

## EPA Finalizes More Stringent Standards for Control of Emissions from New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder

**T**he U.S. Environmental Protection Agency (EPA) is adopting more stringent exhaust emission standards for large marine diesel engines as part of a coordinated strategy to address emissions from all ships that affect U.S. air quality.

EPA's coordinated strategy includes Clean Air Act standards, as well as implementation of the international standards for marine engines and their fuels contained in Annex VI to the International Convention on the Prevention of Pollution from Ships (a treaty called MARPOL). The strategy also includes designation of U.S. coasts as an Emission Control Area (ECA) through an amendment to MARPOL Annex VI. By 2030, this coordinated strategy is expected to reduce annual emissions of NO<sub>x</sub> in the United States by about 1.2 million tons and PM emissions by about 143,000 tons.

### Changes from Proposed Rule

The final rule provides more flexibility in complying with the fuel sulfur requirements than proposed. First, vessels may now use other methods to achieve sulfur dioxide emissions reductions equivalent to those obtained by the use of lower sulfur fuel.

Second, a fuel availability relief provision has been added for use only by vessels with diesel engines operating on the Great Lakes and Saint Lawrence Seaway. This provision allows operators to buy the lowest sulfur marine residual fuel available if fuel that meets the near-term 1.0 percent (10,000 ppm) fuel sulfur standard is not

available. This provision preserves the greatest benefits of this rulemaking, while avoiding undue consequences for a narrow segment of the regulated industry.

Furthermore, we are finalizing an economic hardship relief provision for vessels with diesel engines operating on the Great Lakes and Saint Lawrence Seaway. This option provides temporary relief from the 2015 ECA-level fuel sulfur standards upon demonstration that the burden of compliance costs would cause serious economic hardship.

Finally, reflecting technical challenges to the use of lower sulfur fuels in steamships, a corresponding potential for reduced safety and a clear directive from the Congress, we are excluding from this final action the application of the ECA-level fuel sulfur standards in MARPOL Annex VI to existing steamships operating on the Great Lakes and Saint Lawrence Seaway.

## Background

Previous Clean Air Act (CAA) standards for new U.S.-flagged Category 3 compression-ignition marine engines (also called marine diesel engines) at or above 30 liters per cylinder displacement are found at 40 CFR Part 94, and have been in effect since January 2004 ([68 FR 9745](#), February 28, 2003). These standards are equivalent to the current international standards for marine engines contained in MARPOL Annex VI. These standards rely on engine-based technologies to reduce exhaust emissions of nitrogen oxides (NO<sub>x</sub>). EPA is adopting additional emission control standards for these engines because of the opportunity to achieve significant public health benefits, and the improved feasibility of applying high efficiency emission control technologies to these engines.

EPA's controls for the sulfur content of marine distillate fuel have been in effect since July 2007 ([69 FR 38957](#), June 29, 2004). These requirements apply to fuel produced or offered for sale in the United States and to distillate grades DMX, DMA, and their equivalents. While EPA has not adopted fuel sulfur limits for residual fuel under the CAA, the MARPOL Annex VI fuel sulfur limits currently apply to marine fuel oil used by any vessel.<sup>1</sup> MARPOL Annex VI contains two sets of fuel sulfur limits, consisting of a global cap on fuel sulfur levels and regional requirements for designated ECAs that set the maximum sulfur content in fuel that can be used by vessels while operating in those areas.

MARPOL Annex VI is being amended to add new levels, or tiers, of engine NO<sub>x</sub> emission standards and fuel sulfur limits. Similar to the current Annex VI, the pending amendments consist of a two-part program, with stringent new global NO<sub>x</sub> standards beginning in 2011, new global fuel sulfur standards beginning in 2012, plus more stringent NO<sub>x</sub> and fuel sulfur controls that will apply in designated ECAs.

## The Need to Reduce Emissions from Category 3 Marine Diesel Engines

Category 3 marine diesel engines are significant mobile source emitters. Category 3 marine diesel engines being produced today must meet relatively modest emission requirements and therefore generate significant emissions of NO<sub>x</sub>, fine particulate matter (PM<sub>2.5</sub>), and sulfur

oxides (SO<sub>x</sub>) that contribute to nonattainment of the National Ambient Air Quality Standards for PM<sub>2.5</sub> and ozone. These engines also emit hydrocarbons (HC), carbon monoxide (CO), and hazardous air pollutants or air toxics that are associated with adverse health effects. Emissions from these engines also cause harm to public welfare, and contribute to visibility impairment and other detrimental environmental impacts across the United States.

Air pollution from large marine diesel engines affects not just populations living near ports and coastlines, but also those living hundreds of miles inland. These engines are significant contributors to our national mobile source emission inventory and their contribution is expected to grow in the future. Without further action, by 2030, NO<sub>x</sub> emissions from ships are projected to more than double, growing to 2.1 million tons a year, while annual PM<sub>2.5</sub> emissions are expected to almost triple to 170,000 tons.

When people breathe this polluted air, their health is adversely affected leading to lost productivity due to increased illnesses, hospitalizations and even premature deaths. EPA believes that diesel exhaust is likely to be carcinogenic to humans by inhalation. Children, people with heart and lung diseases, and the elderly are thought to be most at risk. Reducing emissions from these large marine diesel engines will lead to significant public health benefits and will help states and localities attain and maintain PM and ozone National Ambient Air Quality Standards.

## **Program to Address Emissions from Ships**

EPA's coordinated strategy to address emissions from ocean-going vessels<sup>2</sup> consists of the standards being finalized in today's action, a separate action designating U.S. coasts as an ECA, and implementation of MARPOL Annex VI through the Act to Prevent Pollution from Ships.

### **New Clean Air Act Standards for Category 3 Engines**

EPA is adopting revisions to the CAA engine program to include two additional tiers of NO<sub>x</sub> standards for new Category 3 marine diesel engines installed on vessels flagged or registered in the United States. The final near-term Tier 2 standards for newly built engines will apply beginning in 2011 and will require more efficient use of current engine technologies, including engine timing, engine cooling, and advanced computer controls. The Tier 2 standards will result in a 15 to 25 percent NO<sub>x</sub> reduction below the current Tier 1 levels. The final long-term Tier 3 standards for newly built engines will apply beginning in 2016 and will require the use of high efficiency emission control technology such as selective catalytic reduction to achieve NO<sub>x</sub> reductions 80 percent below the current levels.

In addition to the NO<sub>x</sub> emission limits, EPA is adopting standards for emissions of HC and CO from new Category 3 engines. EPA is not adopting a standard for PM emissions for Category 3 engines. However, significant PM emissions benefits will be achieved through the ECA fuel sulfur requirements that will apply to ships that operate in areas that affect U.S. air quality. EPA is also requiring engine manufacturers to measure and report PM emissions.

Finally, EPA is finalizing a change to the diesel fuel program that will allow for the production and sale of 1,000 ppm sulfur fuel for use in Category 3 marine vessels. In addition, the new fuel

requirements will generally forbid the production and sale of marine fuel oil above 1,000 ppm sulfur for use in most U.S. waters, unless the vessel employs alternative devices, procedures, or compliance methods that achieve equivalent emission reductions.

## **ECA Designation**

On July 17, 2009, the International Maritime Organization (IMO) approved in principle a U.S.-Canada proposal to amend MARPOL Annex VI to designate an ECA off our coasts.<sup>3</sup> ECA designation would ensure that ships that affect U.S. air quality meet stringent NO<sub>x</sub> and fuel sulfur requirements while operating within the designated area, up to 200 nautical miles off U.S. coasts.

## **Annex VI Implementation**

The Act to Prevent Pollution from Ships (APPS) is a U.S. law (33 USC 1901 et seq.) that was last amended when President Bush signed into law the Maritime Pollution Prevention Act of 2008 ([Public Law 110-280](#), July 21, 2008). APPS is the law that authorizes and requires the United States to implement MARPOL Annex VI, now that the United States is a Party to this international treaty.<sup>4</sup> The 2008 APPS amendments require compliance with all aspects of Annex VI by all persons subject to the engine and vessel requirements of Annex VI. The amendments also authorize the U.S. Coast Guard and EPA to enforce the provisions of Annex VI against domestic and foreign vessels and to develop implementing regulations as necessary. In addition, APPS gives EPA sole authority to certify that U.S. marine engines meet the Annex VI requirements.

In this final rule, EPA is adopting regulations under APPS authority to implement the provisions of MARPOL Annex VI. Under these regulations, both U.S.- and foreign-flagged ships subject to the engine and fuel standards of MARPOL Annex VI must comply with the applicable Annex VI provisions when they enter U.S. ports or operate in most internal U.S. waters including the Great Lakes.

In comments on this rule, issues were raised on the application of the 1,000 ppm ECA fuel sulfur standard to the small number of legacy steamships operating on the U.S. coasts. As these vessels do not operate exclusively within U.S. internal waters, they fall under the U.S. Government's (primarily EPA and the U.S. Coast Guard's) implementation of the ECA provisions of the IMO MARPOL Annex VI treaty. The MARPOL Annex VI ECA fuel sulfur limits apply to all vessels and have no specific provisions for steamships. However, we recognize that special challenges exist for the use of lower sulfur fuel in steamships. For the small number of steamships that operate outside of the Great Lakes and that would be subject to the 1,000 ppm ECA fuel standards, EPA is committed to working on this issue with the U.S. Coast Guard and other members of the U.S. delegation to IMO as well as other interested stakeholders, including the affected steamship operators. We are committed to resolving this issue before the end of 2011, well in advance of January 2015 when the 1,000 ppm fuel sulfur standard will enter into force.

## **Program Costs**

The estimated operational and hardware costs of implementing the coordinated strategy are approximately \$1.85 billion in 2020, increasing to \$3.11 billion in 2030. The operational costs

in 2020 are estimated to be \$1.82 billion. Nearly 89 percent of the 2020 costs are attributable to the fuel sulfur provisions. The hardware costs to apply engine controls to U.S.-flagged vessels are expected to be \$31.9 million in 2020, increasing to \$47.4 million in 2030 as more ships are built to comply with CAA Tier 3 NO<sub>x</sub> standards.

When attributed by pollutant, at a net present value of 3 percent from 2010 through 2040,<sup>5</sup> the NO<sub>x</sub> controls are expected to cost about \$510 per ton of NO<sub>x</sub> reduced, SO<sub>x</sub> controls are expected to cost about \$930 per ton of SO<sub>x</sub> reduced, and the PM controls are expected to cost about \$7,950 per ton of PM reduced. These costs compare favorably to other recently adopted mobile source programs, such as the 2008 Locomotive-Marine rule, which had NO<sub>x</sub> and PM cost effectiveness of \$730 and \$8,400 per ton, respectively.

The impacts of these costs on society are estimated to be minimal, resulting in a small increase in the cost of transported goods. For example, a container ship in liner service across the Pacific could see an increase of about \$18 per container, or about a 3 percent increase in operating costs. These costs are expected to be completely passed on to consumers of transported goods, on the order of about one cent for a pair of shoes.

EPA plans to further evaluate the economic impacts of the final rule on Great Lakes carriers in a study to be completed by summer 2010. We will be soliciting input from stakeholders as we prepare that report.

## Program Benefits

By 2030, when this coordinated strategy to address emissions from ocean-going vessels is fully implemented, it is expected to yield significant health and welfare benefits, including:

- reduce annual emissions of NO<sub>x</sub> in the United States by about 1.2 million tons and PM emissions by about 143,000 tons.
- reduce NO<sub>x</sub> emission rates by 80 percent and PM emission rates by 85 percent, compared to the current limits applicable to these engines.
- annually prevent between 12,000 and 31,000 premature deaths, 1,400,000 work days lost, and 9,600,000 minor restricted activity days.

The monetized health benefits are projected to range from \$110 billion to \$270 billion, assuming a 3 percent discount rate, or between \$99 billion and \$240 billion, assuming a 7 percent discount rate. These estimated benefits exceed the projected costs by a ratio of over 30:1.

## For More Information

You can access the final rule and other documents related to our coordinated strategy for ocean-going vessels electronically on the EPA's Office of Transportation and Air Quality web site at:

[www.epa.gov/otaq/oceanvessels.htm](http://www.epa.gov/otaq/oceanvessels.htm)

For additional information, please contact the Assessment and Standards Division at:

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Footnote:

<sup>1</sup> The globally-applicable requirements of MARPOL Annex VI became enforceable in the United States through the Act to Prevent Pollution from Ships (APPS) in January 2009.

<sup>2</sup> Here ocean-going is a descriptive term used because the vast majority of these vessels operate in the oceans, either navigating internationally or operating extensively in coastal areas. However this descriptive term does not represent the legal applicability of any emission standards. For example, larger vessels operating in freshwater lakes or rivers may be included.

<sup>3</sup> [Proposal to Designate an Emission Control Area for Nitrogen Oxides, Sulphur Oxides and Particulate Matter, Submitted by the United States and Canada, IMO Document MEPC59/6/5, 2 April 2009. \(PDF\)](#) (74 pp, 1.75M)

<sup>4</sup> The U.S. became a Party to MARPOL Annex VI by submitting its instrument of ratification to the International Maritime Organization (IMO) on October 8, 2008.

<sup>5</sup> The net present value is a sum of many years worth of emissions reductions, discounting the value that future reductions have to society vs reductions in the present day.