

Sakhalin project provides valuable lessons

By JL Thorogood, TW Hogg, AG Kalshikov, CJSC Elvary Neftegaz, BP

AN EXPLORATION WELL drilled by a joint venture between Rosneft and BP in summer 2004 was the first success after a long period of no exploration activity and represented a step out into a new and untested exploration play.

Wells in Sakhalin involve a 7-month permitting cycle and a logistical supply chain that extends 3,500 miles to Singapore. The sea ice-free weather window lasts from late June to mid-November. Environmental restrictions stipulate that all mud and cuttings from below the 30-in. conductor, even though the well may be drilled with a water-based mud, must be recovered for disposal.

The team overcame a wide range of organisational, logistical, regulatory, environmental and technical challenges to drill the well in summer 2004. The lessons learned were consolidated and formed the basis for a successful season in 2005 with a different rig.

INTRODUCTION

Oil has been produced from Sakhalin since the 1920s. The northern town of Okha is built around an oilfield dating from the earliest days. Offshore exploration was carried out in the 1970s and 1980s, leading to the discovery of the major fields being developed by the Sakhalin 1 and Sakhalin 2 Production Sharing Agreements.

When the first members of the project team arrived in Sakhalin in August 2003, other operators advised that there was a very low chance of being able to organise and drill a well, starting from scratch, in less than 12 months.

BP is a 49% shareholder in a joint venture with Rosneft, the Russian state oil company. The operations base is located in Yuzhno-Sakhalinsk in southern Sakhalin. It is 8,000 km and 10 time zones from London and a 9-hour flight from Moscow. Operations take place offshore at the extreme north end of the island, about 500 miles from the base office.

The main logistics base at Moskalvo is only accessible from early June to early November. The drilling location is clear of ice only in late June. Storms begin in



Ann Smith photo

The Sedco 600, seen here preparing for a basket transfer during a storm, had been cold-stacked for a year before the 2004 Sakhalin operations and required modifications before startup.

September and remain intense through the winter.

THE ORGANISATION

Rosneft personnel contribute their understanding of operations in Russia while the BP heritage staff brings technical knowledge of safe operations in remote harsh environments.

The project team is responsible for executing the entire scope of the activity, including well engineering, operations supervision, aviation, logistics, shore base, incident management, blowout contingency planning, health, safety and environmental compliance, cuttings disposal, permitting, IT systems and telecommunications.

Few members of the project team knew each other. The industrial climate in September 2003, after a round of lay-offs and repatriations, made some key posts impossible to fill satisfactorily, adding to the team's workload.

PROJECT SCHEDULE

Given the scale of the undertaking and the late start, it was clear in retrospect that the 2004 exploration project was run to an extremely demanding schedule.

Uncertainties and unknowns plagued the early part of the project.

Planning and contracting became predictable once the joint venture was clearly defined and a budget approved. This took place about 4 months before the well commenced.

REGULATORY ENVIRONMENT

Russian regulations are extensive and complex. The permitting cycle takes 7 months and requires lengthy calculations to estimate discharges. Fees are assessed on the planned level of discharges and penalties levied for exceedance. Panels of reviewers are appointed by state bodies with oversight on environment, natural resources and industrial safety. Their task is to review the applications critically. Small questions can and do cause significant delays to the granting of permits.

Individuals in positions of responsibility for the operation have to be formally trained in the Russian Safety Legislation. Training runs for 3 days, ending with a written test and an interview. A license is renewable every 3 years. To assist compliance, a substantial effort had to be organised to train and examine

key crew members during the mobilisation phase in Singapore.

The precise method of importation of the rig was heavily researched because of the different ways that the rig could be presented to the authorities and the significant difference in customs duties that might ensue. In 2004 there was debate on the precise application of Russian Tax Legislation in relation to the "Value Added Tax" applicable to well construction operations in international waters.

Customs regarded the rig as part of Russian territory, but border guards regarded the rig as an "international" destination. Since the local airport was not an international gateway, helicopter flights were prohibited without special permission from Moscow. This problem wasn't discovered until late, and obtaining consent required intervention at the highest levels.

ENVIRONMENTAL CONDITIONS

There is extreme sensitivity to environmental issues in Sakhalin. Active non-governmental organisations monitor compliance with regulations for protec-

tion of the environment. Permitting of each well requires development of a full environmental and social impact assessment, which must be approved at local and federal levels before being subject to independent review in Moscow.

The wellsite is monitored by an independent contractor for compliance with discharge approvals.

Environmental regulations prohibits the discharge of any cuttings to sea in the Russian Federation once the conductor has been set. Especially in Sakhalin, the health of the local fisheries and protection of the Western Pacific Grey Whale population are paramount.

Mud and cuttings are returned to the rig by attaching the marine riser directly to the wellhead with a pin connector. With this arrangement, the only protection against shallow gas blowouts is the rig's diverter system. This practice was the cause of serious incidents in the 1980s. To conduct an operation with a pin connector requires a dispensation from company operations policy. Under the terms of the dispensation, it is necessary to drill a pilot hole to 20-in. casing depth to prove absence of shallow gas before com-

mencing the well itself. Cuttings have to be skipped and shipped to shore.

The area first becomes clear of ice in early May, but there are unpredictable instances of drifting pack-ice until mid-to late June. Severe storms and rapidly decreasing temperatures in the autumn result in a very clear cut-off date in mid-October for un-winterised drilling units.

THE RIG

The rig used in 2004, **Transocean Inc's** semisubmersible Sedco 600, had been coldstacked for a year. Modifications were necessary to ensure adequate lifeboat capacity. The ballast system was upgraded to meet standards of the Joint Venture, and wind walls were erected round the drill floor and monkey board. The rig startup followed a thorough pre-contract audit. Audit findings were lengthy and required detailed planning to accommodate in the shipyard re-activation programme.

High surface currents are a feature of the location. They hampered operation of the Russian supply vessels. Although thought to be simply a problem associated with deepwater operations, analysis

pointed to vortex-induced vibration in the marine riser with a high probability of fatigue failure unless preventive measures were taken. A special task force made up of staff from the Joint Venture, rig management, consultants and contractor engineering personnel met in Singapore and worked the problem at short notice. They proposed to wrap the riser with 4-in. diameter mooring line to suppress damaging vortices. The recommendations were implemented and a real-time monitoring system attached to the riser for the duration of the operation to verify the performance predictions.

Dramatic vibration was observed in 20-in. casing running string. In 2005, with more planning time, the riser was fitted with custom-designed strakes and the monitoring procedures repeated.

It was initially suggested by organisations on the island that importation of the rig involved a lengthy and expensive process. However, a recent change to the regulations enabled the rig to be imported, complete with all installed equipment, and approved as a single unit.

Two key documents are required before a rig can operate in Russian waters: the Industrial Safety Declaration and the Permit to Use. The former is akin to the Safety Case. Obtaining the Permit to Use requires a technical inspection of the rig and testing of critical components and a review of key technical documentation.

The rig employed in 2005, the Transocean Legend, was mobilised from Brazil after a period in cold stack. Following a detailed audit, extensive work on all rig systems was required in Singapore prior to acceptance. Some of the work continued through the tow northwards and was completed just before deployment on location.

OPERATIONAL HEALTH, SAFETY

During both seasons, focus was placed on crew competence and training. Attention was paid to the re-activation of the Contractor's Safety Management System and a gap analysis carried out against the Joint Venture standards.

The drilling contractor held safety leadership workshops for the crews in Singapore. Company drilling supervisors were in place on the rig throughout the shipyard re-activation and upgrade project. They remained on the rig during the tow northwards and used the time to ensure that the critical elements of BP's Eight Golden Rules of Safety, lifting operations

and permit to work, were fully embedded in the way that the crew worked.

In addition to maintaining a regular review of high-level project risks, a series of major risk assessments were carried out in targeted areas:

- Well-specific risk assessment to identify technical hazards;
- Offshore operations risk assessment to identify hazards involved in the operations on location and on the ware barge;

- Onshore operations risk assessment to identify risks associated with shore base and cuttings pit operations;

- Team health risk assessment to verify that the working conditions for the project team were fully evaluated;

- Hazard and operability review of the well testing system;

- Risk assessment of the shallow gas emergency procedures.

A specialist consultancy reviewed the safety culture on-board the rig. A Journey Management study was conducted to ensure that the risks associated with long crew change travel times were assessed and addressed.

Critical safety-related areas — such as aviation, both fixed and rotary wing, marine operations, driving and lifting activities — were subject to assessment and approval by specialist teams.

Workplace safety at the cuttings pit was a major concern, and the services contractor prepared written procedures for all activities. Once the equipment was set up on site, crews walked through the procedures before a final walk-through by the management team. At this point the pit site was declared operational.

The project team was responsible for providing first-line response to all incidents. An Incident Management Team was set up and trained. In addition to all the normal contingency plans, authorities required a full blowout contingency plan and a contract for emergency support from a major well control organisation.

During 2004 the team was heavily stressed as a result of the late start and limited resources, resulting in a demanding schedule. Although the work was done and a safe result achieved, the organisational model was clearly unsustainable. Immediate steps were taken to re-constitute the team on a rotational basis as soon as it was clear that there were to be further operations in 2005.

REMOTE AREA LOGISTICS

Crew changes involved flying people from the UK, US, Australia and Indonesia to Yuzhno-Sakhalinsk and then by charter to Okha. A formal Journey Management study emphasised the need for proper overnight rest for the crews prior to commencing work offshore. This was achieved by scheduling boat journeys at night or accommodating crews in a hotel overnight before flying them to the rig.

In the 2004 season, resolution of the issue of the border guards and the international status of the local airport was completed late in the operation. As a result, a dedicated crew change vessel was chartered at short notice from Japan. Crew changes for the majority of the well were carried out by boat from

the port of Moskalvo with Billy Pugh basket transfer. The required permits were obtained in good time in 2005. However, a significant number of crew changes still was required due to extensive sea fog in the area in early summer.

Apart from being 500 miles north of the main operations office, the island is 3,500 miles from Singapore. One-way mobilisation of the rig to location, including customs clearance and inspections, requires at least 35 days. All equipment already on the island were committed to other operators. Because of the taxation implications, none of this equipment was accessible to the Joint Venture operation, even in emergencies. All equipment for the well had to be mobilised from Singapore, including 320 drill cuttings bins for the skip and ship operation.

Shipment of the equipment from Singapore to location was accomplished using a ware barge.

The port of Moskalvo, on the Northwest side of the island, 12 hours sailing from the location was the focus of the skip and ship operation. Nearly derelict, it was being used for the export of large amounts of scrap steel to China. The

Joint Venture established a small base for handling the cuttings bins, stacking casing and other items. There was no water or fuel at the base. In 2005 the ware barge was not available. An additional supply vessel was chartered instead. All the pre-mixed brine was prepared in Singapore and shipped up in the rig and vessels.

Despite the complexity of the logistical operation, neither in 2004 nor 2005 was there any downtime on the rig waiting for supplies or missing equipment.

SKIP AND SHIP

An environmental and social impact assessment for a well won't be approved without prior approval of plans for disposal of the drill cuttings. There was a choice between land farming and burial in pits. Eventually, the latter course was chosen.

The pits were excavated and lined and sealed under specialist supervision. Eight shallow wells were drilled around the site to monitor for possible ground-water contamination.

To determine the number of cuttings bins, account was taken of the length and

size of hole section, rate at which skips could be filled and handled by the rig cranes (6/hour), number of bins per vessel (80), the sailing time to the port (12 hours) and the round trip time for truck convoys onshore (4 hours).

Five hundred bins were fabricated on short notice. They were shipped from the rig, unloaded from the boats at the shore base and onto trucks for transport in 8-vehicle convoys 32 km to the pit site. In 2005 the number was reduced to 250 because it proved possible to ship whole mud ashore in supply boat tanks.

Environmental and governmental regulations limited the choice of drilling fluid chemicals. Oil-based drilling fluids are currently not allowed from floating drilling units. A KCl polymer mud was chosen.

This was the first occasion that a 26-in. surface hole section had been contained, and it alone accounted for 35% of the total volume. Each cuttings skip had a full capacity of 3.5 cubic meters. The estimate of the number of skips was based on filling to between 75% and 80%. The mud on cuttings value was projected at 65% cuttings and 35% drilling fluids to mud. Comparing actual volumes with the prediction suggests that the number of skips used was considerably less in the upper hole sections. This is attributed to losses along with dispersal of mudstones into the drilling fluid. Some whole mud was transferred to a supply vessel, pumped into cuttings bins at the quayside and mixed with cement before being discharged into the waste pit. The 12 ¼-in. section incurred more clean-up than the previous sections.

THE OUTCOME

The 2004 well was a rank wildcat. It was the first to be drilled in the Deriugin Basin. There was considerable uncertainty about the pore pressure and fracture gradient regime. Provision was made for running a 16-in. string to guard against possible complications associated with a slump zone. The operation started late because of permitting delays. Some mechanical problems were encountered, some rig downtime was experienced, and there was slow drilling at total depth. Operations were complete by early October.

The well in 2005 was drilled some 25 km from the 2004 well. Its design benefited from the engineering lessons learned from the 2004 season, enabling the 16-in.

casing string to be eliminated and 20-in. casing point deepened. Although the operation started late and significant downtime was experienced with the BOP and rig systems, once bedded down, operations continued with rapidly improving efficiency.

KEY LESSONS LEARNED

- Staffing a project team can take 3 to 9 months. Considerable care is required to ensure that the organisational model is sustainable.
- Late start in a tight employment market exposes a project to significant risk.
- Drastic prioritisation of activities may be required to ensure that the essentials are in place before operation start-up.
- Environmental regulations can impose demands on the operation that require additional measures to ensure operational safety.
- Extension of the weather window past established limits requires winterisation of the rig and careful analysis, planning and rehearsal of operational procedures.
- To function reliably, rigs taken from cold stack require more detailed pre-contract technical audit than is normally possible to carry out when in cold stack.
- Putting a rig to work in Russian waters requires an Industrial Safety Declaration and granting of a Permit to Use.
- Although the water depth in the area is only around 100m, the high currents created a problem of vortex-induced vibration of the riser.
- Permitting of operations in frontier areas can present unexpected surprises that take time and high-level intervention to resolve. Local permitting expertise is essential.
- In a zero discharge environment, skip and ship of water-based mud and cuttings is feasible.
- Careful planning of crew changes using journey management specialists was essential to manage the safety risks associated with long travel times.
- Despite the complexity of the operation and distances involved, planning enables the operation to be conducted without logistics-related downtime.

This article is based on IADC/SPE paper #99044, presented at the Drilling Conference on 21 Feb in Miami Beach, Fla. ■