SUB-COMMITTEE ON BULK LIQUID AND GASES
10th session
agenda item 14
BLG 10/14/..
26 January 2006

Strengthening Annex VI Limits For Shipping Emissions of Air Pollution

Submitted by Friends of the Earth International

SUMMARY

Executive Summary: This document calls on the Sub-Committee to recommend revisions to Annex VI containing stringent limits on the emissions of NOx, SOx and PM from ships, and to include consideration of shore-side power, and presents recent information on ship emissions, their impacts and controls in support thereof. This document was produced by a coalition of environmental and public health NGOs.[1]
Action to be taken: Paragraph 5
Related Documents: MEPC 53/4/1, MEPC53/4/4; MEPC 53/4/8.

1 Introduction.

At the conclusion of the 53rd meeting of the Marine Environment Protection Committee (MEPC) of the International Maritime Organization (IMO) held in July, 2005 (MEPC 53), the MEPC instructed its Sub-Committee on Bulk Liquids and Gases (BLG) to examine techniques for reducing air pollution from ships, and to review the potential for revised international controls of that pollution, including:

- Nitrogen oxide (NOx) emissions from both new and existing ships;
- Sulfur oxide (SOx) emissions from both new and existing ships;
- Particulate matter (PM) emissions from ships; and
- Volatile organic carbon (VOC) emissions from ship cargoes.[2]

Existing international ship emissions regulations were adopted in 1997, and are limited to NOx emissions from new ships and sulphur content in fuel.[3] Control technology for the control of ship emissions has advanced considerably since 1997, as has understanding of the harmful impacts caused by such emissions on human health and the environment.

BLG's examination of shipping emission controls must produce strong recommendations for substantial reductions of this air pollution. Such reductions are necessary to reduce the substantial impact that shipping emissions presently have on public health and the environment. Furthermore, such reductions are feasible and cost-effective, less costly than equivalent reductions

[1] Clean Air Task Force, Bluewater Network—a Division of Friends of the Earth –US, Coalition for a Safe Environment, European Environmental Bureau, European Federation for Transport and Environment, North Sea Foundation, Seas at Risk and Swedish NGO Secretariat on Acid Rain.
[2] *See* Annex 8 of the Report of the Working Group of Air Pollution from Ships, MEPC 53/WP.11, 21 July, 2005.
[3] Annex VI to the Convention for the Prevention of Pollution from Ships, 1973, as Modified by the Protocol of 1978 Relating Thereto (MARPOL 73/78), September 26, 1997.

from land-based sources, and will produce public health benefits far in excess of their costs. Internationally, ships are subject to very few and very lax air emission limits—in fact, ships are presently the most under-regulated major sources of air pollution in much of the world. However, efforts have begun in recent years to begin to regulate ship emissions, both on the international, national and state level.

As public awareness grows concerning the level of ship emissions of air pollution—especially compared to land-based sources like cars and trucks—and as awareness grows concerning the public health and environmental damage caused by these emissions, political pressure on national and local regulators around the world will become increasingly stronger for steep reductions. At present, the IMO, through its MEPC and BLG, is the international body with the clearest authority to require meaningful reductions of ship emissions. IMO should seize this opportunity to regulate these emissions rigorously on a consistent world-wide basis. If it does not, then piecemeal regulation around the globe will be the likely result.

In April 2005, Friends of the Earth International (FOEI) submitted to MEPC 53 a background paper (MEPC 53/4/1) demonstrating that shipping emissions of air pollution have a substantial impact on human health and the environment, and that feasible and cost-effective means are available to reduce those emissions. A submission by Finland, Germany, the Netherlands, Norway, Sweden, and the United Kingdom (MEPC 53/4/4) made similar points, and proposed the initiation of the present review of Annex VI emissions. Since those papers were drafted last spring, additional information and analyses from a variety of entities have confirmed their conclusions.

This paper summarizes some of the more important of these developments, and urges the revision of Annex VI to include stringent limits on emissions of NOx, PM and SOx from ships—both new and existing ships.

2 *Recent Control Technology Developments.*

A number of forward-looking shipping lines and engine manufacturers have indicated over the last year or so that substantial reductions of ship emissions such as NOx may be obtained using existing technology. For instance, at a May 2005 conference sponsored by the Swedish Maritime Administration on Air Pollution from Ships, the Viking Line reported that use of humid air motor (HAM) technology reduced NOx emissions by 75-85%.[4] At the same time, lube oil consumption was reduced by about 30%, fuel consumption was reduced by an average of 5%, engines ran cleaner, extending engine life, and operating and maintenance costs were reduced. Viking also retrofitted several of its ships with selective catalytic reduction (SCR) control technology, producing NOx reductions of 80-90%. *Id.* At the same conference, Wartsila reported that a combination of wet methods—use of heavy fuel oil microemulsion with combustion air saturation (CASS) produced NOx reductions in medium speed engines of up to 90% from current Annex VI standards, or about 60% from current typical new engine emission levels.[5] According to Wartsila, NOx levels of 3 g/kWh are within reach using these approaches, which come at a reasonable cost. *Id.* The use of common rail injection systems will eliminate visible smoke, even

[4] Presentation of Ulf Hagstrom, Marine Superintendent, Technical sector, Viking Line Apb, "Humid Air Motor (HAM) and Selective Catalytic Reduction (SCR) Viking Line," at Swedish Maritime Administration Symposium/Workshop on Air Pollution from Ships (May 24-26, 2005).

[5] Presentation of D Paro, Senior Vice President, Technology, Wartsila Corporation, "NOx Reduction by Engine Modifications," at Swedish Maritime Administration Symposium/Workshop on Air Pollution from Ships (May 24-26, 2005).

on ships using the above NOx reduction measures, presumably reducing PM emissions somewhat. *Id.* Mann B&W Diesel has also reported NOx reductions from 2-stroke engines of up to 40% using HAM, about 50% with exhaust gas recirculation (EGR), and over 90% with SCR.[6]

Several in-depth analyses of available controls to reduce shipping emissions have been performed over the last year or so. One of the more rigorous studies was performed by Entec for the European Commission.[7] That study found the following mid-range NOx reductions and costs for a variety of control measures for large and medium-sized vessels:[8]

Measure	**NOx Reduction**	**Cost (new) (euro/tonne NOx)**	**Cost (retrofit) (euro/tonne NOx)**
Basic I&M (2-stroke only	20%	9	15-24
Advanced I&M	30%	19-33	Variable
Direct Water Injection	50%	345-360	Variable
Humid air motors	70%	198-230	263-282
SCR	90%[a]	313-563[b]	358-612[b]

[a] SCR can also reduce SO2 and PM emissions in ships operating on lower sulfur RO (by 44% and 18%, respectively or MD (by 96% and 63%, respectively).
[b]SCR operating costs depend on the fuel burned, increasing with fuel sulfur content.

The EC Ship Emissions Report also compared the cost-effectiveness of reducing NOx emissions from ships against that of NOx reductions from a variety of those land-based sources. The cost of reducing shipping emissions was lower—in some cases, dramatically lower—than that of any of the land-based sources examined.[9] For example, the marginal estimated NOx abatement cost for existing power and district heating plants was over 4000 euro/tonne, while that for heavy-duty trucks and buses was over 8000 euro/tonne (over *13 times* the cost of the *most costly* shipping abatement measure).

The EC Ship Emissions Report also reviewed two primary SO_2 abatement measures—sea water scrubbing and switching to low- sulfur fuel.[10] Sea water scrubbing was estimated to reduce SO_2 emissions by an average of about 75%, and PM emissions by about 25%. Switching from 2.7% sulfur fuel to 1.5% sulfur fuel would reduce SO_2 emissions by 44%, and PM by 18%; switching to 0.5% sulfur fuel would reduce SO_2 emissions by over 80%. Both methods were cost-effective, with sea-water scrubbing being particularly so. The cost-effectiveness of seawater scrubbing was estimated at about 350 euro/tonne for a new medium-sized vessel and 535 euro/tonne for an existing one. Switching to 1.5% sulfur fuel was estimated to cost between 1230 and 2050 euro/tonne SO_2 removed, while switching to 0.5% sulfur fuel was estimated to cost

[6] See, e.g., Presentation of Kjeld Aabo, Sr. Manager, Mann B&W Diesel A/S, "Emission Control—2-stroke engines," at EU Workshop on Low-Emission Shipping, 4 and 5 September 2003.
[7] Entec UK Limited (August 2005), Final Report for European Commission Directorate-General-Environment, "Service Contract of Ship Emissions: Assignment, Abatement and Market-based Instruments" (EC Ship Emissions Report), available on the Internet at: http://europa.eu.int/comm/environment/air/transport.htm.
[8] EC Ship Emissions Report, Task 2b—NOx Abatement, Executive Summary at pages iv-vi.
[9] EC Ship Emissions Report, Task 2b—NOx Abatement, Executive Summary at page vii, Section 5.2 at page 38.
[10] EC Ship Emissions Report, Task 2c— SO_2 Abatement, Executive Summary at pages ii-iv.

between 1438 and 1690 euro/tonne. Again, estimated shipping emissions abatement costs were lower that that of almost all other land-based SO_2 sources.[11]

A number of recent studies have examined the use of shore-side power.[12] In both Europe and California, the use of shore-side power can reduce emissions of NOx, SOx and PM by 90% or more. To more thoroughly analyze this approach, the State of California in the United States is currently conducting a feasibility study on the use of shore-side power in California ports that is expected to be completed in early 2006.

In the Netherlands EU air quality limit values are exceeded seriously, in particular in the areas of the Port of Rotterdam. This is not only detrimental for health reasons, but also for economic development. Emissions of NO_x, SO_2 and PM from shipping are predicted to increase in this area. For this reason, the Port of Rotterdam has ordered a feasibility study into shoreside electricity for ships, which will be delivered in 2006.

3 *Recent Health Effects Assessments and Regulatory Developments*

Several recent studies in California have examined the public health effects of shipping emissions and emissions of other diesel engines involved in port operations. For example, a task force developing a plan to control air emissions from activities at the Port of Los Angeles found that diesel emissions produce a myriad of harmful effects during all stages of human development, from prenatal (low birth weight, increased birth defects) to adulthood (elevated incidence of lung cancer and heart attacks).[13] The California Air Resources Board (CARB) recently found that exposure to air emissions from auxiliary engines on ships operating in California waters "can result in increased cancer risk and non-cancer health impacts, such as premature death, irritation to the eyes and lungs, allergic reactions in the lungs, and asthma exacerbation."[14] CARB is conducting a risk assessment of elevated cancer risks and other non-cancer health effects from diesel PM emissions associated with the operation of the Ports of Los Angeles and Long Beach. CARB recently released a draft report, finding, among other things, that:

- Emissions from ship activities (transiting, maneuvering and hotelling) represent about 3/4 of total PM emissions at the ports or within California Coastal Waters

---

[11] EC Ship Emissions Report, Task 2c— SO_2 Abatement, Section 5.2 at pages 22-25.

[12] *See, e.g.*, with respect to the United States: a paper on the shore-side installation for cruise ships in Juneau, Alaska, that has operated successfully for more than five years (R. Maddison, D.H. Smith , "Going Cold Iron in Alaska");
a study conducted by the Port of San Francisco in 2005 that found that shore-side power was technically feasible for a proposed new cruise terminal (http://www.sfport.com/site/uploadedfiles/sfport/maritime_act/ENVIRON_Final_Report_091305_main%20body_Rev.pdf);
and the California Air Resources Board Draft Emission Reduction Plan for Ports and International Goods Movement that cites a goal and timeline for implementing shore-side power at its ports of 80 percent of ships by 2020 (http://www.arb.ca.gov/planning/gmerp/dec1plan/chapter3.pdf).
See also, with respect to Europe: EC Ship Emissions Report, Task 2a, available on the Internet at: http://europa.eu.int/comm/environment/air/pdf/task2_shoreside.pdf.

[13] Report to Mayor Hahn and Councilwoman Hahn by the No Net Increase Task Force (June 24, 2005), available on the Internet at: http://www.portoflosangeles.org/DOC/REPORT_NNI_Final.pdf. .

[14] California Air Resources Board, Staff Report: Initial Statement of Reasons for Proposed Rulemaking; Proposed Regulation for Auxiliary Engines and Diesel-Electric Engines Operated on Ocean-Going Vessels within California waters and 24 nautical miles of the California Baseline (October 2005), at page ES-6, available on the Internet at: http://www.arb.ca.gov/regact/marine2005/isor.pdf.

- Diesel PM emissions from the ports impact a large area, resulting in elevated cancer risks over the entire 20 mile by 20 mile study area, and causing other potential non-cancer health impacts as well, including premature death, asthma attacks, lost work days and minor restricted activity days.[15]

In a related report, CARB found that air emissions from just the operation of auxiliary engines of ships at the two ports resulted an area of about 2250 acres where the potential cancer risk was over 200 in a million, exposing about 48,000 people.[16]

Given the emerging recognition of the substantial public health and environmental impacts of shipping emissions, it is not surprising that state, national and regional authorities have been proposing and enacting regulations to reduce shipping emissions of air pollution. For example, the European Commission has adopted a European Union Strategy to reduce air pollution from ships. As part of that strategy, the European Parliament and Council has adopted a directive requiring the use of low sulfur fuel by certain ships operating in European waters, specifically including:

- A 1.5% sulfur limit for fuels used by passenger vessels on regular service between EU ports, effective 2006; and
- A 0.1% sulfur limit for fuels used by inland vessels and seagoing ships at berth in EU ports, effective 2010.[17]

More stringent fuel regulations are likely to be considered by the EU over the next few years.

CARB has also been examining shipping emissions, their impacts and potential controls. CARB staff recently has prepared a draft emission reduction plan as part of a broader plan to reduce emissions from international trade and the movement of goods through California.[18] That plan envisions a wide variety of emission reduction measures from ships, trucks, locomotives and other sources involved in port and goods movement activities. In fact, CARB has already adopted one of the ship emission reduction measures in the plan. On December 8, 2005, CARB adopted a regulation to reduce emissions of diesel PM, NOx and SOx from the use of auxiliary diesel engines operated on ocean-going vessels within California waters.[19] This regulation requires the use of marine distillate fuel (~0.5% sulfur) or equally effective emission controls, effective 2007.[20] This regulation is expected to reduce emissions of PM by 75%, SOx by 80%, and NOx by 6% from ships with auxiliary engines using HFO. Beginning in 2010, marine gas oil with 0.1% sulfur content is required.

CARB has indicated that its next priority will be reducing emissions from the main propulsion engines on ocean-going ships. The use of shore-side power will also be considered.

---

[15] CARB, Draft Diesel Particulate Matter Exposure Assessment Study for the Ports of Los Angeles and Long Beach (October 3, 2005), at pages 2-3, available on the Internet at: http://www.arb.ca.gov/msprog/offroad/marinevess/documents/100305draftexposrep.pdf.

[16] *Id.*, at pages ES-6 –8.

[17] Directive 2005/33/EC of the European Parliament and Council Modifying Directive 1999/32 as Regards the Sulfur Content of Marine Fuels, available on the Internet at: http://europa.eu.int/eur-lex/lex/LexUriServ/site/en/oj/2005/l_191/l_19120050722en00590069.pdf.

[18] CARB, Draft Emission Reduction Plan for Ports and International Goods Movement in California (December 1, 2005), available on the Internet at: http://www.arb.ca.gov/planning/gmerp/gmerp.htm.

[19] ARB News Release of December 8, 2005, "Air Resources Board Adopts Measures to Reduce Emissions from Goods Movement Activities," available on the Internet at: http://www.arb.ca.gov/newsrel/nr120805.htm.

[20] CARB, "Emission Limits and Requirements for Auxiliary Engines and Diesel-Electric Engines Operated on Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baseline," available on the internet at: http://www.arb.ca.gov/regact/marine2005/appa.pdf.

4 Conclusion.

The IMO must act decisively and promptly to reduce substantially emissions of air pollution from ships. The public health and environmental impacts from this under-regulated source are not acceptable and cannot be justified. This is particularly so in view of the availability of feasible, cost-effective measures to reduce shipping emissions.

We urge BLG to recommend that emission reductions achievable by after-treatment control technologies be required, from both new and existing ships. Thus, BLG should require reductions of 70-90% for NOx and at least 70-80% for SO_2 (larger reductions may be required in populated port areas). Deep PM reductions should also be required, although the PM reduction co-benefits of NOx and SOx reductions should be considered. We urge BLG to recommend that these reductions be phased in as soon as possible, but no later than the 2010-2015 time period.

We also urge BLG to recommend that MEPC initiate in the Annex VI revisions a standardization process for on-shore power supply for ships as proposed by Germany and Sweden in their 23 December 2005 submission to MEPC ("Proposal to initiate a standardization process for on-shore power supply(cold ironing)," MEPC 54/4/3); and furthermore, that MEPC establish an international threshold and timeline for the phasing in of shoreside power to help achieve the more stringent reductions in shipping emissions that should be required by Annex VI.

5 Action Requested of the Subcommittee

The sub-Committee is invited to consider the above views and to recommend to MEPC stringent limitations for air emissions from ships.