Ice management and Arctic Logistics

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Abstract

Oil Exploration and Production Offshore Sakhalin Island – Ice Management and Marine Operations

To date there have only been a few operations where ice management has been used in the offshore oil and gas industry and even fewer where it has been used to actively support oil production and export operations.
The Sakhalin II project Phase1 was an example of where ice management was used over several years to extend the operating season and hence increase production. Phase 1 of the project consisted of a gravity based production platform called 'Molikpaq' which was linked by a 2km underwater pipeline to a Single Anchor Leg Mooring (SALM) to which an Floating Storage and Offtake vessel (FSO) was connected by a hawser (both with only light ice capabilities). Crude oil was exported from the stern of the FSO to export tankers using a floating hose mounted on a large reel. The tanker position and alignment was assisted by a hold back tug.
Ice forms in the Sakhalin production area starting around November the 20th and it takes around 20 days to reach 30cms thickness. The thickness then gradually increases over the winter to reach around 1.2m thick with some heavy ridging. The ice starts to reduce in thickness in April/May and is normally completely absent from the work site by mid-June.
The SALM was the only option for export and so until the SALM could be raised from the seabed in 'ice free' waters then the Molikpaq was not able to produce. There was therefore a good incentive to try and raise the SALM early and to lower it to the seabed late in order to maximise the window of opportunity for production.
Initial assets consisted of two ice class Super 1A platform supply vessels and an additional icebreaker was chartered to assist in the shoulder periods. An ice management team consisting of around 10 members, including ice scientists and ice masters, was assembled and mobilised to site based on the best estimates as to when their services would be needed. This involved monitoring the weather and ice throughout the year to try and gauge whether it would be an early or late season.
Pre-season meetings were held to discuss the work scope and to fully align the team with the objectives. The team consisted of Russian and Canadian nationals and was led by an ice team director who acted as the focal point back to management ashore to ensure that there was one consolidated position on ice conditions from the team. A key item that arose was the need for good IT interconnectivity between the team members who were based on different vessels and on the platform and FSO. A local Area Network (LAN) was set up and used effectively but proved to be temperamental on occasions due to the weather conditions. The back-up communication system was the satellite system which proved to be very costly when used as the primary source of data exchange. It was very important to have historical data to hand for previous seasons as this could be compared to current conditions and matched to analogues to get an indication as to what may happen with the ice. This meant that the recording of all data collected in a uniform manner in standardised folders with a strict protocol for naming of files was very important to enable previous data sets to be readily accessed when required.
The team was involved in collecting data and analysing satellite images and making reconnaissances with helicopters and support vessels over a wide area to assess the ice that was likely to come to site well in advance of its actual arrival. The team at the worksite then closely monitored the ice drift

direction and predicted where it would come from in the next few hours to enable the icebreakers on site to only break that ice that was likely to impact the work site. The icebreakers were constantly fed the sectors that they needed to break ice in and the ice Masters onboard guided the captains as to the best tactics to use to reduce the ice to a level that was safe for the SALM and export system to be raised/lowered or safely operated.

A T-Time was developed for each operation that was to be carried out and this was adjusted on a daily basis to reflect work in hand. This was then compared to any areas of dangerous ice that it was considered could not be ice managed if they were to come to site and operations continued or were stopped and the system made safe accordingly.

In the last couple of years that the project was operating before the pipeline to shore was completed, enabling year round operation, 3 new azimuthal platform supply vessels were delivered to the project. These were used for the ice management and their enhanced abilities enabled the operations season to be extended significantly. They were deployed ahead of the SALM/FSO and maintained in a stationary position in line with the drift by turning their azimuth thrusters out to the sides and using the thrust to energetically move the broken surface ice clear of the work site at the same time as counteracting the current drift. Operating in this mode was outside of the normal operating experience of the ship's crews and so training from ice experts was required to achieve full performance from the vessels.

In conclusion the key learning points from this operation were:

- A dedicated, competent ice management team is required as there is too much work for it to be carried out by others in an operational role.
- Good communications/data links between the members of the ice management team are required as well as comprehensive data recording.
- Azimuthal vessels in most situations have much better ice management performance than linear vessels.
- Assess all parts of the system to take out any weak links which may reduce the effectiveness of the whole. i.e. in Sakhalin a small non-ice classed workboat was required for SALM laydown
- Multiple weather forecasts from different providers to predict ice drift as accurately as possible and satellite images to detect dangerous ice. Feedback needs to be given to weather service providers to better calibrate their models.
- Only break the ice that you need to for the operation as otherwise you waste fuel and time.
- Start cautiously with any ice management operation and build on experience gained, as ice conditions differ in every location.
- Need to be flexible with resources to address changing conditions, forecast errors and unexpected developments