INTERNATIONAL MARITIME ORGANIZATION

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SUB-COMMITTEE ON BULK LIQUIDS AND GASES
11th session
Agenda item 5

BLG 11/5/27
23 February 2007
Original: ENGLISH

REVIEW OF MARPOL ANNEX VI AND THE NO_x TECHNICAL CODE

Air quality concerns from particulate matter and oxides of sulphur

Submitted by the United States

SUMMARY

Executive summary:	This document provides an overview of the public health and welfare concerns associated with PM and SO_x emissions in general, as well as specific information regarding the contribution of marine vessels to PM and SO_x pollution in the United States and elsewhere. This information has all been generated in the past decade, since the adoption of MARPOL Annex VI by IMO in 1997, and provides a clear basis for revisions to Annex VI to reduce SO_x emissions from marine vessels. This information is in response to the recent submission from the Oil Companies International Marine Forum in document, BLG 11/5/9.
Action to be taken:	Paragraph 14
Related documents:	BLG 11/5/9, BLG 10/14/13, BLG-WGAP 1/2/11, BLG-WGAP 1/INF.2, MEPC 53/4/1, MEPC 53/4/4 and MEPC 55/4/5

Introduction

1 This document comments on BLG 11/5/9 and is submitted in accordance with the provisions of paragraph 4.10.5 of the revised Guidelines on the Organization and method of work of MSC and MEPC and their subsidiary bodies (MSC-MEPC.1/Circ.1).

2 MEPC 53 instructed the BLG Sub-Committee to consider future emission limits for marine diesel engines and their fuels. BLG was tasked with examining available and developing techniques for reducing oxides of nitrogen (NO_x) and recommending future NO_x emission limits. BLG was also instructed to consider particulate matter (PM) controls, as well as the need for further limits on sulphur content in marine fuels.

3 In document BLG 11/5/9, the Oil Companies International Marine Forum suggested that the need for amendments to MARPOL Annex VI has not been established in general, and specifically the basis for a change in either the global sulphur cap or the existing SECA limits for sulphur has not been established. MEPC and BLG have already received a number of submissions on this issue which demonstrate the need for revisions to Annex VI and the need for additional reductions in SO_x emissions from marine vessels. These include documents MEPC 53/4/1, MEPC 53/4/4, BLG 10/14/13, MEPC 55/4/5, BLG-WGAP 1/2/11 and BLG-WGAP 1/INF.2. This document provides additional support for revisions to Annex VI and for significant reductions in SO_x and PM emissions.

4 In the nearly ten years since MAPROL Annex VI was adopted, substantial and compelling information has become available demonstrating that the public health impacts of PM and SO_x air pollution are more of a significant concern than previously understood. Since that time the knowledge regarding the contribution to PM and SO_x air pollution from ships has increased and recent analysis make it clear that historical estimates of shipping's emissions contribution were underestimated. This document summarizes some of the information from the scientific community published in the past ten years regarding the adverse health and welfare concerns associated with PM and SO_x, and the contribution of ships to these pollutants. This information presents a clear and compelling need to consider significant reductions in air pollution from marine vessels.

Health and welfare impacts from SOx and PM

5 Ocean-going marine vessels are a significant source of PM and SO_x. The sulphur in marine fuel is primarily emitted as SO_2, with a small fraction (~ 1-2 per cent) of the SO_2 being converted to SO_3. SO_3 almost immediately forms sulphate and is emitted as PM by the engine[1]. Recent estimates by some in the scientific community indicate ocean-going vessels represent approximately 9 per cent of the world's SO_x emissions[2]. In the atmosphere, SO_2 is also transformed into particulate sulphate. In the United States, particulate sulphates are one of the major contributors to ambient $PM_{2.5}$, being responsible for roughly 40 per cent of the ambient $PM_{2.5}$[3].

6 Ocean-going vessels contribute both to direct emissions of PM, as well as the formation of secondary particulates in the atmosphere from the emissions of NO_x and SO_x. This past fall, the US EPA finalized revisions to the US National Ambient Air Quality Standards for PM, which lowered the 24-hour $PM_{2.5}$ micron standard from 65 to 35 micrograms/cubic meter. This revision was based on a comprehensive review of the state of the scientific data which demonstrated that a lower 24-hour ambient $PM_{2.5}$ standard was necessary to protect human health and welfare[4]. The supporting data and analysis can be found in the US EPA Particulate Matter Air Quality Criteria Document (PM AQCD)[5]. The following is a brief summary of the health impacts associated with PM.

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1 "Final Regulatory Support Document: Control of Emissions from New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder", US Environmental Protection Agency, EPA Report EPA 420-R-03-004, January 2003, available at http://epa.gov/otaq/marine.htm.

2 Corbett, J.J., and Koehler, H. 2003. Updated Emissions from Ocean Shipping. Journal of Geophysical Research, Vol. 108. Available at http://www.agu.org/.

3 "The Particulate Pollution Report – Current Understanding of Air Quality and Emissions through 2003", US Environmental Protection Agency, EPA Report EPA 454-R-04-002, December 2004, available at http://www.epa.gov/air/airtrends/aqtrnd04/pm.html.

4 See71 Federal Register, page 61144, "National Ambient Air Quality Standards for Particulate Matter", published October 17, 2006, available at http://www.gpoaccess.gov/fr/index.html.

5 US EPA (2004) Air Quality Criteria for Particulate Matter (Oct 2004), Volume I – EPA Report EPA600/P-99/002aF and Volume II – EPA Report EPA600/P-99/002bF, available at http://cfpub2.epa.gov/ncea/cfm/recordisplay.cfm?deid=87903.

7 The US EPA Particulate Matter Air Quality Criteria Document (PM AQCD), states that available scientific findings "demonstrate that human health outcomes are associated with ambient PM,"[6] and reflects US EPA's analysis of policy-relevant science from the PM AQCD, regarding the health effects associated with particulate matter. There are also recent studies published after the finalization of the PM AQCD which are also discussed below. Taken together, this information supports the conclusion that PM-related emissions are associated with serious adverse health effects, and forms a strong scientific basis for the member States to act and develop long-term solutions to the air pollution emitted by marine vessels.

PM health impacts: short-term exposure mortality and morbidity studies

8 As discussed in the PM AQCD, short-term exposure to $PM_{2.5}$ is associated with mortality from cardiopulmonary diseases (PM AQCD, p. 8-305), hospitalization and emergency department visits for cardiopulmonary diseases (PM AQCD, p. 9-93), increased respiratory symptoms (PM AQCD, p. 9-46), decreased lung function (PM AQCD Table 8-34) and physiological changes or biomarkers for cardiac changes (PM AQCD, Section 8.3.1.3.4). Among the studies of effects from short-term exposure to $PM_{2.5}$, several studies specifically address the contribution of mobile sources to short-term $PM_{2.5}$ effects on daily mortality. These studies indicate that there are statistically significant associations between mortality and PM related to mobile source emissions (PM AQCD, p.8-85). The analyses incorporate source apportionment tools into daily mortality studies and are briefly mentioned here. Analyses incorporating source apportionment by factor analysis with daily time-series studies of daily death indicated a relationship between mobile source $PM_{2.5}$ and mortality[7, 8].

PM health impacts: long-term exposure mortality and morbidity studies

9 Long-term exposure to elevated ambient $PM_{2.5}$ is associated with mortality from cardiopulmonary diseases and lung cancer (PM AQCD, p. 8-307), and effects on the respiratory system such as decreased lung function or the development of chronic respiratory disease (PM AQCD, pp. 8-313, 8-314). This paper emphasize the results of two long-term studies, the Six Cities and American Cancer Society (ACS) prospective cohort studies, based on several factors – the inclusion of measured PM data, the fact that the study populations were similar to the general population, and the fact that these studies have undergone extensive reanalysis (PM AQCD, p. 8-306, EPA Staff Paper, p.3-18)[9,10,11]. These studies indicate that there are significant associations for all-cause, cardiopulmonary, and lung cancer mortality with long-term exposure to $PM_{2.5}$.

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[6] US EPA (2005) Review of the National Ambient Air Quality Standard for Particulate Matter: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper. EPA Report EPA452/R-05-005, available at http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_cr_sp.html.

[7] Laden F; Neas LM; Dockery DW; et al. 2000. "Association of fine particulate matter from different sources with daily mortality in six U.S. cities." Environ Health Perspectives 108(10):941-947. Available at http://www.ehponline.org/docs/montharch.html.

[8] Schwartz J; Laden F; Zanobetti A. 2002. "The concentration-response relation between PM(2.5) and daily deaths." Environ Health Perspective 110(10): 1025-1029. Available at http://www.ehponline.org/docs/ montharch.html.

[9] Dockery, DW; Pope, CA, III; Xu, X; et al. 1993. "An association between air pollution and mortality in six U.S. cities." N Engl J Med 329:1753-1759. Available at http://content.nejm.org/search.dtl.

[10] Pope, CA, III; Burnett, RT; Thun, MJ; Calle, EE; et al. 2002. "Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution." J Am Med Assoc 287: 1132-1141. Available at http://jama.ama-assn.org/contents-by-date.0.dtl.

[11] Krewski, D; Burnett, RT; Goldberg, M S; et al. 2000. "Reanalysis of the Harvard Six Cities study and the American Cancer Society study of particulate air pollution and mortality. A special report of the Institute's Particle Epidemiology Reanalysis Project." Cambridge, MA: Health Effects Institute. Available at http://pubs.healtheffects.org/view.php?id=6.

Emission contributions and air quality impacts from shipping in North America

10 Marine vessels are a significant source of direct PM, as well as SO_x, and NO_x, both of which contribute to ambient particulate matter, and the impact of ship emissions on worldwide air quality is expected to grow as marine transportation grows. In the US EPA final regulatory action on large marine vessels completed in 2003, it was estimated that ocean-going marine vessels would contribute approximately 530,000 tons of NO_x, 54,000 tons of direct PM, and 400,000 tons of SO_x, on an annual basis in the US by the year 2030[12]. This represents 28 per cent of the United States mobile source NO_x emissions, about 20 per cent of direct PM emissions, and about 83 per cent of SO_x emissions.

11 Emissions from ships are of great concern in deep water ports in the United States. In 2006, more than 30 deep water ports were located in areas which do not achieve the US National Ambient Air Quality Standards for PM and/or ozone. In Canada, recent estimates suggest that by 2020 the contribution of ships to total SO_x emissions from transportation sources will be over 90%, the contribution to NO_x will be over 22%, and the contribution to $PM_{2.5}$ will be over 32%.

12 In California, ocean-going marine vessels represent 81 per cent of the total SO_x emissions associated with goods movement in 2005, which is 81 tons per day. By 2020, ocean-going marine vessels will produce 180 tons per day of SO_x emissions in California, or 99 per cent of all SO_x from goods movement. The California Air Resources Board estimates that in 2005 there were 2,400 premature deaths in the State due to air pollution caused by goods movement[13].

Emission contributions and air quality impacts from shipping in Europe

13 The United States is not the only nation being impacted from the high levels of air pollution from ocean-going vessels. A recent report completed for the European Commission indicates that by 2020, ships will be responsible for more than 30 per cent of the sulphur deposition in large areas of Europe, and up to 50 per cent in coastal areas[14]. This same report evaluates a range of potential strategies for reducing the health impact of shipping in Europe, including large reductions in marine-generated SO_x emissions which are projected to result in substantial decreases in estimated premature mortality.

Action requested of the Sub-Committee

14 The Sub-Committee is invited to note the above information and take action as appropriate.

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[12] See "Final Regulatory Support Document: Control of Emissions from New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder", EPA420-R-03-004, January 2003, available at http://epa.gov/otaq/marine.htm

[13] See "Proposed Emission Reduction Plan for Ports and Goods Movement in California" California Air Resources Board, see Table I-1 and Table II-6, available at www.arb.ca.gov/planning/gmerp/march21plan/march22_plan.doc

[14] "Interim report – Analysis of Policy Measures to Reduce Ship Emissions in the Context of the Revision of the National Emissions Ceiling Directive", International Institute for Applied Systems Analysis (IIASA), October 2006.