Parker builds world's first arctic-class drill barge

Ross D Murphy,
Parker Drilling Co International

Have you ever tried to escape from an offshore drilling rig in an amphibious, tracked escape vehicle to then be rescued by a custom built icebreaker?

Have you ever used a giant vacuum cleaner to transport drill cuttings off your rig?

Have you ever worked in an offshore environment that is a world class nature preserve in a country that has never experienced the offshore oil industry?

Have you ever worked in a place where the winter to summer temperature ranges from Arabian Desert heat to Siberian cold?

Welcome to the first offshore drilling operation in the shallow North Caspian Sea in Kazakhstan!

Parker Rig 257: Designed for Caspian Sea operations, Parker Rig 257 was upgraded to operate as an arctic drill barge. The rig was designed to meet 4 criteria: environmental and personnel safety; remote, shallow-water operations; severe, arctic weather; and an HPHT, H2S reservoir.

In 1997, **Parker Drilling Co** was awarded a contract to design, build and operate a barge rig for use in the Kazakhstan sector of the shallow north Caspian Sea. The operator is **OKIOC**, a consortium of 9 international oil companies (**BP-Amoco**, **Agip**, **Mobil**, **TotalFina**, **Statoil**, **Inpex**, **Phillips Petroleum**, **British Gas** and **Shell**). The drill site is 75 miles south of Atyrau in 10 ft of water. This area of the North Caspian is a world renowned nature preserve and a natural resource gem for the Republic of Kazakhstan. The effort to drill in this unique part of the world combines technology and people in an effort the leave the smallest environmental footprint ever left behind in a wildcat exploration program.

BACKGROUND

The tender to supply a drilling rig centered on several key aspects:

- Safety for environment and people;
- Remote, shallow water offshore operation;
- Severe weather conditions;
- A high pressure-high temperature, poison gas reservoir.

This combination of drilling challenges had not been attempted before in the oil industry. The North Caspian is home the world's largest supply of caviar, taken from the beluga or sturgeon. It is also home to the Caspian seal and many species of migratory waterfowl and shorebirds, including flamingoes.

Health, safety and environment issues drove the design process. Each of the "shareholders" (member companies of the consortium) supplied people and technology to the design process to be sure the best practices of each company would be used. This commitment to HSE issues opened the door for discussions and the adoption of the most comprehensive HSE program ever attempted in this type of remote environment.

The key HSE systems involve the fire, gas and smoke detection and alarm systems, the cascade breathing air systems, the Arktos escape vehicles, 15K BOPE, TOGA gas diversion system, heating, ventilation and air conditioning system, the temporary refuge and communication system.

The expected reservoir presents a unique mix of problems also. The nearby super-giant Tengiz field is the look alike to the anticipated reservoir. Moveable salt, bottom hole pressures at or above 12,000 psi, a cavernous limestone reservoir and 20% percent H2S are expected. In other words, the expected reservoir will behave like a HPHT North Sea well, contain H2S similar to reservoirs in Canada, require operating in a remote offshore location in a climate that varies from Siberian arctic cold to Arabian Desert heat. Do all of this in shallow water that fluctuates in depth based on the wind direction in a country with no history of offshore oil well drilling. This combination of challenges has never been attempted before.

RIG DESIGN AND UPGRADE

In early 1998, Parker Rig 257 was transported from the coastal areas Nigeria to Louisiana for partial refurbishment. In August 1998, the rig was moved in 4 pieces to Astrakhan, Russia for final completion. The rig was moved in several sections via the Mediterranean Sea to the Black Sea to the Sea of Azoz through the Volga-Don Canal to Astrakhan, Russia. The rig was reassembled in a shipyard there. The work in Astrakhan lasted from September 1998 to July 1999, when the rig was towed to the drill site.

When the project reached the Astrakhan shipyard, the construction process and design drivers changed course. The operation took on the appearances of a North Sea type of operation due to the weather conditions and stringent environment and safety systems to be installed. The original design scope for the rig refurbishment only included upgrading quarters, mud systems, and stability concerns. After more time was spent evaluating the actual environmental and weather conditions, the complexity of the design needs emerged. The rig was basically redesigned while it was being refurbished. What emerged was a drilling machine that meets many of the standards expected of rigs operating in the North Sea, arctic and remote areas, and environmentally sensitive areas.

Modifications included:

• New sponsons and junction parts were connected to the existing hull to increase the storage capacity and improve the draft and stability. The rig increased in tonnage from 1500 tons to 9000 tonnes;

• 14-ft high ice deflectors were installed on the external areas of the hull;

• Both the junior and senior living quarters were expanded and rebuilt to accommodate 96 people;

• A temporary refuge (TR) was included;

• A third 1600-hp mud pump was added;

• A 5th generator was installed to provide maximum power requirements for heating, top drive and operating 3 mud pumps;

• The mud system was upgraded to zero-discharge of drill cuttings and effluents. A Max-Vac system was installed to move cuttings off the rig to a custom-built cuttings barge;

• BOP's and choke manifolds were upgraded to 15,000 psi;

• State-of-the-art fire, smoke and gas detection system was installed to activate protective devices at concentrations of H2S as low as 5 ppm;

• A **Varco** TDS3 top drive was added;

• The mast was upgraded to 1.3 MM lb hook load in arctic conditions.

The rig is classed by the **American Bureau of Shipping** and the **Russian Maritime Registry** to offshore operations.

STABILITY AND HULL INTEGRITY

In the winter, the temperature can drop to -40° F. The North Caspian freezes to a thickness of 3 ft. The ice "rubblizes": It breaks up and moves with the wind. When the ice meets an obstacle, it stacks and piles to heights up to 100 ft. This ice puts significant side forces on the structures, deforming and moving those structures. The rig was designed to monitor and withstand those ice forces. To control the ice rubbling around the drill site, 2 measures were taken. First, 6-ft diameter piles with 1-in. wall thickness were driven into the sea floor around the drill site to a depth of about 90 ft. Second, the rig was equipped with ice deflectors. These are curved shields placed around the circumference of the rig to "deflect" the ice and prevent ice rubble to rise over the deck of the rig.

5 UNIQUE SYSTEMS

There are 5 unique systems that have not been used together on *any* rig before.

• Arktos Escape Vehicles: Due the shallow water and limited abilities of support vessels in the winter, the requirement existed for a means to evacuate the rig safety and quickly. In the summer, the water depths are too unpredictable to allow the use of North Sea type escape pods or boats. There was no practical way to launch the escape pods and get away from the rig. In the winter, even with custom built ice breakers on standby at all times at the rig, there was no way to evacuate the men from the rig and quickly get them to the ice breakers.

The Arktos Escape Vehicle is a unique, amphibious, tracked vehicle that is used in all types of terrain. The vehicle can be used as a boat with a jet propulsion type of engine. It can be used as an over the ice vehicle and driven like a military tracked vehicle. It can climb ice rubble in the water and on a firm surface. In other words, it can fall through the ice, climb up on the rubble and pull itself out of the water. All the while, it has a safe breathing air system for the men inside.

• The heating, ventilation and air-conditioning system is unique in many ways. First, to ensure the safety of the men liv-

ing in close proximity to a potential release of poison gas, the sleeping rooms and other areas of the rig are design to have "positive pressure". This means, that if a poison or combustible gas release occurs, the gas will not flow into the accommodation areas of the rig. This will allow the men to put on SCBA (self-contained breathing apparatus) in order to work or to escape to the Arktos vehicles. The various alarm systems that function interactively with the HVAC system are designed to seal off areas where poison gas or smoke has been detected.

• The temporary refuge is a room designed to serve as a command center and/or an evacuation point. It is equipped with winter survival suits and SCBA's. The cascade air breathing system has ports located in the TR also. The men and women on the rig are extensively trained in emergency response and evacuation.

• The closed mud system and automated cuttings handling system are designed for zero discharge and to move the drill cuttings from the rig to a cuttings barge. The mud cleaning and mixing system itself is not unique to the offshore industry. There is the usual compliment of shale shakers, high G dryers and centrifuges. The unique aspect of this rig is cuttings movement system. To move the cuttings from the shale shakers to the cuttings barge is the difficult part. A machine called a Max-Vac is used. It is a system that conveys the cuttings with an auger to a hopper which gravity feeds into a tank where a vacuum is placed on the material. The cuttings are then blown to hoppers located on the cuttings barge. The cuttings are dropped into compartments that are sealed when full.

• Arctic-class support vessels: The operation is supported by 2 arctic-class icebreakers, 3 arctic-class tug boats, 2 Bell 212 helicopters and 5 supply barges. The 2 icebreakers are capable or carrying an 800-ton cargo and can operate in less than 10 ft of water. The icebreakers can travel through ice thickness up to 3 ft and can travel at 3 knots through ice 2 ft thick. They travel backwards in ice, using the propellers to churn the ice to the consistency of ice cream. One icebreaker will be near the rig at all times for use as an emergency vessel. The custom-built shallow draft tugboats handle the movement of the support barges and movement of the rig from location to location.

THE PEOPLE WHO WORK ON THE RIG

With extensive experience in the FSU and Kazakhstan, Parker Drilling Co did not have trouble attracting and hiring excellent local workers. Experience at the Tengiz field with a worldwide expatriate workforce demonstrated that experience in drilling deep, high pressure, poison gas wells in places such as Iran, Kuwait, Canada, US Anadarko Basin, and Papua New Guinea is transferable to Kazakhstan.

Even with this level of experience, each local employee went through an intense three-week HSE and rig orientation course followed by English language courses. As the men showed proficiency in the HSE issues and language, they were sent from the Atyrau, Kazakhstan training center to Astrakhan, Russia to assist in the work on the rig. When the rig went to the drill site, the men were further drilled and trained on escape and well control situations. Training is ongoing.

LOOKING BACK

Was the entire rig refurbishment process done in a smooth and seamless manner? No. Very few, if any projects of this scope have been carried forward without an assortment of "if I had that to do again, I would do it differently" statements. Here are some lessons learned.

The project was on a fast track to meet the terms of a PSA. Rigs were in short supply, trained men were not available, and the complexity of drilling in the North Caspian was not fully understood at the outset of the project.. The logical choice was an inland barge rig similar to what is used in the US Gulf Coast and Nigeria. The problem here was how to drill in the winter? As the design process expanded to meet the winter drilling needs, the time to *do* the modifications was growing short. Couple the short time frame to do the modifications with the evolution of offshore regulations in Kazakhstan led to many redesigns and changes of scope of the work.

The complexity of the design of the safety systems, HVAC system, cascade breathing air systems, Arktos escape vehicle systems were more difficult to resolve than first thought. As the project developed, the more it looked like a North Sea operation rather than a typical barge operation. This required rethinking the design parameters more that once. The rig itself "grew" in size from 1,500 tons to over 9,000 tons.

The ice-deflector system, the ballast requirements, hull-monitoring system, rig heating system were larger than originally planned when the decision was made to drill year round.

The environment protection systems were a level of complexity higher than originally planned due to the "zero discharge" requirement. Wastewater had to be treated to a level above any current industry standards for water discharges.

Construction problems while in Astrakhan were about what was expected. The main problems centered on logistics and the quality of locally available material. The workers were experienced, but lacked a strong understanding of safety and HSE issues in the workplace. The project in Astrakhan was completed in 9 months with only one LTI. At times, there were over 450 workers working around the clock on the rig.

Kazakhstan regulatory requirements grew as the project progressed. This came as a result of the regulatory agencies becoming more familiar with North Sea standards and standards in other areas of the world.

SUMMARY

The best summary that can be offered is that on 4 September 1999, the Kashagan East 1 was spud and is drilling ahead safely and efficiently. Would we do this again? Yes, that is what the oil industry is business to do—find new oil anywhere we can and deliver it safer and cheaper than in the past.

SPECIAL ACKNOWLEDGEMENTS

The author would like to thank ***OKIOC****, especially* ***Keith Dall****ard,* ***Paul Jefferies****,* ***Andre Chura****,* ***John Foulkes*** *and* ***Jean Normand****. Thanks to* ***ArcticGeoscience International*** *for guidance through the regulatory maze in Russia and Kazakhstan. A special thanks to* ***J B Cochran*** *for innovative insight into the combinations of systems needed.*