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REDUCTION OF GHG EMISSIONS FROM SHIPS

Report of the Correspondence Group on the Development of Technical Guidelines on Carbon Intensity Reduction (TOR 1)

Submitted by China, Japan and the European Commission

SUMMARY

Executive summary:	This document provides the report of the Correspondence Group on the Development of Technical Guidelines on Carbon Intensity Reduction established at MEPC 75, on TOR 1 (the draft technical guidelines supporting the EEXI framework)
Strategic direction, if applicable:	3
Output:	3.2
Action to be taken:	Paragraph 32
Related documents:	MEPC 75/18; MEPC 76/7/3, MEPC 76/7/5, MEPC 76/7/6, MEPC 76/INF.7, MEPC 76/INF.8, MEPC 76/INF.9 and MEPC 76/INF.10

Introduction

1 The seventy-fifth session of the Committee (MEPC 75) established the Correspondence Group on the Development of Technical Guidelines on Carbon Intensity Reduction, under the joint coordination of China, Japan and the European Commission. The overview of the Correspondence Group is provided in document MEPC 76/7/3 (China, Japan and the European Commission).

2 This document provides the report of the Correspondence Group on TOR 1 (the draft technical guidelines supporting the EEXI framework). The summary of comments provided by the members on TOR 1 is provided in document MEPC 76/INF.7 (China, Japan and the European Commission).

Summary of discussion on TOR 1 (EEXI)

TOR 1.1: Draft guidelines on the method of calculation of the attained EEXI

3 The Group considered the "draft guidelines on the method of calculation of the attained EEXI", using the base document circulated by the coordinators. The base document was developed based on annex 1 of document ISWG-GHG 7/2/7 (Greece et al.) with some refinements to reflect the views and proposals made at ISWG-GHG 7 and MEPC 75. Having thoroughly reviewed the base document, the Group further considered and discussed the following items in particular:

.1 Definition of $P_{ME(i)}$; Power of main engines (section 2.2.1);

.2 Definition of $P_{AE(i)}$; Power of auxiliary engines (section 2.2.2);

.3 Measures for pre-EEDI ships to obtain V_{ref} ; Ship speed (section 2.2.3); and

.4 Correction factor for ro-ro cargo and ro-ro passenger ships (f_{jRoRo}) (section 2.2.6).

Definition of $P_{ME(i)}$; Power of main engines (section 2.2.1)

4 The Group considered how the power of main engines ($P_{ME(i)}$) should be represented in the EEXI formula, in cases where Shaft / Engine Power Limitation was installed. The members had common views that the upper bound of $P_{ME(i)}$ should be 75% of the rated installed power (*MCR*), and that even in case of applying the Shaft / Engine Power Limitation, there should be a margin between $P_{ME(i)}$ and the limited installed power of the engine (MCR_{lim}). However, the views were divergent on the size of the margin.

5 Several members argued that a 15% margin would be sufficient and would avoid over-estimation of the EEXI performance, and suggested $P_{ME(i)}$ to be 87% (=1/1.15) of MCR_{lim} or 75% of *MCR*, whichever is lower. Some other members argued that 20% margin would be consistent with the sea margin under the existing EEDI framework, and suggested $P_{ME(i)}$ to be 83% (=1/1.20) of MCR_{lim} or 75% of *MCR*, whichever is lower.

6 Nevertheless, the large majority of the members throughout the discussion argued that the entire consistency with the EEDI formula would be crucial to ensure the level playing field among ships, and suggested $P_{ME(i)}$ to be 75% of MCR_{lim}. Those members supporting 75% of MCR_{lim} further noted that the EEXI performance would not be overestimated by using 75% of MCR_{lim}, as the absolute value of the margin would decrease proportional to the $P_{ME(i)}$ by means of the Shaft / Engine Power Limitation.

7 Following the discussion and having noted the views provided by the members, the Group incorporated $P_{ME(i)}$ to be 75% of MCR_{lim} in the draft guidelines. However, this is not a consensus of the Group, as several members did not agree to set $P_{ME(i)}$ to be 75% of MCR_{lim}, and thus this could be further considered by ISWG-GHG 8 or the Committee.

8 Notwithstanding the above, for LNG carriers having steam turbine or diesel electric propulsion, for which $P_{ME(i)}$ is defined as 83% of *MCR* in the EEDI formula due to their technical specifications, the Group defined $P_{ME(i)}$ to be 83% of MCR_{lim}, which was also aligned with the EEDI formula, in the draft guidelines. Besides, for those ship types, in order to avoid releasing of excessive natural boil-off gas to the atmosphere, allowance of the power necessary for combustion of such excessive natural boil-off gas was incorporated.

Definition of $P_{AE(i)}$; Power of auxiliary engines (section 2.2.2)

9 The Group considered how the power of auxiliary engines ($P_{AE(i)}$) should be calculated for cruise passenger ships and ro-ro passenger ships in cases where the electric power table was not available.

10 Respecting the specific technical features of those ship types, the Group developed alternative methods to calculate $P_{AE(i)}$, which was to use the pre-certified value of the annual average figure and to use an approximation formula provided for each ship type. These alternative methods were incorporated into the draft guidelines accordingly.

Measures for pre-EEDI ships to obtain V_{ref} ; Ship speed (section 2.2.3)

11 The Group firstly considered the use of sea trial records to obtain the ship speed V_{ref}. In general, the large majority of the members supported the use of sea trial records, while the views were split with regard to the draught condition of the sea trial and the conditions to ensure accuracy and robustness of the sea trial report. The latter condition was discussed under TOR 1.2 (draft guidelines on survey and certification of the attained EEXI).

12 In cases where the sea trial results under the EEDI draught condition, which might have been calibrated by the tank test, were available, the Group developed a formula to obtain the ship speed V_{ref} using the sea trial records and power correction in accordance with the cubic law.

13 In cases where the sea trial results under the design load draught condition, which might have been calibrated by the tank test, were available, the Group developed a formula to obtain the ship speed V_{ref} using the sea trial records, the capacity factor in accordance with the Admiralty formula and power correction in accordance with the cubic law.

14 On the other hand, in cases where the sea trial results were neither under the EEDI draught nor design load draught condition, the Group could not identify a reliable method to calibrate the results to the EEDI draught condition. Therefore, such sea trial results, neither under the EEDI draught nor design load draught condition, were not incorporated in the draft guidelines.

15 Then, the Group considered a formula to obtain the approximated ship speed $V_{ref,app}$. based on statistical mean of distribution of ship speed and engine power. The formula consists of the statistical mean of the ship speed in the category (V_{avg}) adjusted by the ratio of main engine power in accordance with the cubic law. Besides, in order to avoid overestimating the ship speed (i.e. inadequately better EEXI) so as to avoid undermining the effect of the EEXI, the Group considered a performance margin which was to be deducted from the average ship speed in the formula.

16 Following the discussion and having noted the views provided by the members, the Group defined the performance margin m_V to be 5% of the average ship speed or 1 knot, whichever was lower, and incorporated it in the draft guidelines. However, this is not a consensus of the Group, as several members did not agree to the definition, and thus this could be further considered by ISWG-GHG 8 or the Committee.

17 The Group further considered the method to the effect of energy saving devices into the attained EEXI. Having considered the views and proposals by the members, the Group added a paragraph stating that the effect of energy saving devices might be reflected in the ship speed V_{ref} with the approval of the verifier. The Group further identified the sea trials,

dedicated model tests and/or numerical calculations with the approval of the verifier as the methods for the evaluation of the energy saving devices.

Correction factor for ro-ro cargo and ro-ro passenger ships (f_{jRoRo}) (section 2.2.6)

18 Reflecting the views raised by the members of the Group, as well as those raised at ISWG-GHG 7 and MEPC 75, the Group considered an alternative definition of the correction factor for ro-ro cargo and ro-ro passenger ships (f_{jRoRo}), aiming at reflecting the efficiency improvements by means of Shaft/Engine Power Limitation.

19 Following the discussion and having noted the views provided by the members, the Group defined an alternative correction factor for ro-ro cargo and ro-ro passenger ships (f_{jRoRo}) and incorporated it in the draft guidelines.

Development of the draft guidelines on the method of calculation of the attained EEXI

20 Following the discussion, the Group finalized the "draft guidelines on the method of calculation of the attained EEXI", as set out in annex 1 of this document.

TOR 1.2: Draft guidelines on survey and certification of the attained EEXI

21 The Group considered the "draft guidelines on survey and certification of the attained EEXI", using the base document circulated by the coordinators. The base document was developed based on annex 2 of document ISWG-GHG 7/2/7 with some refinements to reflect the views and proposals made at ISWG-GHG 7 and MEPC 75. Having thoroughly reviewed the base document, the Group further considered and discussed in particular the following items, which are both related to the discussion under TOR 1.1 (draft guidelines on the method of calculation of the attained EEXI):

.1 Verification of the attained EEXI in relation to sea trials (section 4.2); and

.2 Verification of the attained EEXI in relation to numerical calculations (section 4.2 and appendix).

Verification of the attained EEXI in relation to sea trials (section 4.2)

22 Having incorporated the use of sea trial records in the draft EEXI calculation guidelines, the Group considered the conditions to ensure accuracy and robustness of the sea trial report. The Group initially considered the latest version of the ISO standard (ISO 15016:2015) referred in the EEDI guidelines, but then noted that such a standard might not be applicable to existing ships.

23 Following the discussion and having noted the views provided by the members, the Group developed conditions on sea trials conducted by existing ships, with a reference to ISO 15016:2002, and incorporated them in the draft guidelines.

Verification of the attained EEXI in relation to numerical calculations (section 4.2 and appendix)

24 Noting that numerical calculations would be useful to estimate the performance of existing ships as those may complement tank tests, the Group developed a method to verify the results of the numerical calculations with a reference to the defined quality standards (e.g. the ITTC standards).

Development of the draft guidelines on survey and certification of the attained EEXI

25 Following the discussion, the Group finalized the "draft guidelines on survey and certification of the attained EEXI", as set out in annex 2 of this document.

TOR 1.3: Draft guidelines on the Shaft/Engine Power Limitation System to comply with the EEXI requirements and use of a power reserve

26 The Group considered the "draft guidelines on the Shaft/Engine Power Limitation System to comply with the EEXI requirements and use of a power reserve", using the base document circulated by the coordinators. The base document was developed based on annex 3 of document ISWG-GHG 7/2/7 with some refinements to reflect the views and proposals made at ISWG-GHG 7 and MEPC 75. Having thoroughly reviewed the base document, the Group further considered and discussed the following items in particular:

.1 Technical requirements for SHaPoLi / EPL system (section 2); and

.2 Use of a power reserve by un-limiting the shaft / engine power limitation (section 3).

Technical requirements for the SHaPoLi / EPL system (section 2)

27 The Group considered the technical requirements that the SHaPoLi / EPL system should satisfy, in particular from the perspectives of engines' mechanical conditions and actual ship operations. During the discussion, technical neutrality of the systems was emphasized, and some prescriptive conditions had been deleted. Furthermore, it was noted that the ship's officer in charge of navigational watch (OOW), in addition to the master, should also have access to the SHaPoLi / EPL system.

28 Following the discussion and having noted the views provided by the members, the Group developed technical requirements for the SHaPoLi / EPL system, and incorporated them in the draft guidelines. These requirements are aimed to ensure that shaft/engine power is appropriately limited and that un-limited power can be sufficiently indicated or recorded.

Use of a power reserve by un-limiting the shaft/engine power limitation (section 3)

29 The Group considered the conditions under which the use of power reserve by un-limiting the shaft/engine power limitation would be allowed. The members had common views that the use of power reserve should be allowed only for the purpose of securing the safety of a ship or saving life at sea, in accordance with regulation 3.1 of MARPOL Annex VI. However, the views were split on to what extent the possible cases of using the power limit should be illustrated in the guidelines. Some members preferred simply referring to MARPOL regulations while others preferred listing up the possible cases for clarity of ship operators and crews.

30 Following the discussion and having noted the views provided by the members, the Group developed the conditions on the use of power reserve and incorporated them in the draft guidelines. The conditions are fully aligned with regulation 3.1 of MARPOL Annex VI, and although several possible cases were illustrated, these cases are identified as just possible examples, which do not prejudge nor preclude the use of a power reserve.

Development of the draft guidelines on the Shaft/Engine Power Limitation System to comply with the EEXI requirements and use of a power reserve

31 Following the discussion, the Group finalized the "draft guidelines on the Shaft/Engine Power Limitation System to comply with the EEXI requirements and use of a power reserve", as set out in annex 3 of this document.

Action requested of the Committee

32 The Committee is invited to:

.1 note the discussion at the Correspondence Group on the Development of Technical Guidelines on Carbon Intensity Reduction, on TOR 1 (the draft technical guidelines supporting the EEXI framework), as summarized in this document;

.2 consider, with a view to adoption at this session:

.1 the "draft guidelines on the method of calculation of the attained EEXI", as set out in annex 1 (TOR 1.1);

.2 the "draft guidelines on survey and certification of the attained EEXI", as set out in annex 2 (TOR 1.2); and

.3 the "draft guidelines on the Shaft/Engine Power Limitation System to comply with the EEXI requirements and use of a power reserve", as set out in annex 3 (TOR 1.3).

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ANNEX 1

DRAFT GUIDELINES ON THE METHOD OF CALCULATION OF THE ATTAINED ENERGY EFFICIENCY EXISTING SHIP INDEX (EEXI)

CONTENTS

1 Definitions

1.1 *MARPOL* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocols of 1978 and 1997relating thereto, as amended.

1.2 For the purpose of these Guidelines, the definitions in MARPOL Annex VI, as amended, apply.

2 Energy Efficiency Existing Ship Index (EEXI)

2.1 EEXI formula

The attained Energy Efficiency Existing Ship Index (EEXI) is a measure of ship's energy efficiency (g/t*nm) and calculated by the following formula:

$$\frac{\left(\prod_{j=1}^{n} f_j\right)\left(\sum_{i=1}^{nME} P_{ME(i)} \cdot C_{FME(i)} \cdot SFC_{ME(i)}\right) + \left(P_{AE} \cdot C_{FAE} \cdot SFC_{AE}*\right) + \left(\left(\prod_{j=1}^{n} f_j \cdot \sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{neff} f_{eff(i)} \cdot P_{AEeff(i)}\right) C_{FAE} \cdot SFC_{AE}\right) - \left(\sum_{i=1}^{neff} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME}**\right)}{f_i \cdot f_c \cdot f_i \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m}$$

* If part of the Normal Maximum Sea Load is provided by shaft generators, SFC_{ME} and C_{FME} may – for that part of the power – be used instead of SFC_{AE} and C_{FAE}

** In case of $P_{PTI(i)} > 0$, the average weighted value of ($SFC_{ME} \cdot C_{FME}$) and ($SFC_{AE} \cdot C_{FAE}$) to be used for calculation of P_{eff}

Note: This formula may not be applicable to a ship having diesel-electric propulsion, turbine propulsion or hybrid propulsion system, except for cruise passenger ships and LNG carriers.

Ships falling into the scope of EEDI requirement can use their attained EEDI calculated in accordance with the *2018 Guidelines on the method of calculation of the attained EEDI for new ships* (resolution MEPC.308(73), as amended, the "EEDI Calculation Guidelines" hereafter) as the attained EEXI if the value of the attained EEDI is equal to or less than that of the required EEXI.

2.2 Parameters

For calculation of the attained EEXI by the formula in paragraph 2.1, parameters under the EEDI Calculation Guidelines apply, unless expressly provided otherwise. In referring to the aforementioned guidelines, the terminology "EEDI" should be read as "EEXI".

2.2.1 $P_{ME(i)}$; Power of main engines

In cases where overridable Shaft / Engine Power Limitation is installed in accordance with the *Guidelines on the shaft / engine power limit to comply with the EEXI requirements and use of a power reserve* (resolution MEPC.[…]), $P_{ME(i)}$ is 75% of the limited installed power (MCR_{lim}) for each main engine *(i)*. In cases where the overridable Shaft / Engine Power Limitation and shaft generator(s) are installed, in referring to paragraph 2.2.5.2 (option 1) of the EEDI Calculation Guidelines, "MCR_{ME}" should be read as "MCR_{lim}".

For LNG carriers having steam turbine or diesel electric propulsion, $P_{ME(i)}$ is 83% of the limited installed power (MCR_{lim}, MPP_{lim}), divided by the electrical efficiency in case of diesel electric propulsion system, for each main engine *(i)*. For LNG carriers, the power from combustion of the excessive natural boil-off gas in the engines or boilers to avoid releasing to the atmosphere

or unnecessary thermal oxidation should be deducted from $P_{ME(i)}$ with the approval of the verifier.

2.2.2 $P_{AE(i)}$; Power of auxiliary engines

2.2.2.1 $P_{AE(i)}$ is calculated in accordance with paragraph 2.2.5.6 of the EEDI Calculation Guidelines.

2.2.2.2 For ships where power of auxiliary engines (P_{AE}) value calculated by paragraphs 2.2.5.6.1 to 2.2.5.6.3 of the EEDI Calculation Guidelines is significantly different from the total power used at normal seagoing, e.g. in cases of passenger ships, the P_{AE} value should be estimated by the consumed electric power (excluding propulsion) in conditions when the ship is engaged in a voyage at reference speed (V_{ref}) as given in the electric power table, divided by the average efficiency of the generator(s) weighted by power (see appendix 2 of the EEDI Calculation Guidelines).

2.2.2.3 In cases where the electric power table is not available, the P_{AE} value may be approximated either by:

.1 annual average figure of P_{AE} at sea from onboard monitoring obtained prior to the EEXI certification;

.2 for cruise passenger ships, approximated value of power of auxiliary engines ($P_{AE,app}$), as defined below:

$$P_{AE,app} = 0.1193 \times GT + 1814.4 \quad [\text{kW}]$$

.3 for ro-ro passenger ships, approximated value of power of auxiliary engines ($P_{AE,app}$), as defined below:

$$P_{AE,app} = 0.866 \times GT^{0.732} \quad [\text{kW}]$$

2.2.3 V_{ref} ; Ship speed

2.2.3.1 For ships falling into the scope of the EEDI requirement, the ship speed V_{ref} should be obtained from an approved speed-power curve as defined in the *2014 Guidelines on survey and certification of the energy efficiency design index (EEDI)*, as amended (resolution MEPC.254(67), as amended).

2.2.3.2 For ships not falling into the scope of the EEDI requirement, the ship speed V_{ref} should be obtained from an estimated speed-power curve as defined in the *Guidelines on survey and certification of the attained EEXI* (resolution MEPC.[…]).

2.2.3.3 For ships not falling into the scope of the EEDI requirement but whose sea trial results, which may have been calibrated by the tank test, under the EEDI draught and the sea condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines are included in the sea trial report, the ship speed V_{ref} may be obtained from the sea trial report:

$$V_{ref} = V_{S,EEDI} \times \left[\frac{P_{ME}}{P_{S,EEDI}}\right]^{\frac{1}{3}} \quad [\text{knot}]$$

where,

$V_{S,EEDI,}$ is the sea trial service speed under the EEDI draught; and

$P_{S,EEDI}$ is power of the main engine corresponding to $V_{S,EEDI}$.

2.2.3.4 For containerships, bulk carriers or tankers not falling into the scope of the EEDI requirement but whose sea trial results, which may have been calibrated by the tank test, under the design load draught and sea condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines are included in the sea trial report, the ship speed V_{ref} may be obtained from the sea trial report:

$$V_{ref} = k^{\frac{1}{3}} \times \left(\frac{DWT_{S,service}}{Capacity}\right)^{\frac{2}{9}} \times V_{S,service} \times \left[\frac{P_{ME}}{P_{S,service}}\right]^{\frac{1}{3}} \quad [\text{knot}]$$

where,

$V_{S,service}$ is the sea trial service speed under the design load draught;

$DWT_{S,service}$ is the deadweight under the design load draught;

$P_{S,service}$ is the power of the main engine corresponding to $V_{S,service}$;

k is the scale coefficient, which should be:

.1 0.95 for containerships with 120,000 DWT of less;

.2 0.93 for containerships with more than 120,000 DWT;

.3 0.97 for bulk carrier with 200,000 DWT or less;

.4 1.00 for bulk carrier with more than 200,000 DWT;

.5 0.97 for tanker with 100,000 DWT or less; and

.6 1.00 for tanker with more than 100,000 DWT.

2.2.3.5 In cases where the speed-power curve is not available or the sea trial report does not contain the EEDI or design load draught condition, the ship speed V_{ref} can be approximated by $V_{ref,app}$ to be obtained from statistical mean of distribution of ship speed and engine power, as defined below:

$$V_{ref,app} = (V_{ref,avg} - m_V) \times \left[\frac{\sum MCR_{ME}}{MCR_{avg}}\right]^{\frac{1}{3}} \quad [\text{knot}]$$

For LNG carriers having steam turbine propulsion systems, "MCR_{ME}" should be read as "$MCR_{SteamTurbine}$".

For LNG carriers having diesel electric propulsion system and cruise passenger ship having non-conventional propulsion,

$$V_{ref,app} = (V_{ref,avg} - m_V) \times \left[\frac{\sum MPP_{Motor}}{MPP_{avg}}\right]^{\frac{1}{3}} \quad [\text{knot}]$$

where,

$V_{ref,avg}$ is a statistical mean of distribution of ship speed in given ship type and ship size, to be calculated as follows:

$$V_{ref,avg} = A \times B^{C}$$

where

A, B and C are the parameters given in the appendix;

m_V is a performance margin of a ship, which should be 5% of $V_{ref,avg}$ or 1 knot, whichever is lower.

MCR_{ME} is rated installed power of the main engine and MPP_{Motor} is rated output of motor; and

MCR_{avg} is a statistical mean of distribution of MCRs for main engines and MPP_{avg} is a statistical mean of distribution of MPPs for motors in given ship type and ship size, to be calculated as follows:

$$MCR_{avg} or\ MPP_{avg} = D \times E^{F}$$

where

D, E and F are the parameters given in the appendix;

In cases where the overridable Shaft / Engine Power Limitation is installed, the ship speed V_{ref} approximated by $V_{ref,app}$ should be calculated as follows:

$$V_{ref,app} = (V_{ref,avg} - m_V) \times \left[\frac{\sum MCR_{lim}}{MCR_{avg}}\right]^{\frac{1}{3}} \quad [\text{knot}]$$

For LNG carriers having diesel electric propulsion system and cruise passenger ship having non-conventional propulsion, the ship speed V_{ref} approximated by $V_{ref,app}$ should be calculated as follows:

$$V_{ref,app} = \left(V_{ref,avg} - m_V\right) \times \left[\frac{\sum MPP_{lim}}{MPP_{avg}}\right]^{\frac{1}{3}}$$

2.2.3.6 Notwithstanding the above, in cases where the energy saving device* is installed, the effect of the device may be reflected in the ship speed V_{ref} with the approval of the verifier, based on the following methods in accordance with defined quality and technical standards:

.1 sea trials after installation of the device; and/or

.2 dedicated model tests; and/or

.3 numerical calculations.

* Devices that shift the power curve, which results in the change of P_P and V_{ref}, as specified in MEPC.1/Circ.815.

2.2.4 *SFC*; Certified specific fuel consumption

In cases where overridable Shaft / Engine Power Limitation is installed, the *SFC* corresponding to the P_{ME} should be interpolated by using *SFC*s listed in an applicable test report included in an approved NO_X Technical File of the main engine as defined in paragraph 1.3.15 of the NO_X Technical Code.

Notwithstanding the above, the *SFC* specified by the manufacturer or confirmed by the verifier may be used.

For those engines which do not have a test report included in the NO_X Technical File and which do not have the *SFC* specified by the manufacturer or confirmed by the verifier, the *SFC* can be approximated by SFC_{app} defined as follows:

$$SFC_{ME,app} = 190\ [g/kWh]$$

$$SFC_{AE,app} = 215\ [g/kWh]$$

2.2.5 C_F ; Conversion factor between fuel consumption and CO_2 emission

For those engines which do not have a test report included in the NO_X Technical File and which do not have the *SFC* specified by the manufacturer, the C_F corresponding to SFC_{app} should be defined as follows:

$C_F = 3.114\ [t \cdot CO_2/t \cdot Fuel]$ for diesel ships (incl. HFO use in practice)

Otherwise, paragraph 2.2.1 of the EEDI Calculation Guidelines applies.

2.2.6 Correction factor for ro-ro cargo and ro-ro passenger ships (f_{jRoRo})

For ro-ro cargo and ro-ro passenger ships, f_{jRoRo} is calculated as follows:

$$f_{jRoRo} = \frac{1}{F_{n_L}^{\alpha} \cdot \left(\frac{Lpp}{B_S}\right)^{\beta} \cdot \left(\frac{B_S}{d_S}\right)^{\gamma} \cdot \left(\frac{Lpp}{\nabla^{1/3}}\right)^{\delta}}$$; if $f_{jRoRo} > 1$ then $f_j = 1$

where the Froude number, F_{n_L}, is defined as:

$$F_{n_L} = \frac{0.5144 \cdot V_{ref,F}}{\sqrt{L_{pp} \cdot g}}$$

where $V_{ref,F}$ is the ship design speed corresponding to 75% of MCR_{ME}.:

and the exponents α, β, γ and δ are defined as follows:

Ship type	Exponent:			
	α	β	γ	δ
Ro-ro cargo ship	2.00	0.50	0.75	1.00
Ro-ro passenger ship	2.50	0.75	0.75	1.00

APPENDIX

Parameters to calculate $V_{ref,avg}$

Ship type	A	B	C
Bulk carrier	10.6585	DWT of the ship	0.02706
Gas carrier	7.4462	DWT of the ship	0.07604
Tanker	8.1358	DWT of the ship	0.05383
Containership	3.2395	DWT of the ship where DWT ≤ 80,000 80,000 where DWT > 80,000	0.18294
General cargo ship	2.4538	DWT of the ship	0.18832
Refrigerated cargo carrier	1.0600	DWT of the ship	0.31518
Combination carrier	8.1391	DWT of the ship	0.05378
LNG carrier	11.0536	DWT of the ship	0.05030
Ro-ro cargo ship (vehicle carrier)	16.6773	DWT of the ship	0.01802
Ro-ro cargo ship	8.0793	DWT of the ship	0.09123
Ro-ro passenger ship	4.1140	DWT of the ship	0.19863
Cruise passenger ship having non-conventional propulsion	5.1240	GT of the ship	0.12714

Parameters to calculate MCR_{avg} or MPP_{avg} (= D x E^F)

Ship type	D	E	F
Bulk carrier	23.7510	DWT of the ship	0.54087
Gas carrier	21.4704	DWT of the ship	0.59522
Tanker	22.8415	DWT of the ship	0.55826
Containership	0.5042	DWT of the ship where DWT ≤ 95,000 95,000 where DWT > 95,000	1.03046
General cargo ship	0.8816	DWT of the ship	0.92050
Refrigerated cargo carrier	0.0272	DWT of the ship	1.38634
Combination carrier	22.8536	DWT of the ship	0.55820
LNG carrier	20.7096	DWT of the ship	0.63477
Ro-ro cargo ship (vehicle carrier)	262.7693	DWT of the ship	0.39973
Ro-ro cargo ship	37.7708	DWT of the ship	0.63450
Ro-ro passenger ship	9.1338	DWT of the ship	0.91116
Cruise passenger ship having non-conventional propulsion	1.3550	GT of the ship	0.88664

Calculation of parameters to calculate $V_{ref,avg}$ and MCR_{avg}

Data sources

1 IHS Fairplay (IHSF) database with the following conditions are used.

Ship type	Ship size	Delivered period	Type of propulsion systems	Population
Bulk carrier	≥ 10,000 DWT	From 1 January 1999 to 1 January 2009	Conventional	2433
Gas carrier	≥ 2,000 DWT		Conventional	292
Tanker	≥ 4,000 DWT		Conventional	3345
Containership	≥ 10,000 DWT		Conventional	2185
General cargo ship	≥ 3,000 DWT		Conventional	1673
Refrigerated cargo carrier	≥ 3,000 DWT		Conventional	53
Combination carrier	≥ 4,000 DWT		Conventional	3351
LNG carrier	≥ 10,000 DWT		Conventional, Non-conventional	185
Ro-ro cargo ship (vehicle carrier)	≥ 10,000 DWT		Conventional	301
Ro-ro cargo ship	≥ 1,000 DWT	From 1 January 1998 to 31 December 2010	Conventional	188
Ro-ro passenger ship	≥ 250 DWT		Conventional	350
Cruise passenger ship having non-conventional propulsion	≥ 25,000 GT	From 1 January 1999 to 1 January 2009	Non-conventional	93

2 Datasets with blank/zero "Service speed", "Capacity" and/or Total kW of M/E" are removed.

3 Ship type is in accordance with table 1 and table 2 of resolution MEPC.231(65). However, "Gas carrier" does not include "LNG carrier". Parameters for "LNG carrier" are given separately.

***

ANNEX 2

DRAFT GUIDELINES ON SURVEY AND CERTIFICATION OF THE ATTAINED ENERGY EFFICIENCY EXISTING SHIP INDEX (EEXI)

Table of contents

1 GENERAL

The purpose of these guidelines is to assist verifiers of the Energy Efficiency Existing Ship Index (EEXI) of ships in conducting the survey and certification of the EEXI, in accordance with regulations 5, 6, 7, 8 and 9 of MARPOL Annex VI, and assist shipowners, shipbuilders, manufacturers and other interested parties in understanding the procedures for the survey and certification of the EEXI.

2 DEFINITIONS[1]

2.1 *Verifier* means an Administration, or organization duly authorized by it, which conducts the survey and certification of the EEXI in accordance with regulations 5, 6, 7, 8 and 9 of MARPOL Annex VI and these Guidelines.

2.2 *Ship of the same type* means a ship the hull form (expressed in the lines such as sheer plan and body plan), excluding additional hull features such as fins, and principal particulars of which are identical to that of the base ship.

2.3 *Tank test* means model towing tests, model self-propulsion tests and model propeller open water tests. Numerical calculations may be accepted as equivalent to model propeller open water tests or used to complement the tank tests conducted (e.g. to evaluate the effect of additional hull features such as fins, etc. on ships' performance) with the approval of the verifier.

2.4 *MARPOL* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocols of 1978 and 1997 relating thereto, as amended.

2.5 For the purpose of these Guidelines, the definitions in MARPOL Annex VI, as amended, apply.

3 APPLICATION

These Guidelines should be applied to ships for which an application for a survey for verification of the ship's EEXI specified in regulation 5 of MARPOL Annex VI has been submitted to a verifier.

4 PROCEDURES FOR SURVEY AND CERTIFICATION

4.1 General

4.1.1 The attained EEXI should be calculated in accordance with regulation 20A of MARPOL Annex VI and the *Guidelines on the method of calculation of the attained Energy Efficiency Existing Ship Index (EEXI)* (resolution MEPC.[…]) (EEXI Calculation Guidelines).

4.1.2 The 2013 Guidance on treatment of innovative energy efficiency technologies for calculation and verification of the attained EEDI (MEPC.1/Circ.815) should be applied for calculation of the attained EEXI, if applicable.

4.1.3 The information used in the verification process may contain confidential information of submitters, including shipyards, which requires Intellectual Property Rights (IPR) protection.

[1] Other terms used in these Guidelines have the same meaning as those defined in the *2018 Guidelines on the method of calculation of the attained EEDI for new ships* (resolution MEPC.308(73)) and the *Guidelines on the method of calculation of the attained EEXI* (resolution MEPC.[…]).

In the case where the submitter wants a non-disclosure agreement with the verifier, the additional information should be provided to the verifier upon mutually agreed terms and conditions.

4.2 Verification of the attained EEXI

4.2.1 For verification of the attained EEXI, an application for a survey and an EEXI Technical File containing the necessary information for the verification and other relevant background documents should be submitted to a verifier, unless the attained EEDI of the ship satisfies the required EEXI.

4.2.2 The EEXI Technical File should be written at least in English. The EEXI Technical File should include, but not limited to:

.1 deadweight (DWT) or gross tonnage (GT) for ro-ro passenger ship and cruise passenger ship having non-conventional propulsion;

.2 the rated installed power (*MCR*) of the main and auxiliary engines;

.3 the limited installed power (MCR_{lim}) in cases where the overridable Shaft / Engine Power Limitation system is installed;

.4 the ship speed (V_{ref});

.5 the approximate ship speed ($V_{ref,app}$) for pre-EEDI ships in cases where the speed-power curve is not available, as specified in paragraph 2.2.3 of the EEXI Calculation Guidelines;

.6 an approved speed-power curve under the EEDI condition as specified in paragraph 2.2 of the EEDI Calculation Guidelines, which is described in the EEDI Technical File, in cases where regulation 20 of MARPOL Annex VI (Attained EEDI) is applied;

.7 an estimated speed-power curve under the EEDI condition, or under the design load draught to be calibrated to the EEDI condition, obtained from tank test and numerical calculations, if available;

.8 estimation process and methodology of the power curves, as necessary, including documentation on consistency with the defined quality standards (e.g. ITTC 7.5-03-01-02 and ITTC 7.5-03-01-04 in their latest revisions) and the verification of the numerical setup with parent hull or the reference set of comparable ships in case of using numerical calculations;

.9 a sea trial report including sea trial results, which may have been calibrated by the tank test, under the sea condition as specified in paragraph 2.2.2 of the EEDI Calculation Guidelines, if available;

.10 calculation process of $V_{ref,app}$ for pre-EEDI ships in cases where the speed-power curve is not available, as specified in paragraph 2.2.3 of the EEXI Calculation Guidelines;

.11 type of fuel;

.12 the specific fuel consumption (*SFC*) of the main and auxiliary engines, as specified in paragraph 2.2.4 of the EEXI Calculation Guidelines;

.13 the electric power table[2] for certain ship types, as necessary, as defined in the EEDI Calculation Guidelines;

.14 the documented record of annual average figure of the auxiliary engine load at sea obtained prior to the date of application for a survey for verification of the ship's EEXI, as specified in paragraph 2.2.2.3 of the EEXI Calculation Guidelines, if applicable;

.15 calculation process of $P_{AE,app}$, as specified in paragraph 2.2.2.3 of the EEXI Calculation Guidelines, if applicable;

.16 principal particulars, ship type and the relevant information to classify the ship as such a ship type, classification notations and an overview of the propulsion system and electricity supply system on board;

.17 description of energy saving equipment, if available;

.18 calculated value of the attained EEXI, including the calculation summary, which should contain, at a minimum, each value of the calculation parameters and the calculation process used to determine the attained EEXI; and

.19 for LNG carriers:

.1 type and outline of propulsion systems (such as direct drive diesel, diesel electric, steam turbine);

.2 LNG cargo tank capacity in m^3 and BOR as defined in paragraph 2.2.5.6.3 of the EEDI Calculation Guidelines;

.3 shaft power of the propeller shaft after transmission gear at 100% of the rated output of motor (MPP_{Motor}) and $\eta_{(i)}$ for diesel electric;

.4 shaft power of the propeller shaft after transmission gear at the de-rated output of motor ($MPP_{Motor,lim}$) in cases where the overridable Shaft / Engine Power Limitation is installed;

.5 maximum continuous rated power ($MCR_{SteamTurbine}$) for steam turbine;

.6 limited maximum continuous rated power ($MCR_{SteamTurbine,lim}$) for steam turbine in cases where the overridable Shaft / Engine Power Limitation is installed; and

.7 $SFC_{SteamTurbine}$ for steam turbine, as specified in paragraph 2.2.7.2 of the EEDI Calculation Guidelines. If the calculation is not available from the manufacturer, $SFC_{SteamTurbine}$ may be calculated by the submitter.

[2] Electric power tables should be validated separately, taking into account the guidelines set out in appendix 2 of the *2014 Guidelines on Survey and Certification of the EEDI*, as amended (resolution MEPC.254(67), as amended).

A sample of an EEXI Technical File is provided in the appendix.

4.2.3 The *SFC* should be corrected to the value corresponding to the ISO standard reference conditions using the standard lower calorific value of the fuel oil, referring to ISO 15550:2002 and ISO 3046-1:2002. For the confirmation of the *SFC*, a copy of the approved NO_X Technical File and documented summary of the correction calculations should be submitted to the verifier.

4.2.4 For ships equipped with dual-fuel engine(s) using LNG and fuel oil, the C_F-factor for gas (LNG) and the specific fuel consumption (*SFC*) of gas fuel should be used by applying the criteria specified in paragraph 4.2.3 of the *2014 Guidelines on survey and certification of the energy efficiency design index (EEDI)*, as amended,[3] as a basis for the guidance of the Administration.

4.2.5 Notwithstanding paragraphs 4.2.3 and 4.2.4, in cases where overridable Shaft / Engine Power Limitation is installed, or in cases where engines do not have a test report included in the NO_X Technical File, *SFC* should be calculated in accordance with paragraph 2.2.4 of the EEXI Calculation Guidelines. For this purpose, actual performance records of the engine may be used if satisfactory and acceptable to the verifier.

4.2.6 The verifier may request further information from the submitter, as specified in paragraph 4.2.7 of the EEDI Survey and Certification Guidelines, in addition to that contained in the EEXI Technical File, as necessary, to examine the calculation process of the attained EEXI.

4.2.7 In cases where the sea trial report as specified in paragraph 4.2.2.9 is submitted, the verifier should request further information from the submitter to confirm that:

.1 the sea trial was conducted in accordance with the conditions specified in paragraphs 4.3.3, 4.3.4 and 4.3.7 of the EEDI Survey and Certification Guidelines, as applicable;

.2 sea conditions were measured in accordance with ISO 15016:2002 or the equivalent if satisfactory and acceptable to the verifier;

.3 ship speed was measured in accordance with ISO 15016:2002 or the equivalent if satisfactory and acceptable to the verifier; and

.4 the measured ship speed was calibrated, if necessary, by taking into account the effects of wind, tide, waves, shallow water and displacement in accordance with ISO 15016:2002 or the equivalent which may be acceptable provided that the concept of the method is transparent for the verifier and publicly available/accessible.

4.2.8 The estimated speed-power curve obtained from the tank test or numerical calculations and the sea trial results calibrated by the tank test should be reviewed on the basis of the relevant documents in accordance with the EEDI Survey and Certification Guidelines, the defined quality standards (e.g. ITTC 7.5-03-01-02 and ITTC 7.5-03-01-04 in its their latest revisions) and the verification of the numerical setup with parent hull or the reference set of comparable ships.

[3] Resolution MEPC.254(67), as amended.

4.2.9 In cases where the overridable Shaft / Engine Power Limitation system is installed, the verifier should confirm that the system is appropriately installed and sealed in accordance with Guidelines on the Shaft / Engine Power Limitation system to comply with the EEXI requirements and use of a power reserve (resolution MEPC.[…]) and that a verified Onboard Management Manual (OMM) for overridable Shaft / Engine Power Limitation is on board the ship.

4.3 Verification of the attained EEXI in case of major conversion

4.3.1 In cases of a major conversion of a ship taking place at or after the completion date of the survey for EEXI verification specified in regulation 5.4.7 of MARPOL Annex VI, the shipowner should submit to a verifier an application for a general or partial survey with the EEXI Technical File duly revised, based on the conversion made and other relevant background documents.

4.3.2 The background documents should include as a minimum, but are not limited to:

.1 details of the conversion;

.2 EEXI parameters changed after the conversion and the technical justifications for each respective parameter;

.3 reasons for other changes made in the EEXI Technical File, if any; and

.4 calculated value of the attained EEXI with the calculation summary, which should contain, as a minimum, each value of the calculation parameters and the calculation process used to determine the attained EEXI after the conversion.

4.3.3 The verifier should review the revised EEXI Technical File and other documents submitted and verify the calculation process of the attained EEXI to ensure that it is technically sound and reasonable and follows regulation 20A of MARPOL Annex VI and the EEXI Calculation Guidelines.

4.3.4 For verification of the attained EEXI after the major conversion, speed trials of the ship may be conducted, as necessary.

APPENDIX

SAMPLE OF EEXI TECHNICAL FILE

1 Data

1.1 General information

Shipowner	XXX Shipping Line
Shipbuilder	XXX Shipbuilding Company
Hull no.	12345
IMO no.	94112XX
Ship type	Bulk carrier

1.2 Principal particulars

Length overall	250.0 m
Length between perpendiculars	240.0 m
Breadth, moulded	40.0 m
Depth, moulded	20.0 m
Summer load line draught, moulded	14.0 m
Deadweight at summer load line draught	150,000 tons

1.3 Main engine

Manufacturer	XXX Industries
Type	6J70A
Maximum continuous rating (MCR_{ME})	15,000 kW x 80 rpm
Limited maximum continuous rating with the Engine Power Limitation installed ($MCR_{ME,lim}$)	11,000 kW x 72 rpm
SFC at 75% of MCR_{ME} or $MCR_{ME,lim}$	166.5 g/kWh
Number of sets	1
Fuel type	Diesel Oil

1.4 Auxiliary engine

Manufacturer	XXX Industries
Type	5J-200
Maximum continuous rating (MCR_{AE})	600 kW x 900 rpm
SFC at 50% MCR_{AE}	220.0 g/kWh
Number of sets	3
Fuel type	Diesel Oil

1.5 Ship speed

Ship speed (V_{ref}) (with the Engine Power Limitation installed)	13.20 knots

2 Power curve

(Example 1; case of the EEDI ship)
The approved speed-power curve contained in the EEDI Technical File is shown in figure 2.1.

(Example 2; case of the pre-EEDI ship)
The estimated speed-power curve obtained from the tank test and numerical calculations, if available, is shown in figure 2.1.

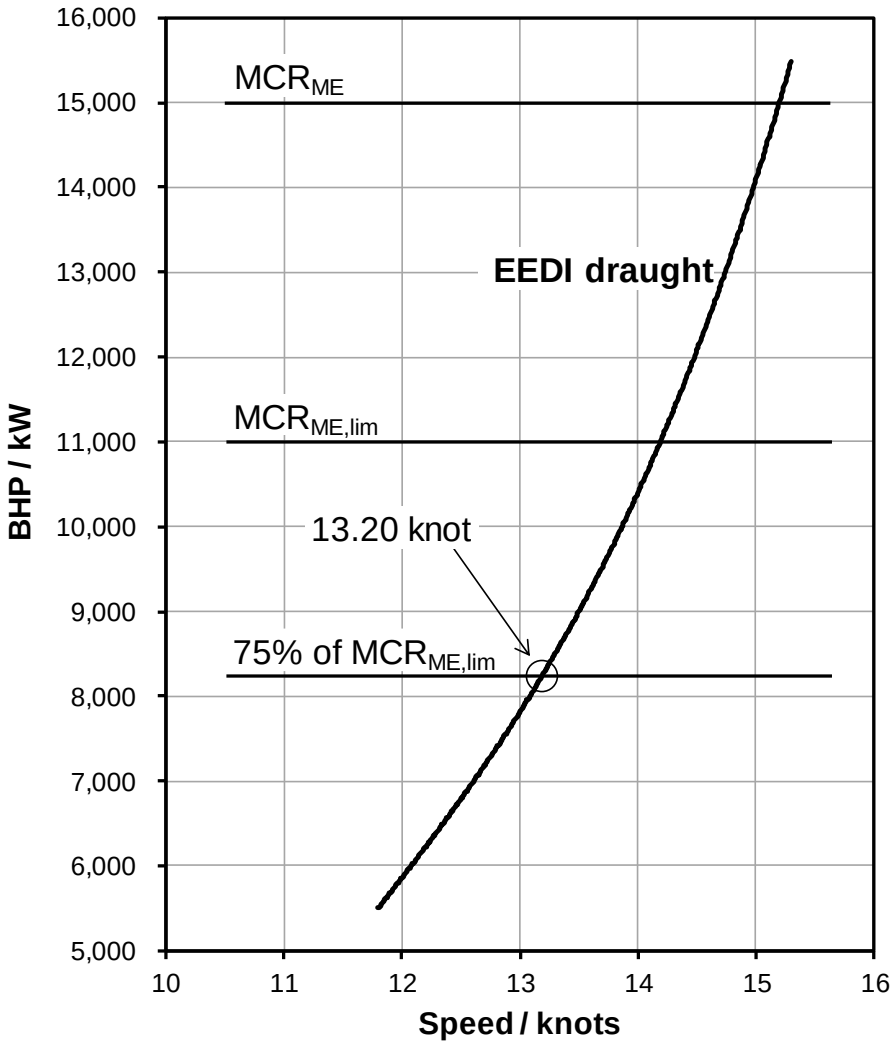

Figure 2.1: Power curve

3 Overview of propulsion system and electric power supply system

3.1 Propulsion system

3.1.1 Main engine
Refer to paragraph 1.3 of this appendix.

3.1.2 Propeller

Type	Fixed pitch propeller
Diameter	7.0 m
Number of blades	4
Number of sets	1

3.2 Electric power supply system

3.2.1 Auxiliary engines
Refer to paragraph 1.4 of this appendix.

3.2.2 Main generators

Manufacturer	XXX Electric
Rated output	560 kW (700 kVA) x 900 rpm
Voltage	AC 450 V
Number of sets	3

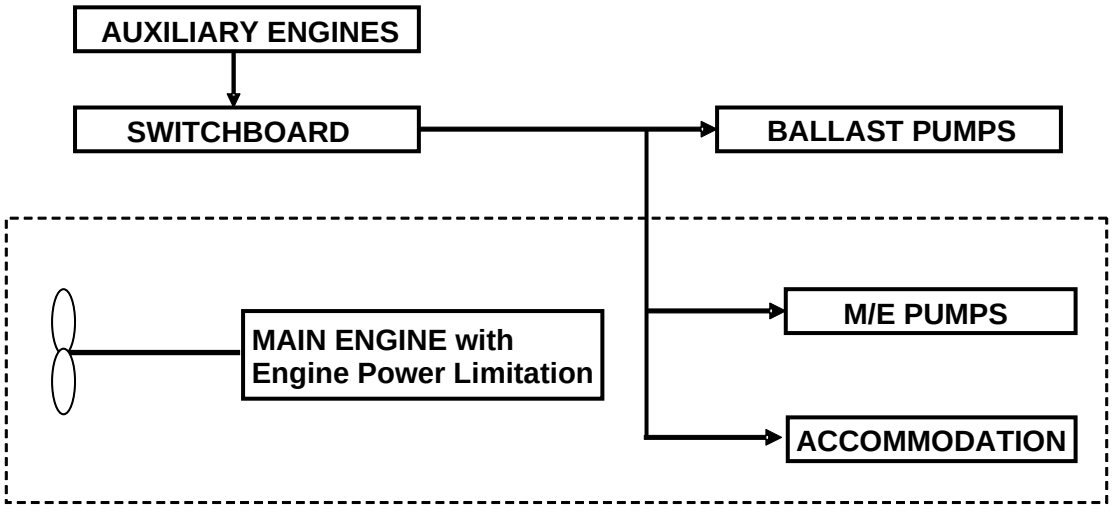

Figure 3.1: Schematic figure of propulsion and electric power supply system

4 Estimation process of speed-power curve

(Example; case of pre-EEDI ship)
Speed-power curve is estimated based on model test results and numerical calculations, if available. The flow of the estimation processes is shown below.

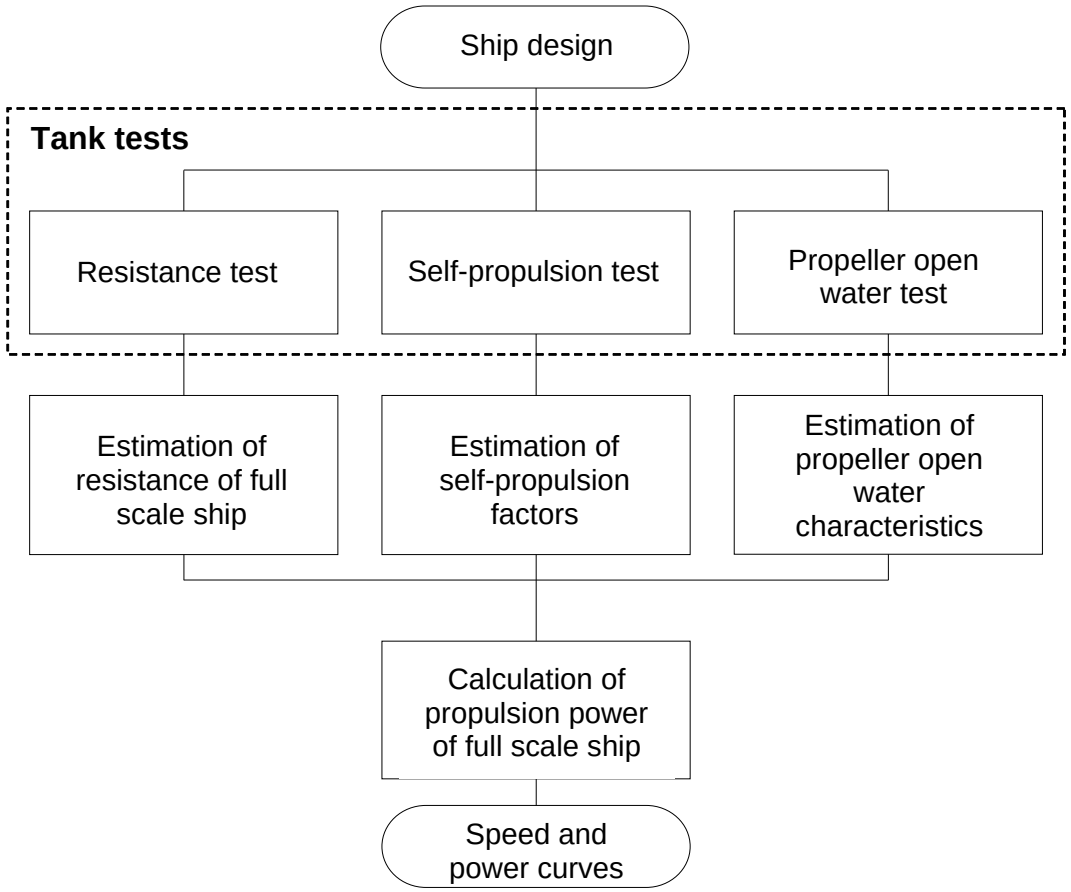

Figure 4: Flow-chart of process for estimating speed-power curve from tank tests

5 Description of energy saving equipment

5.1 Energy saving equipment the effects of which are expressed as $P_{AEeff(i)}$ and/or $P_{eff(i)}$ in the EEXI calculation formula

N/A

5.2 Other energy saving equipment

(Example)

5.2.1 Rudder fins

5.2.2 Rudder bulb

……
(Specifications, schematic figures and/or photos, etc. for each piece of equipment or device should be indicated. Alternatively, attachment of a commercial catalogue may be acceptable.)

6 Calculated value of attained EEXI

6.1 Basic data

Type of ship	Capacity DWT	Speed V_{ref} (knots)
Bulk carrier	150,000	13.20

6.2 Main engine

MCR_{ME} (kW)	$MCR_{ME,lim}$ (kW)	P_{ME} (kW)	Type of fuel	C_{FME}	SFC_{ME} (g/kWh)
15,000	11,000	8,250	Diesel oil	3.206	166.5

6.3 Auxiliary engines

P_{AE} (kW)	Type of fuel	C_{FAE}	SFC_{AE} (g/kWh)
625	Diesel oil	3.206	220.0

6.4 Ice class

N/A

6.5 Innovative electrical energy efficient technology

N/A

6.6 Innovative mechanical energy efficient technology

N/A

6.7 Cubic capacity correction factor

N/A

6.8 Calculated value of attained EEXI

$$EEXI = \frac{\left(\prod_{j=1}^{M} f_j\right)\left(\sum_{i=1}^{nME} P_{ME(i)} \cdot C_{FME(i)} \cdot SFC_{ME(i)}\right) + \left(P_{AE} \cdot C_{FAE} \cdot SFC_{AE}\right)}{f_i \cdot f_c \cdot f_l \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m}$$

$$+ \frac{\left\{\left(\prod_{j=1}^{M} f_j \cdot \sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{neff} f_{eff(i)} \cdot P_{AEeff(i)}\right) \cdot C_{FAE} \cdot SFC_{AE}\right\}}{f_i \cdot f_c \cdot f_l \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m}$$

$$- \frac{\left(\sum_{i=1}^{neff} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME}\right)}{f_i \cdot f_c \cdot f_l \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m}$$

$$= \frac{1 \times (8250 \times 3.206 \times 166.5) + (625 \times 3.206 \times 220.0) + 0 - 0}{1 \times 1 \times 1 \times 150000 \times 1 \times 13.20 \times 1}$$

$$= 2.41\ (g - CO_2/ton \cdot mile)$$

attained EEXI: 2.41 g-CO_2/ton mile

***

ANNEX 3

DRAFT GUIDELINES ON THE SHAFT / ENGINE POWER LIMITATION SYSTEM TO COMPLY WITH THE EEXI REQUIREMENTS AND USE OF A POWER RESERVE

Table of contents

0 General

The purpose of these Guidelines is to provide technical and operational conditions that the SHaPoLi / EPL system should satisfy in complying with the EEXI requirements and in using a power reserve for existing ships. However, noting that guidelines on the SHaPoLi / EPL system under EEDI framework on new ships are currently considered at the Committee, these guidelines under EEXI and EEDI may be consolidated into one set of guidelines as appropriate upon consideration by the Committee, taking into account circumstances and technical limitation of existing ships.

1 Definitions

1.1 *Shaft power* means the mechanical power transmitted by the propeller shaft to the propeller hub. It is the product of the shaft torque and the shaft rotational speed. In case of multiple propeller shafts, the shaft power means the sum of the power transmitted to all propeller shafts.

1.2 *Engine power* means the mechanical power transmitted from the engine to the propeller shaft. In case of multiple engines, the engine power means the sum of the power transmitted from the engines to the propeller shafts.

1.3 *Overridable Shaft Power Limitation (SHaPoLi) system* means a verified and approved system for the limitation of the maximum shaft power by technical means that can only be overridden by the ship's master or the officer in charge of navigational watch (OICNW) for the purpose of securing the safety of a ship or saving life at sea. (See figure 1 for an illustration of engine load diagram.)

1.4 *Overridable Engine Power Limitation (EPL) system* means a verified and approved system for the limitation of the maximum engine power by technical means that can only be overridden by the ship's master or OICNW for the purpose of securing the safety of a ship or saving life at sea. (See figure 1 for an illustration of engine load diagram.)

1.5 *Power reserve* means shaft / engine power above the limited power which cannot be used in normal operation unless in the case when SHaPoLi / EPL is unlimited for the purpose of securing the ship safety.

1.6 *MARPOL* means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocols of 1978 and 1997 relating thereto, as amended.

1.7 For the purpose of these Guidelines, the definitions in MARPOL Annex VI, as amended, apply.

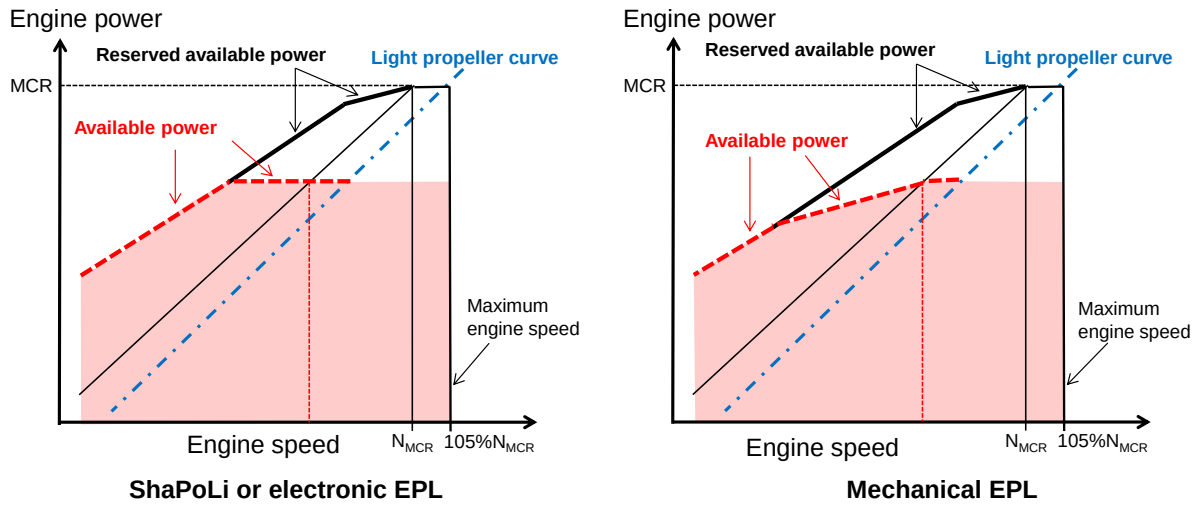

Figure 1: Engine load diagram on Shaft/Engine Power Limitation

2 Technical requirements for the SHaPoLi / EPL system

2.1 Required main systems

The SHaPoLi / EPL system should consist of the following main arrangements:

.1 SHaPoLi:

.1 sensors for measuring the torque and rotational speed delivered to the propeller(s) of the ship. The system includes the amplifier and the analogue to the digital converter;

.2 a data recording and processing device for tracking and calculation of the data as given in paragraph 2.2.5.1 of these Guidelines; and

.3 a control unit for calculation and limitation of the power transmitted by the shaft to the propeller(s);

.2 EPL:

.1 for the mechanically controlled engine, a sealing device which can physically lock the fuel index by using a mechanical stop screw sealed by wire or an equivalent device with governor limit setting so that the ship's crew cannot release the EPL without permission from the ship's master or OICNW, as shown in figure 2; or

.2 for the electronically controlled engine, fuel index limiter which can electronically lock the fuel index or direct limitation of the power in the engine's control system so that the ship's crew cannot release the EPL without permission from the ship's master or OICNW.

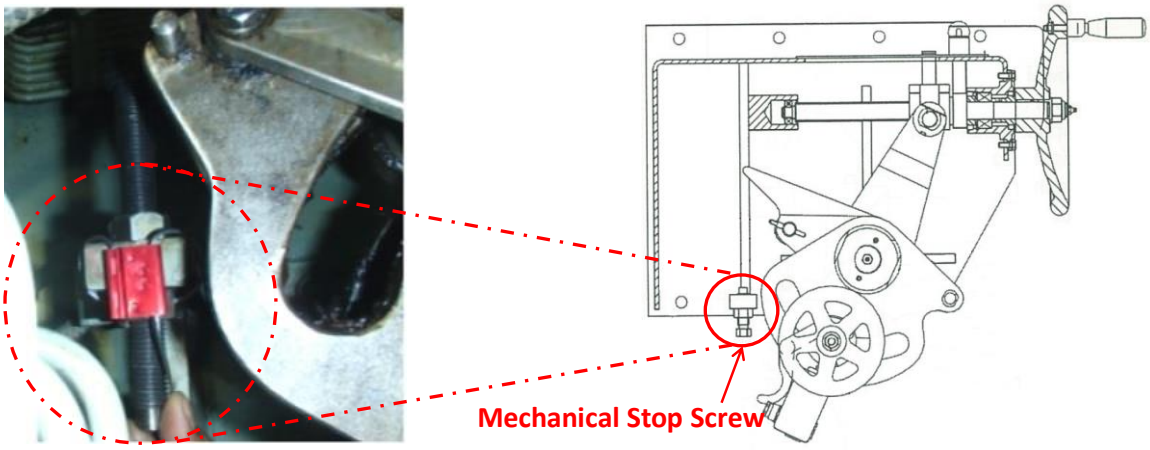

Figure 2: Sealing of mechanical stop screw

2.2 General system requirements

2.2.1 The SHaPoLi / EPL system should be non-permanent but should require the deliberate action of the ship's master or OICNW to enable the use of unlimited shaft / engine power (power reserve) of the ship.

2.2.2 For SHaPoLi / EPL system for the electronically controlled engine, the control unit should inform the ship's master or OICNW clearly and conspicuously when the ship's shaft / engine power exceeds the limited shaft / engine power as stated in the Onboard Management Manual (OMM) for SHaPoLi / EPL or in any case of system malfunction.

2.2.3 For EPL for the mechanically controlled engine, the sealing device should either:

.1 visibly indicate removal of the sealing when the ship's engine power exceeds the limited engine power as stated in the OMM for EPL or in any case of system malfunction; or

.2 be equipped with other systems such as an alert-monitoring system which can indicate when the ship's engine power exceeds the limited engine power as stated in the OMM for EPL or in any case of system malfunction and recording the use of un-limited mode, verified by the Administration or the RO.

2.2.4 The SHaPoLi / EPL system (or each sub system) should be tamper-proof.

2.2.5 The SHaPoLi / EPL system for the electronically controlled engine should indicate following data during operation:

.1 for SHaPoLi, shaft rotational speed, shaft torque and shaft power (and total shaft power in case of multiple shaft arrangements) to be recorded constantly in un-limiting mode; or

.2 for EPL, a fuel index sealing system or power limitation system which can indicate and record the use of un-limited mode.

2.2.6 The procedure for SHaPoLi / EPL depends on the propulsion system and should be described in the OMM for SHaPoLi / EPL in accordance with section 4 of these Guidelines.

3 Use of a power reserve by un-limiting the shaft / engine power limitation

3.1 The use of a power reserve is only allowed for the purpose of securing the safety of a ship or saving life at sea, consistent with regulation 3.1 of MARPOL Annex VI (e.g. operating in adverse weather and ice-infested waters, participation in search and rescue operations, avoidance of pirates and engine maintenance). Use of a power reserve should not have adverse impact on the propeller, shaft and related systems.

3.2 Any use of a power reserve should be recorded in the record page of the OMM for SHaPoLi / EPL, signed by the master and should be kept on board. The record should include:

.1 ship type;

.2 IMO number;

.3 ship size in DWT and/or GT, as applicable;

.4 ship's limited shaft / engine power and ship's maximum unlimited shaft / engine power;

.5 position of the ship and timestamp when the power reserve was used;

.6 reason for using the power reserve;

.7 Beaufort number and wave height or ice condition in case of using the power reserve under adverse weather condition;

.8 supporting evidence (e.g. expected weather condition,) in case of using the power reserve for avoidance action;

.9 records from the SHaPoLi / EPL system for the electronically controlled engine during the power reserve was used; and

.10 position of the ship and timestamp when the power limit was reactivated or replaced.

3.3 In case of having used a power reserve, the ship should without delay notify its Administration or RO responsible for issuing the relevant certificate and the competent authority of the relevant port of destination with the information recorded in accordance with paragraph 3.2. On an annual basis, the Administration should report uses of a power reserve to IMO with the information recorded in accordance with paragraph 3.2.

3.4 Once the risks have been mitigated, the ship should be operated below the certified level of engine power under the SHaPoLi / EPL. The SHaPoLi / EPL system should be reactivated or replaced by the crew immediately after the risks have been prevented and the ship can be safely operated with the limited shaft / engine power. The reactivation or replacement of the SHaPoLi / EPL system should be confirmed (e.g. validation of mechanical sealing) with supporting evidence (e.g. engine power log, photo taken at the occasion of resetting the mechanical sealing) by the Administration or the RO at the earliest opportunity.

3.5 Any defect of the SHaPoLi / EPL system should be reported to the Administration or RO responsible for issuing the relevant certificate in accordance with regulation 5.6 of MARPOL Annex VI.

3.6 The port State control officers should inspect whether the SHaPoLi / EPL system has been properly installed and used in accordance with the IEE Certificate and the OMM as described in section 4 of these Guidelines. If overriding of the SHaPoLi / EPL without proper notification in accordance with paragraph 3.3 of these Guidelines has been detected, the reactivation or replacement of the SHaPoLi / EPL should be immediately conducted in the presence of the Administration or the RO at the port.

4 Onboard Management Manual (OMM) for SHaPoLi / EPL

4.1 The SHaPoLi / EPL system should be accompanied by the OMM for SHaPoLi / EPL that should be permanently on board the ship for inspection.

4.2 The OMM for SHaPoLi / EPL should be verified by the Administration or the RO after a survey verifying the ship's attained EEXI, as required by regulation 5.4 of MARPOL Annex VI.

4.3 The OMM for SHaPoLi / EPL should, as a minimum, include:

.1 SHaPoLi:

.1 a technical description of the main system as specified in section 2 of these guidelines as well as relevant auxiliary systems;

.2 identification of key components of the system by manufacturer, model/type, serial number and other details as necessary;

.3 description of a verification procedure demonstrating that the system is in compliance with the technical description in accordance with items .1 and .2;

.4 the maximum shaft power for which the unit is designed;

.5 service, maintenance and calibration requirements of sensors according to sensor manufacturer and a description how to monitor the appropriateness of the calibration intervals, if applicable;

.6 the SHaPoLi record book for the recording of service, maintenance and calibration of the system;

.7 the description how the shaft power can be limited and unlimited and how this is displayed by the control unit as required by paragraph 2.2.5 of these Guidelines;

.8 the description of how the controller limits the power delivered to the propeller shaft;

.9 the identification of responsibilities;

.10 procedures for notification of the use of power reserve and the detections of malfunctions of the system in accordance with paragraphs 3.4 and 3.5 of these Guidelines;

.11 time required for un-limiting the SHaPoLi; and

.12 procedures for survey of the SHaPoLi system by the Administration/RO.

.2 EPL:

.1 rated installed power (MCR) or motor output (MPP) and engine speed (N_{MCR});

.2 limited installed power (MCR_{lim}) or motor output (MPP_{lim}) and engine speed ($N_{MCR,lim}$);

.3 technical description of the EPL system;

.4 method for sealing the EPL (mechanically controlled engine);

.5 method for locking and monitoring the EPL (electronically controlled engine);

.6 procedures and methods for releasing the EPL;

.7 time required for un-limiting the EPL;

.8 procedures for survey of the EPL system by the Administration/RO;

.9 procedure for the report on release of the EPL; and

.10 administrator of the EPL system.

5 Demonstration of compliance of the SHaPoLi / EPL system

5.1 The demonstration of compliance of the SHaPoLi / EPL system should be verified by an appropriate survey in accordance with regulation 5.4 of MARPOL Annex VI for the verification of the ship's EEXI according to regulation 20A. The survey should include the verification and validation of the system by addressing the following items:

.1 the verification of compliance of the system with the OMM for SHaPoLi / EPL;

.2 the verification of compliance of the system with the specifications set out in section 2 of these Guidelines; and

.3 the verification of the OMM for SHaPoLi / EPL that the OMM for SHaPoLi / EPL is in compliance with the specifications set out in section 4 of these Guidelines.

5.2 In cases where the SHaPoLi / EPL system is applied and no changes are made to NO_X critical settings and/or components* outside what is allowed by the engine technical file as defined in the 2008 NO_X Technical Code (NTC 2008), engine re-certification is not needed.

* NO_X critical parameters and components are listed in NO_X Technical File under the section "Components, setting and operating values of the engine which may influence its NO_X emission".

5.3 In cases where the SHaPoLi / EPL system is applied and the NO_X critical settings and/or components are altered beyond what is allowed by the engine technical file as defined in NTC 2008, the engine needs to be re-certified. In such a case, for an EEDI-certified ship where the SHaPoLi / EPL system is applied at a power below that required by regulation 21.5 of MARPOL Annex VI (minimum power requirement), the certified engine power should be at the power satisfying that requirement.