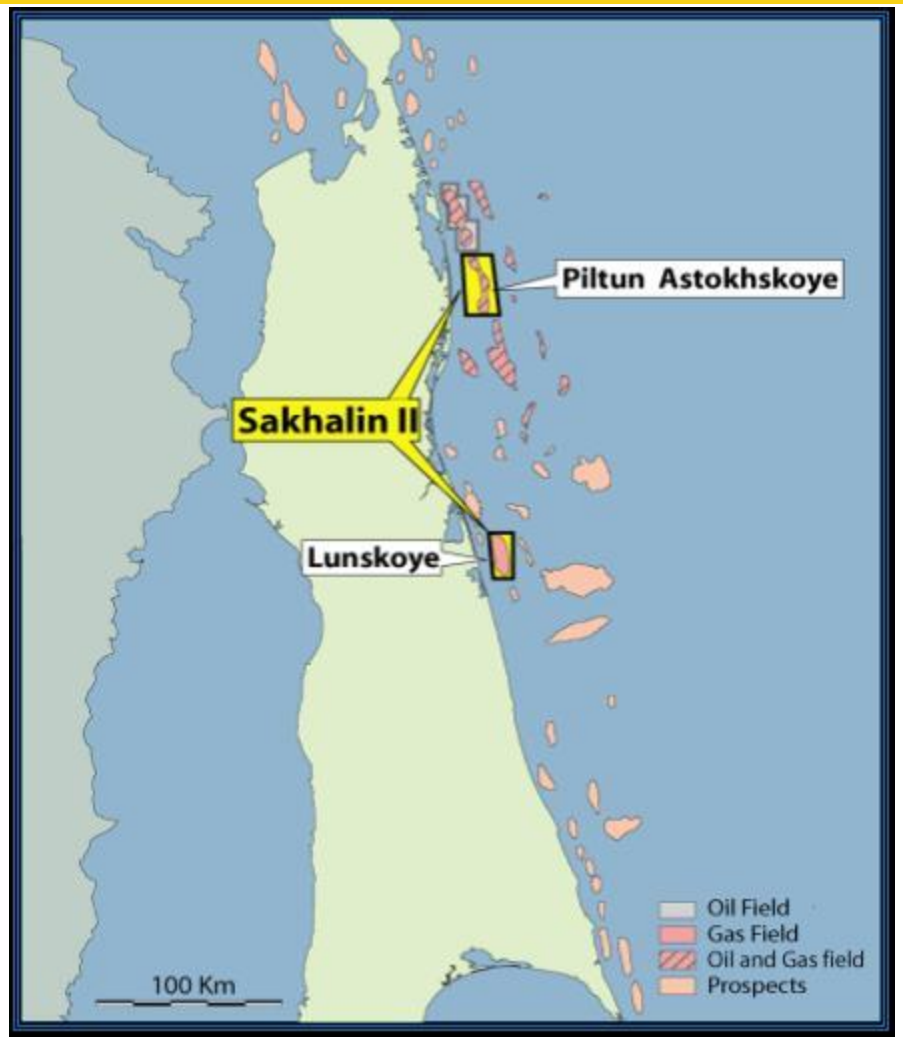
OIL EXPLORATION AND PRODUCTION OFFSHORE SAKHALIN ISLAND

ICE MANAGEMENT AND MARINE OPERATIONS

IAN REED – PRINCIPAL ARCTIC MARINE FACILITIES ADVISOR

THE ASSETS: A HUGE RESOURCE



Sakhalin II oil reserves equate to more than one year of current Russian crude oil exports (2.5 million barrels per day).

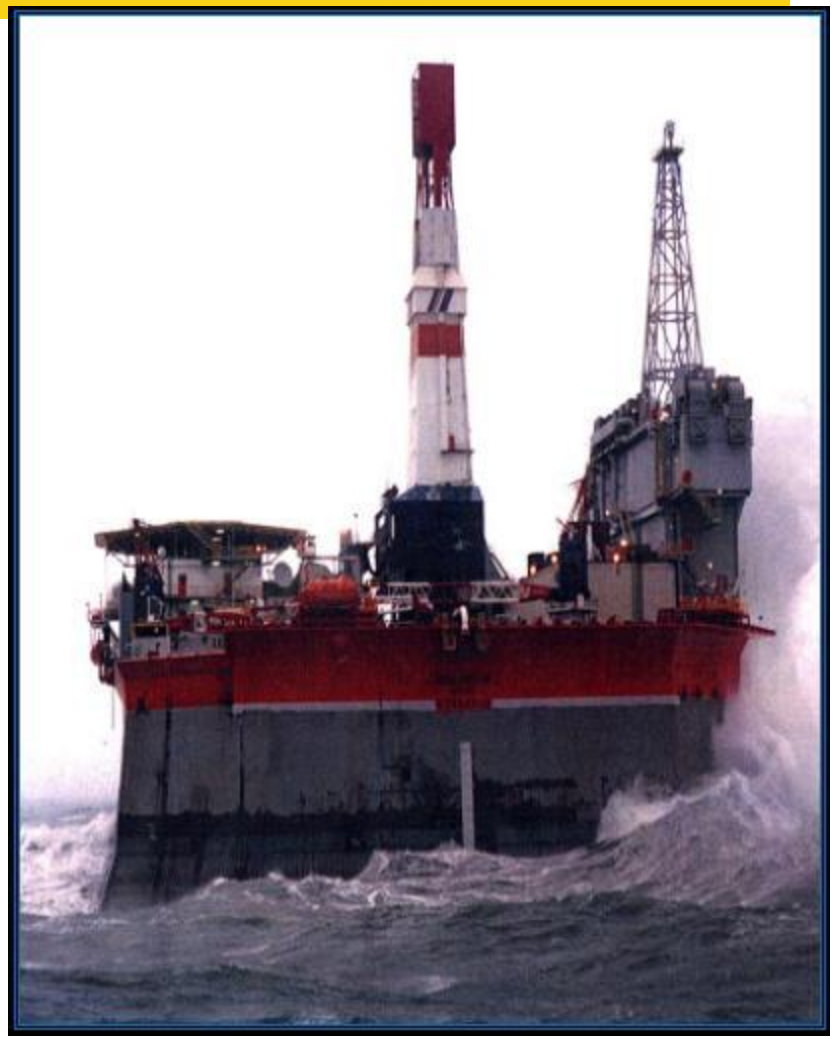
Sakhalin II gas reserves represent nearly five years of Russian gas exports to Europe, enough to supply current global LNG demand for four years.

SAKHALIN ISLAND

- Remote.
- Lack of infrastructure.
- Low population density – 600,000 people.
- Seismically active area.
- Rich onshore and offshore wildlife.
- Territory: 87,100 km^2
- Length: 948 km.
- Min. width: 30km.
- Mountain areas 66%.
- Regional center: Yuzhno-Sakhalinsk.

SAKHALIN CLIMATE – EXTREME WEATHER

- Temperatures range from +25 to –35 degrees.
- Offshore ice from December till June.
- Waves up to 10 metres significant.
- Temperature offshore can drop to –70 degrees with wind chill.
- Frequent fog in spring and summer.
- Earthquake zone.



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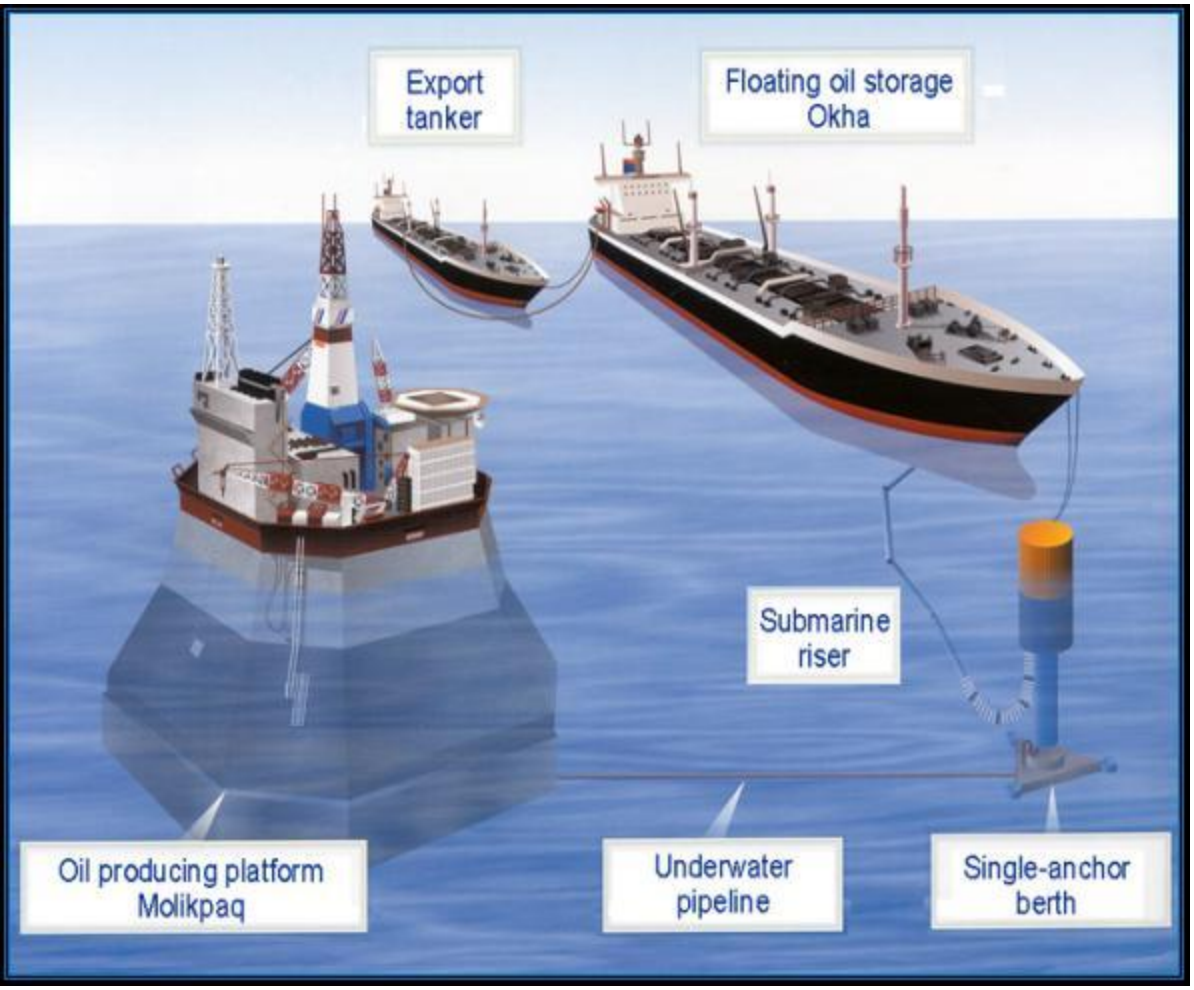
PHASE 1

Vityaz Complex



- First offshore oil production in Russia, July 1999.
- From 1999 seasonal oil production: six months/year but started year round in September 2008
- Output up to 92,000 barrels/day (11,000 tonnes/day).
- World class safety and environmental performance.

MOLIKPAQ PLATFORM

Converted drilling rig first used in the Canadian Arctic.

Means ‘big wave’ in the Inuit language.

Molikpaq is 120 metres wide, weighs 37,523 tonnes and it is ballasted down with 278,000 cubic meters of sand.

FSO AND SALM

FSO Okha was ice classed D0 with ABS and was especially modified for Sakhalin conditions. It had a large hose reel on the stern to keep the export hose out of the water. It had an “Ï” tube running from the keel to the focsle which was trace heated to allow the import hose to remain clear of ice

OFFSHORE SUPPORT AND SUPPLY

Offshore platforms require continuous supply of equipment and marine cover.

It is achieved by the use of ice class Pacific supply boats.

Standby boats Smit Sakhalin and Smit Sibu carry ice notation Lloyds 1A super, Canadian Arctic Class 4.

They performed year round standby and oil response duties at the platforms, one at the Northern two fields and one at Lunskoye.

OFFSHORE SUPPORT AND SUPPLY

In order to keep this project operating throughout the year special ice class platform supply boats were built.

Currently they are on continuous supply runs

Two further vessels are acting as standby for the offshore platforms with this increasing to three in the Winter months

OFFSHORE SUPPORT AND SUPPLY

The ice class DNV Ice-10 Platform Supply Vessels purpose built for Sakhalin II project are :

- Pacific Endeavour
- Pacific Endurance
- Pacific Enterprise

The vessels are designed to achieve a constant speed of 1.5 knots in 1.5 meters thick first year ice. They are also capable of breaking ice and making sternway in 4 m polar ice pack. Being equipped with high power Aquamasters they can turn 180 degrees in less than 90 seconds as well as clear an escort channel 70 meters wide in 0.5 meters first year ice.

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PHASE II

OFFSHORE PLATFORMS

Lunskoye - A

- Gas production 1800 mmscf/d
- Possible oil rim
- 30 well slots
- 4 leg concrete gravity base
- Topsides 22,000 tonne
- Installed August 2006

OFFSHORE PLATFORMS

Piltun-Astokhskoye-B

- Oil production 70,000 b/d
- Gas production 92 mmscf/d
- 45 well slots
- 4 leg concrete gravity base.
- Topsides 28,000 tonne
- Installed June 2007

PRIGORODNOYE LNG PLANT AND EXPORT TERMINAL

- First LNG plant in Russia
- Built on a 490 hectare site at Prigorodnoye on Aniva Bay
- LNG plant receives, treats, processes and liquefies gas from the Lunskoye field and associated gas from the Piltun-Astokhskoye field.
- OET supports the storage and export of 170,000 barrels of crude oil per day, along with 5,000 barrels per day of condensate from the LNG facility.

PRIGORODNOYE HARBOUR TUGS

Operations in Prigorodnoye require support of the harbour tugs. Sakhalin Energy operates four purpose built ice class 1A tugs equipped with Aquamaster propulsion system (Z drive).

The tugs are designed to operate in up to 80 cm of level ice.

The four harbour tugs are designed for escort work in ice and meet tankers at the ice edge where necessary.

A minimum of three tugs are used for berthing.

LNG TANKERS FOR SAKHALIN PROJECT

The 145 000 m^3 LNG carrier Grand Elena shown here is an Ice Class 1C vessel purpose built for the project. It is one of 5 purpose built vessels for the project.

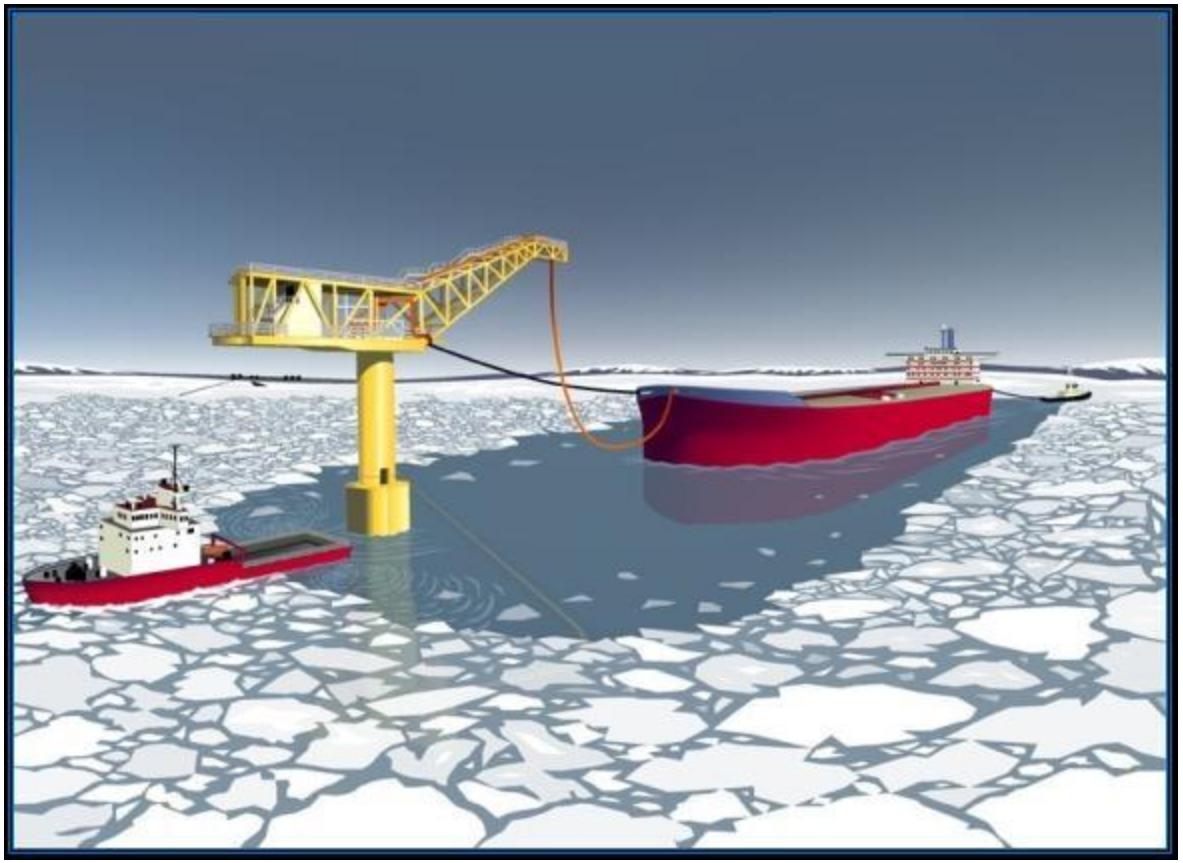
To increase the safety of navigation an additional escort ice breaker will be deployed during winter months to assist vessels in safe passage through Aniva Bay.

OIL EXPORT TERMINAL AND TLU

Oil export from Prigorodnoye is via a Tanker Loading Unit (TLU). Suezmax size vessels load a full cargo every two to three days.

There is a tie back tug used for each vessel berthing at the TLU for the duration of her stay.

TLU OPERATIONS IN ICE



The export tanker moors up to the TLU and an ice breaker tug fitted with the Aquamaster propulsion system positions itself updrift from the TLU.

By spreading the Aquamasters at approximately 80 deg.

the tug maintains position and the propeller wash creates a wide swath of open water, the technique has been used and proven in Vityaz operations.

NEW CONCEPT IN ICE BREAKING AND ICE MANAGEMENT

Ice breaking and ice management techniques have changed in the last few years. This was possible due to mainly azimuth type propulsion systems being installed on the new generation ice breakers. The vessels are equipped with the Aquamaster type thrusters which provide exceptional maneuverability and station keeping. The powerful propeller wash, which is achievable in all directions breaks up the ice with ease. The captains have gone through an extensive training in maneuvering and handling of ships fitted with the Z drive systems in Europe and in Russia as the handling of this type of propulsion system is as different from the conventional type as is flying an airplane from flying a helicopter.

AQUAMASTER PROPULSION SYSTEM

The Aquamaster propulsion systems installed on the vessels are of two types:

1- the CP propellers with constant speed as installed on the harbour tugs and

2 - fixed pitch propellers with variable speed as installed on the PSVs. Both designs can achieve maximum power and thrust in all directions.

BREAKING ICE USING AQUAMASTERS

Harbour tug Svitzer Aniva breaking ice at the LNG jetty at the Prigorodnoye Export Terminal.

The tug is using Aquamasters to break up and wash ice away, a very effective technique to clear space for the LNG carriers in the turning circle and at the jetty.

OIL TANKERS FOR SAKHALIN PROJECT

Oil tankers loading at Prigorodnoye during winter months are ice class 1C and fitted with the special bow loading arrangements designed by Pusnes to keep the loading hose clear of ice.

Shown on the photo is the M/T Governor Farkhutdinov, an Aframax size crude oil tanker of approximately 108 000 DWT.

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HOW SEIC OPERATED

Vityaz Complex successfully operated in ice 1999 - 2008

With the help of an Ice Management Team crude oil production and exports continued until ice reached 30 cm of thickness or was no longer manageable. The platform supply vessels were utilized for ice management duty. Equipped with Aquamasters the boats could keep station while providing open water work environment for the FSO and the SALM laydown operations by angling out the Aquamasters, using high power and blasting the ice away. For this to be effective the ice had to be pre-broken.

OSRV IN VITYAZ

To be prepared for an unlikely event of pollution Sakhalin Energy deployed an OSR vessel IRBIS. This vessel also carried an ice class and operated and provided support in the first month of ice formation as well as in the last few weeks of ice season. This restriction was due to her relatively low power. During the periods when she was not on site the two standby vessels were equipped with full winterized OSR package.

END OF SEASON OPERATIONS

The vessels engaged in the SALM laydown were normally supported by an ice breaker from the FESCO fleet.

The ice breakers provided long range ice scouting as well as close range ice breaking and protection support.

START OF SEASON

Production has taken place with significant amounts of ice still in the Sea of Okhotsk outside of the work site, all of which could potentially harm the SALM and tanker if proper control and management were not to be exercised.

The start of season is fundamentally different to the end of season due to the thickness of the ice encountered which can damage subsea components of the SALM system meaning better protection is required.

Assets used are normally:

- Smit Sakhalin to raise the buoy
- A Pacific boat for close in ice protection work
- An icebreaker for scouting and nearby ice breaking work.

STAMUKHA

START OF SEASON

Ice breaker Krasin was normally required at the start of season operations to provide protection from very heavy ice migrating from the Sakhalin Bay and the northern parts of the Okhotsk Sea.

She had 36 000 HP and was not too maneuverable so was used for heavy ice breaking work well updrift of the work site.

VITYAZ COMPLEX EXPORTS OIL IN ICE

Oil export operations were possible well into the ice season when full Ice Management was in place. This was the first and only ice management operation of this type in the world with 100% success rate.


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