



MARINE ENVIRONMENT PROTECTION
COMMITTEE
60th session
Agenda item 4

MEPC 60/4/35
15 January 2010
Original: ENGLISH

PREVENTION OF AIR POLLUTION FROM SHIPS

Mandatory EEDI requirements – Draft text for adding a new part to MARPOL Annex VI for regulation of the energy efficiency of ships

Submitted by Japan, Norway and the United States

SUMMARY

<i>Executive summary:</i>	Japan, Norway and the United States propose a draft text for the application of mandatory technical measures to improve the energy efficiency of ships and present the concept for establishment of the required EEDI reduction rates. The document also includes a provision for the inclusion of the SEEMP in the proposed framework.
<i>Strategic direction:</i>	7.3
<i>High-level action:</i>	7.3.1
<i>Planned output:</i>	7.3.1.1 and 7.3.1.3
<i>Action to be taken:</i>	Paragraph 17
<i>Related documents:</i>	MEPC 58/4/15, MEPC 58/4/17, MEPC 58/4/18, GHG-WG 2/2/16, MEPC 59/4/2, MEPC 59/4/36, MEPC 59/INF.26, MEPC 59/24, MEPC 60/4/36 and MEPC 60/4/37

Introduction

1 This document presents a proposal to establish a mandatory framework regarding the Energy Efficiency Design Index (EEDI) for new ships and the Ship Energy Efficiency Management Plan (SEEMP) for all ships in operation. MEPC 59 agreed that debates on the type of legal instrument and application issues should be discussed in light of the outcome of COP 15. Hence, this document is submitted in accordance with the document deadline identified in document MEPC 60/1/Add.1.

Review of discussions on the application of technical measures

2 The first Intersessional Meeting of the Working Group on Greenhouse Gas Emissions from Ships (GHG-WG 1) developed a draft regulatory text for a mandatory new ship CO₂ design index (paragraph 2.24 of document MEPC 58/4).

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3 At the second Intersessional Meeting of the Working Group on Greenhouse Gas Emissions from Ships (GHG-WG 2), taking into account the draft regulatory text developed at GHG-WG 1, Japan submitted document GHG-WG 2/2/16, "Regulatory framework for mandatory application of the Energy Efficiency Design Index (EEDI) and the verification and certification procedures for the EEDI", which contains the first outline for the draft text of part two of MARPOL Annex VI as its annex 1. The group noted the draft text with acknowledgement to Japan for its effort to improve editorially the draft proposed regulatory framework. While noting the intention of Japan to submit another document on the regulatory framework to MEPC 59, the group noted that it would be useful to hold an informal exchange of views among interested delegations in this regard, in order for Japan to prepare such a submission (paragraph 2.48 of document MEPC 59/4/2).

4 Considering the results of the informal exchange of views at GHG-WG 2, Japan and Norway submitted to MEPC 59 document MEPC 59/INF.26, "Updated Information on the Draft Text of Possible Framework for the Application of Technical Measures to Improve the Energy Efficiency of Ships". However, the Committee agreed that all documents including MEPC 59/INF.26 and the debates on the type of legal instrument and application issues, in their entirety, should be left for future sessions, where the issues should be discussed in light of the outcome of COP 15 (paragraph 4.40 of document MEPC 59/24).

5 Based on the decision at the last session, this session should address the type of legal instrument and application issues. Thus, in order to contribute to the discussions on the matters, the co-sponsors propose a draft text for the application of technical measures to improve the energy efficiency of ships and also present the concept for establishment of the required EEDI reduction rates.

Legal instrument for mandatory application

6 Regarding the legal instrument to introduce the aforementioned mandatory EEDI scheme, the co-sponsors are of the view that adding a new part to MARPOL Annex VI, which addresses the improvement of energy efficiency of ships to reduce greenhouse emissions, could be the primary option.

7 The MARPOL Convention and its Annexes, equipped with well-established and workable practices, including verification, certification and inspection, can provide a similar legal basis for the mandatory EEDI scheme. Also, considering the urgency of establishing an effective mandatory mechanism to improve the energy efficiency of ships, the amendments to MARPOL Annex VI seem appropriate because it is the earliest and probably the only way to establish such a mechanism in the short term. On the other hand, taking into account that the current MARPOL Annex VI addresses prevention of air pollution from ships, such as emissions of SO_x and NO_x, which have direct impacts on human health and the environment, it is reasonable to separate this new issue from the current Annex VI and thus to add a new part (Part two) addressing the improvement of energy efficiency.

Concept of EEDI requirements

8 The co-sponsors follow the general ideas on the EEDI mandatory requirements contained in annex 6 to document MEPC 58/4 (Report of the outcome of the first Intersessional Meeting of the Working Group on Greenhouse Gas Emissions from Ships) and document MEPC 59/INF.26 (Japan and Norway). This means that, for each ship, its attained EEDI should not exceed the relevant required EEDI, which is determined by the baselines developed by the Organization and the EEDI reduction rate (X). For new ships of a certain gross tonnage and above, the following should be satisfied:

$$\text{Attained EEDI} \leq \text{Required EEDI} = (1-X/100) * \text{Baseline}$$

where:

The attained EEDI is to be calculated in accordance with the interim Guidelines on the method of calculation of the Energy Efficiency Design Index for new ships (“the Calculation Guidelines”, hereafter);

The EEDI baseline is to be determined by the Organization for each ship type category as contained in the Calculation Guidelines, through the statistical analysis using data from the Lloyds-Fairplay database, following the methodology given in the “Guidance of Developing the Baselines”, of which a draft is proposed in document MEPC 60/4/7 (Denmark and Japan).

9 The EEDI reduction rate X would be determined according to the year ships are constructed. It is suggested here to take a three-phased approach, at the time of developing the mandatory EEDI requirements for the first time; longer-term reduction rates would be set at a later stage, taking into account the development and experiences gained during the early era of the EEDI requirements and their implementation.

Phase 1: For ships of which contract is signed from [1 January 2013 to 31 December 2017]

$$X = aa\%;$$

Phase 2: For ships of which contract is signed from [1 January 2018 to 31 December 2022]

$$X = bb\%; \text{ and}$$

Phase 3: For ships of which contract is signed from [1 January 2023 to 31 December 2027]

$$X = cc\%.$$

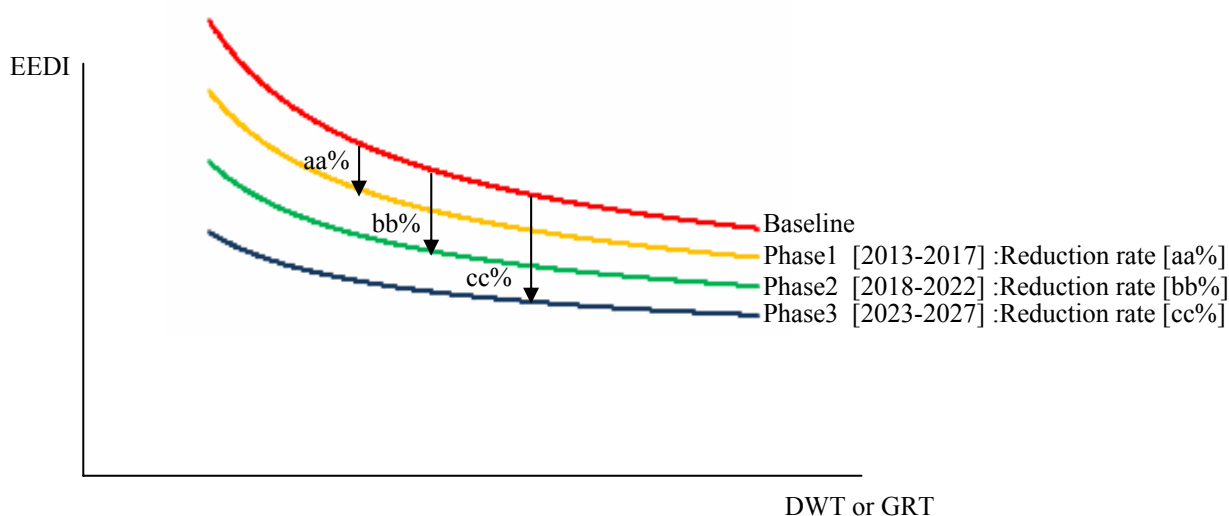


Figure 1: Phased approach to set the EEDI requirements

Efficiency measures and EEDI

10 A detailed formula is provided in the Calculation Guidelines as follows:

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

11 In considering how to improve the energy efficiency of ships, it is important to understand the relationship between the EEDI and efficiency improvement measures, i.e. how each improvement measure affects the EEDI. The conceptual and simple formula for the calculation of the EEDI is set out below, which may be helpful for understanding this relationship:

$$\text{EEDI (g/tonnes-mile)} = \frac{\text{Engine Power(kW)} \times \text{SFC(g/kWh)} \times C_F}{\text{Capacity (DWT)} \times \text{Speed(kt)}}$$

Simply put, there are three approaches to improve the EEDI value:

.1 DWT enlargement:

Although larger DWT requires larger engine power, DWT enlargement can improve the efficiency – i.e. reduce the EEDI value. This is because, generally speaking, the necessary engine power increases in proportion to the DWT increase is powered by two-third, and therefore the increase of the denominator outweighs that of the numerator. It should be noted that, while DWT enlargement improves the efficiency and lowers the EEDI of a ship, the ship would be subject to a lower (more stringent) required EEDI value due to the capacity increase;

.2 Speed reduction:

Lowering the speed would reduce the necessary engine power considerably as the engine power is in proportion to the speed powered by three. Thus, speed reduction is very effective in improving the efficiency; and

.3 Application of new technologies:

New technology here means one which can be considered as technically achievable and be applicable to a particular ship type from an engineering viewpoint. The advantage of application of new technology is that it can improve the EEDI value without changing DWT or ship speed; the improvement in efficiency would not cause any changes to, or constraints on, the operation patterns of the ship.

Consideration on how to set appropriate reduction rates for the required EEDI for new ships

12 Figure 2 illustrates the relationship between the EEDI and improvement measures. The point of “Base Ship” represents the EEDI and DWT of the average and representative ship among existing ships with a conventional machinery and propulsion system. The point of “Modified Ship” represents the EEDI and DWT where various efficiency improvement measures are assumed to have been applied to the “Base Ship” and now the “Base Ship” becomes a newly designed “Modified Ship”.

13 The effect of (a) size increase is to move EEDI in parallel with the baseline; thus, it does not contribute to the downward shift of the lines. The effect of (b) speed reduction does contribute to the downward shift, however, it should be recalled that the required EEDI value for a new ship is “minimum” requirement for every new ship. No matter what special circumstances (route-specific) ships are obliged to operate under, they would have to satisfy this minimum requirement. In view of the above, the co-sponsors consider that speed reduction should be kept aside as an option or some margin for shipowners to meet the required EEDI value. In conclusion, reduction rates should be determined by the effects of (c) application of new technologies only.

14 In order to set the reduction rate X, one has to consider the appropriate combination of technologies to be applied for a particular ship type. It should be noted that there is a “time factor” for such a combination of technologies: maturity of each technology and future prospects for further development of such technologies, has to be considered. Therefore, extensive case studies would be necessary to find out which technologies could be applied to a representative ship type to be built in a certain year.

15 Once the reduction rate X is established by such technical considerations, there will be freedom for each ship on how to satisfy the required EEDI value. After X is determined, ships do not necessarily apply those specific technologies that have been applied in analytical works of setting the reduction rate X. The designer or builder of ships may choose other combinations of technologies, or, even without using any new technologies, they may resort to “low-tech” solutions; i.e. to have a lower design speed (thus lower engine output) to achieve the required EEDI reduction.

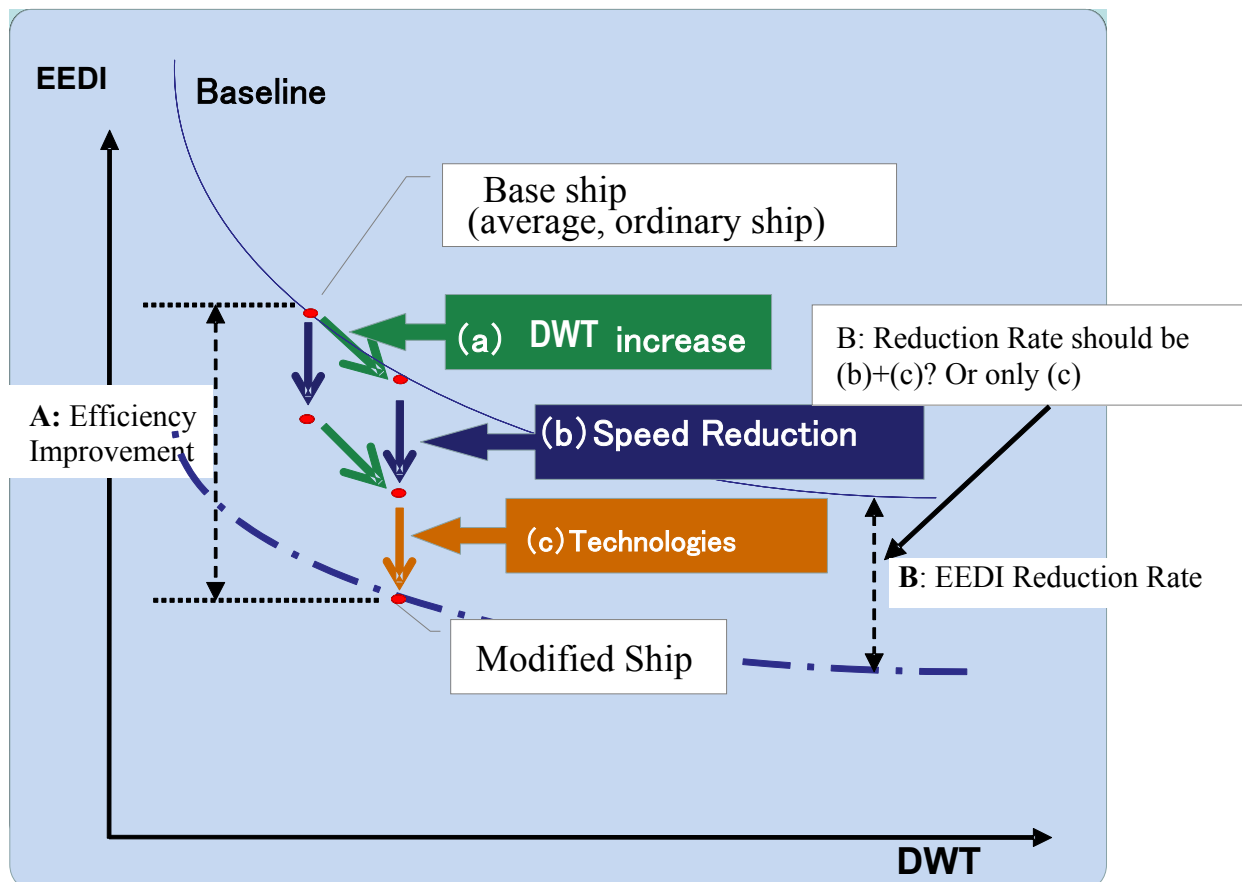


Figure 2: Improvement measures for EEDI

Draft text for the application of technical measures

16 The annex to this document contains the draft text for the application of mandatory technical and operational measures to improve the energy efficiency of ships.

Action requested of the Committee

17 The Committee is invited to consider the proposed framework for mandatory application of the EEDI and SEEMP, contained in the annex to this document, and take action as appropriate.

ANNEX

**DRAFT TEXT FOR A NEW PART IN MARPOL ANNEX VI ON ENERGY
EFFICIENCY OF SHIPS**

Regulation X-1 – Definitions

For the purpose of this annex:

- 1 “Existing ship” means a ship which is not a new ship.
- 2 “New ship” means a ship:
 - .1 for which the building contract is placed on or after the entry into force of this Part of this annex; or
 - .2 in the absence of a building contract, the keel of which is laid or which is at a similar stage of construction on or after six months after the entry into force of this Part of this annex; or
 - .3 the delivery of which is on or after [30] months after the entry into force of this Part of this annex.
- 3 “Major Conversion” means a conversion of a ship:
 - .1 which substantially alters the dimensions or carrying capacity of the ship; or
 - .2 which changes the type of the ship; or
 - .3 the intent of which in the opinion of the Administration is substantially to prolong its life; or
 - .4 which otherwise so alters the ship that, if it were a new ship, it would become subject to relevant provisions of the present Convention not applicable to it as an existing ship; or
 - .5 which substantially alters the energy efficiency of the ship.
- 4 “Passenger ship” means a ship which carries more than 12 passengers as defined in SOLAS chapter I, regulation 2.
- 5 “Dry cargo carrier” means a ship which is constructed generally with single deck, top-side tanks and hopper side tanks in cargo spaces, and is intended primarily to carry dry cargo in bulk, and includes such types as ore carriers and combination carriers as defined in SOLAS chapter IX, regulation 1.
- 6 “Gas tanker” means a gas carrier as defined in SOLAS chapter II-1, regulation 3.
- 7 “Tanker” means an oil tanker as defined in MARPOL Annex I, regulation 1 or chemical tanker and an NLS tanker as defined in MARPOL Annex II, regulation 1.
- 8 “Container ship” means a ship designed exclusively for the carriage of containers in holds and deck.
- 9 “Ro-ro cargo ship (Vehicle carrier)” means a ship with multi deck ro-ro cargo ship designed for the carriage of empty car and trucks.

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|----|---|
| 10 | “Ro-ro cargo ship (Volume carrier)” means a ship with a deadweight per lanemetre less than [4]* tons/m, designed for the carriage of cargo transportation units. |
| 11 | “Ro-ro cargo ship (Weight carrier)” means a ship with a deadweight per lanemetre of [4] tons/m or above, designed for the carriage of cargo transportation units. |
| 12 | “General cargo ship” means a ship with a multi-deck or single deck hull designed primarily for the carriage of general cargo. |
| 13 | “Ro-ro passenger ship” means a passenger ship as defined in SOLAS chapter II-1, Part A, regulation 2.23. |
| 14 | ... (any other “commodity” type of definitions). |

* NOTE: The value should be further investigated during the period of voluntary use of the EEDI.

Regulation X-2 – Application

- | | |
|---|--|
| 1 | The provisions of this Part of this annex shall apply to all ships of [400] gross tonnage and above, which fall into one of the categories in regulation X-1.4 – X-1.13, except where expressly provided otherwise in regulation [X-xx, X-yy] of this Part of the annex. |
| 2 | The provisions of this Part of this annex shall not apply to: <ul style="list-style-type: none">.1 ships operating in waters subject to the sovereignty or jurisdiction of the State whose flag the ship is entitled to fly. However, each Party shall ensure, by the adoption of appropriate measures, that such ships act in a manner consistent with this Part of this annex, so far as is reasonable and practicable;.2 any warship, naval auxiliary or other ship owned or operated by a State and used on government non-commercial service. However, each Party shall ensure, by the adoption of appropriate measures not impairing operations or operational capabilities of such ships owned or operated by it, that such ships act in a manner consistent, so far as is reasonable and practicable, with this Part of this annex. |

Here it is written in a way that the application is limited to those ships of which categories are listed and defined in regulation X-1, subparagraphs 4 to 13. Therefore, such specialized ships as ocean tugs and offshore supply vessels, would not be covered as they do not fall into the ship categories in regulation X-1. The inclusion of such ships can be done by adding a ship category definition as appropriate in regulation X-1.

Based on the discussion at GHG-WG 2 (paragraph 2.8 of document MEPC 59/4/2), it was regarded as reasonable and practicable to establish three levels for the application of the provisions. Ships belonging to the category I are exempted from all the provisions of this Part of the Annex. Ships in category II are subject to all the provisions of this Part of this annex except for those of Required EEDI (regulation X-4). Ships in category III are subject to all the provisions.

Category I is the group of very small ships and boats (less than [400] gross tonnage), of which contribution to CO₂ emissions is very small. Category II is the group of relatively small ships (between [400] and [Y] gross tonnage), of which Attained EEDIs shall be calculated so that shipowners can compare ship performance and choose more energy efficient ships, but will not be compared with the Required EEDI.

In addition, it is considered necessary to exempt ships operating only in waters subject to the sovereignty or jurisdiction of the State whose flag the ship is entitled to fly, as they are already covered by the existing across-sector regime. However, encouraging each Party to ensure that such ships act in a manner consistent with the provisions for the other categories/types of ships is considered beneficial. The similar provisions are included in the Ballast Waste Management Convention and the draft Ship Recycling Convention.

<Quick reference of the application of the requirements>

	GT	Attained EEDI (with verification)	Required EEDI
Category I	- [400]	X	X
Category II	[400] - [Y]	O	X
Category III	[Y] -	O	O
Not international ships		X	X

O: applied X: not applied

Regulation X-3 – Attained Energy Efficiency Design Index (Attained EEDI)

1 The Attained EEDI shall be calculated for each new ship. The EEDI shall be specific to each ship and shall indicate the estimated performance of the ship in terms of energy efficiency, and be accompanied by the technical file that contains the information necessary for the calculation of the EEDI and that shows the process of calculation. The EEDI shall be verified, based on the technical file, either by the Administration or by any person or organization authorized by it taking into account guidelines developed by the Organization.

2 Attained EEDI is defined as:
(EEDI formula and the definitions of parameters, as currently contained in MEPC.1/Circ.681 “Interim Guidelines on the method of calculation of the Energy Efficiency Design Index for new ships”.)

There should be consideration to what extent and level of detail the calculation methodology of EEDI is to be written in the instrument itself with the rest of the detailed definitions and technical explanation being left to the Code or the Guidelines.

MARPOL Annex I includes quite detailed provisions on the calculation of the mean oil outflow parameter in regulation 23 and regulation 24. Meanwhile, MARPOL Annex VI leaves much of the measurement methodology and parameter settings to the NO_x Technical Code.

Attained EEDI of ships should be verified, based on the technical file, either by the Administration or by any person or organization authorized by it taking into account the guidelines for verification and certification to be developed by the Organization. Technical file should include necessary information to verify Attained EEDI. For the consistent and transparent verification, the detailed requirements on the technical file should be described in the guidelines.

Refer to MEPC.1/Circ.682 "Interim Guidelines on voluntary verification on the Energy Efficiency Design Index" and to document MEPC 60/4/5 (verification trials) submitted by Japan.

Regulation X-4 – Required EEDI

1 For new ships of [Y] gross tonnage and above, the attained EEDI shall be as follows:

$$\text{Attained EEDI} \leq (1-X/100) \times \text{Baseline value (Required EEDI)}$$

where X is the reduction factor of the EEDI, in percentage, compared to the EEDI baseline, to be determined as follows:

For ships of which contract is placed on or after [day month year] and before [day month year] $X = [\quad]$

For ships of which contract is placed on or after [day month year] and before [day month year] $X = [\quad]$

For ships of which contract is placed on or after [day month year] and before [day month year] $X = [\quad]$

2 The Baseline value shall be calculated as follows:

$$\text{The Baseline value} = a \times b^{-c}$$

where a, b and c are the parameters determined by the following table:

Ship Type	A	b	c
Tanker		DWT of the ship	

3 If the design of a ship allows it to fall into more than one of the above ship type definitions, the required EEDI for the ship shall be the most stringent (the lowest) required EEDI.

4 Beginning in [year] and completed no latter than [year], the Organization shall review the status of technological developments to implement the standards set forth in paragraph 1 of regulation X-4 and shall, if proven necessary, adjust the time periods set forth in that paragraph.

For ships in category III, their Attained EEDI should be equal to or below their Required EEDI, which should be determined by the baselines developed by the Organization and the reduction factor (X). Required EEDI should be strengthened in a gradual manner to ensure the constant energy improvement of new ships. As the baseline and the reduction factors are to set the requirement level itself, they should be specified inside the instrument. However, in order to reflect the degree of technological development in the future, the review clause similar to the amended MARPOL Annex VI may be introduced.

Japan submits document MEPC 60/4/36 which provided for analysis on the reduction rates on EEDI.

Regulation X-5 – Ship Energy Efficiency Management Plan (SEEMP)

NOTE: This document has not analysed appropriate methods of making the SEEMP mandatory. This Regulation X-5 is inserted as a place-holder for SEEMP requirements, and the text below is a very preliminary draft, pending concrete proposals in the future.

[1 The ship shall keep on board a SEEMP approved either by the Administration or by any person or organization recognized by it.

2 SEEMP shall be developed taking into account the guidelines adopted by the Organization, and contain, at least:

- .1 Information of ship (Name of ship, Ship type, Gross tonnage, Capacity, etc.);
- .2 Its properties (Date of development, Implementation period, Planned Date of next evaluation etc.);
- .3 Energy efficiency measures (Improved voyage planning, Weather routing, Just in time, Speed optimization, etc.);
- .4 Monitoring tools (Energy Efficiency Operational Indicator (EEOI) is considered as primary monitoring tool and other monitoring tools can be used if convenient or beneficial for a company or a ship);
- .5 Measurable goals (Target of EEOI, Annual fuel consumption, etc.);
- .6 ... (other items to be considered).]

There should be a notion here that SEEMP should be appropriately updated and maintained.

Refer to MEPC.1/Circ.683 “Guidance for the development of a Ship Energy Efficiency Management Plan (SEEMP)”.

Regulation X-6 – Surveys

1 Ships to which this Part of this Annex applies shall be subject to the surveys specified below:

- .1 an initial survey before the ship is put in service, or before the International Certificate on the Energy Efficiency of the Ship is issued. This survey shall verify that the EEDI required by regulations X-3 and X-4 as well as the SEEMP required by regulation X-5 is in accordance with the requirements of this Part of the annex;
- .2 a renewal survey for SEEMP at intervals specified by Administration, but not exceeding [] years. [The renewal survey shall be such as to ensure that SEEMP complies with applicable requirements of this Part of this annex.];
- .3 [an additional survey, either general or partial, according to the circumstances, after a major conversion of the ship. The survey shall be such as to ensure that any such change and major conversion have been made in the way that the ship complies with the requirements of this Part of this annex and that the EEDI is recalculated as necessary.]

This regulation is to be discussed together with the draft Guidelines on Survey and Certification, which will be a revised version of MEPC.1/Circ.682 “Interim Guidelines on voluntary verification of the Energy Efficiency Design Index”.

Regulation X-7 – Issue or endorsement of certificate

1 An International Certificate on the Energy Efficiency of the Ship shall be issued, after an initial or renewal survey in accordance with the provisions of regulation X-6, to any ship of [] gross tonnage and above engaged in voyages to ports or offshore terminals under jurisdiction of other Parties.

2 Such certificate shall be issued or endorsed either by the Administration or by any person or organization duly authorized by it. In every case, the Administration assumes full responsibility for the certificate.

3 ... (followed by the standard clauses as the other IMO instruments)

Regulation X-8 – Port State control on operational requirements

1 A ship when in a port of another Party is subject to inspection by officer duty authorized by such Party concerning operational requirements under this Part of the annex, where there are clear grounds, for believing that the master or crew are not familiar with essential shipboard procedures relating to the prevention of pollution from ships.

2 In the circumstances given in paragraph 1 of this regulation, the Party shall take such steps as will ensure that the ship shall not sail until the situation has been brought to order in accordance with the requirements of this Part of this annex.

3 Procedures relating to the port State control prescribed in article 5 of the present Convention shall apply to this regulation.

4 Nothing in this regulation shall be construed to limit the rights and obligations of a Party carrying out control over operational requirement specifically provided for in the present Convention.