



Sakhalin Energy Investment Company Ltd.

Project Alternatives

Liquefied Natural Gas Plant / Oil Export Terminal Site Selection Report

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1 PROPOSED LOCATION

Sakhalin Energy Investment Company (Sakhalin Energy) will construct a liquefied natural gas plant and associated export facilities, as well as an oil export terminal (OET) at Prigorodnoye, on the south coast of Sakhalin Island in the Aniva bay area. This location is 13 kilometres (km) east of Korsakov, which is a port 53 km south of the administrative centre of the Sakhalin region, Yuzhno-Sakhalinsk.

2 ALTERNATIVE DESIGN APPROACHES

Sakhalin Energy considered a number of options for the processing and export of hydrocarbons produced at the Piltun-Astokhskoye and Lunskeye oil and gas fields.

There are two principal ways of transporting natural gas in large volumes. These are by pipeline in its natural state as a gas, and as a liquid. To liquefy natural gas it must be cooled to very low temperatures – this is the function of a liquefied natural gas (LNG) plant. LNG has the advantage that, when cooled and converted to a liquid, its liquid form it reduces in volume 600 times, and is thus convenient to store and to transport, so long as it remains cold.

For the Sakhalin II project, liquefaction in an LNG plant was considered preferable to pipeline gas for several reasons, including the transport aspect. Also, gas markets in the Asia region – the natural market for Sakhalin gas – are already adapted to take LNG. Indeed, Japan and Korea are the world's biggest markets for LNG. Another consideration in the choice of LNG was the cost of developing the Lunskeye field, which is a very large gas field, and the associated infrastructure. The high cost of developing the field and infrastructure means that a rapid build-up and sales of gas production from the field is to enable Sakhalin Energy to recover its investment more quickly than if production was developed slowly. Sakhalin Energy believes that this rapid build-up is best achieved by selling LNG, which can be delivered to several buyers and in different countries at the same time. Unlike pipeline gas, where a pipeline is fixed between the point of production or processing, and the customer, LNG can be delivered by tanker to several markets, so it is more flexible. Pipeline gas sales build up would be much slower and therefore uneconomic.

It has also been suggested that Sakhalin Energy should consider using DiMethylEther (DME) technology, another technology developed to convert gas to liquids, instead of LNG. Sakhalin Energy commissioned a comparison of LNG technology with DME and this report is available on our public website (www.sakhalinenergy.com). In summary, the report concluded that there are clear advantages to LNG. DME technology has not been commercially developed, whereas LNG technology has been proven to operate successfully over several decades and



is the gas liquids technology of choice in the Asia region – Sakhalin Energy’s natural market. LNG is a more energy efficient fuel than DME, and requires less capital expenditure to produce the same amount of energy. The LNG production process also produces less CO₂ than the DME manufacturing process.

3 FACTORS IN CHOICE OF LOCATION

A number of options were investigated with regard to the proposed site for the LNG plant, oil and LNG storage and export facilities at the time of the 1992 feasibility study for the Sakhalin II Project.

Nine port locations around Sakhalin Island were evaluated as potential terminal sites for the LNG plant/OET. These were: Tomari, Ulegorsk, Poronaisk, Ilyinsky, Kholmsk, Nevelsk, Korsakov, De Kastri and Prigorodnoye.

Given the need for Sakhalin Energy to guarantee year-round supplies of LNG to market, it was decided to select if possible a site in the south of the island where ice conditions are less severe than in the north.

The suitability of each of these sites was assessed against technical, operational and economic criteria. The technical considerations included water depth, ice problems, wind and wave conditions, seismic faults, safety, space, and shipping requirements.

Some or all of these considerations were considered to be unacceptable problems at seven of the nine locations. For instance, one of the criteria was the ability to safely bring tankers and LNG carriers in to the harbour loading points on a year-round basis. The criterion was that the ice conditions had to meet a minimum standard under which we could safely operate 12 months of the year. The fact that there has been a record of heavy sea ice at the ports of Poronaisk and Ulegorsk in winter, made them unacceptable. Similarly, winds were considered an unacceptable problem at the unsheltered ports of Ilyinsky, Kholmsk and Nevelsk. For example, an offshore facility at Ilyinsky would experience gale force winds ten times a month for almost three months during the winter. These conditions would seriously affect the loading of oil and LNG and create serious ship-handling and mooring problems and with it safety risks.

Evaluation of seismic data for Sakhalin Island also disclosed potential problems for some prospective port sites. Seismic activity is a potential problem throughout Sakhalin, and is one of the key design considerations of all components of the Phase 2 Project, but it is of special concern at Ulegorsk, Ilyinsky, Tomari, Kholmsk, Nevelsk and Korsakov. Although



Prigorodnoye is not far from a minor seismic fault, the risk can be safely handled by design and by siting beyond the 5-7 km buffer zone.

In terms of available space, the only port options with acceptable space were Prigorodnoye and De Kastri. At other sites, developments would result in crowded facilities and would compromise seismic precautions and raise safety considerations.

The south-eastern coast was considered but rejected because of the risk of ice in winter.

A potential site – Ilyinsky – was initially identified as suitable on the south-western coast of Sakhalin Island but rejected as weather conditions are less favourable on the western coast than in the south. Technically it would have been possible to use Ilyinsky, but Sakhalin Energy would have needed to construct a breakwater to do so. We considered the additional environmental impacts of building a breakwater. Given the goal to minimize the environmental footprint of our operations on the landscape, we considered it was more desirable to avoid the physical disturbance of building a breakwater if possible.

Of the nine site options, only Prigorodnoye and De Kastri emerged as acceptable options. The ice conditions at De Kastri, a northerly port, are far more severe than at Prigorodnoye, which is relatively ice-free in the winter months. Thus Prigorodnoye is a more attractive option than De Kastri. Prigorodnoye and was chosen as the optimal site. (If conditions of ice do occur at Prigorodnoye in the winter months, oil will be shipped using only double-hulled tankers.)

The proposed site at Prigorodnoye was selected for several other reasons:

1. It was close (13 km) to the urban centre of Korsakov, but sufficiently far removed to minimise disturbance.

There are potential benefits related to the proximity to Korsakov which fit with Sakhalin Energy's commitment to maximizing employment opportunities for local people and businesses from the Project:

Access to local support services;

Opportunities for work for local people that would not require them to move away from their homes as well as related prospects for potential expansion of or services from Korsakov port.



Note that the port itself will not be used to import and unload equipment. Instead, a purpose-built temporary facility will be constructed at the LNG site. The reasons for this are:

Development and use of Korsakov port would necessitate either the construction of a bypass road around the town (costly and invasive) or heavy vehicle traffic through the town;

Even if Korsakov were used, a special facility would have to be built anyway to handle very large items.

2. The bay is sheltered, allowing good control of vessels and thus minimising the risk of an accident.
3. Although there are several natural bays along this coast with similar facilities, the proposed site lies within a natural valley. Only six farms were located on the site, so disruption in terms of resettlement is minimal. The proposed site lies within a natural hollow such that the LNG plant will not be dominantly visible even from most of the dachas near the site.

4 ABOUT THE SITE

The site is on a plain that slopes gently down to the shore. This land is currently categorised as forestry area. There is some salmon fishing in the nearby Mereya river. The site is in relatively sheltered water with a benign climate for wind and waves. No breakwater and minor shore protection is required. Deep water (15.0 m) is found at close distance (1500 m). No significant dredging works are required.

The area of the plot of land identified for development of the LNG and OET facilities (477.1 ha) is generally natural agricultural land of low productivity. The majority of this land (331.4 ha) was previously used by

- Korsakovsky state farm. In addition, other areas inside the plot of land are:
- Farmer's plot (Katsubo, total area 25.0 ha);
- Land of Ozerskoye settlement Administration (16.0 ha);
- General purpose road lands (9.9 ha - roads Korsakov – Ozerskoye, Prigorodnoye – Novoye);
- State Forest Stock (3.0 ha), frontier guard station (0.3 ha);
- Land of Korsakov Administration (4.0 ha);



- Land of Goszemzapasa (State Land Reserve) (96.6 ha);
- Military land.

By March 2003 households from the five seasonally and year-round occupied farms had been resettled. They were compensated in line with Russian regulatory requirements. In addition, supplemental assistance was provided to all of these households in accordance with Sakhalin Energy's supplemental assistance programme. This programme was developed to address gaps between Russian regulatory compensation and international standards, such as those of the World Bank Group. One farm located just west of the site, but in the safety zone will be resettled in Q2 2003. The public road which currently runs just north of the shoreline will be re-routed so that it runs behind the site.

Several factors played a role in determining the proposed location of the LNG plant and OET at the Prigorodnoye site. Survey work conducted by Sakhalin Energy identified examples of the Glen Spruce, a Russian Federation Red Book (listed) species at two locations at the west and northwest of the site. The oil and gas pipeline leading to the LNG plant/OET will be routed to avoid these places. No other activities are planned in this area.

Survey work also identified two archaeological sites of interest: a small, disused army camp along the south bank of the river Tikhaja, close to the river Mereya, west of the proposed detour road. The oil and gas pipeline has been routed in such a way to avoid the site, and a fence will be erected around the site for its protection. The second site, a concrete Japanese school pavilion, has been removed from the site, restored and is now on public display at the Sakhalin Regional Museum in Yuzhno-Sakhalinsk.

Neither the LNG/OET facilities nor the safety (exclusion) zone around them will encroach on the settlement of dachas (summer houses) that lies adjacent to the site on and behind a hill rising to the west. A safety zone of 0.5 km has been established for the LNG/OET facilities by the Russian regulatory authorities. This means that use of the dachas will not be affected by the LNG/OET facilities.