

Design Memo:

Date: June 20, 2007

Subject: Marine Vessel Air Emissions Regulations
(follow up to the April 25, 2007 Workshop on Air Emissions)

This memo summarizes current and proposed regulations for reducing air emissions from marine vessels, and our ideas on the likely direction of new regulations. Proposed regulations have been published by EPA and, subsequent to our Workshop, a bill to amend the Clean Air Act has been introduced to Congress. The existing and proposed EPA regulations affect the competitiveness of the U.S. fleet as they are applicable to U.S. flag vessels only. The proposed U.S. legislation will impose rigorous sulfur limits on the fuel burned by vessels operating within 200 nm of the U.S. coast, raising technical and safety concerns. This memo outlines some of these concerns, and is intended to provide background to U.S. flag operators interested in commenting on these proposed regulations.

Overview of Proposed Air Emission Regulations

Appendix A summarizes the presentation on regulatory development given at the April 25, 2007 workshop in Iselin, New Jersey. Also included is a discussion on the proposal submitted to Congress by Senator Boxer and Representative Solis, which calls for amending the Clean Air Act to reduce emissions from marine vessels. This bill was introduced in May 2007.

In summary, there are three key regulatory development efforts under way. These are:

1) EPA:

EPA has established Tier 2 requirements for Category 1 and 2 engines (<30 liters per cylinder) for engines delivered after January 2007. This regulation applies to SSDG's up to about 2500 kW, and effectively requires burning of MGO or installation of after treatment technologies (i.e. scrubbers).

EPA has proposed Tier 3 and Tier 4 requirements for Category 1 and 2 engines, which would go into effect during years 2010-2014 and 2014-2017. Tier 3 would require burning lower sulfur fuels (about 0.1% sulfur or 1,000 ppm) and in-engine technology changes to reduce NOx. Tier 4 would require burning ultra-low sulfur fuel (0.0015% sulfur or 15 ppm), and after treatment such as SCR's to reduce NOx. Comments to this proposed rulemaking must be submitted by July 3, 2007.

EPA has temporarily postponed publishing its proposed rules for Category 3 (>30 liter per cylinder) engines.

2) IMO:

The IMO BLG subcommittee has entertained numerous proposals for revising the MARPOL Annex VI regulations. The most interesting proposals are from INTERTANKO, the U.S., and Norway.

The INTERTANKO proposal calls for a 1% (10,000 ppm) sulfur cap by 2010 and a 0.5% (5,000 ppm) sulfur cap by 2015, applicable to vessels worldwide. It requires use of distillate fuel and does not allow for alternative emission abatement technologies.

The U.S. proposal calls for a 0.1% (1,000 ppm) sulfur cap by 2010, applicable to SECA's to about 200 nm from coasts (including the U.S.), and NOx reductions [from current Annex VI levels] of about 20% in 2011 and 80% by 2016. Norway does not believe that 80% NOx reductions can be achieved in practice, and proposed that a 40% NOx reduction be required. Both Norway and the U.S. proposed 20% NOx reductions for existing [pre 2000 built] engines. The U.S. and Norwegian proposals allow for application of equivalent emission abatement technologies.

3) U.S. Congress:

The proposed "Marine Vessel Emissions Reduction Act of 2007" would be applicable to both U.S. and foreign flag vessels operating within 200nm of the U.S. coast and calling at U.S. ports. By December 2010, it calls for a 0.1% (1,000 ppm) sulfur cap, or the best attainable but in no case exceeding 0.2% (2,000 ppm). The bill calls for EPA to develop two tiers of even more rigorous requirements, for implementation in 2012 and 2016. Similar to the EPA IMO proposal, equivalent emission abatement technologies would be permitted.

HEC Views on the Direction of Future Regulations

Although cargo ships and tankers are the most efficient of the transportation modes (see Table 1), marine vessel air emissions are the least regulated of the primary transportation modes. Whereas the other modes burn low sulfur distillates, oceangoing ships typically burn residual fuels producing higher levels of SOx and particulate matter (PM). Therefore, reductions in emissions from ships will be more easily attained as compared to these other modes. Considering the current regulatory environment, it seems certain that new, technology forcing regulations for reducing harmful air emissions from marine vessels will be forthcoming.

Energy Use (kW-hr/tkm)	Tanker	Rail (Diesel)	Truck	Air (Boeing 747)
	0.01	0.07	0.18	2.00

Emissions (g/tkm)	Product Tanker	Rail (Diesel)	Truck	Air (Boeing 747)
NOx	0.15	0.35	0.31	5.69
SOx	0.10	0.01	0.01	0.17
PM	0.01	0.01	0.01	n/a
CO ₂	5	17	50	552

Table 1 Transportation Efficiency Comparison
(assumes 2.6% sulfur fuel oil for tanker operation with ballast return leg)

At the BLG11 subcommittee meeting in April 2007, no consensus was reached on the various proposals to revise MARPOL Annex VI. An ICS paper calling for an in depth study of emissions and fuel availability was forwarded by BLG to MEPC56 for consideration. We initially felt that this action by BLG would delay adoption of a comprehensive revision to MARPOL until at least 2015, while such a study was conducted. However, we now believe that unilateral national initiatives such as the proposed U.S. legislation (*Marine Vessel Emissions Reduction Act of 2007*) and the *European Sulphur Directive* will put increased pressure on IMO to accelerate efforts.

We believe the likely direction for future international regulations is a combination of the INTERTANKO and U.S. proposals, where distillate fuels with a 1% and then 0.5% sulfur cap are required worldwide, and more stringent limits on sulfur content, PM and NO_x emissions are imposed in coastal SECA's. The final regulations will likely allow for the reduction of SO_x and PM through equivalent emission abatement technologies, as few Administrations support the INTERTANKO preference to mandate distillate fuel.

HEC Views on the Direction of Future Ship Design

The price differential between distillate and residual fuel oil is significant and likely to grow as demand increases for the distillate fuels. Scrubbers are effective in reducing SO_x and PM emissions, and could possibly allow for the burning of residual oil, at least when operating outside of the SECA's. However, there are a number of technical and environmental concerns with scrubbers. These include:

- a) The seawater effluent will be contaminated with corrosive SO_x solutions, heavy metals, polycyclic aromatic hydrocarbons (PAH's), and other contaminants found in residual oils. The effluent must be cleaned before discharge, and there may be future restrictions on discharging this effluent in coastal regions. As large amounts of seawater are required, this presents a serious technical challenge. Also, the sludge byproduct will be a hazardous material requiring disposal ashore.
- b) Future regulations are likely to impose more stringent NO_x reduction requirements, likely to 40% to 80% of current levels. This will probably mean application of after treatment devices such as SCR's. Installing scrubbers and SCR's in the same system presents technical challenges. The gas must first be scrubbed as the SCR is not sulfur tolerant. However, the scrubber reduces the stack gas temperature whereas the SCR requires high temperature stack gas. Intermediate heating will further complicate an already complex system.

Although scrubbers in inert gas systems are well proven, the few scrubbers that have been installed in diesel engine exhaust systems have been unreliable. It is likely that material and design changes will solve the corrosion problems, although some ongoing maintenance can be expected. Other concerns expressed by industry representatives include: safety risks in switching between residual oils and the low sulfur (low viscosity) fuels, the ability to ensure that the emission abatement equipment is functioning properly, and the stack gas monitoring requirements that may be imposed on active systems.

Looking 10 years into the future, there is no certainty scrubbers will be able to meet the PM standards for SECA's. Ultra low sulfur fuel (15 ppm sulfur) and catalytic PM control technologies may be required. This is of concern as over 75% of trade is within 200 nm of coastlines.

In summary, we are not convinced that scrubber technology will be a long term solution for marine vessels. The further development of scrubber technology could change the picture but, for now, we believe the marine industry will rely on burning of lower sulfur fuel oils.

Newbuildings should have sufficient tankage to allow for continuous burning of both HFO and very low sulfur fuel oils. Lower sulfur contents tend to translate to lower viscosity oils. Both the main and auxiliary diesel engines should be arranged for burning ISO-8217 F-DMA with a viscosity range down to 1.5 cSt at 40 degrees C. Space for future installation of SCR's should be considered. Although the current proposals for existing engines call for NOx levels which can be achieved through "in engine" modifications, regulations for existing ships could become more stringent in future years.

NOx level reductions of 40% to 80% as presented in the Norwegian, U.S. and Japanese BLG proposals will likely require SCR or equivalent after treatment. It is unlikely that IMO will implement these requirements before 2015. However, the proposed bill for amending the Clean Air Act calls for EPA to establish standards by 2012 based on best available technology.

Comments on Proposed Emissions Regulations

We support rigorous, technology forcing marine vessel emission regulations provided they are effective, achievable and fairly applied across the industry. The EPA regulations which are applicable to U.S. flag vessels worldwide put U.S. flag vessels at a competitive disadvantage and do little to improve air quality. We support the general framework of the proposed *Marine Vessel Emissions Reduction Act of 2007*, as it applies equally to U.S. flag and foreign flag ships. However, we are concerned about the ability of industry to meet the aggressive emissions targets without compromising safety, and the ability of EPA to properly perform the technical feasibility and cost-benefit analyses required of EPA. More specific comments are as follows:

- a) An important consideration is whether refining capacity will be available to provide for the projected increase in consumption of distillate fuels, should a low sulfur cap be implemented. At the workshop in April, Dr. Rudolph Kassinger expressed his belief that it could take at least 20 years to fully convert existing refineries. Note however, that regulations requiring the transition to distillate fuels and thus ensuring a market expansion will encourage refiners to increase capacity of distillate. In addition to further refining residual into distillate, more uses may also be found for the remaining residual oil. This still presents supply-demand issues for the limited supply of low sulfur distillates in the future, and a more gradual transition to burn low and ultra-low sulfur fuels should be considered.
- b) Approximately 230 million tonnes of residual oil is consumed on marine vessels each year. At current prices, switching from residual to distillate fuel will cost roughly \$70 billion per year in fuel costs alone. These considerable costs will ultimately be borne by

the consumer, pointing to the need for a comprehensive cost-benefit analysis. Such studies have yet to be carried out by EPA or others.

- c) Marine transportation is the most energy efficient transportation mode for moving cargo. In terms of emissions of SO_x and PM per tonne of cargo moved, it is comparable to other modes and its greenhouse gas emissions are significantly less than the other modes. Although it is recognized that ships burn less refined fuels than the other modes and therefore emission reductions can be more easily achieved on marine vessels, consideration should be given to the overall impact of emission reduction regulations on the competitiveness of shipping. Fuel costs represent a significant portion of ship operating costs. As these costs increase, there will be a shift of tonnage from marine vessels to other less energy efficient transportation modes.
- d) It is noted that the EPA's Tier 2 regulations for Category 1 and 2 diesel engines, and the proposed Tier 3 and Tier 4 regulations, apply to U.S. flag vessels only. As fuel is a significant portion of a vessel's operating costs, this puts U.S. flag oceangoing ships at a competitive disadvantage to foreign flag vessels. We estimate that operating costs for a Panamax product tanker will increase by over \$500,000 per year. Increased operating costs for a Panamax containership will be significantly higher. Air emission regulations for oceangoing ships should preferably be through IMO. However, if established unilaterally, the regulations should at least treat U.S. flag vessels on the same basis as foreign flag vessels. This is the approach used in the other regulations including the European initiative and the CARB regulations.
- e) The EPA regulations imposed on U.S. flag oceangoing vessels (those certified to trade internationally) do little to improve air quality, as less than 5% of the U.S. international trade is carried on U.S. flag vessels. Because the provisions apply to U.S. flag newbuildings only, we estimate the reduction in emissions from oceangoing ships within the coastal regions will be less than 0.5%.
- f) EPA should recognize that U.S. shipyards contribute a very small fraction of the worldwide construction of oceangoing ships, and therefore are not in a position to stimulate technical changes to large marine engines. Engine efficiency improvements and emission abatement technologies will only be realized when the demand comes from the much larger world market.
- g) It is noted that the EPA Tier 2 regulation and proposed Tier 3 and 4 regulations apply to U.S. vessels trading worldwide. Further study is needed to improve our understanding of the transport and fate of SO_x, PM and NO_x emissions from marine vessels. However, it is clear that the impact of emissions in the open ocean will be considerably less than those occurring close to land. This reasoning is reflected in EPA's IMO proposal calling for SECA's approximately 200 nm from the coastline. Because U.S. flag vessels represent such a small portion of the world's fleet, it is also uncertain whether these vessels will be able to purchase the low sulfur distillates in foreign ports.
- h) EPA's Tier 4 emission standards are based on an assumption that fuel will be available with a sulfur cap of 0.0015% (15 ppm) after June 1, 2012 as required by 40CFR

80.510(c)(1). The rationale is that this will allow use of catalytic after treatment as currently applied on diesel engines for road vehicles. Considering that marine vessels spend a limited time in port (near population centers), the justification for bringing PM levels to those required for road vehicles needs to be established through cost-benefit analysis. As discussed in comment g), better modeling of the transport of air pollutants from marine vessels needs to be developed if benefits are to be properly accounted for. In addition, ocean going vessels may not be able to obtain fuel in foreign ports that meet the EPA standard of 15 ppm. Use of higher sulfur fuel in after treatment equipment designed for 15 ppm sulfur may damage the equipment. We believe a 0.1% sulfur cap (1,000 ppm) may be more appropriate for marine vessels than the proposed 15 ppm cap.

- i) The proposed EPA regulations call for Tier 4 requirements on diesel engines for items such as emergency generators and lifeboat engines. On oceangoing ships, these engines are rarely operated. Consideration should be given to operating profiles when determining emission standards.
- j) The proposed EPA regulations call for meeting new emission standards when diesel engines are “re-manufactured”. EPA should recognize that large diesel engines on oceangoing ships are normally not “re-manufactured” during the life of the vessel. There also exists very limited space in the engine room and stack of most ships to install scrubbers or SCR’s. Again, EPA should recognize the unique nature of the oceangoing tanker and cargo fleet in its cost-benefit analysis.
- k) The proposed *Marine Vessel Emissions Reduction Act of 2007* calls for EPA to “require the same level of emission control achieved by similar engines in other types of vehicles or sources unless EPA determines that level is not achievable by marine engines by January 1, 2012.” This would mean implementation of 15 ppm sulfur fuel, particulate traps, and NOx reduction technologies such as SCR’s. The capital and operating costs to implement this strategy will be very high, making new ships uncompetitive. The likely outcome is that older foreign flag vessels will be utilized for U.S. trade, and the newer ships will trade elsewhere. As noted in comment h), the justification for reducing the sulfur content to 15 ppm on ocean going marine vessels needs to be established.
- l) We are concerned about the EPA’s capability for carrying out the feasibility, safety, and cost-benefit analyses of emission reduction technologies, as called for in the proposed Clean Air Act amendment. To date, the regulatory assessments and cost-benefit assessments conducted by EPA on the Category 1 and 2 diesel engine regulations and proposed regulations have not considered the unique features of oceangoing ships such as the time spent offshore vs. the time spent near population centers, the worldwide availability of low sulfur fuels, the commercial practice to burn residual fuels in large slow speed engines, and the free market nature of international maritime trade.
- m) Approximately 230 million tonnes of residual oil is consumed on marine vessels each year. At current prices, switching from residual to distillate fuel will cost roughly \$70 billion per year in fuel costs alone. These increased costs will ultimately be borne by the consumer. Such large costs point to the need for a rigorous cost-benefit analysis, which has yet to be carried by EPA or others.

Public Comments to the Proposed Regulations

EPA posted their proposed Tier 3 and Tier 4 regulations for Category 1 and 2 diesel engines in the FR on April 3, 2006. Public comments are due by July 3, 2007. You can access the proposed rule and also instructions for submitting comments at:

<http://www.epa.gov/otaq/marine.htm>

It is important that the U.S. maritime industry submit comments on the EPA proposed regulations. Of the hundreds of comments posted to date, few relate to the maritime sector.

As examples, HEC letters on the EPA proposed regulation and the proposed *Marine Vessel Emissions Reduction Act of 2007* are provided as attachments 1 and 2 to this report.

APPENDIX A: SUMMARY of MARINE VESSEL EMISSIONS REGULATIONS

This appendix summarizes the presentation on regulatory development given at the April 25, 2007 workshop in Iselin, New Jersey. Also included is a discussion on the proposal submitted to Congress by Senator Boxer and Representative Solis, which call for amending the Clean Air Act to reduce emissions from marine vessels. This proposed legislation was presented in May 2007.

MARPOL Annex VI

IMO MARPOL Annex VI (Existing Regulation):

Although the U.S. has yet to ratify MARPOL Annex VI, a sufficient number of countries ratified the amendments and Annex VI went into force in May 2005. Annex VI sets a 4.5% (45000 ppm) limit on sulfur content in marine fuel oil, limits NO_x emissions for slow speed and medium speed diesel engines, and established the concept of SECA's (Sulfur Emission Control Areas). Ships operating in SECA's are limited to fuel with a 1.5% sulfur content. A SECA was initially established in the Baltic, and the North Sea SECA will be enforced beginning in August 2007.

The sulfur cap has little impact on overall emissions as the average sulfur content of residual fuels is 2.7%, and very little of the worldwide production exceeds the 4.5% sulfur cap. The NO_x requirements are set at a level that is readily attainable with existing technologies. The engine manufacturers have made the necessary changes to meet these requirements.

IMO MARPOL Annex VI (Proposed Revisions):

IMO has established as a priority the revision of Annex VI by 2010.

The IMO BLG subcommittee (Bulks, Liquids & Gases) which has the mandate to develop the Annex VI revisions met in April 2006 (BLG11). Numerous proposals for revising Annex VI were submitted by member states and NGO's. Key provisions of the more significant proposals are summarized below:

US Proposal (BLG 11/5/15):

- By 2011, SECA's to be established along the U.S. coastal region [200 nm] and elsewhere as desired. In these areas, distillate fuel oil with a 0.1% sulfur cap (1000 ppm) shall be burned, or technologies shall be employed that effectively limit SO_x and PM emissions to those obtained with the 0.1% sulfur fuel.
- For new engines with a capacity greater than 30 liters per cylinder (typically engines approximately 2500 kW), Tier II requirements reducing NO_x emissions by 15% to 25% shall be imposed in 2011, and Tier III limits calling for 80% reduction shall be imposed in 2016.
- For certain existing [pre 2000] engines, NO_x reductions of about 20% shall be required by 2012.

INTERTANKO Proposal (BLG-WGAP 1/2/5):

- By 2010, calls for a global sulfur emission control area (applicable worldwide) requiring burning of distillate fuels with a 1% (10,000 ppm) sulfur cap.
- Reduces the sulfur cap to 0.5% (5,000 ppm) by 2015.

Norway Proposal (BLG 11/5/22, 11/5/23, 11/5/24):

- By 2015, a global sulfur emission control area (applicable worldwide) requiring burning of distillate fuels with a 0.5% (5,000 ppm) sulfur cap.
- Tier II NO_x reductions of 20% by 2010, and Tier III NO_x reductions of 40% by 2015.
- For existing slow speed diesel engines on ships delivered between 1980 and 2000, a Tier I reduction in NO_x to existing Annex VI levels (17 g/kW h).

ICS Proposal (BLG 11/5/8):

- Calls for goal based approach, with study to substantiate “holistic” approach that considers NO_x, SO_x, PM and greenhouse gases.

Some of the important differences between these proposals are as follows:

- a) The INTERTANKO and Norwegian sulfur cap proposals are applicable worldwide, whereas the U.S. proposal calls for SECA’s with a more stringent sulfur cap.
- b) The U.S. and Norwegian proposals have similar Tier II NO_x limits. It is generally acknowledged that these limits can be achieved with “in engine” technologies. The Tier III proposals differ significantly, with the U.S. requesting an 80% NO_x reduction and Norway calling for a 40% NO_x reduction. Both these levels will require after treatment such as SCR’s. Based on experience with Norwegian flag vessels outfitted with SCR’s, Norway believes the 80% reduction is not achievable in practice.
- c) The INTERTANKO proposal does not allow for other technologies which provide equivalent emissions. The U.S. proposal allows for alternative approaches to burning the 0.1% sulfur fuel, provide they meet SO_x, NO_x and PM limits.

At BLG 11 the various proposals were reviewed and summarized, although there was no consensus on the preferred solution. BLG11 forwarded the ICS paper calling for an in depth study of emissions and fuel availability to MEPC56 for consideration. If MEPC decides to pursue a comprehensive emissions assessment, the regulations based on such a study will like not be completed until 2015/2016. If this is the case, a logical compromise will be to adopt a less stringent sulfur cap during the interim period.

Although the lack of consensus at IMO suggests that the deadline will be extended, unilateral initiatives such as the *European Sulphur Directive* and the proposed U.S. legislation (*Marine Vessel Emissions Reduction Act of 2007*) will put increased pressure on IMO to accelerate efforts.

European Initiatives

The *EU Marine Fuel Sulphur Directive 2005/33* adopted the SECA’s requirements for the Baltic and North Sea and set a minimum distillate fuel cap of 0.2% while vessels are in port. This sulfur cap reduces to 0.1% in 2010. The European initiative allows for emission abatement technologies as a substitute for burning the lower sulfur fuels.

California Air Resources Board (CARB) Regulations

Key provisions in CARB's regulations pertaining to auxiliary diesel engines are as follows:

- As of January 1, 2007, requires burning of MGO or MDO with a sulfur cap of 0.5% (5,000 ppm) in auxiliary diesel engines for oceangoing ships. This requirement applies to non direct drive engines including diesel electric propulsion plants.
- As of January 1, 2010, reduces the sulfur cap to 0.1% (1,000 ppm). This reduced sulfur cap is subject to review in 2008, to verify whether safe and cost effective technologies are available to achieve this limit.
- The CARB regulations apply to vessels operating within 24 nautical miles of the California coast, and calling at California ports.
- Alternative emission abatement technologies are permitted.
- Applies to U.S. flag and foreign flag vessels.

CARB is also considering standards applicable to the main engines of oceangoing ships.

EPA Regulations

EPA's Tier 2 requirements for Category 1 and 2 engines (<30 liters/cylinder in size) became effective for engines delivered after January 1, 2007. Key provisions include:

- Tier 2 requirements establish particulate matter (PM) and hydrocarbon (HC) limits, and have NOx limits that are more restrictive than the Annex VI requirements. For auxiliary diesel engines (B&W, Wartsila or equal) to satisfy the PM requirements, either after treatment (scrubbers) are required or MGO must be burned. The native ash and sulfur contained in MDO will exceed these specified PM levels. The NOx requirements can be satisfied by adjusting timing, resulting in a efficiency reduction of about 5%.
- Unlike the EPA IMO proposal and the proposed Maine Vessel Emissions Reduction Act of 2007, this regulation applies to U.S. flag only and is applicable to worldwide trade (rather than being limited to 200nm of U.S. coasts). It applies to newbuildings only, and has no applicability to existing ships.

EPA has proposed Tier 3 and Tier 4 requirements for Category 1 and 2 engines.

- The Tier 3 requirements would become effective during the timeframe from 2009-2014, depending on the size of the engines. The regulations would apply to newly delivered or rebuilt engines, and call for a further 50% reduction in PM and a further 20% reduction in NOx. Tier 3 regulations are expected to be achieved by engine modifications and perhaps water/fuel emulsions, and the burning of lower sulfur distillate fuels. Scrubbers offer a possible alternative to the low sulfur fuel oils.
- The Tier 4 requirements would become effective during the timeframe from 2014-2017. Tier 4 requirements reduce the PM limit, and lowers all NOx to 1.8 g/kW r and all HC to 0.19 g/kW h (NOx by 80% and PM by 90%). The likely means for achieving Tier 4 is by burning 0.0015% (15 ppm) distillate and applying after treatment technologies.

EPA has postponed its release of emissions requirements for Category 3 engines (> 30 liters per cylinder) until December 2009, as it pursues international regulation of these engines at IMO.

Proposed “Marine Vessel Emissions Reduction Act of 2007”

In May 2007, Senator Boxer and Representative Solis introduced legislation to amend the Clean Air Act to reduce emissions from oceangoing ships. Key provisions are as follows:

- This legislation would apply to domestic and foreign flag vessels calling U.S. ports beginning December 2010 and operating within 200 nm of the U.S. coast.
- The fuel sulfur cap should be 0.1% (1,000 ppm) or the lowest sulfur level technically feasible, but in no case greater than 0.2% (2,000 ppm). Equivalent emission abatement technologies are permitted.
- EPA is to develop standards for in-use engines by January 2012.
- EPA is to develop even more stringent standards for new engines, the first tier to be introduced in 2012 and the second tier in 2016.

ATTACHMENT 1

June 20, 2007

Environmental Protection Agency
Mailcode 6102T
1200 Pennsylvania Avenue, N.W.
Washington DC 20460

Subject: Docket OAR-2003-0190
Proposed Rule:
Control of Emissions of Air Pollution from Locomotives and Marine
Compression-Ignition Engines Less Than 30 Liters per Cylinder

Dear Sir or Madam:

Herbert Engineering Corp. is a U.S. naval architecture and marine engineering firm. Our firm's primary business is the design of U.S. flag and foreign flag oceangoing cargo ships, principally tankers, LNG carriers, and containerships. In recent years, we have also been involved in the installation of a number of pollution abatement systems on marine vessels. We thank you for this opportunity to comment on the proposed rulemaking for Category 1 and 2 engines. We believe the oceangoing fleet has unique characteristics that require separate consideration in the emissions rulemaking process, and offer you our perspective as designers of these vessels.

We support rigorous, technology forcing marine vessel emission regulations. However, we are concerned that the general nature of the cost-benefit analyses conducted to date overstate the impact of emissions from oceangoing ships, particular when operating at a distance from land, and underestimate costs of compliance. In this regard, we offer the following comments:

- 1) Marine transportation is the most energy efficient transportation mode for moving cargo. In terms of emissions of SOx and PM per tonne of cargo moved, it is comparable to other modes and its greenhouse gas emissions are significantly less than the other modes. Although it is recognized that ships burn less refined fuels than the other modes and therefore emission reductions can be more easily achieved on marine vessels, consideration should be given to the overall impact of emission reduction regulations on the competitiveness of shipping. Fuel costs represent a significant portion of ship operating costs. As these costs increase, there will be a shift of tonnage from marine vessels to other less energy efficient transportation modes. This shift should be accounted for in your cost-benefit analysis.
- 2) Oceangoing vessels spend only part of their life in port or near coastlines. The cost-benefit analysis conducted by EPA should account for the operating profile of vessels, and the transport mechanisms of pollutants when emitted at sea. Application of road vehicle technologies including 15ppm ultra low sulfur diesel and after treatment may not be justified for oceangoing vessels.

- 3) We believe the fate and transport modeling of SO_x, PM, and NO_x emissions from ships at sea are not sufficiently understood. More research is needed in this area, as it could have a significant impact on the contribution of oceangoing ships to the emissions footprint and subsequently on the benefits of reducing marine emissions.
- 4) The proposed regulations call for Tier 3/Tier 4 requirements on diesel engines for items such as emergency generators and lifeboat engines. On oceangoing ships, these engines are rarely operated. Consideration should be given to operating profiles when performing the cost-benefit analysis used to justify the proposed regulations.
- 5) EPA should recognize that large diesel engines on oceangoing ships are normally not “re-manufactured” during the life of the vessel. Also, very limited space is available in the engine room and stack of most ships, making it difficult to accommodate pre and post treatment technologies in existing vessels. The cost of such conversions on existing ships needs to be understood and properly accounted for.

We are also concerned that the proposed EPA regulations which are applicable to U.S. flag vessels worldwide put U.S. flag cargo vessels at a competitive disadvantage to foreign flag vessels. In this regard, we offer the following comments:

- 1) The EPA regulations imposed on U.S. flag oceangoing vessels (those certified to trade internationally) do little to improve air quality, as less than 4% of the U.S. international trade is carried on U.S. flag vessels. Because the provisions apply to U.S. flag newbuildings only, reductions in coastal emissions over the next 10 to 15 years will be minimal.
- 2) EPA should recognize that U.S. shipyards contribute a very small fraction of the worldwide construction of oceangoing ships, and therefore are not in a position to stimulate technical changes to large marine engines. Engine efficiency improvements and emission abatement technologies will only be realized when the demand comes from the much larger world market.
- 3) As noted in the ANPRM, IMO is the best venue for regulating emissions from the international fleet. With this in mind, we cannot understand the justification for enforcing these rules only on new U.S. Flag ships. The enforcement of these emission standards on the worldwide trading of U.S. flag vessels should be reconsidered.
- 4) The justification for requiring U.S. flag vessels to meet EPA requirements for emissions when sailing outside 200nm from U.S. coastlines should be reviewed. Such emissions will have little impact on U.S. air quality, and there is uncertainty about the availability of the low sulfur fuels in foreign ports. Until these emission limits are internationally applied, fuel availability will also be of concern for U.S. government vessels operating outside U.S. waters. As noted in the ANPRM, IMO is the best venue for regulating emissions from the international fleet. This rationale should also apply to U.S. vessels trading in international waters.

We believe EPA should redouble its efforts at IMO. A majority of Administrations and maritime industry representatives worldwide support rigorous marine vessel emission standards, provided they are fairly and universally applied and justifiable from a cost-benefit perspective. We also note that a bill has been introduced into Congress to revise the Clean Air Act to cover emissions

from ships operating within 200nm of the U.S. coast and calling at U.S. ports. Although an IMO sanctioned SECA is preferred to this legislation, it at least creates a level playing field for both U.S. flag and foreign flag vessels. When the appropriate national and/or international regulations are adopted, these should supersede EPA's unilateral regulations on U.S. flag oceangoing vessels.

Please do not hesitate to contact me with any questions you may have. We look forward to continued discussion on these proposed regulations, and also assisting EPA and the other stakeholders in moving forward effective international regulations.

Sincerely,



Keith Michel

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ATTACHMENT 2

June 20, 2007

Senator Barbara Boxer
United States Senate
112 Hart Senate Office Building
Washington DC 20510

Subject: Marine Vessel Emissions Reduction Act of 2007

Dear Senator Boxer,

I would like to express my support for your leadership role in seeking to reduce emissions from marine vessels. The proposed Marine Vessel Emissions Reduction Act of 2007 will be an important contribution towards reducing harmful air emissions. Relative to the proposed legislation, I would like to offer the following comments:

- 1) It is appreciated that your proposal specifically states that the regulation will apply to both domestic and foreign-flagged oceangoing vessels that enter U.S. ports. EPA regulations imposing Tier 2 emission limits for Category 1 and 2 engines on marine vessels completed their phased-in implementation schedule in January 2007. Unfortunately, these regulations apply only to new U.S. flag vessels. It puts U.S. crewed vessels at a competitive disadvantage to foreign flag vessels, and also encourages life extension of older, less efficient vessels in lieu of building new ships. Furthermore, because some 96% of international trade is moved on foreign flag vessels, this EPA regulation will have negligible impact on the environment.

As you move forward your legislation, please consider being more specific and stating that emission requirements for oceangoing U.S. flag vessels should be the same as those for foreign flag vessels, and that this legislation should pre-empt current EPA regulations applicable only to new U.S. flag ships.

- 2) Because of the low lubricity of fuel oil with 1000 ppm (0.1%) sulfur content or less, there are technical and safety challenges with using this fuel in the main engines and diesel generator engines of existing oceangoing ships. Throughout their regulatory process for marine vessel emissions, EPA has demonstrated a lack of understanding of oceangoing ships and the technologies related to air emissions from these ships. I support your proposal for requiring the lowest quantity of sulfur that is technically feasible by December 2010, but question whether EPA has the expertise to make such a decision. I encourage you to introduce a requirement for an independent study on the technical feasibility of burning the low sulfur fuels on oceangoing vessels, including consideration of safety aspects relative to this issue. This study could also review and offer comments on the cost-benefit analysis to be conducted by the EPA. The Marine Board of the

National Academy of Sciences is an excellent venue for such a study, as its membership has a good understanding of these issues.

- 3) Oceangoing vessels spend only part of their life in port or near coastlines. The cost-benefit analysis conducted by EPA should account for the operating profile of vessels, and the transport mechanisms of pollutants when emitted at sea. Application of road vehicle technologies including 15ppm ultra low sulfur diesel and after treatment may not be justified for oceangoing vessels.
- 4) SO_x, NO_x and particulate matter are key health concerns, but we should not lose sight of the long-term importance of controlling greenhouse gases. Although at this time it is not appropriate to specify requirements for green house emissions for ships, I suggest adding wording to the legislation stating that “due consideration should be given to minimizing CO₂ emissions”. Unfortunately, some of the approaches for reducing SO_x, NO_x, and PM may increase greenhouse gas emissions.
- 5) Finally, I would like to express my concern regarding the lack of leadership taken by the U.S. at the international level. Preferably, this legislation would have been established at the International Maritime Organization. I am convinced that equivalent IMO regulations could now be in effect thereby avoiding the need for unilateral U.S. legislation, if only the EPA and the Administration had taken appropriate and timely action. The EU through establishment of IMO sanctioned Sulfur Emission Control Areas (SECA’s) in the Baltic and North Sea took the proper approach. Considering the urgency of this legislation, it may no longer be practical to go through IMO. However, please consider adding wording to the legislation that requires EPA to make its best effort to work with IMO to bring the U.S. requirements into Annex VI of MARPOL by 2010.

My company has been California based for the last forty-five years, where we have established a reputation as a leader in designing energy efficient oceangoing ships. If there is anything I can do to answer technical questions on emission issues, please do not hesitate to contact me. I would also be pleased to meet with you and/or your staff to discuss this proposed legislation. Again, I would like to thank you for moving this important legislation forward.

Sincerely,



Keith Michel

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