эфиромасляные соединения
(масла, жиры) - 6,4%; Соли - 0,9%; Танины - 0,07%; SiO₂ - 0,2%; Серы - 0,14%; Фосфор -
0,014%; Na₂O - 2,828%; MgO - 0,707%; Al₂O₃ - 4,121%; SiO₂ - 22,141%; P₂O₅ - 0,048%; S общая -
0,517%; Cl общая - 2,141%; K₂O - 1,311%; CaO - 1,455%; Se - 0,0004%; TiO₂ - 0,234%; V - 0,004%;
Cr - 0,0003%; MnO - 0,025%; Ni - 0,0016%; Cu - 0,0025%; Zn - 0,0044%; Ga - 0,00007%; As - 0,0002%; Rb -
0,0001%; Sr - 0,022%; Y - 0,00005%; Zr - 0,0044%; Hg - 1,253%; W - 0,004%; Fe₂O₃ - 1,293%; Co -
0,0004%; Pb - 0,0008%;
(химический и (или) компонентный состав отходов, в процентах)

СУЩЕСТВИИ
в определенной системе и физической форме: твердой, жидкой, пылеобразной, пастообразной, газообразной, сыпучей, вязкой, густой,
переземлемой, пылеобразной, жидкой, густой, вязкой, потерявшие свои потребительские свойства, или - указать другое

имеющий **4** **четвертый** класс опасности по степени негативного воздействия
(класс опасности) (примечание) на окружающую среду



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 of 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.



Главному исполнительному директору
«Сахалин Энерджи Инвестмент Компани, Лтд»

Р.Ю. Дашкову



О наилучших доступных технологиях

Уважаемый Роман Юрьевич!

В соответствии с Постановлением Правительства Российской Федерации от 23 декабря 2014 № 1458 «О порядке определения технологии в качестве наилучшей доступной технологии, а также разработки, актуализации и опубликования информационно-технических справочников по наилучшим доступным технологиям» Федеральное агентство по техническому регулированию и метрологии определено федеральным органом исполнительной власти, осуществляющим определение технологических процессов, оборудования, технических способов, методов и технологий для конкретной области

ора информации о применяемых на вашем процессах, оборудовании, источниках ских, технических и организационных ; снижении загрязнения ОС и повышения сбережения, необходимой для разработки гь в наш адрес до 20 февраля 2015

3.

Е. В. Ногин



Thank you for your attention!

Any questions?

