

# Kashagan past and future marine challenges

Shallow draft marine operations in ice infested waters

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5<sup>th</sup> March 2020







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27/02/20







The North Caspian Project is the first major offshore oil and gas development in Kazakhstan. It covers four fields: Kashagan, Kairan, Aktoty, and Kashagan South West.

The giant Kashagan field ranks as one of the largest oil discoveries of the past four decades, with approximately 9-13 billion barrels (1-2 billion tonnes) of recoverable oil. The Kashagan reservoir lies 80km offshore from the city of Atyrau in 3-4 meters of water, and is more than 4km deep (4,200 meters).

In 2016, the first offshore oil in the history of Kazakhstan was commercially produced from Kashagan. The Operator of the project, North Caspian Operating Company N.V. (NCOC), completed a major pipeline replacement project ahead of schedule and on September 28 re-opened the first wells offshore.

The President of Kazakhstan, Nursultan Nazarbayev, honoured the project workers and veterans with a personal visit to Atyrau on December 7, 2016.

The first million tonnes was exported in the first days of 2017, and NCOC safely reached actual production levels of over 400,000 barrels per day.

Given its scale and technical complexity, the North Caspian project will be developed in phases.



The combined safety, engineering and logistics challenges in a harsh offshore environment make Kashagan Phase 1 one of the largest and most complex industrial projects currently being developed anywhere in the world.



Development of the Kashagan field represents a unique combination of technical complexity and supply-chain coordination in a harsh offshore environment where temperatures can drop below -30°C in winter and rise to +40°C in summer







Because of its low salinity due to the inflow of fresh water from the Volga River, shallow waters of only three to four metres, and subarctic temperatures, this part of the Caspian freezes every winter. Drifting ice and ice scouring on the seabed put heavy restraints on construction, production and logistics, calling for innovative technical solutions.



The Kashagan reservoir is located some 4,200 meters below the seabed and is highly pressurized. The light crude oil from the Kashagan field has a high sour gas content hydrogen sulfide (H<sub>2</sub>S) and carbon dioxide (CO<sub>2</sub>). The particular challenge of Kashagan is posed by the harsh operating environment, which requires many more precautions and a much larger investment to manage the safety risks.





Located at the confluence of the Ural and Volga rivers, the North Caspian Sea its environment and are characterized by rich and diverse flora and fauna with 60% of the species unique to the Caspian Sea. Ŵhile sturgeon often the İS considered the most commercially valuable species, the Caspian Sea is also home to seals, and its coastal wetlands attract a variety of birds, including many of those listed in the Red Book of Kazakhstan.



The Caspian Sea is also a major migration route for birds flying from Asia to Siberia. Preserving this sensitive environment in the northern part of the Caspian Sea and minimizing impacts on the environment are key challenges in developing oil and gas fields in this area.





The main production hub – D Island, collects also the oil produced by the second hub A island, other than 3 production clusters constructed on artificial islands.

The artificial island are NUI – Normally Unattended installations, and operation there are completely automatized and remote controlled from D Island.

Access to such locations is needed for inspections and planned maintenance on weekly and monthly basis.







## **Production module load-in**







#### **Logistics Marine Operations**

To maintain the supply chain to the offshore installation, the marine fleet should be able to operate 24/7.

The main constraints – shallow waters, level ice, low temperatures, and potential presence of toxic/explosive gases, requires a tailor made marine supporting fleet.

Along the years several different solution have been implemented, starting with the shallow draft Russian river ice breakers – Kapitan Chudinov class, equipped with 4 diesel electric driven screw props, to the Arcticaborg/Antarcticaborg, Ice Class category 1A, powered by 2 × ABB Azipod based propulsion system, to the Tulpar bespoke category 1A\*/ F, icebreaking vessel...











... To the Mangystau: first vessel ever made with the new ice category confirmed at the Aker Arctic Ice Towing Tank, at the presence of the Class representative:





A specialized supply chain was designed, constructed and certified meant to transport cargoes on ice strengthened barges, capable withstand ice stresses generated while being pushed through ice by supply vessels

After satisfactory results of theoretical predictions, validated through ice model tests, the convoy was tested in the field verifying the actual stresses imposed on the structures by means of string gages





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The peculiar operational environment required to design a bespoke means of the evacuation.

The IBEEV – ice Breaking Emergency Evacuation Vessel was conceived.

Capable to transport 340 persons, including 3 crew personnel, the IBEEV is capable to sustain the life of occupants for 6 hours in complete segregation, by means of oxygen candles and C02 scrubbers.

Designed to operate in complete segregation from the external air, the IBEEV is equipped with AIP – Air independent System.

Based on stored compressed air, the AIP enable the IBEEV to navigate in ice infested waters with 2 diesel engines and reach the place of refuge without utilizing the external air, which could be potentially polluted by explosive gases.









### **Caspian Sea Fluctuation**

Accurate bathymetry, water level fluctuation prediction, satellite ice charting and vessel route monitoring support the marine operation to mitigate the impact of shallower waters.

















The new ultra shallow the marine fleet should be able to execute the following tasks:

- Emergency Evacuation from the D-island and the satellite islands
- Supply functions from Bautino to D-island and the satellite islands

The following are the main requirements:

- icebreaking capability 50 cm level ice (with and without the barge)
- maximum draught 1.5 m
- AIP & TR air independent propulsion system and temporary refuge for evacuation purposes to be able to reach safe area without air.

The actual cargo transportation would be with a barge in pusher mode



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#### **ICE BREAKING EMERGENCY EVACUATION CRAFT**

- The new ultra Ice Breaking Emergency Evacuation Craft is meant to gradually substitute the old IBEEV, depending on the actual fluctuation of the Caspian Sea water level as it will be ascertained during the next years
- On option with compressed combustible air system same solution adopted by the IBEEV – was abandoned in the past [2007]
- The advanced technological level reached by battery powered propulsion system suggests promising potential result to enable Company to design and eventually deliver an emergency evacuation vessel – smaller than the IBEEV, carrying ~100/120 POB. and capable to reach the place of safety within one hour – as per Company performance standard, navigating in AIP at ultra shallow draft < 1.5 meters</li>









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