INTERNATIONAL MARITIME ORGANIZATION

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GREENHOUSE GAS WORKING GROUP
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Agenda item 2

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CONSIDERATION OF THE ENERGY EFFICIENCY DESIGN INDEX FOR NEW SHIPS

Proposals on the effect of generators and diesel-electric propulsion systems

Submitted by the Netherlands

SUMMARY

Executive summary:	This document contains proposals with regard to the formulation of effect of generators and diesel-electric propulsion in the EEDI, based on the outcome of a recent conducted Dutch study into application of the EEDI to existing ships, designed and/or built in the Netherlands
Strategic direction:	7.3
High-level action:	7.3.1
Planned output:	7.3.1.3
Action to be taken:	Paragraph 18
Related documents:	MEPC 58/WP.8 and MEPC 58/23

Introduction

1 In support of the preparation for the second intersessional meeting of the Working Group on Greenhouse Gas Emissions from Ships, this submission provides input into the discussion on the further development of the Energy Efficiency Design Index (EEDI), in this document referred to as the Index.

2 The text of this submission is related to item 1 of the Terms of Reference for the second intersessional WG meeting.

3 This document is submitted in accordance with MSC-MEPC.1/Circ.2, Guidelines on the organization and method of work.

Objective

4 The Terms of Reference for the second intersessional meeting contain the instruction in item 1 to "consider towards finalization" the EEDI for new ships, taking into account any trial application of the Index by calculation. The objectives of this submission are to propose two modifications to the formula, based on the study recently conducted by the Netherlands, into application of the Index to existing ships, designed and/or built in the Netherlands. A copy of the study can be downloaded from the website: www.cmti.nl

5 This submission proposes two modifications. The first one regarding the effect of shaft generators in the Index formula and the second one regarding the Index calculation of vessels with diesel-electric propulsion.

Auxiliary power and shaft generator

6 In the proposed Index the auxiliary power is taken as a percentage of the installed propulsion power. Depending on the size of the main engines, this amounts to 2.5% or 5% of the installed propulsion power. The fact that the actual auxiliary power installed on the vessels varies largely between ship types and individual designs is disregarded.

7 As the auxiliary power is taken as a fixed percentage of the installed power, no correction is made for the effect of shaft generators. The consequence of this formulation is that the application of shaft generators will be discouraged, while these generators have a very high overall efficiency. In a configuration where all auxiliary power is produced by a shaft generator, driven by the main engine, this power will be taken into account in the Index twice. This because the installed main engine power is larger than it would have been without a shaft generator.

8 To solve this discrepancy, a revised approach is suggested. In case the auxiliary power is produced by the main engine via the shaft generator, the "P_{ae}" should be set to zero, and not be taken as a percentage of the installed propulsion power.

Diesel electric propulsion

9 Characteristic for a fully diesel-electric propulsion configuration of a ship is the absence of a diesel engine dedicated to propulsion of the ship. Several engines of the same or different rating produce all the necessary power for the ships propulsion as well as for all other systems.

10 According to the MEPC 58/WP.8[1], diesel-electric power is introduced in the formula by adding the parameter P_{pti}. The total shaft power is $P_s = P_{me} + P_{pti}$. In a diesel-electric layout $P_{me} = 0$, because there is no main engine, therefore $P_s = P_{pti}$. However, a PTI shaft motor is not the same as an electric motor for a diesel-electric propulsion. But in line with the debate during MEPC 58, it is assumed that $P_s = P_{elec}$, the total installed electric propulsion power. It is proposed to replace P_{pti} with $\sum_{i=1}^{n} P_{eleci}$, defined as 75% of the total rated power of the electric propulsion engines (EPP).

[1] MEPC 58/J proposal by Denmark which resulted in the proposal of the GHG working group of MEPC 58.

11 In line with the debate during MEPC 58, P_{ae} will be zero, as it is linked to P_{me}. However, this does not reflect actual power consumption used for propulsion and hotel systems. It should be a percentage of the total installed electric propulsion power (EPP). Therefore it is proposed to calculate P_{ae} according to the following formulae:

If EPP >10.000kW : $P_{ae} = 0.025 * EPP + 250$
If EPP < 10.000kW: $P_{ae} = 0.050 * EPP$

Proposed formula for vessels with diesel electric propulsion will be as follows:

$$\frac{\left(\prod_{j=1}^{M} f_j\right) P_{AE} C_{FAE} SFC^*_{AE} + \left(\sum_{i=1}^{nelec} P_{eleci} - \sum_{i=1}^{nWHR} P_{WHRi}\right) C_{FAE} SFC_{AE} - \left(\sum_{i=1}^{neff} f_{eff} P_{eff} C_{eff} SFC_{MEi}\right)}{f_i \; Capacity \; V_{ref} \; f_W}$$

12 This is illustrated by a calculation for a vessel, equipped with four generator sets of about 1,300 kW per set. The propulsion consists if two electric engines, each driving a propeller. The first calculation shows the effect of the proposed Index formula. The total installed power is taken as propulsion power, because it is not clear which part of the installed power is used for propelling the vessel:

	P_{mei}			P_{ae}			P_{elec}-P_{whr}				
3.1144	205	3975	265	3.1144	205	0	3.1144	205			
	2537847		+	169189.8		+	0				
										60.08	gCO_2/tNm
				45057							

13 Due to the fact that it is difficult to extract the power used for ship propulsion from the total installed power, the calculation results in an Index value much higher than for a similar vessel with a conventional propulsion configuration.

14 In the next calculation, the formula as proposed under paragraph 10 and 11 is applied. P_{me} is set to zero, and the propulsion power is derived from the installed electric propulsion power ($\sum_{i=1}^{n} P_{eleci}$). 75% of the power is used, to match the 75% MCR requirement. The auxiliary power is derived from the total installed electric propulsion power (EPP).

	P_{me}			P_{ae}			P_{elec}-P_{whr}				
3.1144	0	0	150	3.1144	205	2,250	3.1144	205			
	0		+	95767.8		+	1436517				
										34.01	gCO_2/tNm
				45057							

15 This calculation results in a drop of 43% in Index value. By using the proposed method of calculating diesel electric propelled vessels, a better comparison can be made with conventional propelled vessels. A compensation factor F_{elec} can be added to the formula to give compensation on the power losses which occur in converting diesel engine power into electric power, to be multiplied with:

$\sum_{i=1}^{n} P_{eleci}$. A realistic value for F_{elec} is 1.15.

Proposals

16 The Index for vessels equipped with shaft generators should be calculated as proposed under paragraph 8.

17 The Index for vessels equipped with diesel-electric propulsion should be calculated as proposed under paragraphs 10 and 11.

Action requested of the Intersessional Meeting

18 The Intersessional Meeting is invited to consider the proposals provided in this document during its deliberations on the EEDI.