DANGER IN MOTION:

It's Time to Clean Up Trains and Boats

STATE AND TERRITORIAL AIR POLLUTION PROGRAM ADMINISTRATORS

and

ASSOCIATION OF LOCAL AIR POLLUTION CONTROL OFFICIALS

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Danger in Motion:
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Executive Summary

Diesel-fueled locomotives and marine engines are among the largest and most dangerous under-regulated sources of pollution in the United States. According to this analysis, *Danger in Motion: It's Time to Clean Up Trains and Boats*, conducted by the State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO), approximately 4,400 people die prematurely each year from breathing the fumes emitted by these diesel engines.

If left unchecked, locomotive and marine diesel engines could produce nearly half the particulate matter (PM) pollution from all diesel engines by the year 2030, more than a quarter of the emissions of nitrogen oxides (NO_x), a pollutant which can be converted in the air either to fine particles or to ozone, and high levels of toxic air pollutants.

Locomotive and marine diesel engines today are legally permitted to emit pollutants at much higher rates than trucks, buses or nonroad diesel engines. A typical train, for example – even one that meets new railroad emissions standards – will emit as much particle pollution over its life as nearly 500 trucks.

The exhaust from diesel engines contributes to unhealthy concentrations of fine particles and ozone, which are linked to serious problems, including premature death, increased risk of lung cancer, heart disease, aggravated asthma and other respiratory conditions. In addition, PM, NO_x and ozone adversely affect the environment in various ways, including visibility impairment, crop damage and acid rain.

The U.S. Environmental Protection Agency (EPA) has already adopted a comprehensive clean-up strategy for other new diesel engines, including trucks, buses and nonroad engines, such as construction and farming equipment. In those cases, the EPA standards call for approximately a 95-percent reduction in fine-particle pollution ($PM_{2.5}$) and a 90-percent reduction in NO_x.

State and local air regulators are urging EPA to take immediate action to adopt a similar clean-up strategy for new locomotives and marine diesel engines to reduce emissions by at least 90 percent. Although EPA promised in 2004 to propose more effective standards for these engines by mid-2005, the agency has not yet moved forward to do so. Each year of continued EPA inaction in this matter translates into thousands more premature deaths.

EPA could avoid most of the 4,400 annual premature deaths if it takes timely action on a regulatory program for locomotives and marine diesel engines that achieves emission reductions commensurate with those required by other federal rules controlling onroad and nonroad diesel emissions. Such a clean-up strategy would also avoid on the order of 90 percent of the nearly 5,700 heart attacks, 2,200 emergency room visits by children with asthma and over 370,000 lost work days

each year as a result of exposure to locomotive and marine diesel emissions. Health-related benefits would total more than $27 billion a year.

Stringent controls on new locomotive and marine engines are necessary for states and localities to attain and maintain the federal health-based National Ambient Air Quality Standards (NAAQS) for ozone and particle pollution. More stringent NAAQS, as are being contemplated by EPA for PM, would magnify even further the critical need for EPA to tackle the problem of locomotive and marine diesel engines.

Locomotive and Marine Diesel Engines

Diesel-fueled locomotive and marine engines are used in a number of different applications.

There are three types of diesel locomotives, as depicted below: 1) line-haul, which haul goods and freight between two points throughout the country, 2) switch, which transfer loads within a rail yard and 3) passenger, which are used for transportation purposes.

Locomotive Types

Line-haul locomotive

Passenger locomotive

Switch locomotive

Diesel-fueled marine engines are those with fewer than 30 liters per cylinder and are generally divided into four types: 1) under 50 horsepower, such as sailboats and gen sets (used for auxiliary power by sailboats and recreational boats), 2) recreational boats, like cruisers and yachts, 3) Category 1 commercial marine vessels, including workboats, police boats and fishing vessels and 4) Category 2 commercial marine vessels, such as tugboats, ferries, Great Lakes freighters and auxiliary power engines used by ocean-going vessels. (Note that Category 3 marine engines used in ocean-going vessels, like cruise ships and container ships, are not included among diesel-fueled marine engines and are regulated separately by EPA.) Below are examples of diesel-fueled marine engines.

Diesel Marine Applications

<50 hp – Sailboat

Recreational – Yacht

Recreational – Cruiser

Category 1 – Workboat

Category 1 – Fishing boat

Category 1 – Police boat

Category 2 – Ferry

Category 2 – Tugboat

Category 2 – Great Lakes freighter

Category 2 – Auxiliary power for ocean-going vessel

Locomotive and Marine Diesel Emissions

On June 29, 2004, EPA published an Advance Notice of Proposed Rulemaking (ANPRM) for controlling emissions from locomotives and marine diesel engines less than 30 liters per cylinder (69 *Federal Register* 39275, www.epa.gov/fedrgstr/EPA-AIR/2004/June/Day-29/a11294.htm). In that notice, EPA appropriately acknowledged that "[m]arine diesel engines less than 30 liters per cylinder (marine diesel engines) and locomotives are significant contributors to our national mobile source inventory. Even with recent emission standards for these sectors, the contribution of these engines is expected to grow."

In fact, as EPA reports in its ANPRM, and as is reflected in the table below, by 2030, due to the expected future growth in the use of these engines and reductions in pollution from other diesel engines, the locomotive and marine diesel engine contribution to the mobile source NO_x emissions inventory is expected to increase more than two-fold, from 12.4 percent in 1996 to 27.1 percent in 2030, when their emissions are anticipated to total 1,136,128 tons per year. At the same time, the contribution of these engines to the mobile source diesel $PM_{2.5}$ emissions inventory is expected to more than quadruple, from 10.3 percent in 1996 to 44.9 percent in 2030, when their emissions are projected to be 29,125 tons per year.

Locomotive and Marine Diesel Emissions
as a Percent of Mobile Source Emissions Inventory – 1996 and 2030

	1996 % Mobile Source NO_x	1996 % Mobile Source Diesel PM	2030 % Mobile Source NO_x	2030 % Mobile Source Diesel PM
Locomotives	7.2	5.6	11.5	17.9
Marine Diesel	5.2	4.7	15.6	27.0
TOTAL	12.4	10.3	27.1	44.9

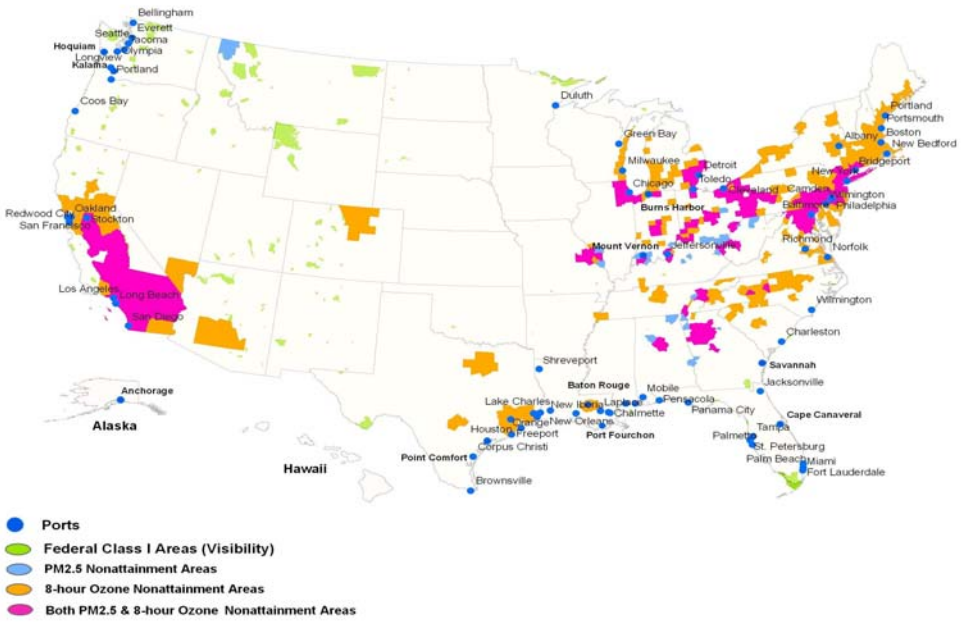
U.S. EPA

Locomotive and marine diesel emissions are not only significant in quantity, but also prevalent throughout the country, as illustrated by the following maps.

U.S. Rail Crossings

U.S. DOT

U.S. Ports in Relation to Nonattainment Areas



Public Health and Economic Impacts

The substantial levels of emissions from locomotive and marine diesel engines translate into startling health impacts, including premature death, heart disease, aggravated asthma and other respiratory conditions and, because diesel exhaust is a likely human carcinogen, increased risk of lung cancer.

STAPPA and ALAPCO have conducted an analysis to quantify many of these dangers, using the same methodology employed by EPA to estimate the health impacts of the Tier 4 nonroad diesel engine standards adopted by the agency in 2004 (U.S. EPA, *Final Regulatory Analysis: Control of Emissions from Nonroad Diesel Engines*, May 2004, www.epa.gov/otaq/regs/nonroad/equip-hd/2004fr/420r04007.pdf). We have summarized the methodology in Appendix A.

The associations' findings are striking. Locomotive and marine diesel emissions are responsible for 4,400 premature deaths each year. Exposure to these emissions also prompts, among other things, nearly 5,700 heart attacks, 2,200 emergency room visits by children with asthma and over 370,000 lost work days annually.

The table below includes a complete list of STAPPA and ALAPCO's findings. The associations further calculated that the economic impact of these adverse health effects caused by locomotive and marine diesel emissions totals over $30 billion a year. (Note that STAPPA/ALAPCO's analysis, like EPA's methodology, was limited to PM-related health impacts ("endpoints") only, and does not include ozone-related health impacts.)

Adverse Health Impacts of Locomotive and Marine Diesel Emissions

PM-Related Endpoint	Incidences/Year – 2030
Premature Mortality, long-term exposure (adults, 30 years & older)	4,407
Infant Mortality (infants, under 1 year)	8
Chronic Bronchitis (adults, 26 years & older)	2,076
Non-fatal Myocardial Infarction (adults, 18 years & older)	5,653
Hospital Admissions – Respiratory (adults, 20 years & older)	1,916
Hospital Admissions – Cardiovascular (adults, 20 years & older)	1,405
Emergency Room Visits from Asthma (18 years & younger)	2,204
Acute Bronchitis (children, 8 to 12 years)	5,110
Asthma Exacerbations (asthmatic children, 6 to 18 years)	73,452
Lower Respiratory Symptoms (children, 7 to 14 years)	60,678
Upper Respiratory Symptoms (asthmatic children, 9 to 11 years)	45,029
Work Loss Days (adults, 18 to 65 years)	370,453
Minor Restricted Activity Days (Adults, 18 to 65 years)	2,171,620

STAPPA/ALAPCO

Implications for States and Localities

The problem posed by locomotive and marine diesel emissions has particular implications for state and local clean air agencies, which currently face the daunting challenge of developing strategies to achieve the health-based NAAQS for ozone and $PM_{2.5}$. EPA estimates that air quality in nearly 130 metropolitan areas nationwide currently violates the 8-hour ozone and/or $PM_{2.5}$ standards, exposing over 150 million people to unhealthful levels of air pollution and the serious health dangers discussed above.

It is increasingly clear that considerable efforts by EPA and state and local agencies will be needed to tackle the sources of pollution that contribute to these widespread problems. Further, many additional areas of the country seek ways to reverse unacceptably high levels of toxic air pollution. As noted earlier, locomotive and marine diesel engines are not only significant contributors to these problems, but without further controls, their relative contribution is projected to multiply.

Additionally, on December 20, 2005, EPA proposed new, more stringent NAAQS for PM and projected that such new standards would likely increase the number of areas out of attainment and expand the emission reduction responsibility of current nonattainment areas (U.S. EPA, *EPA Proposes to Revise the NAAQS for Particle Pollution – Tables and Maps, December 27, 2005,* www.epa.gov/air/particles/pdfs/presentation20051227a.pdf). Tighter ambient air quality standards would magnify even further the already critical need for EPA to confront the problem of locomotive and marine diesel engines.

EPA's Current Diesel Regulations

The regulatory requirements currently in place for locomotive and marine diesel engines are extremely modest.

With respect to locomotives, rules issued by EPA in 1998, and phased in from 2001 to 2005, will reduce NO_x and PM emissions from new locomotive engines by only about 50 percent and do not compel the use of modern emission control devices.

Marine diesel standards issued by EPA in 1999 and being phased in from 2004 to 2007 are even weaker, garnering emission reductions of about 30 percent for NO_x and 25 percent for PM, again, without requiring modern emission controls.

These mediocre regulations are in stark contrast to the far more effective approach EPA has taken to control emissions from other sources of diesel pollution. Standards issued by the agency in 2000, and reaffirmed in 2001, will cut harmful pollution from new onroad heavy-duty diesel trucks and buses by 95 percent beginning in 2007. In 2004, EPA applied a similar strategy to the control of diesel engines in new nonroad heavy-duty equipment used for construction and farming, setting phased-in engine standards that will reduce emissions by more than 90 percent beginning in 2008.

In both the onroad and nonroad rules, EPA took action to dramatically reduce the sulfur content of diesel fuel. These fuel requirements, which also extend to fuel used in locomotive and marine diesel engines (though not to the marine residual fuel used by very large engines in ocean-going vessels), will create immediate health benefits and make it possible for engine manufacturers to use advanced emission-control systems.

However, to put a finer point on the disparity between emission control requirements for locomotive and marine diesel engines and those for other large

diesels, a typical locomotive engine – even one that meets EPA's most recent standards – will emit as much PM over its lifetime as nearly 500 MY 2007 trucks.

EPA's Unfulfilled Commitment

EPA has recognized the need to rectify the vast regulatory discrepancy that exists for locomotive and marine diesel engines. In its 2004 rule to control emissions from nonroad diesel engines and fuels (69 *Federal Register* 39153, www.epa.gov/otaq/url-fr/fr29jn04.pdf), EPA indicated that it would follow with new companion emission standards requiring significantly cleaner new locomotive and marine diesel engines.

EPA formalized this commitment its June 29, 2004 ANPRM, in which the agency stated that it expected to publish a Notice of Proposed Rulemaking for locomotive and marine diesel engines by mid-2005 and a Final Rulemaking by mid-2006.

However, despite this commitment – and despite the obvious need to clean up these sources of pollution – EPA has, disappointingly, taken no further action on the issue. The agency's inaction translates into the continuation of thousands of premature deaths each year that could be avoided by timely and effective controls.

STAPPA/ALAPCO Recommendation and Related Benefits

Clearly, there is a compelling need to more rigorously control emissions from locomotive and marine diesel engines. STAPPA and ALAPCO fully support EPA's intended efforts to promulgate a timely and effective program to control emissions from these engines and the agency's conclusion in its 2004 ANPRM that such a program will help reduce the harmful health and welfare effects of PM, NO_x, ozone and toxic air pollution. In fact, EPA acknowledges in its ANPRM the viability of regulating locomotive and marine diesel engines as early as 2011, and requiring advanced technologies to achieve emission reductions of at least 90 percent, consistent with the onroad and nonroad diesel rules.

To accomplish this goal, STAPPA and ALAPCO urge EPA to take immediate action to adopt aggressive, aftertreatment-based engine standards to reduce emissions of $PM_{2.5}$ and NO_x by at least 90 percent, with full implementation taking effect beginning in 2011.

Such an approach is consistent with Section 213 of the Clean Air Act, which instructs EPA to establish locomotive and marine engine standards that "achieve the greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available" with appropriate consideration given to cost, noise, energy and safety.

Implementation of STAPPA and ALAPCO's recommendation will also put emission reduction requirements for locomotive and marine diesel engines on par with requirements for other onroad and nonroad diesel engines and in a similar timeframe.

Moreover, the health benefits of appropriately rigorous regulations would be dramatic. STAPPA and ALAPCO have estimated that nearly 4,000 premature deaths per year could be avoided if EPA were to adopt locomotive and marine diesel engine standards consistent with our recommendation. A complete list of projected PM-related health benefits is below. We have further estimated that the economic benefits to accrue from implementation of our recommendation would be $27 billion per year.

Health Benefits Associated with
STAPPA/ALAPCO's Locomotive and Marine Diesel Recommendation

PM-Related Endpoint	Avoided Incidences/Year – 2030
Premature Mortality, long-term exposure (adults, 30 years & older)	3,966
Infant Mortality (infants, under 1 year)	7
Chronic Bronchitis (adults, 26 years & older)	1,868
Non-fatal Myocardial Infarction (adults, 18 years & older)	5,087
Hospital Admissions – Respiratory (adults, 20 years & older)	1,725
Hospital Admissions – Cardiovascular (adults, 20 years & older)	1,265
Emergency Room Visits from Asthma (18 years & younger)	1,983
Acute Bronchitis (children, 8 to 12 years)	4,599
Asthma Exacerbations (asthmatic children, 6 to 18 years)	66,107
Lower Respiratory Symptoms (children, 7 to 14 years)	54,610
Upper Respiratory Symptoms (asthmatic children, 9 to 11 years)	40,526
Work Loss Days (adults, 18 to 65 years)	333,408
Minor Restricted Activity Days (Adults, 18 to 65 years)	1,954,458

STAPPA/ALAPCO

Appendix A

Methodology for Calculating Health and Economic Impacts of Locomotive and Marine Diesel Engines in 2030

STAPPA and ALAPCO have estimated the health and economic impacts of locomotive and marine diesel emissions using the identical methodology that EPA followed in its *Final Regulatory Analysis: Control of Emissions from Nonroad Diesel Engines* (RIA) (May 2004).

In calculating the impacts of locomotive and marine diesel engine emissions on public health, we apply "emissions scaling factors" derived in Section 9.2 of the RIA, and "apportionment factors," as explained in Section 9.3. Our analysis, like EPA's calculations on its nonroad diesel engine regulation, only examines the health and visibility impacts associated with *particulate matter*. Accordingly, *ozone* health and welfare impacts of emissions from locomotive and marine engines are not included.

In our analysis, we use EPA's formula (below) from Chapter 9.4 of the agency's nonroad RIA for calculating premature mortality.

$$\textit{Scaled Incidence} = \textit{Modeled Incidence} * \sum_i R_i A_i$$

1. The "modeled incidence" is the projected number of incidences (e.g., premature mortalities – 13,800) from the "Modeled Preliminary Control Option" for 2030 (see Table 9A-30 of the RIA).

2. "R_i" are the ratios of locomotive and marine diesel emissions, estimated by EPA in its June 29, 2004 Advance Notice of Proposed Rulemaking, divided by the emissions reductions from nonroad engines estimated in the "Modeled Preliminary Control Option" (see Table 9-5 of the RIA).

3. "A_i" are the "health benefits apportionment factors," which represent the emissions ratios EPA has developed, through complex air pollution modeling, to determine the relative contributions of sulfates, nitrates and direct particulate matter to the formation of $PM_{2.5}$ concentrations in the atmosphere (see Table 9-10 of the RIA).

Therefore, to calculate, for example, estimated premature mortalities from locomotive and marine diesel engines in 2030, the formula is:

NO_x	SO_x	PM

[(1,136,128/1,009,744) x 16.8%] + [(0/483,401) x 20.5%] + [29,125/138,208) x 62.7%] = 32%

32% x 13,800 = 4,407 premature mortalities

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