INTERNATIONAL MARITIME ORGANIZATION

IMO

E

MARINE ENVIRONMENT PROTECTION COMMITTEE
58th session
Agenda item 4

MEPC 58/4/3
31 July 2008
Original: ENGLISH

PREVENTION OF AIR POLLUTION FROM SHIPS

Liaison with the Secretariats of UNFCCC and IPCC concerning the Carbon to CO_2 conversion factor

Note by the Secretariat

SUMMARY	
Executive summary:	This document provides information on the outcome of liaison with the Secretariats of UNFCCC and IPCC in order to harmonize the Carbon to CO_2 conversion factor
Strategic direction:	7.3
High-level action:	7.3.1
Planned output:	7.3.1.3
Action to be taken:	Paragraph 18
Related documents:	MEPC 58/4 and GHG-WG 1/3/1

BACKGROUND

1 The first intersessional meeting of the Working Group on Greenhouse Gas Emissions from Ships (GHG-WG 1) was held in Oslo, Norway, from 23 to 27 June 2008 and its report has been circulated as MEPC 58/4.

2 In the context of its consideration on the review of the CO_2 Operational Index (MEPC/Circ.471), the Working Group (the group) discussed the possible modification of the Carbon (C) to CO_2 conversion factors set out in the said circular.

DISCUSSION ON THE C TO CO_2 CONVERSION FACTOR AT THE INTERSESSIONAL MEETING (MEPC 58/4, SECTION 3)

3 The group considered document GHG-WG 1/3/1* (INTERTANKO) addressing the current C to CO_2 conversion factors, as specified in MEPC/Circ.471, and proposing new modified factors for those fuels most used in shipping, i.e. MDO, MGO, HSFO and LSFO, according to the actual hydrocarbon content in each fuel type after deduction of impurities and other components.

---

* Please bring your own copy of this document to the meeting.

4 Most delegations, including observers, among those who took the floor in the ensuing discussion, supported the proposal by INTERTANKO. However, the following observations were made:

.1 it was recalled that the C to CO_2 factors in MEPC/Circ.471 had been taken from the revised 1996 IPCC Guidelines for national GHG inventories; and that consistency should be ensured between the data used by IMO and those by IPCC, UNFCCC and other UN bodies;

.2 the C to CO_2 conversion factor for LNG in MEPC/Circ.471 could also be recalculated as LNG was increasingly used as fuel in ships; and

.3 the revised C to CO_2 factors proposed by INTERTANKO should be validated by a scientific body or an international organization such as ISO.

5 In response to comments on the sulphur content of fuel oil used in the calculations for the revised C to CO_2 conversion factor, INTERTANKO clarified that they had used the 2.70% Sulphur figure as the prevailing number obtained from current monitoring of worldwide average sulphur. In this respect, the group agreed that it would be useful to calculate a factor for 0.1% sulphur content fuel oil due to be mandatory in a few years' time in ECAs under the revised MARPOL Annex VI.

6 In conclusion, the group agreed that: in order to approve the review of MEPC/Circ.471 at MEPC 58, documents submitted to previous sessions of the Committee which contain concrete proposals for amendments, could be used to prepare draft text of amendments for approval and that the Secretariat should liaise with the Secretariats of UNFCCC and IPCC in order to harmonize the C to CO_2 conversion factors and report the outcome to MEPC 58.

C TO CO_2 CONVERSION FACTOR FOR LOW SULPHUR MARINE DIESEL AND GASOIL (MDO/MGO)

7 In response to the request by the group, INTERTANKO has calculated a proposed C to CO_2 conversion factor for low sulphur (0.1%) fuel, as follows:

Low Sulphur Marine Diesel and Gasoil

Non Hydrocarbon components

Component type	Percentage in fuel
Sulphur Content	0.1%
Ash and Metals	0.01%
Water	0.2%
Total	0.31%

Total Hydrocarbon content of fuel = 99.69%

(a) Average Molecular size of hydrocarbon in fuel = C_{18}

Thus:

C_{18} = (18 x 12.011) + (18 x 2 + 2) = Av. Molecular weight 254.198

Total Carbon Molecular weight = 18 x 12.011 = 216.198

Carbon % of fuel = (216.198/254.198) x 0.9969 = 84.79%

(MEPC/Circ.471 factor = N/A)

(b) Carbon content of CO_2

CO_2 = (12.011 + 2 x 15.9994) = 44.01

Carbon Content of CO_2 = 44.01 / 12.011 = **3.6641246**

(c) Carbon index (g CO_2 / tonne fuel)

Carbon index = 3.6641246 x 0.8479 = 3.1068112…….. OR

3.1068112 tonnes of CO_2 per tonne of fuel combusted
(MEPC/Circ.471 factor = N/A)

8 For ease of reference, the other C to CO_2 factors proposed by INTERTANKO in its document GHG-WG 1/3/1 are as follows:

FUEL TYPE	**Carbon to CO_2 conversion factor**
Marine diesel and marine gas oils (MDO/MGO)	**3.082**
Low Sulphur Fuel Oils (LSFO)	**3.075**
High Sulphur Fuel Oils (HSFO)	**3.021**

LIAISON WITH THE UNFCCC AND IPCC SECRETARIATS

9 Following the request by the group, the Secretariat has contacted the UNFCCC and IPCC Secretariats in order to ensure harmonization of the C to CO_2 conversion factors used by both organizations. The ensuing paragraphs provide a summary of the information obtained from these organizations.

UNFCCC

10 For the time being, the revised 1996 IPCC Guidelines are used by Parties under the UNFCCC and the Kyoto Protocol, whilst the more recent 2006 IPCC Guidelines are under consideration under the Convention but no decisions on their use has been taken yet.

11 The emissions database in the IPCC website (http://www.ipcc-nggip.iges.or.jp/EFDB/main.php) provides complementary emission factors and is independent from the Guidelines. The database does not appear to have factors for marine bunker fuels. However, proposals on emission factors can be uploaded to the database to be reviewed by a board of IPCC experts for validation. IMO may directly submit its proposals on emission factors to this database. If these were accepted and included in the database, the MEPC could approve their use taking into consideration that they have been through a revision of the IPCC.

IPCC

12 The IPCC Secretariat has provided the following information.

Emission Factors

13 The 2006 IPCC Guidelines base their emission factors on an analysis of empirical carbon contents from around the world, rather than a theoretical assessment, and may therefore be expected to better reflect the real world emission of CO_2 for shipping.

14 The IPCC guidelines estimate emissions of CO_2 from fuel combustion based on the carbon content of the fuels. However, rather than take the theoretical approach used in document GHG-WG 1/3/1 the authors analysed the reported carbon contents from national emission inventory reports, the IEA and available national data. (It should be noted that the IPCC Guidelines encourage users to use their actual national carbon contents, if they are known, rather than the default data presented here.) This enabled both a mean value to be determined and an assessment of the variability of the carbon content to be made. The resultant factors are shown below in Table 1 converted to mass units. The data from the IPCC 1996 Guidelines were based on little available data but both this figure, and the data presented in document GHG-WG 1/3/1, lie within the range of the actual reported data analysed for the 2006 Guidelines.

15 The authors of the 2006 Guidelines believed that their empirical approach best represented the actual emission from fuel in use rather than a theoretical consideration of an assumed fuel composition.

Table 1 Comparison of Emission Factors kg CO_2/kg Fuel

FUEL TYPE	GHG-WG 1/3/1	IPCC 2006 Guidelines			Revised 1996 Guidelines
		Default	Lower[b]	Upper[b]	
Marine diesel and marine gas oils (MDO/MGO)	3.082	3.19	3.01	3.24	3.212[a]
Low Sulphur Fuel Oils (LSFO)	3.075	3.13	3.00	3.29	
High Sulphur Fuel Oils (HSFO)	3.021				

NOTES: [a] This is for "Ocean-Going Ships, for the USA based on Weaver (1988). "Boats" have a factor of 3.188.
[b] Calculated using the "lower" or "upper" data for both the emission factor and calorific value.

The figures given in document GHG-WG 1/3/1 lie within the range in the IPCC 2006 Guidelines. There is uncertainty in all these estimates and so the IPCC has, for pragmatic reasons, presented the number to 3 significant figures although this overstates the accuracy.

Comments

1. It is important to include in the estimates all fuels used – not just propulsion fuels.

2. It is believed that, in some places, low quality fuels or fuels with other products added may be used with different carbon and energy contents. Additional information on this point would be welcomed.

3. The 2006 IPCC Guidelines give default emission factor for other greenhouse gases besides CO_2. CH_4 and N_2O are shown in Table 2 (although there are few measurements and large uncertainties). There may also be emissions of fluorinated gases from refrigeration and cooling units that need to be estimated as well.

Table 2 Default water-borne navigation CH_4 and N_2O emission factors (Table 3.5.3, Volume 2, 2006 IPCC Guidelines)

	CH_4 (kg/TJ)	N_2O (kg/TJ)
Ocean-going Ships *	7 ± 50%	2 (+140%, -40%)
* Default values derived for diesel engines using heavy fuel oil. Source: Lloyd's Register (1995) and EC (2002)		

4. The IPCC guidelines also contain good practice guidance that should be followed in to collection of data and estimation of emissions. Review of parties emission estimates considers both the methods and factors used as well as the good practice guidance.

The IPCC Guidelines

16 The IPCC Guidelines for estimating emissions of Greenhouse gases have been developed over many years. They have been written by teams of authors, nominated by governments, and reviewed and accepted by governments at plenary sessions of the IPCC. The Guidelines comprise:

- 2006 IPCC Guidelines for National Greenhouse Gas Inventories (5 Volumes)
- Good Practice Guidance for Land Use, Land-Use Change and Forestry, (2003)
- Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2000)
- Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (3 Volumes)

While the latest (the 2006 IPCC Guidelines) are being considered for use by the UNFCCC, the other documents have been adopted by the UNFCCC for reporting, both under the Convention and the Kyoto Protocol. All the IPCC guidelines, methods and emission factors are freely available from the website http://www.ipcc-nggip.iges.or.jp.

Background Data

17 Tables 2 and 3 below are extracts from the 2006 IPCC Guidelines and present the background numbers used to generate the data in Table 1.

Table 3 – CO_2 Emission Factors for shipping, (kg/TJ) Table 3.5.2, Volume 2, IPCC 2006 Guidelines ("Lower", the 2.5 percentile, and "Upper", the 97.5 percentile, are the limits of the 95% confidence interval assuming a log-normal distribution, see section 1.5, Volume 2, 2006 IPCC Guidelines)

Fuel		Default	Lower	Upper
Gasoline		69 300	67 500	73 000
Other Kerosene		71 900	70 800	73 600
Gas/Diesel Oil		74 100	72 600	74 800
Residual Fuel Oil		77 400	75 500	78 800
Liquefied Petroleum Gases		63 100	61 600	65 600
Other Oil	Refinery Gas	57 600	48 200	69 000
	Paraffin Waxes	73 300	72 200	74 400
	White Spirit & SBP	73 300	72 200	74 400
	Other Petroleum Products	73 300	72 200	74 400
Natural Gas		56 100	54 300	58 300

Table 4 Calorific Values of Liquid Fuels, (TJ/Gg) (extract from Table 1.2 Volume 2 of 2006 IPCC Guidelines). ("Lower", the 2.5 percentile, and "Upper", the 97.5 percentile, are the limits of the 95% confidence interval assuming a log-normal distribution, see section 1.5, Volume 2, 2006 IPCC Guidelines)

Fuel type English description		Net calorific value (TJ/Gg)	Lower	Upper
Crude Oil		42.3	40.1	44.8
Orimulsion		27.5	27.5	28.3
Natural Gas Liquids		44.2	40.9	46.9
Gasoline	Motor Gasoline	44.3	42.5	44.8
	Aviation Gasoline	44.3	42.5	44.8
	Jet Gasoline	44.3	42.5	44.8
Jet Kerosene		44.1	42.0	45.0
Other Kerosene		43.8	42.4	45.2
Shale Oil		38.1	32.1	45.2
Gas/Diesel Oil		43.0	41.4	43.3
Residual Fuel Oil		40.4	39.8	41.7
Liquefied Petroleum Gases		47.3	44.8	52.2
Ethane		46.4	44.9	48.8
Naphtha		44.5	41.8	46.5
Bitumen		40.2	33.5	41.2
Lubricants		40.2	33.5	42.3
Petroleum Coke		32.5	29.7	41.9
Refinery Feedstocks		43.0	36.3	46.4
Other Oil	Refinery Gas [2]	49.5	47.5	50.6
	Paraffin Waxes	40.2	33.7	48.2
	White Spirit and SBP	40.2	33.7	48.2
	Other Petroleum Products	40.2	33.7	48.2

ACTION REQUESTED OF THE COMMITTEE

18 The Committee is invited to consider the information provided and decide as appropriate.