

## June 2018 Development Paper

### MariEMS Learning Material

This is the 23rd compilation by Professor Dr Reza Ziarati on the work of the EU funded Erasmus + MariEMS' partners and material extracted from the IMO TTT Course. The material is composed from Chapter 23 of the learning material. Readers are also advised to refer to the papers on IdeaPort and IdealShip projects led by C4FF and published by MariFuture.

## 23. Chapter 4 of MARPOL Annex vi

### 23.1 Overview

As a result of energy efficiency debate at the IMO and subsequent agreements, a new Chapter 4 was added to MARPOL Annex VI. Table 23.1 shows (in red) the list of added new regulations.

Resolution MEPC.176(58)	Resolution MEPC.203(62)
Chapter III Reg. 12 Ozone Depleting Substances Reg. 13 Nitrogen Oxides(NOx) Reg. 14 Sulphur Oxides(SOx) and Particular Matter Reg. 15 Volatile Organic Compounds (VOCs) Reg. 16 Shipboard Incineration Reg. 17 Reception Facilities Reg. 18 Fuel Oil Availability and Quality	Chapter III Reg. 12 Ozone Depleting Substances Reg. 13 Nitrogen Oxides(NOx) Reg. 14 Sulphur Oxides(SOx) and Particular Matter Reg. 15 Volatile Organic Compounds(VOCs) Reg. 16 Shipboard Incineration Reg. 17 Reception Facilities Reg. 18 Fuel Oil Availability and Quality
	<b>Chapter IV</b> <b>Reg. 19 Application</b> <b>Reg. 20 Attained EEDI</b> <b>Reg. 21 Required EEDI</b> <b>Reg. 22 SEEMP</b> <b>Reg. 23 Promotion of technical co-operation and transfer of technology relating to the improvement of energy efficiency of ships</b>
Appendix I ~VI	Appendix I ~VI <b>Appendix VIII Form of International Energy Efficiency(IEE) Certificate</b>

**Table 23.1 newly added regulations (marked red) for energy efficiency of ships**

In this section, a short description of the main aspects of these regulations is provided. Further details on the subject can be found in relevant publications by IMO in particular the IMO book on MARPOL Annex VI [IMO MARPOL Annex VI, 2013].

### 23.2 Regulation 19 – Application

This regulation specifies the domain of application of the energy efficiency regulations. Accordingly, Chapter 4 of MARPOL Annex VI applies to all ships of 400 gross tonnage and above that are engaged in international waters. It gives limited power to Administrations to waive the requirements for EEDI for a new ship up to a delivery date of 1 July 2019; subject to informing the IMO and other Parties to MARPOL Annex VI of this decision.

The “waiver” clause came about due to significant discussions at MEPC and stressing that some ships may not be able to comply with IMO requirements whilst considered as good design ships. It is important that waiver applied to specific ships and not the whole of flag State fleet. So far, there has been no need for Administrations to use this option.

### **23.3 Regulation 20 – Attained EEDI**

This regulation deals with the Attained EEDI and specifies the need for its calculation and verification. Attained EEDI is the actual EEDI of a ship as calculated using EEDI formula.

According to this regulation:

- The Attained EEDI must be calculated for each new ship, each new ship when undergoes a major conversion, or existing ships that undergo so many changes as according to judgment by Administration can be considered as a new ship.
- The Attained EEDI is only applicable to a large number of ship types but not all ships. For example, fishing vessels are not required to have an Attain EEDI.
- The Attained EEDI must be calculated taking into account relevant IMO guidelines.
- The Attained EEDI must be accompanied by an “EEDI Technical File” that contains the information necessary for the calculation of the attained EEDI and that shows the process of calculation.
- The Attained EEDI must be verified, based on the EEDI Technical File, either by the Administration or by any organisation duly authorized by it.

As indicated, some ship types (e.g. fishing vessels) are not yet part of the EEDI regulations. Specifically, the following list provides the ship types that are currently required to comply with Attained EEDI regulation.

- Bulk carrier
- Gas carrier (none LNG carriers)
- Tanker • Container ship
- General cargo ship
- Refrigerated cargo ship
- Combination carrier
- Ro-Ro cargo ships (vehicle carrier)
- Ro-Ro cargo ships
- Ro-Ro Passenger ship
- LNG carrier
- Cruise passenger ships (having non-conventional propulsion)

Also, specific ship types such as those with turbine propulsion (with the exception of LNG ships) are also excluded.

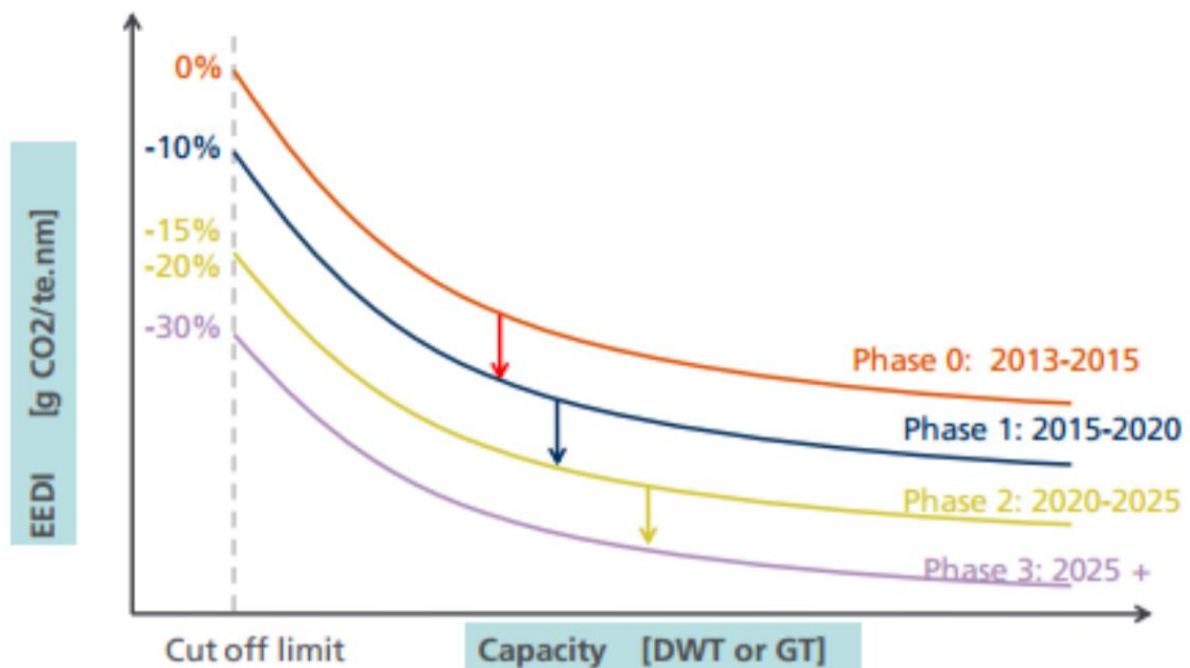
## 23.4 Regulation 21 – Required EEDI

This regulation specifies the methodology for calculation of the Required EEDI and all relevant details. The Required EEDI is the regulatory limit for EEDI and its calculation involves use of “reference lines” and “reduction factors”.

The basic concepts included in this regulation are:

- Reference line: A baseline EEDI for each ship type, representing reference EEDI as a function of ship size.
- Reduction factor: This represents the percentage points for EEDI reduction relative to the reference line, as mandated by regulation for future years. This factor is used to tighten the EEDI regulations in phases over time by increasing its value.
- Cut-off levels: Smaller size vessels are excluded from having a Required EEDI for some technical reasons. Thus, the regulatory text specifies the size limits. This size limit is referred to as cut off levels.
- Implementation phases: the EEDI will be implemented in phases. Currently, it is in phase 1 that runs from year 2015 to 2019. Phase 2 will run from year 2020 to 2024 and phase 3 is from year 2025 onwards.

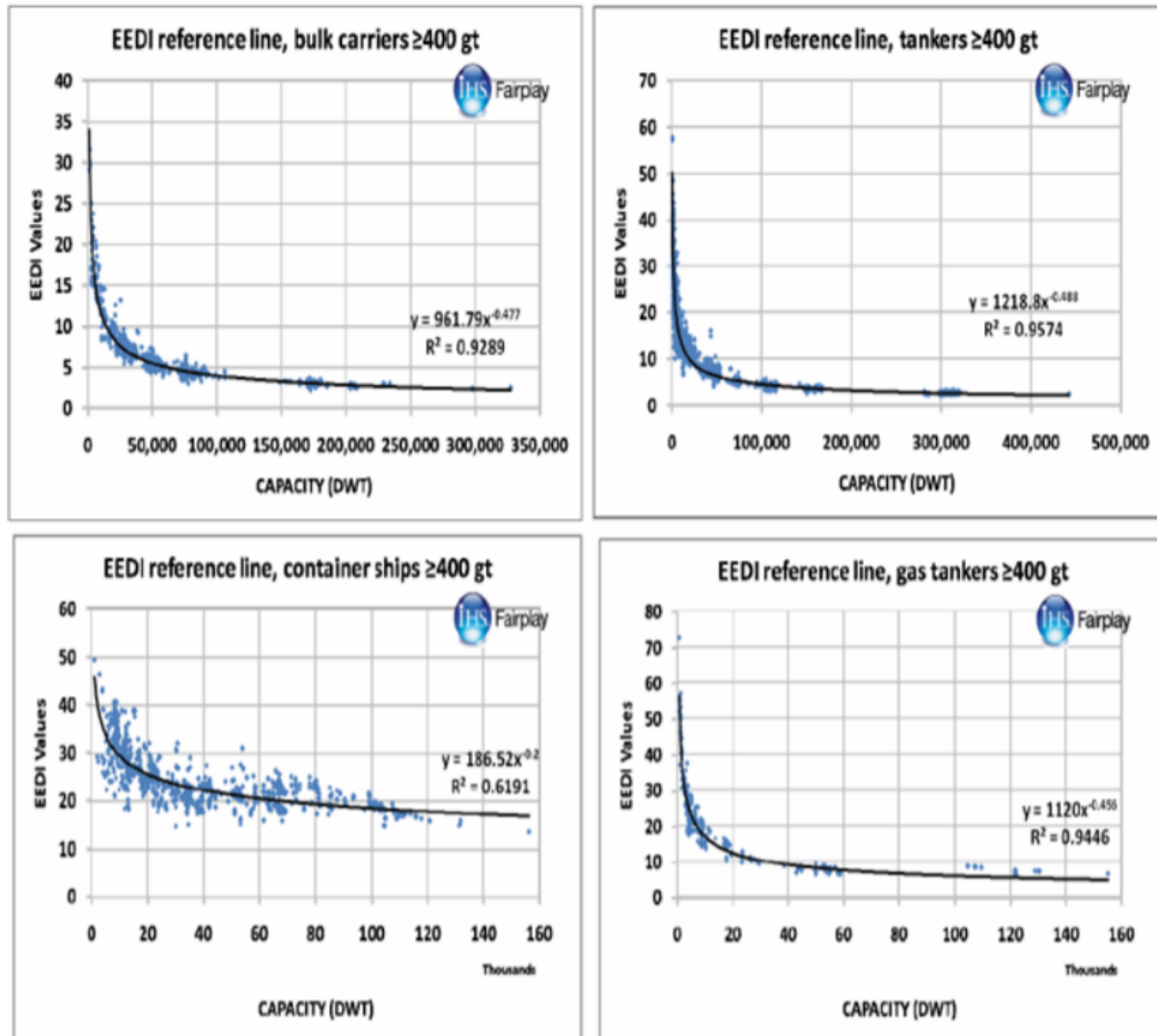
Figure 23.4.1 shows the above concepts in diagrammatic format:



**Figure 23.4.1: Concept of Required EEDI, reduction factor, cut off limits and EEDI phases**

### 23.4.1 EEDI Reference line

This is a baseline EEDI for each ship type, representing reference EEDI as a function of ship size (see graph for Phase 0 in Figure 2.1). The reference lines are developed by the IMO using data from a large number of existing ships and analysing these data as is shown in Figure 23.4.2.



**Figure 23.4.2: EEDI Reference Lines as developed by the IMO using techniques in Resolution MEPC.231 (65)**

Full details of how reference lines are developed including sources of data, data quality checks, number of ships selected and year of build, ship sizes, etc. are fully described in relevant IMO guidelines [see Resolution MEPC.231 (65) and Resolution MEPC.233 (65)]. As indicated, the above reference lines are produced through regression analysis of a large number of data and the resultant regression equation is shown on each diagram. These regression equations are then embodied in Regulation 21 in the form of a formula:

$$\text{Reference EEDI} = a * b^{-c}$$

Parameters a, b and c for some of the ship types are given in Table 23.4.3.

Ship type defined in regulation 2	a	b	c
2.25 Bulk carrier	961.79	DWT of the ship	0.477
2.26 Gas carrier	1120.00	DWT of the ship	0.456
2.27 Tanker	1218.80	DWT of the ship	0.488
2.28 Container ship	174.22	DWT of the ship	0.201
2.29 General cargo ship	107.48	DWT of the ship	0.216
2.30 Refrigerated cargo carrier	227.01	DWT of the ship	0.244
2.31 Combination carrier	1219.00	DWT of the ship	0.488

2.33 Ro-ro cargo ship (vehicle carrier)	$(DWT/GT)^{-0.7} \cdot 780.36$ where $DWT/GT < 0.3$	DWT of the ship	0.471
	1812.63 where $DWT/GT \geq 0.3$		
2.34 Ro-ro cargo ship	1405.15	DWT of the ship	0.498
2.35 Ro-ro passenger ship	752.16	DWT of the ship	0.381
2.38 LNG carrier	2253.7	DWT of the ship	0.474
2.39 Cruise passenger ship having non-conventional propulsion	170.84	GT of the ship	0.214

**Table 23.4.3: Parameters for determination of EEDI Reference value [Resolutions MEPC.203(62) and MEPC.251(66)]**

### 23.4.2 EEDI reduction factor (X)

This represents the percentage points for EEDI reduction relative to reference line, as mandated by regulation for future years. The value of “reduction factor” is decided by the IMO and is recorded in Regulation 21. This is shown in Table 24.2.3.

Ship Type	Size	Phase 0 1 Jan 2013 – 31 Dec 2014	Phase 1 1 Jan 2015 – 31 Dec 2019	Phase 2 1 Jan 2020 – 31 Dec 2024	Phase 3 1 Jan 2025 and onwards
Bulk carrier	20,000 DWT and above	0	10	20	30
	10,000 – 20,000 DWT	n/a	0-10*	0-20*	0-30*
Gas carrier	10,000 DWT and above	0	10	20	30
	2,000 – 10,000 DWT	n/a	0-10*	0-20*	0-30*
Tanker	20,000 DWT and above	0	10	20	30
	4,000 – 20,000 DWT	n/a	0-10*	0-20*	0-30*
Container ship	15,000 DWT and above	0	10	20	30
	10,000 – 15,000 DWT	n/a	0-10*	0-20*	0-30*
General Cargo ships	15,000 DWT and above	0	10	15	30
	3,000 – 15,000 DWT	n/a	0-10*	0-15*	0-30*
Refrigerated cargo carrier	5,000 DWT and above	0	10	15	30
	3,000 – 5,000 DWT	n/a	0-10*	0-15*	0-30*
Combination carrier	20,000 DWT and above	0	10	20	30
	4,000 – 20,000 DWT	n/a	0-10*	0-20*	0-30*
LNG carrier***	10,000 DWT and above	n/a	10**	20	30
Ro-ro cargo ship (vehicle carrier)***	10,000 DWT and above	n/a	5**	15	30
Ro-ro cargo ship***	2,000 DWT and above	n/a	5**	20	30
	1,000 – 2,000 DWT	n/a	0-5**, **	0-20*	0-30*
Ro-ro passenger ship***	1000 DWT and above	n/a	5**	20	30
	250 – 1,000 DWT	n/a	0-5**, **	0-20*	0-30*
Cruise passenger ship*** having non-conventional propulsion	85,000 GT and above	n/a	5**	20	30
	25,000 – 85,000 GT	n/a	0-5**, **	0-20*	0-30*

Note: n/a means that no required EEDI applies.

- \* Reduction factor to be linearly interpolated between the two values dependent upon ship size. The lower value of the reduction factor is to be applied to the smaller ship size.
- \*\* Phase 1 commences for those ships on 1 September 2015.
- \*\*\* Reduction factor applies to those ships delivered on or after 1 September 2019, as defined in paragraph 43 of regulation 2.

**Table 23.4.4: EEDI reduction factors, cut off limits and implementation phases [Resolutions MEPC.203 (62) and MEPC.251 (66)]**

### 23.4.3 Required EEDI calculation formula

Using the above concept, the following equations show the way Required EEDI is calculated for a ship. First, for each ship a “reference EEDI” is calculated using the below equation:

$$\text{Reference EEDI} = a * b^c \dots \dots (1)$$

Where:

b: Ship capacity

a and c: Constants agreed for each ship type and included in the regulation.

Reference EEDI: Reference value for EEDI.

The next step is to establish the reduction factor (X) for the ship. This is dependent on year of ship built and is specified within the regulation (see Table 23.4.4). Having established the Reference EEDI and X, the Required EEDI is calculated from the following equation:

$$\text{Required EEDI} = (1 - X/100) * (\text{Reference EEDI}) \dots \dots (2)$$

Where:

X: Reduction rate; agreed and included in Regulation.

Required EEDI: The regulatory limit of the ship’s EEDI, which the actual EEDI must not exceed.

The Required EEDI applies only to ships named in column 1 and the ship sizes specified in column 2 of Table 23.4.3. For these ships, regulation 22 stipulates that Attained EEDI must always be less than or equal to Required EEDI:

$$\text{Attained EEDI} < \text{Required EEDI} \dots \dots (3)$$

Where:

Attained EEDI: The actual EEDI of the ship, as calculated by the shipyard and verified by a recognized organization.

This regulation additionally stipulates the following:

- “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”.
- “For each ship to which this regulation applies, the installed propulsion power shall not be less than the propulsion power needed to maintain the manoeuvrability of the ship under adverse conditions as defined in the guidelines to be developed by the Organization”. “At the beginning of Phase 1 and at the midpoint of Phase 2, the IMO shall review the status of technological developments and, if proven necessary, amend the time periods, the EEDI

reference line parameters for relevant ship types and reduction rates set out in this regulation". This review process is currently underway at the IMO.

### **23.5 Regulation 22 – SEEMP**

Regulation 22 is on SEEMP and states:

1. Each ship shall keep on board a ship specific Ship Energy Efficiency Management Plan (SEEMP). This may form part of the ship's Safety Management System (SMS).
2. The SEEMP shall be developed taking into account guidelines adopted by the Organization." [MEPC Resolution 203(62)] Accordingly:
  - Each ship more than 400 GT that is involved in international voyages should have a SEEMP on board.
  - There is no specific reference to a need for review and verification of a SEEMP's content. However, its existence on board must be verified.
  - The SEEMP should be developed according to IMO guidelines.

### **23.6 Regulation 23 – Technical cooperation and technology transfer**

This regulation was developed at the request of developing countries following a significant debate at IMO MEPC on role of various countries on GHG reduction efforts as well as the technological and financial difficulties that developing countries may face as a result of energy efficiency regulations. This regulation entitled "Promotion of technical co-operation and transfer of technology relating to the improvement of energy efficiency of ships".

It stipulates that:

1. Administrations shall, in co-operation with the Organization and other international bodies, promote and provide, as appropriate, support directly or through the Organization to States, especially developing States that request technical assistance.
2. The Administration of a Party shall co-operate actively with other Parties, subject to its national laws, regulations and policies, to promote the development and transfer of technology and exchange of information to States which request technical assistance, particularly developing States, in respect of the implementation of measures to fulfil the requirements of chapter 4 of this annex, in particular regulations 19.4 to 19.6". [MEPC Resolution 203(62)].

In support of the implementation of the above regulation, IMO MEPC approved a new Resolution MEPC.229 (65). This Resolution provides a framework for the promotion and facilitation of capacity building, technical cooperation, and technology transfer to support the developing countries in the implementation of the EEDI and the SEEMP.