Hybrid propulsion gains popularity

Two azimuthing propulsion units flanking a shaft line in the middle has become an increasingly popular design alternative to explore in icebreaker projects as it combines the advantages of both options.

Choosing the propulsion configuration is one of the most important decisions in a new icebreaking concept. The alternatives are usually determined by several internal and external factors ranging from the vessel's future mission and principal dimensions to the prevailing ice conditions and water depth in the intended operational area.

Best of both worlds

A traditional shaft line is very efficient when sailing straight ahead in heavy ice whereas azimuthing propulsion provides exceptional manoeuvrability. In addition, the latter allows incorporating the Aker Arctic DAS™ solution, whereby a ship sails ahead in open water and lighter ice conditions but turns around and proceeds stern-first through heavy ice.

Although the idea of combining azimuthing propulsion with shaft lines had been brewing since the late 1980s, the full potential of this type of hybrid configuration in icebreaking was realized during the development of the first icebreaking LNG carriers in the 2000s. This propulsion layout has also gained popularity in icebreakers in recent years.

Decision based on efficiency

"The trend has been to use azimuthing propulsion in small-to-medium-sized icebreakers and independently-operating double acting merchant ships, whereas shaft lines have been preferred in icebreaking research ships and heavy polar icebreakers," says Tuomas Romu. "However, the decision concerning which propulsion configuration to use should always be done on a case-by-case basis depending on project-specific boundary conditions."

If two azimuthing propulsion units do not provide enough thrust and a third one is considered, the width of the hull often becomes a limiting factor, as multiple adjacent units require a considerable area for turning 360 degrees. Combining azimuthing thrusters with a shaft line can then become a viable option.

"While two larger azimuthing units could also be chosen, the drawback is increased vessel draught and the limited availability of very large propulsion units," adds Maximilian Vocke.

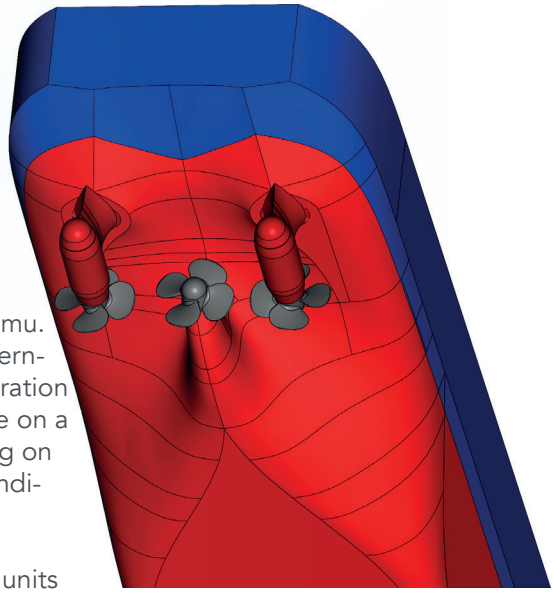
No power limitation

Turning in heavy ice can be a challenge for a vessel equipped with conventional shaft line propulsion and rudders. Combining it with azimuthing thrusters not only improves manoeuvrability, but also allows extended astern operation in ice.

"A noticeable advantage with shaft lines is the possibility to go beyond 20 MW, a power level currently not possible with azimuthing thrusters," Vocke underlines.

So-called twin-azimuth hybrid propulsion is thus especially valuable for heavy polar icebreakers and large commercial ice-going vessels to achieve reliability, redundancy, maximum icebreaking capability and good manoeuvrability in both open water and ice.

"On the other hand, it has become an interesting option also in smaller icebreaker projects where a shallow draught may limit propeller diameter and, consequently, thrust," Romu points out.



It is important to achieve a correct balance between the three propulsors to ensure the desired outcome.

Various configurations tested

Over the years, Aker Arctic has tested various configurations in model scale to determine the optimal hull geometry, propulsion power split, and position of azimuthing propulsion units relative to the shaft line in the middle.

"We have discovered that there are certain challenges which have to be addressed in the design to ensure that the end result is what the customer desires," Romu emphasises. "Some issues have been revealed through trial and error in ice model tests."

In modern heavy icebreakers, the combination of azimuthing propulsion units and shaft lines has replaced the classic triple-shaft configuration prevalent since the late 1800s. ■