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PREVENTION OF AIR POLLUTION FROM SHIPS

The Energy Efficiency Design Index (EEDI) and Underpowered Ships

Submitted by Greece

SUMMARY

Executive summary:	This document presents some concerns in the application of the Energy Efficiency Design Index (EEDI) in that it may favour underpowered ships, which emit more CO_2 for the same speed
Strategic direction:	7.3
High-level action:	7.3.1
Planned output:	7.3.1.1 and 7.3.1.3
Action to be taken:	Paragraph 16
Related documents:	MEPC 59/24, MEPC 59/WP.8; MEPC.1/Circ.681, MEPC.1/Circ.682; MEPC 59/4/20 and MEPC 60/4/15

Introduction

1 MEPC 59 agreed to circulate the interim Guidelines on the method of calculation of the Energy Efficiency Design Index (EEDI) for new ships (MEPC.1/Circ.681) and the interim Guidelines for voluntary verification of the EEDI (MEPC.1/Circ.682).

2 This document is submitted in accordance with MSC-MEPC.1/Circ.2, Guidelines on the organization and method of work and makes some additional observations on the EEDI formula which are in Greece's opinion important. The main thrust of this document has to do with possible misapplications of the EEDI formula if the ship is underpowered.

EEDI and underpowered ships

3 Greece believes that by developing the EEDI formula, the main goal was to help design the best possible ship hull forms, propulsion systems and other technologies, so as to improve the energy efficiency of new ships and to reduce CO_2 emissions. Greece believes that the above main goal has not changed, and that utmost care should be exercised so as to not shift the focus of action to practices that may achieve a lower EEDI on paper but may have negative side effects as regards overall energy efficiency and CO_2 emissions.

4 In another submission by Greece, document MEPC 60/4/15 entitled "Comments on the EEDI Baseline Formula", Greece has argued that the current combination of EEDI formulae and EEDI baseline effectively imposes an upper bound on the service speed, or, alternatively, on the MCR of the ship. As such, it encourages (read: "mandates") the construction of underpowered ships, which, in their attempt to go faster or just maintain the service speed in fair (3-5 Beaufort) weather, would emit disproportionately more CO_2. This is illustrated below by some actual examples.

The Concern

5 Greece urges a second look at the EEDI formula with a view to ensure that the formula appropriately favours a ship that has the lower fuel consumption in actual fair weather operating conditions, not simply at sea trials. It is the CO_2 which will be emitted during the actual operation of the ship that is harmful to the environment and this needs to be minimized.

6 For this to be achieved, the formula must first ensure that the power of 75% MCR is truly sufficient to achieve the service speed (V_{ref}) in actual sea conditions. Greece has serious doubts that the current formula ensures that, even after the foreseen inclusion of the weather factor f_w.

7 Although Greece does not claim to have all the answers at present, it has faith in the combined wisdom of IMO and hopes that the below thoughts may assist to achieve an improved EEDI which will result in real CO_2 reductions using good and improved ship designs as opposed to using a smart application of the variables in the formula.

8 Greece believes that a reliable way must be agreed to evaluate the "actual sea performance" of each different ship design, removing perhaps operational variables from the formula which could be manipulated to make a not so good design look good. One such variable is speed. Especially a speed which will only be verified at sea trials and thus it is not so relevant as regards real CO_2 reduction.

9 Society's demands have caused the development of more energy efficient, faster surface transport in all modes. This must not be overlooked by shipping when designing the EEDI formula, particularly if the possible side effects of slower speeds as mentioned in Greece's MEPC 60 submission entitled "Comments on the EEDI Baseline Formula" (paragraph 23 of document MEPC 60/4/15) are to be addressed. Particularly, a possible cargo shift to other surface modes or even air, as a result of speed reduction in shipping imposed by the EEDI formula, would result in a net increase of CO_2, either regionally or globally.

Current Ship Designs

10 Current Ship Designs, particularly in tankers and bulk carriers, tend to optimize deadweight carrying capacity due to limitations in the ports which these ships serve. This has coined the expression of "trade optimized ships". Such ships have length (LOA) and beam (B) limitations (which in the last several years have remained the same since they have reached the maximum operating limits due to port restrictions, Panama Canal, etc.) while their depth and draught have kept increasing. As is natural, these ships have a fuller hull Block Coefficient and wider, blunter bows, which create substantial resistance to head winds and waves. These ships are designed to attain a commercially acceptable nominal speed in still water (sea trial conditions), but because of their dimensions and fullness, require substantially greater power to overcome usual trading weather conditions particularly when trading in actual sea conditions.

11 The fuller bows alone would require larger engines. However, the increased resistance of full bows becomes particularly evident at real sea conditions (even at mild sea states equivalent to 3-5 Beaufort) and not at the "still water" conditions of sea trials. In other words, the resistance of a non-hydrodynamic bow increases exponentially in even mild waves compared to still water. On the other hand, the actual ship fuel consumption is not officially measured at sea trials. If it is measured, it is "for reference only" and reflects the sea trial "still water" conditions. The effects of the full bow cannot be apparent, especially for bulk carriers which perform sea trials in ballast condition at ballast draught, and thus most of the bow is out of the water. Adding a sea margin of, say, 15%, makes sense only if it is added on top of the true operating resistance of the ship at full load and not on top of an artificially estimated low resistance.

12 This problem is further accentuated if the ship design and powering is based on a "design" draught which is substantially less than the "scantling" draught which is the ship's full loaded draught. If the contract speed refers to a fictitious, never used in practice "design" draught, which is substantially less than the full draught, then the engine may look as being sufficient, since it only has to overcome, on paper, the reduced resistance of the design draught. This point is becoming more obvious over the last years where the "design" speed has been linked to the design draught and not the scantling draught. Such ships in practice need to operate at 90% MCR or more and therefore burn more fuel than an identical ship with a larger engine. Despite the fact that the EEDI components (DWT, Speed) refer to "Capacity" (i.e. scantling) values, a careful second look at the EEDI formula is urged to ensure that this practice (i.e. selecting MCR based on reduced ship resistance demands rather than the real ones) is eliminated.

13 By increasing the engine power (e.g., by adding one cylinder) certain owners have been able to operate at full draught at 75% MCR and reap all the benefits of a reduced consumption. Typically the extra cost of the larger engine is paid off in a few years due to the savings in fuel costs. However such major changes to a shipyard's standard design is not possible for the majority of owners, irrespective of their willingness to pay the extra cost. This is particularly true in a seller's market. Shipyards naturally resist the disruption to their production line. With the EEDI formula as it stands at present, such, more energy efficient ships, would be penalized unless it is explicitly agreed that the "Derated" MCR power of such larger engines should be used in the formula in place of the Full Rated MCR.

14 Recent actual case studies and comparisons of such ships, where a larger engine was fitted, made by some major yards and the engine manufacturer, some of which were subsequently built and operated, have shown a dramatic reduction in daily fuel consumption compared to the previous "standard" yard design (much more than the yard design department and the engine maker had originally estimated). We present below two such actual examples.

Examples

No 1. Handymax/Supramax 2008 design

DWT: 56,000 MT, Service speed 14.5 knots.
Required power to achieve this speed with 15% sea margin = 7,940 kW

A. ORIGINAL (STANDARD) DESIGN
Engine Size: 6 Cylinders, 50 cm bore, MCR 9,480 kW
SFOC at 7,940 kW of this engine = **168.7 gr/kWh (gram per kilo-Watt-hour)**

B. REVISED SHIPYARD DESIGN
Engine Size: 7 Cylinders, 50 cm bore, MCR 11,060 kW
DERATED MCR 9,480 kW
SFOC at 7,940 kW of this engine = **165.1 gr/kWh**

Nominal saving (using MDO and ISO conditions) = **0.7 tonnes/day**
However using fuel oil and non-ISO conditions, the real fuel saving is much higher.

No 2. Panamax 1999 design (design has been built and operated since 2001)
DWT: 75,000 MT, Service speed 14.5 knots.
Required power to achieve this speed with 15% sea margin = 9,571 kW

A. ORIGINAL (STANDARD) DESIGN
Engine Size: 5 Cylinders, 60 cm bore, MCR 11,275 kW
SFOC at 9,571 kW of this engine = **167.4 gr/kWh**

B. REVISED SHIPYARD DESIGN
Engine Size: 6 Cylinders, 60 cm bore, MCR 13,530 kW
DERATED MCR 11,275 kW
SFOC at 9,571 kW of this engine = **161.7 gr/kWh**

Nominal saving (using MDO and ISO conditions) = **1.3 mt/day**
However, using fuel oil and non-ISO conditions, the real fuel saving is much higher.

In both the above examples, unless the derated MCR is used in the EEDI formula for the more efficient revised designs, their EEDI would come out higher (worse).

Conclusions

15 Based on the above, Greece proposes the following:

.1 Until full development of a reliable weather factor (f_w) is completed, apply 15% sea margin to the speed to account for the transition from sea trial confirmation to actual sea conditions and, thus, to truly select an engine MCR and its related SFOC for 75% MCR operation in actual sea conditions.

.2 Require explicitly, in case an engine is derated, to use the derated MCR in the EEDI formula.

Action requested of the Committee

16 The Committee is invited to consider the information provided in this document and, in particular, the proposal in paragraph 15, and decide as appropriate.

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