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INTERIM GUIDELINES FOR VOLUNTARY SHIP CO_2 EMISSION INDEXING FOR USE IN TRIALS

1 The Marine Environment Protection Committee, at its fifty-third session (July 2005), approved the Interim Guidelines for Voluntary Ship CO_2 Emission Indexing for Use in Trials, and requested the Secretariat to issue the Interim Guidelines by an MEPC Circular (MEPC 53/24, paragraph 4.55.1).

2 The Interim Guidelines, as approved by the Committee, are attached at annex hereto.

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ANNEX

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1 The Conference of Parties to the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto, held from 15 to 26 September 1997 in conjunction with the Marine Environment Protection Committee's fortieth session, adopted Conference resolution 8, on CO_2 emissions from ships. The resolution invites the Marine Environment Protection Committee to consider what CO_2 reduction strategies may be feasible in light of the relationship between CO_2 and other atmospheric and marine pollutants, especially NO_x since NO_x emissions may exhibit an inverse relationship to CO_2 reduction.

2 IMO Assembly resolution A.963(23) on "IMO Policies and Practices Related to the Reduction of Greenhouse Gas Emissions from Ships" urged the Marine Environment Protection Committee (MEPC) to identify and develop the mechanism or mechanisms needed to achieve the limitation or reduction of Greenhouse Gas (GHG) emissions from international shipping and, in doing so, to give priority to the establishment of a GHG baseline; and the development of a methodology to describe the GHG efficiency of a ship in terms of GHG emission index for that ship. In developing the methodology for the GHG emission indexing scheme, MEPC should recognize that CO_2 is the main greenhouse gas emitted by ships.

3 As urged by the Assembly, MEPC 53 approved Interim Guidelines for Voluntary Ship CO_2 Emission Indexing for Use in Trials.

4 The Interim Guidelines should be used to establish a common approach for trials on voluntary CO_2 emission indexing, which will enable shipowners to evaluate the performance of their fleet with regard to CO_2 emissions. As the amount of CO_2 emitted from a ship is directly related to the consumption of bunker fuel oil, the CO_2 indexing will also provide useful information on a ship's performance with regard to fuel efficiency.

5 These Guidelines shall be updated, taking into account:

- Operational experiences from trials of the index for different ship types, as reported to MEPC by industry, organizations and Administrations;

- Progress in ISO regarding ship's CO_2 performance;

- Any other relevant developments.

6 Industry, organizations and interested Administrations are invited to promote the use of the attached Interim Guidelines in trials and report their experiences back to MEPC 58 (October 2008).

ANNEX

Interim Guidelines for Voluntary Ship CO_2 Emission Indexing for the Use in Trials

Contents

1 INTRODUCTION

In 1997 IMO adopted a resolution on CO_2 emissions from ships[1]. This resolution invites the Marine Environment Protection Committee (MEPC) to consider what CO_2 reduction strategies would be feasible for ships.

IMO Assembly further adopted resolution A.963(23) on IMO policies and practices related to the reduction of greenhouse gas emissions from ships, which requests the MEPC to develop a greenhouse gas emission index for ships, and guidelines for application of that index.

This document constitutes the guidelines for the application of an IMO CO_2 emissions index for ships. It sets out:

- what the objectives of the IMO CO_2 emissions index are,
- how a ship's CO_2 performance should be measured, and
- how the index could be used to promote low-emission shipping, in order to help limit the impact of shipping on global climate change.

2 OBJECTIVES

The objective of these guidelines is to provide the users with guidance on achieving the targets set by IMO resolution A.963(23). The guidelines provide assistance in the process of establishing a mechanism to achieve the limitation or reduction of greenhouse gas emissions from shipping.

This guideline presents the concept of an index for the energy efficiency of a ship in operation, limited to an expression of efficiency expressed in way of CO_2 emitted per unit of transport work. The guidelines are intended as an objective, performance-based document for guidance on monitoring of the efficiency of ship operation.

These guidelines are recommendatory in nature and present a possible application of an index. However, shipowners are invited to implement these guidelines in their environmental management systems and adopt the principles herein for performance monitoring.

3 DEFINITIONS

3.1 Index definition

In its most simple form *the Carbon Dioxide Transport Efficiency Index* is defined as the ratio of mass of CO_2 per unit of transport work:

$$\text{Index} = m_{CO2} / (\text{transport work})$$

For more details of index calculation see 3.2-3.4 and Appendix 1.

[1] Resolution 8 of the 1997 International Conference of Parties to MARPOL 73/78.

3.2 Fuel consumption

Fuel consumption, FC, is defined as all fuel consumed at sea and in port or for a period in question, e.g. a day, by main and auxiliary engines including boilers and incinerators.

3.3 Distance sailed

Distance sailed, means the actual distance sailed in nautical miles (deck logbook data) for the voyage or period in question.

3.4 Ship and cargo types

The guidelines are applicable for all ships performing transport work.

Ships:

1.	Bulk	Tankers and bulk carriers
2.	General cargo	Container ships, reefers, general cargo, car carriers and specialized ships
3.	Passenger	Passenger ships, ro-ro passenger ships

Cargo:

1.	Bulk cargo	All liquid and solid bulk cargo
2.	General cargo	General cargo which will include TEUs (including the return of empty units), break bulk, heavy lifts, frozen and chilled goods, timber and forest products, cargo carried on freight vehicles, cars and freight vehicles on ro-ro ferries
3.	Passenger	The number of passengers carried

3.5 Cargo

Generally, cargo could be defined in terms of cargo mass.

For bulk and general cargo ships, the mass of transported cargo should be defined in metric tonnes (t).

For ships carrying a combination of containers and other cargoes a TEU mass of 10 t should be applied for loaded TEUs and 2 t for empty TEUs.

For other types of ship, the following units could be applied:

- For bulk carriers and tankers: cubic metres (m^3)
- For passenger vessels: number of passengers
- For car ferries and car carriers: number of car units or occupied lane metres
- For container ships: number of TEUs (empty or full)
- For railway and ro-ro vessels: number of railway cars and freight vehicles, or occupied lane metres

4 ESTABLISHING CO_2 OPERATIONAL INDEX

In order to establish the CO_2 index, the following main steps need to be executed:

.1 Define data sources for data collection.

.2 Collect data.

.3 Convert data to appropriate format.

.4 Calculate CO_2 index.

For existing ships, the CO_2 index should represent an average value of the energy efficiency of the ship operation over a period of one-year. Guidance on the calculation procedure for the index is provided in the Appendix.

For newly built ships the CO_2 index should represent an average value of the energy efficiency of the ship operation over a period of not less than six months.

5 DATA RECORDING AND DOCUMENTATION PROCEDURES

The data recording method used in particular ship types must be uniform so that information can be easily collated and analysed to facilitate the extraction of the required information. The collection of data from ships should include the distance travelled, the quantity and type of fuel used, and all fuel information that may affect the amount of carbon dioxide emitted. Fuel information is provided on the bunker delivery notes that are required under regulation 18 of Annex VI to MARPOL.

The unit used for distance travelled and quantity of fuel should be expressed in nautical miles and metric tonnes. The cargo should be expressed as stated in paragraph 3.5.

It is important that sufficient information is collected on the ship with regard to fuel type and quantity, distance travelled and cargo type so that the efficiency of the ship can be compared with other modes of transport.

The distance travelled should be calculated by actual distance travelled, as contained in the ship's log-book.

Amount and type of fuel used (bunker delivery notes) and distance travelled (according to the ship's log-book) should be documented by the ship based on the format described in the Appendix.

6 MONITORING AND VERIFICATION

Documented procedures to monitor and measure, on a regular basis, should be developed and maintained. Elements to be considered when establishing procedures for monitoring are:

- identification of operations/activities with impact on the performance;
- identification of data sources and measurements that are necessary, and specification of the format;
- identification of frequency and personnel performing measurements; and
- maintain quality control procedures for verification procedures.

The results of this self-critical analysis should be reviewed and used as indicators of the system's success and reliability, as well as identifying those areas in need of corrective action or improvement.

Records are expected to exist to serve as verification of the system operating. For example, records include audit reports and training records. Unlike controlled documents, records are "once and done" documents, resulting from the execution of some process or procedure. Procedures in this element are required for the maintenance of records.

It is important that the source of figures established are properly recorded, the basis on which figures have been calculated and any decisions on difficult or "grey" areas of data. This will provide assistance on areas for improvement and be helpful for any later external verification.

If only internal verification of reports are applied initially, measuring and reporting systems should be developed to allow effective external verification at a later stage. It should be considered stating, for the benefit of external stakeholders, why a report has not been independently verified and the company's future intentions in this regard.

7 APPLICATION OF GUIDELINES

Methodology and application of ship CO_2 indexing, as described in this guideline, provides a transparent and recognized approach for assessment of the GHG efficiency of a ship with respect to CO_2 emissions. These guidelines are considered applicable for ship owners with an implemented environmental management system.

Implementation of the CO_2 index in an established environmental management system should be performed in line with the implementation of any other chosen indicator and follow the main elements of the recognized standards (planning, implementation and operation, checking and corrective action, management review).

When using the CO_2 index as performance indicator, the index should be given a perspective relative to absolute data and trend data:

- The main indicator may be greenhouse gas emissions from energy use.
- Absolute data may be total tonnes of annual CO_2 emissions.
- The CO_2 index may represent the normalized data (CO_2 per tonne mile).
- Trend data may be the index value compared with previous years.

Internal performance criteria and targets could be established as a benchmark for the CO_2 index.

Results from monitoring and measurements could be reported to the management. A management review may include the review of targets, objectives, and CO_2 index to establish the continued suitability in light of changing environmental impact and concerns, regulatory developments, concerns among interested parties, market pressures, internal changes/organizational activity changes, and changes in the environment.

Communication in an environmental management system includes the communication of internal and external environmental information to management, and the communication from management to others of their intentions regarding environmental impacts. Communication could include procedures for internal reporting as well as external reporting on environmental activities of the organization.

APPENDIX

Calculation of CO_2 index based on operational data

General

The objective of the appendix is to provide guidance on calculation of the CO_2 index based on data from the operation of the ship.

Data sources

Primary data sources selected could be the ship log book (bridge log-book, engine log-book, deck log-book and other official records).

Fuel mass to CO_2 mass conversion by carbon content of fuel

Although having many different physical characteristics, fuel oil mainly consists of hydrocarbons, e.g. $C_{15}H_{32}$. C has an atomic weight of 12.011, while Hydrogen (H) has 1. This yields carbon with a mass fraction limited to the range of 85 % to 87.5 %, where diesel oil is in the higher % range and heavy fuel oil in the lower % range. When combusted hydrocarbons react with oxygen (O), which have an atomic weight of 15.9994 then for each CO_2 one C is needed. Using the atomic weights the ratio between CO_2 and carbon is:

$$(12.011 + 2 \times 15.9994) / 12.011 = 44.01/12.01 = 3.664$$

Multiplying with the mass fraction of carbon in the fuel we get the specific emission of CO_2 (C_{carbon}). C_{carbon} for a fuel with 85% carbon content will be:

$$C_{carbon} = 3.664 \times 0.85 = 3.114 \text{ t } CO_2 / \text{t fuel}$$
$$= 3.114 \times 10^6 \text{ g } CO_2 / \text{t fuel}$$

for heavy fuel oil with a carbon content of 85% by mass.

It is recommended to use direct carbon calculations.

If these data are not easily available in a first approach the following default values can be used for the carbon content and the factor $C_{Carbon:\ \mu.}$

Type of fuel	ISO Specification	Carbon content m/m	C_{Carbon} [g CO_2 / t Fuel]
1 Diesel/Gasoil	ISO 8217 Grades DMX through DMC	0.875[1]	3,206,000
2 Light Fuel Oil (LFO)	ISO 8217 Grades RMA through RMD	0.86[2]	3,151,040
3 Heavy Fuel Oil (HFO)	ISO 8217 Grades RME through RMK	0.85[1]	3,114,400
4 Liquid Petrol Gas (LPG)		0.81[1]	2,967,840
5 Natural Gas		0.80[2]	2,931,200

Calculation of the CO_2 Index

The basic expression for the Index is defined as:

$$\text{Index} = \frac{\sum_i FC_i \times C_{Carbon}}{\sum_i m_{cargo,i} \times D_i} \quad \text{(gram } CO_2\text{/tonne identical mile)}$$

Data covering a voyage or period, e.g. a day, in question with corresponding data on fuel consumption/cargo carried and distanced sailed for each voyage in a continuous sailing pattern could be collected as shown in the reporting sheet below.

CO_2 Index reporting sheet

NAME AND TYPE OF SHIP:						
Voyage or day (i)	Fuel consumption (FC) at sea and in port in tonnes				Voyage or time period data	
	Fuel type ( )	Fuel type ( )	Fuel type ( )	…	Cargo (m) (tonnes or units)	Distance (D) (NM)
1						
2						
3						
4						
..						
..						

1 Revised 1996 IPCC Guidelines for national GHG inventories (accessible through the IPCC website www.ipcc.ch).

2 European Commission Decision of C(2004) 130 final. Establishing guidelines for the monitoring and reporting of greenhouse gas emissions.

If data is collected as fuel used in tonnes per voyage, cargo in tonnes and distance in nautical miles, the formula will be:

$$Index = \frac{(\sum_i FC \times C_{Carbon})_{Fuel\ type1} + (\sum_i FC \times C_{Carbon})_{Fuel\ type2} + (\sum_i FC \times C_{Carbon})_{Fuel\ type3} + \ldots}{\sum_i m_{cargo,i} \times D_i}$$

when summing for all voyages i=1 – n.

NOTE: For voyages with m_{cargo} =0, it is still necessary to include the fuel used during this voyage in the summation above the line.

Example:

A simple example including one ballast voyage, for illustration purpose only, is provided below. The example illustrates the application of the formula based on the data reporting sheet.

NAME AND TYPE OF SHIP:						
Voyage or day	Fuel consumption (FC) at sea and in port in tonnes				Voyage data	
(i)	Fuel type (HFO)	Fuel type (HDO)	Fuel type ( )	…	Cargo (m) (tonnes units)	Distance (D) (NM)
1	20	5			25000	300
2	20	5			0	300
3	50	10			25000	750
4	10	3			15000	150
..						
..						

$$I = \frac{100 \times 3{,}114{,}400 + 23 \times 3{,}206{,}000}{(25{,}000 \times 300) + (0 \times 300) + (25{,}000 \times 750) + (15{,}000 \times 150)} = 13.5\ CO_2/t\ fuel\ \ (gCO_2/tonne\ n.m.)$$

Conversion from g/tonne-mile to g/tonne-km

The CO_2 index may be converted from g/tonne-mile to g/tonne-km by multiplication by 0.54.