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AIR POLLUTION AND ENERGY EFFICIENCY

Technical consequences of the EEDI on the ship machinery design, including performance of components and new issues faced as a result of introduced changes

Submitted by IACS

SUMMARY

Executive summary:	This document provides information related to the technical consequences on ship machinery design due to the implementation of the EEDI requirements
Strategic direction, if applicable:	3
Output:	3.6
Action to be taken:	Paragraph 12
Related documents:	None

Background

1 Moving to the next phases of the EEDI scheme, the relevant requirements may lead to the need for further improvement of ship designs or adoption of innovative technologies to improve the energy efficiency of ships. To meet the EEDI requirements post 2020, ship designers will need to consider energy saving technologies or reductions in service speed.

2 The EEDI database currently includes data to support the review of the status of technological development under regulation 21.6 of MARPOL Annex VI, such as ship speed, main engine power and the use of innovative energy efficiency technologies.

3 Many different options have been studied to either address the energy performance of ship designs, or improve already optimal or nearly-optimal standard designs, by considering phenomena usually regarded as secondary in the normal design process, or not yet completely understood. However, such efforts must, as a priority, maintain the safety of shipping. The following paragraphs provide a short overview, which is not exhaustive, regarding the impact of the EEDI requirements on ship machinery design.

Discussion

Engine derating

4 One of the possible ways to comply with the EEDI requirements is by derating the engine. However, if the engine is derated more than necessary to comply with the Required EEDI, a subsequent uprating back to the design Maximum Continuous Rating (MCR) to increase speed may only be possible:

.1 if the related engine auxiliary systems (including shafting) are originally designed and installed to match the larger rating; and

.2 provided the Attained EEDI with the larger rating is no more than the Required EEDI.

Moreover, certification issues related to the use of derated engines with a reserved power, need to be clarified with respect to regulation 13 of MARPOL Annex VI.

Passing through the barred speed range

5 With the introduction of the EEDI requirements, a number of design trends have affected the powertrain designs on ships. These include the trend to use more efficient, larger diameter propellers, as well as more efficient derated engines operating at a lower RPM. As a result, a number of reports have been received from vessel operators using a Barred Speed Range (BSR) with passage times becoming unacceptably long during sea trials. This has led to operators' requests to assess the shaft line fatigue lifetime or a prediction of the time required to pass through BSR, as early as at the plan approval stage.

6 In 'pre-EEDI' times, the BSR passage was limited to a few seconds and therefore potential accumulation of torsional cycles leading to fatigue and failure was insignificant, and hence not of concern. However, since the EEDI requirements have been in place, the small power margins attained by the new 'eco-efficient' engines around the upper and lower limit of the BSR can result in torque not sufficient to pass quickly enough through the BSR. A prolonged stay inside the BSR not only triggers engine alarms in the Engine Control Room, but also causes concerns to the operators from the point of view of fatigue and from the vessel manoeuvrability point of view, particularly in bad weather

Shaft alignment issues

7 Recent design trends in propulsion shafting systems make alignment increasingly more sensitive with lower tolerances and margins to prevent bearing failure. With the introduction of the EEDI requirements, some design trends have affected the shaft alignment tolerances. These include the trend to use more efficient larger diameter propellers of higher weight which are designed to operate at a lower RPM, which results in an increased cantilevered load on the shafting system and a thinner oil film in the stern tube bearing in the lower RPM range. Another design trend is having shorter lengths of shaft line to maximize cargo space and minimize engine-room space; that improves the attained EEDI, but makes the shaft line more sensitive to alignment.

Installation of propulsion improving devices and model tests

8 A reduced effectiveness should be expected for some types of Propulsion Improving Devices (PID). As with all PIDs, this effect should be studied by extensive use of Computational Fluid Dynamics (CFD) analysis or model tests at the design stage to avoid turning an

efficiency-improving device into an additional source of parasitic drag or structural and vibration problems, or both.

Manoeuvrability in heavy seas

9 The speed of a vessel has a significant impact on the fuel consumption because the speed is related to the propulsive power required by approximately a third or fourth power relationship. The corresponding reduction in total fuel consumption is offset a little by the longer time spent to complete the voyage. So, by slowing down, there can be significant savings in fuel for a given voyage. It is therefore easy to understand why there is substantial interest in slow steaming, especially when fuel prices are high. It is also a reason why the EEDI calculations include consideration of ship speed.

10 However, if the only focus of designing for slower speeds is low fuel consumption or reducing the attained EEDI, the result may be low powered ships that may not operate safely in heavy seas or manoeuvre and stop safely. Because of these concerns the issue of minimum power provisions for ships in adverse weather conditions is being addressed by the Organization.

Alternative fuels

11 The increasing use of alternative fuels such as ethane, compressed natural gas (CNG) and bio-fuel that offer a pathway for compliance with the '2020 low sulphur limit requirements' may lead to the need to consider developing new property values in the EEDI calculations.

Action requested of the Committee

12 The Committee is invited to consider the foregoing and take action as appropriate.