Ice risk assessment of Qajaq W

The Qajaq W in ice, photo taken from the Canadian Icebreaker, CCGS Henry Larsen

Last year, Aker Arctic was tasked with evaluating the strength of the hull and propulsion of a ferry intended for traffic between Newfoundland and Quebec in Canada, in order to evaluate the risks of operating in ice.

M/V Apollo has run regular ferry services across the Strait of Belle Isle, between Saint Barbe in Newfoundland and Blanc-Sablon on the south east coast of Quebec, for the last 18 years. She was built in Germany in 1970 and originally operated in the Baltic Sea. The ship was purchased in 2000 to operate the 36 km long route year-round for Labrador Marine Services Inc.

The strait can be ice covered between February and May, especially when south westerly winds push ice from the Gulf of St Lawrence northwards, creating particularly challenging pressured ice conditions. With the *Apollo* aging, the operator was in the process of acquiring a replacement vessel from Germany, the *M/V Grete*, and wanted to have a thorough understanding of the ice operational risks associated with deploying the new vessel on the route, to ensure continued safety for future years. The *Grete* was subsequently renamed *Qajaq W*, meaning kayak in Inuktitut.

Strength evaluation

Aker Arctic's scope of work was to evaluate the strength of the hull and propulsion systems, compare them with the expected ice conditions the ship would face, and with the regulatory requirements for operation in Canadian waters.

"We began by looking at the strength of the hull of the existing ship (*Apollo*) and the new ship (*Qajaq W*)," says Rob Hindley, Head of Machinery and Structural Design at Aker Arctic.

A direct analysis of the structure against the rules was done, with a comparison of rule design pressures for the various structural areas of the ship. The capacity of the structure to withstand ice load was also assessed. These were then used as a comparison to see whether the strength was higher or lower than the *Apollo* and the regulatory rule minimums that would be required.

Propeller ice loads

"For the propeller, we modelled the blade using the Finite Element Method and loaded the propeller with different ice loads to compare the limiting ice load with the rule requirement," Hindley explains.

The two ships have different propulsion configurations, with the *Apollo* being a conventional twin shaft and twin propeller arrangement, whereas *Qajaq W* has one azimuth thruster forward and one aft. As a result, the risks associated with ice loading could not be compared directly.

"We solved this by creating different loading scenarios for various operational manoeuvres, particularly regarding the propulsion. We also had a look at the hull form shape, looking at how ice goes into the propeller from various angles to get a better understanding of the operational risks," says Hindley.

Past ice conditions

The assessment team also looked at the ice conditions the *Apollo* had been operating in, gathering all ice chart data from the strait for the past ten years. The Canadian Arctic Ice Regime Shipping System (AIRSS) assessment tool, which is a Canadian regulatory requirement, was used to evaluate the level of risk to the ship in various ice conditions.

"More importantly, it links the ship's ice class to ice conditions," Hindley underlines.

POLARIS, the IMO system of evaluating operational risk in ice, was also used in the assessment, the POLARIS risk index outcome being compared with the Ice Numeral determined from AIRSS. Actual data from the ship's log, what ice conditions the ship had been operating in both independently and with icebreaker assistance, and days where the decision had been made by the operator not to sail due to tough ice conditions were used to develop an operational risk profile for the *Apollo*, effectively setting a baseline to compare *Qajaq W* against.

Conclusions

"Looking at the strength of both ships in terms of the actual ability of the structure and the propulsion to withstand the ice load we concluded that the new ship

is comparable, and in some areas, significantly stronger than the old ship," Hindley concludes.

It was clear from the review of the previous ship's log entries that the *Apollo's* operators had been prudent in deciding when to proceed out in ice and when not.

"Together this information was used to make the case that the *Qajaq W*, if operated with the same prudence as *Apollo*, should be able to continue the safe ice operational track record that the *Apollo* set originally."

"Being equipped with a different propulsion configuration, we also identified that there were specific areas needing to be addressed through training and operational guidance and we included that advice to the operator, to ensure we had given the complete risk picture," Hindley adds.

First winter

The *Qajaq W* now has her first winter season behind her.

"The *Qajaq W* is much more capable in ice than the *Apollo*," comments Captain Wade Roberts of the *Qajaq W* (and also previously of the *Apollo*). "This past season presented some extremely tough operating conditions with heavy ice and the vessel operated successfully without damage to the hull or thrusters."

Technical details – Qajaq W	
Length	97.8 m
Breadth	17.9 m
Draught	4.2 m
Capacity	700 passengers, 160 cars

Technical details – Apollo	
Length	108.7 m
Breadth	17.2 m
Draught	4.6 m
Capacity	240 passengers, 220 cars