Power, efficiency and reliability

The CRP ECO propulsor

MECHANICAL PROPULSOR **Finland-based Steerprop Ltd recently completed a multi-year programme to develop a high-efficiency, environmentally friendly mechanical azimuth propulsor for power ranges higher than those of previous mechanical propulsors. In the following, Steerprop's Markus Niemi summarises the results of the company's relevant R&D activities.**

The new propulsor, designated SP CRP ECO and available from 4 MW to over 20 MW, is designed to combine the known benefits of mechanical azimuth propulsion with unsurpassed efficiency and environmental friendliness even in the highest power ranges. The first propulsors designed under this programme were sold earlier this year with delivery due in early 2014.

Larger azimuth propulsion systems available to big vessels such as cruise ships, cargo vessels and tankers have been until now mostly confined to electrical podded solutions as component manufacturing limitations have made it technically unfeasible, if not impossible, to build sufficiently large mechanical propulsors. Responding to repeated queries from the global market for a mechanical alternative, Steerprop Ltd began a research and development (R&D) programme to design a large mechanical propulsor available in high power ranges and combining modern efficiency and reliability with high speeds.

Based on positive feedback from owners and operators around the world who for years have utilised dual-ended Steerprop push-pull CRP (contra-rotating propellers) azimuth propulsors in demanding conditions and a variety of applications such as year-round operations in icy Norwegian Sea oil fields, it was decided that the new propulsor would have the high-efficiency push-pull CRP configuration. By dividing the propulsive load between two independent sets of gear wheels, shafting and propellers at opposite ends of the propulsor body, the push-pull CRP combines

three advantages: rugged, almost simplistic mechanical reliability, the efficiency of the CRP and the benefits of a pulling propeller. As the two sets of gear wheels and shafting are independent of each other, the push-pull CRP also offers immense potential for torque – a particular advantage in ice-going applications – while the distance between the propellers makes the propulsor immune to jamming due to ice blocks.

The R&D programme began with a study of whether the required components were readily available on the market. After suppliers and components had been located, a preliminary design of a 10-MW propulsor incorporating the components was created. The design was tested in a variety of vessel configurations to verify its projected advantages, the results confirming the propulsor's predicted efficiency.

Encouraged by results of the model tests, the R&D programme developed the preliminary design into a 20-MW model enhanced with CFD calculations to further refine the hydrodynamic properties of the propulsor body. Other technological developments were included in the enhanced design, among them pressure lubrication to eliminate losses due to immersion lubrication, and an emissions-free shaft seal using pressurised air to increase the environmental friendliness of the propulsor and enable its use in areas particularly sensitive to oil leaks.

"In propulsion, environmental friendliness is in large part how efficiently the propulsor works – that is to say, how little fuel it uses to propel the vessel forward," said Hannu Jukola, a naval architect at Steerprop Ltd. "But with the CRP ECO we looked beyond that. We made sure that the new shaft seal system is completely oil-leak free and that the propulsor produces as little noise and vibrations as possible."

This enhanced design then underwent comparative model tests with other propulsion solutions for a large cruise ship application requiring a high-efficiency propulsion system that caused minimal noise and vibration. In these tests, the Steerprop CRP ECO achieved efficiency superior to that of all other configurations.

While the CRP ECO had been tested in open-water applications, the potential of the high torque in arctic and ice-going applications remained untested. So Steerprop Ltd, together with Aker Arctic Technology Inc, began ice-basin tests on a number of different vessels such as arctic LNG carriers operating on the Northern Sea Route, icebreakers and dedicated ice-management vessels for the northern offshore fields.

The results confirmed high torque's potential to be a real advantage in icy conditions, especially with the push-pull propeller arrangement. Since the propellers are located on opposite sides of the propulsor body several metres apart, they cannot be blocked by large blocks of ice. The tests also revealed a surprising advantage of the CRP propeller's slipstream, which proved to be particularly effective for ice management, especially in the dedicated ice-management vessels necessary for oil fields farther north in the Arctic Ocean. Another ability seen as very effective with the CRP ECO was stern-first icebreaking.

The R&D programme was completed in late 2012, and shortly afterwards the first CRP ECO propulsors were contracted as the main propulsion for a dual-fuel RoPax vessel to be built by Fincantieri in Italy for STQ of Canada. This vessel will operate year-round in Canadian waters and have ice reinforcement according to the FSICR 1A ice class. As per specification, the propulsors will be reinforced in accordance with the FSICR 1A Super ice class.

In the months after the first contract was signed, the CRP ECO has also been contracted for a few other ships, ranging from large naval supply vessels to technology demonstration vessels. In line with Steerprop Ltd's product philosophy, development of the CRP ECO continues.