

**STAFF REPORT:
INITIAL STATEMENT OF REASONS FOR
PROPOSED Rulemaking**



PROPOSED REGULATION FOR COMMERCIAL HARBOR CRAFT

**Stationary Source Division
Emissions Assessment Branch**

September 2007

**State of California
AIR RESOURCES BOARD**

**STAFF REPORT:
INITIAL STATEMENT OF REASONS
FOR THE PROPOSED RULEMAKING**

Public Hearing to Consider

**REGULATIONS TO REDUCE EMISSIONS FROM DIESEL ENGINES ON
COMMERCIAL HARBOR CRAFT OPERATED WITHIN CALIFORNIA WATERS
AND 24 NAUTICAL MILES OF THE CALIFORNIA BASELINE**

To be considered by the Air Resources Board on October 25 and 26, 2007, at:

California Environmental Protection Agency
Headquarters Building
Byron Sher Auditorium
1001 I Street
Sacramento, California

Stationary Source Division
Robert Fletcher, Chief
Robert Barham, Ph.D., Assistant Chief
Emissions Assessment Branch
Daniel E. Donohoue, Chief
Health and Exposure Assessment Branch (RD)
Linda Smith, Ph.D., Chief
Control Strategies Section
Cherie Rainforth, Manager
Regulatory Support Section
Todd Sax, Ph.D., Manager

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**State of California
AIR RESOURCES BOARD**

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AND 24 NAUTICAL MILES OF THE CALIFORNIA BASELINE**

Principal Author

Todd Sterling

Contributing Authors

Kirk Rosenkranz
John Lee
Kathleen Truesdell
Pingkuan Di, Ph.D.
Lisa Williams
Bonnie Soriano
Doug Grandt
Chengfeng Wang, Ph.D.
Reza Mahdavi, Ph.D.
Hien Tran
Joe Calavita

Legal Counsel

Floyd Vergara, P.E., Office of Legal Affairs

Supporting Divisions

Planning and Technical Support Division (PTSD)
Research Division (RD)
Mobile Source Control Division (MSCD)

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EXECUTIVE SUMMARY

The California Air Resources Board (ARB or Board) staff is proposing two essentially identical regulations to reduce diesel particulate matter (PM) and oxides of nitrogen (NOx) emissions from commercial harbor craft in California. For the remainder of this report, the regulations will collectively be referred to as “the regulation.” The proposed Harbor Craft Regulation (regulation) is part of ARB’s ongoing effort to reduce PM and NOx emissions from diesel-fueled engines and vehicles and improve air quality associated with goods movement. A copy of the proposed regulation is provided in Appendix A of this report.

Commercial harbor craft include a variety of vessel types including ferries, excursion vessels, tugboats, towboats, crew vessels, work boats, commercial and charter fishing boats, and other types of harbor craft. Staff estimates that there are about 4,200 harbor craft vessels and 8,300 harbor craft engines currently in use in California. Of these, there are nearly 600 ferries, excursion vessels, tugboats, and towboats equipped with about 1,900 propulsion and auxiliary engines that would be subject to the in-use engine requirements of this regulation. Approximately 80 percent of all harbor craft engines are unregulated diesel engines. These unregulated engines are also referred to as Tier 0 (or “pre-Tier 1”) engines. Currently, about 3.3 tons per day (tpd) of diesel PM and 73 tpd of NOx are emitted from diesel engines on commercial harbor craft operating in California.

Diesel PM was identified as a toxic air contaminant in 1998. Long-term exposures to diesel PM increase the risk of developing lung cancer. Non-cancer impacts, including premature death and respiratory disease, are associated with exposure to directly emitted diesel PM and secondary diesel PM formed when NOx emissions from diesel engines react in the atmosphere to form nitrates. A recent ARB exposure study at the ports of Los Angeles and Long Beach found harbor craft to be the third highest source of diesel PM emissions contributing to the cancer risk from port activity. The study found that over 1.5 million people were exposed to potential cancer risk levels of greater than 10 in a million. Staff estimates that direct and secondary diesel PM from harbor craft are currently responsible for about 90 premature deaths per year.

The proposed regulation includes requirements for both new and in-use (existing) engines used on commercial harbor craft operating in Regulated California Waters. “Regulated California Waters” include all California internal waters; estuarine waters, ports, and coastal waters within 24 nautical miles of the California coastline. The proposal would establish in-use emission limits for both auxiliary and propulsion diesel engines on ferries, excursion vessels, tugboats, and towboats consistent with the United States Environmental Protection Agency (U.S. EPA) marine engine standards. All new harbor craft engines and replacement engines purchased for in-use harbor craft would have to meet emission limits equal to, or more stringent than, the U.S. EPA

marine engine standards in effect at the time the new vessel or engine is purchased. The propulsion engines on new ferries would also have to install the best available aftertreatment technology. All commercial harbor craft vessels would also be subject to monitoring (must have non-resettable hour meters on engines), recordkeeping, and reporting requirements.

The compliance schedule would require that the oldest and highest-use engines on in-use ferries, excursion vessels, tugboats, and towboats comply first, beginning in December 2009. For harbor craft with homeports in the South Coast Air Quality Management District (SCAQMD), the compliance schedule also begins in 2009, but is accelerated by two years for future compliance deadlines. This would provide early benefits for the South Coast Air Basin, which is in non-attainment for the federal annual PM_{2.5} and PM₁₀ ambient air quality standards and 8-hour ozone standard.

The proposed regulation emphasizes engine replacement (repower), rather than retrofits with diesel emission control strategies, because applying retrofits to marine engines presents multiple challenges. While there are several projects underway demonstrating retrofit strategies on marine applications, there are currently no verified strategies for marine engines. Marine applications present challenges due to the uniqueness of each application, the harsh marine operating environment, and safety concerns. In addition, the relatively small size of the marine retrofit market provides fewer incentives for investment by emission control system manufacturers. Safety concerns, including the impact of the additional weight of the emission control equipment, line of sight concerns, and the need for high engine reliability will be important considerations in the design of aftertreatment systems. The requirement for multiple agency review and approval whenever marine vessels are modified, particularly from the U.S. Coast Guard, adds another level of complexity. While staff believes that development of retrofit strategies for marine applications is likely, the market is not sufficiently mature at this time to require retrofits. With that said, the proposal allows for the use of appropriate retrofit technologies as a viable option for those vessel owners and operators that choose to retrofit their engines to comply with the regulation.

Staff estimates that about 80 percent of the diesel engines on commercial harbor craft are Tier 0 engines, based on a 2004 engine inventory conducted by ARB staff. Replacing these Tier 0 engines with lower-emission Tier 2 engines (currently available) would provide a 60 to 65 percent reduction in both PM and NO_x. Replacing Tier 0 engines with Tier 3 engines (available starting 2009 through 2014) would provide a 70 to 80 percent reduction in both PM and NO_x. In 2025, after full implementation of the regulation, the diesel PM emissions from commercial harbor craft would be reduced from baseline 2004 levels by nearly 2.5 tpd (75 percent reduction), and NO_x emissions would be reduced by 45 tpd (60 percent reduction).

The emission reductions from the proposed regulation would result in lower ambient PM levels and reduced exposure to diesel PM. Staff estimates that approximately 310 premature deaths statewide would be avoided by year 2025 from implementation of the proposed regulation. The estimated cost benefit of the avoided premature deaths

and other health benefits due to the emission reductions are estimated to range from \$1.3 to \$2.0 billion.

The reduction in potential cancer risk was assessed based on the overall projected reduction in harbor craft emissions between 2004 and 2020. It was estimated that the population impacted by a risk of 10 in a million would be reduced by over 60 percent due to these emission reductions.

Staff estimates that the regulatory costs for complying with the proposed regulation would be approximately \$140 million (2006 dollars), or about \$10 million annually over the 2009 through 2022 compliance time period for in-use engines. The regulatory costs are the incremental costs of regulation compliance and include those costs associated with the early replacement of engines (the residual value of the engine being replaced, the residual value of the most recent engine rebuild work, and the time value of money associated with the early engine replacement), aftertreatment costs for new ferries, and recordkeeping and reporting costs.

Staff also estimated the total out-of-pocket costs, or new equipment costs, that will occur over the 2009 through 2022 time period related to early engine replacement, aftertreatment costs for new ferries, and recordkeeping and reporting. These costs include both the regulatory costs, such as reporting and recordkeeping and after-treatment costs for new ferries, and normal and routine business costs such as replacing an engine at the end of its service life. The new equipment costs are estimated to be approximately \$460 million (2006 dollars) over the 2009 to 2022 time period.

Staff evaluated the economic impact of complying with the in-use engine requirements on the affected ferry, excursion, tugboat, and towboat vessel businesses by evaluating the impact of the regulatory cost on typical business's "return on owner's equity" (ROE). We found that the overall change in ROE ranges from a negligible decline of about 0.5 percent for a typical tow company, to a decline of about 3.5 percent for a ferry or tug company. A decrease in ROE within this range is not considered to represent a significant impact on profitability.

Staff has determined that multiple federal, State, and local agencies would be impacted by the proposed regulation. The majority of the agencies would not be affected by the in-use compliance requirements and would only be subject to the reporting requirement, resulting in costs of approximately \$100 per engine. One State agency, the California Department of Transportation (Caltrans), and three local agencies operating passenger ferries would be impacted by the in-use engine requirements. The affected local agencies include the City of Vallejo, which operates the Baylink Ferry; the Golden Gate Bridge and Highway Transportation District; and the Port of Los Angeles. Regulatory costs to these local agencies and Caltrans range from about \$2,000 to \$2 million over the life of the regulation.

The cost-effectiveness of the regulation is estimated, based on the regulatory costs, to be about \$29 per pound of diesel PM reduced if all the cost is attributed to diesel PM reductions. The cost effectiveness for this regulation is consistent with those of other recent regulations, such as the Cargo Handling Equipment regulation at \$41 per pound of PM and the Solid Waste Collection Vehicle Regulation at \$28 per pound. If the costs are split evenly between diesel PM and NO_x, the cost effectiveness is estimated at about \$14 per pound for diesel PM and \$1,800 per ton of NO_x. If the costs are attributed to the combined PM and NO_x reductions, cost effectiveness would be about \$1.70 per pound.

1. INTRODUCTION

This Initial Statement of Reasons (Staff Report) presents an evaluation of the need for emission reductions from commercial harbor craft including the corresponding health impacts, a summary of the proposed regulation (two essentially identical regulations collectively referred to hereinafter in the singular), and the projected emissions reductions along with the associated reduction in health risk. The estimated costs for regulation compliance are presented, for both industry and State and local governments, along with the alternative proposals considered. A copy of the proposed regulation is provided in Appendix A. The Technical Support Document, an addendum to the Staff Report, provides more detailed analyses of these subjects and supporting documentation for the proposal. The Technical Support Document is provided under separate cover.

The California Air Resources Board's (ARB or Board) mission is to protect public health, welfare, and ecological resources through the effective and efficient reduction of air pollutants, while recognizing and considering the effects on the economy of the State. The ARB's vision is that all individuals in California, especially children and the elderly, can live, work, and play in a healthful environment – free from harmful exposure to air pollution. To help achieve this, ARB has adopted numerous regulations to control emissions from many different sources, including diesel engines. Diesel engine exhaust is a significant health concern because it is a source of unhealthy air pollutants including gaseous and particulate-phase toxic air contaminants (TAC), particulate matter (PM), oxides of nitrogen (NOx), carbon monoxide, and hydrocarbons.

In 1998, the Board identified diesel PM as a TAC with no Board-specified threshold exposure level, pursuant to Health and Safety Code (HSC) sections 39650 through 39675. A needs assessment for diesel PM was conducted between 1998 and 2000 pursuant to HSC sections 39658, 39665, and 39666. This resulted in ARB staff developing and the Board approving the *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles* (Diesel RRP) in 2000. The Diesel RRP presented information on the available options for reducing diesel PM and recommended regulations to achieve these reductions. The Diesel RRP's scope was broad, addressing all categories of mobile and stationary engines. It included control measures for all off-road diesel sources, such as those covered by the proposed regulation. The ultimate goal of the Diesel RRP is to reduce, by 2020, California's diesel PM emissions and associated cancer risks by 85 percent from the 2000 levels.

In January 2005, the Goods Movement Cabinet Workgroup – created by Governor Schwarzenegger and led by the California Environmental Protection Agency and the Business, Transportation and Housing Agency – established a policy for goods movement and ports to improve and expand California's goods movement industry and infrastructure while improving air quality and protecting public health. The workgroup worked collaboratively with the logistics industry, local and regional governments, neighboring communities, business, labor, environmental groups, and other interested

stakeholders to create a two-phased Goods Movement Action Plan (Action Plan), which outlines a comprehensive strategy to address the economic and environmental issues associated with moving goods via the state's highways, railways, and ports. In April 2006, the Board approved the Emissions Reduction Plan for Ports and Goods Movement in California as part of the Action Plan. The final phase of the Action Plan was completed in January 2007 and includes a framework that identifies the key contributors to goods movement-related emissions. The Action Plan emission reduction goals for existing harbor craft engines are 25 percent reductions for both diesel PM and NOx compared to baseline 2001 levels by 2010, 30 percent reductions compared to 2001 baseline levels by 2015, and 40 percent reduction by 2020.

The federal Clean Air Act (CAA) requires U.S. EPA to establish National Ambient Air Quality Standards (standards) for pollutants considered harmful to public health, including fine particulate matter (PM2.5) and ozone. The South Coast and San Joaquin Valley Air Basins are the two areas in the State that exceed the annual PM2.5 standards. These areas are required by federal law to develop State Implementation Plans (SIPs) describing how they will attain the standards by 2015. The U.S. EPA further requires that all necessary emission reductions be achieved one calendar year sooner – by 2014 – in recognition of the annual average form of the standard. Reductions of NOx emissions are needed because NOx contributes to the formation in the atmosphere of both ozone and PM2.5; diesel PM emission reductions are needed because diesel PM contributes to ambient concentrations of PM2.5. The San Joaquin Valley and South Coast air basins are also in non-attainment for the federal ozone standard. However, they are expected to have until 2023 to attain the federal ozone standard, by invoking the “bump-up” provision in the CAA. The ARB and the districts are working to complete the PM2.5 and ozone SIPs and expect to submit them to the U.S EPA by April 2008 and this fall, respectively.

While all sources of NOx emissions are important, marine vessels play an especially significant role in California's efforts to reach attainment. Emissions from marine vessels, which include commercial harbor craft engines, collectively represent one of several key contributors to ambient PM2.5 levels, the successful control of which will determine whether California is able to meet the 2014 deadline for PM2.5 attainment in the South Coast Air Basin.

Staff is proposing a regulation to reduce diesel PM and NOx emissions from harbor craft vessel engines. Such vessels include but are not limited to, ferries, excursion vessels, tugboats, towboats, crew vessels, work boats, commercial and charter fishing boats, and other types of harbor craft.

The regulation is expected to significantly reduce emissions of diesel PM from in-use harbor craft engines. Diesel PM emission reductions are needed to reduce premature mortality, cancer risk, and other adverse impacts from exposure to this TAC. The regulation would achieve the 2015 and 2020 goals for harbor craft in the Goods Movement Action Plan. By 2020, staff projects that in-use harbor craft diesel PM emissions would be reduced about 70 percent and NOx emissions about 60 percent

from the 2004 baseline. These emission reductions would occur in areas along waterways, near ports, and in those communities surrounding these areas, as well as further inland.

The regulation would also reduce diesel PM and NOx emissions that contribute to exceedances throughout the State of ambient air quality standards for both PM2.5 and ozone. These reductions would assist California in its goal of achieving state and federal air quality standards.

2. EMISSIONS INVENTORY

Approximately 8,300 marine engines currently operate on about 4,200 harbor craft in California. These vessels are located mostly along the California coastline, with some on inland waterways. Harbor craft emit approximately 3.3 tpd of diesel PM and 73 tpd of NOx statewide. A summary of the estimated number of vessels and engines in each category and the emissions contributed are provided in Table 1 and Table 2 below.

Table 1: Commercial Harbor Craft Vessels and Engines (2004)

Vessel Category	Number of Vessels	Number of Engines
Commercial Fishing	2,727	4,308
Charter Fishing	563	1,419
Ferries/Excursion	416	1,348
Tug	128	450
Tow	35	115
Crew and Supply	64	230
Pilot	27	50
Workboats	89	158
Other	136	214
Total	4,185	8,291

Table 2: Commercial Harbor Craft Vessels Emissions Inventory (2004)

Vessel Category	2004 Pollutant Emissions, Tons/Day			
	PM	NOx	HC	CO
Commercial Fishing	0.8	17.4	1.3	4.8
Charter Fishing	0.6	12.7	0.9	3.3
Ferries/Excursion	0.9	21.0	1.4	5.6
Tug	0.6	15.3	1.0	3.8
Tow	0.1	3.0	0.2	0.7
Crew and Supply	0.1	1.4	0.1	0.4
Pilot	0	0.4	0	0.1
Workboats	0	0.5	0	0.1
Other	0.1	1.5	0.1	0.4
Total	3.3	73.2	5.0	19.2

The vessel categories targeted for engine emission reductions are ferries, excursion vessels, tugboats, and towboats. These vessels comprise about 23 percent of the engine inventory, yet generate about 50 percent of the emissions from all harbor craft. These vessels also work within the harbor and generally close to shore, as shown in Figure 1 below.

Figure 1: 2004 Vessel-Specific Diesel PM Emissions by Proximity to Shore

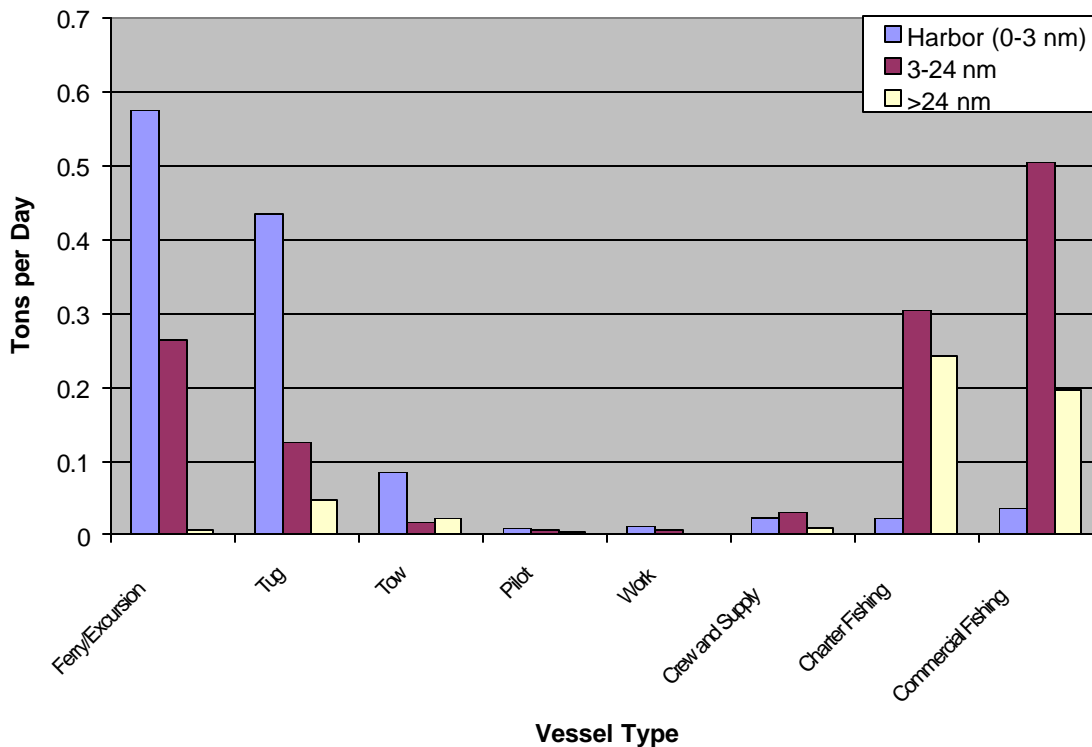


Figure 1 shows that about 70 percent of harbor craft diesel engines are on fishing vessels. However, they generate only about 40 percent of the harbor craft emissions. It is also important to note from Figure 1 that a large portion of the fishing vessel emissions occur more than 24 nautical miles off shore. Emissions released far offshore present a lesser health risk than near-shore emissions. In addition, the commercial fishing industry has been in decline for the last decade. Available data show that the number of working fishing vessels and tonnage of fish landings are declining about six percent per year. Reduced catch and increased competition from foreign markets make the fishing industry less able to bear the costs of regulatory compliance than other commercial harbor craft industries. Because of the lower health risk from the fishing vessels' offshore emissions, as compared to the near-shore emissions of the targeted industries, and the steady decline in the commercial fishing industry, staff is not proposing to require emission reductions from in-use engines on fishing vessels in the current proposal.

From ARB surveys and local district and port inventory data, we estimate that about 35 percent of harbor craft emissions are in the Bay Area Air Quality Management District (BAAQMD), 25 percent are in the SCAQMD, and just over 10 percent in the San Diego County Air Pollution Control District. The remaining 30 percent are distributed over other coastal districts and districts with major inland waterways.

As described in the Technical Support Document, staff projected the commercial harbor craft population for the current and future years using air districts' fleet growth rates adjusted as appropriate by other available information. Staff assumed tugboat growth rate to be flat since these vessels are generally over-powered and are capable of handling larger vessels. The six percent per year decline in commercial fishing vessels was assumed to continue through 2009. From 2010 on, the growth was assumed flat.

Engine population for current and future years was estimated based on the projected vessel population, the assumption that vessels in future years would have the same number of engines per vessel and the same average size as the base year and an engine attrition rate based on ARB's OFFROAD model.

3. HEALTH RISK

A. Cancer Risk

To estimate potential cancer risks from harbor craft, ARB staff conducted a risk assessment for the Ports of Los Angeles and Long Beach (POLA/LB). The POLA/LB health risk assessment estimated that commercial harbor craft are responsible for the third highest impact on cancer risk from port activities. Based on a 2002 POLA/LB inventory, over 1.5 million people are exposed to a cancer risk of greater than 10 in a million due to harbor craft diesel PM emissions in the Los Angeles/Long Beach area. Staff adjusted the potential cancer risk for the 2002 inventory to reflect the ARB 2004 inventory for the SCAQMD. This potential risk based on the 2004 inventory provides a consistent baseline with which to compare the estimated risk using the projected controlled emissions. The adjustment to the 2004 baseline inventory increased the number of people exposed to a 10 in a million risk from 1.5 million to 1.7 million.

Estimates of potential cancer risks from harbor craft activity at these two ports would represent the upper range of cancer risks, given the magnitude of harbor craft emissions in the San Pedro Bay area and the proximity of the emissions to highly urbanized areas. Qualitative estimates of the relative impact of harbor craft emissions for other areas can be made based on a comparison of the relative magnitude of emissions and the proximity of the emissions to urbanized areas. For example, one would expect that the potential cancer risk estimate associated with harbor craft activity in the Bay Area would be similar to the estimate for the POLA/LB, while the cancer risk estimates for San Diego would be about 50 percent lower.

B. Non-Cancer Risk

Staff estimates that exposures to direct and secondary diesel PM emissions from harbor craft can be associated with about 90 premature deaths per year. Approximately half of these premature deaths are due to direct diesel PM and half from secondary diesel PM. All of these estimates are rounded to the tens digit.

Using the 2004 statewide estimate of directly emitted diesel PM emissions (3.3 tpd) and the association between ambient PM exposure and mortality derived from Pope et al. (2002), we estimate approximately 50 premature deaths (a range of 10 to 80, with a 95 percent confidence interval (95% CI), for ages 30 and older) per year statewide can be associated with uncontrolled, directly emitted diesel PM from harbor craft.

These estimates were developed using basin-specific factors relating the non-cancer health impacts to direct diesel PM emissions from harbor craft for the year 2000. After adjusting for population changes between 2000 and 2004 and adjusting for lower on-shore impacts from emissions released off-shore, staff estimates that the public was exposed to about 590 tons of direct diesel PM emissions from harbor craft in 2004. We estimate that approximately 50 annual premature deaths (10 to 80, 95% CI) are associated with this exposure.¹ Estimates of other health impacts, such as hospitalizations and asthma symptoms, were calculated using basin-specific factors developed from other health studies. Details on the methodology used to calculate these estimates, including the adjustment for off-shore PM emissions in the 3 to 24 nautical mile domain, can be found in Appendix A of the Emission Reduction Plan for Ports and Goods Movement in California (ARB, 2006).

In addition to directly emitted PM, diesel exhaust contains NO_x, which is a precursor to nitrates, a secondary diesel-related PM formed in the atmosphere. Lloyd and Cackette (2001) estimated that secondary diesel PM_{2.5} exposures from NO_x emissions can lead to additional health impacts beyond those associated with directly emitted diesel PM_{2.5}. (Lloyd and Cackette, 2001) To quantify such impacts, staff developed population-weighted nitrate concentrations for each air basin, as described in the Technical Support Document, Chapter IV.

Using the 2004 statewide estimate of NO_x emissions from harbor craft and the relationship of NO_x/nitrate to PM-mortality discussed below, we estimated approximately an additional 50 (10 to 80, 95% CI) premature deaths (for ages 30 and older) per year statewide can be associated with uncontrolled, secondary diesel PM from harbor craft.

¹ To account for the differing impact of diesel PM emission from off-shore sources, CARB staff developed a South Coast and a statewide diesel PM emissions impact adjustment factor. For the South Coast, the adjustment factor for ship diesel PM emissions released off-shore was estimated to be 0.1, based on dispersion modeling. For the rest of the state, the adjustment factor was estimated to be 0.25.

In addition to PM-mortality, we estimate that the 2004 estimated emissions (directly emitted and secondary sources) from harbor craft will result in the following statewide non-cancer health impacts:

- 20 hospital admissions due to respiratory causes (10 to 30, 95% CI)
- 40 hospital admissions due to cardiovascular causes (20 to 60, 95% CI)
- 2,400 cases of asthma-related and other lower respiratory symptoms (940 to 3,900, 95% CI)
- 200 cases of acute bronchitis (0 to 430, 95% CI)
- 16,000 work loss days (13,000 to 18,000, 95% CI)
- 90,000 minor restricted activity days (74,000 to 110,000, 95% CI)

4. SUMMARY OF THE PROPOSED REGULATION

Staff is proposing the Board approve adoption of a regulation, pursuant to its authority under HSC sections 43013 and 43018, which would apply to the emissions from diesel engines on commercial harbor craft operating within any of the Regulated California Waters. As a companion to the proposed regulation, staff is proposing that the Board also approve adoption of identical provisions as an airborne toxic control measure (ATCM), pursuant to its authority under HSC section 39666, which would complement the regulation and provide maximum notice to the regulated community of the regulatory requirements on commercial harbor craft. The regulation and ATCM are hereinafter collectively referred to in the singular. The following sections provide more details about the proposed regulation.

A. Emission Standards for Marine Engines

Under the staff's proposal, the emissions of diesel PM and NOx from a regulated diesel engine (both new and in-use) would be identical to those specified by the U.S. EPA marine engine standards for new engines in effect at the time compliance is required. The U.S. EPA marine engine emission standards have phased effective dates and emission levels dependent on the engine size.

The U.S. EPA classifies marine engines as either Category 1, 2, or 3, depending on engine size or cylinder displacement, with the engine size increasing with the higher category number. All of the engines used in California's commercial harbor craft are Category 1 or 2 engines, with about 90 percent of the engines being Category 1 engines. The engine size and approximate maximum horsepower (hp) rating for Category 1 and 2 engines are provided in Table 3. Category 1 engines are rated at less than 5.0 liters per cylinder and can range as high as 2,500 hp. Category 2 engines range in size from 5.0 liters per cylinder to 30 liters per cylinder and can range from about 750 to 5,000 hp. Most propulsion engines used in harbor craft operating in California are Category 1 engines. Auxiliary engines are exclusively Category 1 engines. Harbor craft Category 2 engines are generally used in tugboat, towboat, and some ferry applications.

Table 3: U.S. EPA Marine Engine Categories Used in Harbor Craft

Category	Liters per Engine Cylinder	Approximate Horsepower
Category 1	< 5.0 ^A	50 ^B to <~2500 hp
Category 2	5.0 to 30 ^A	≥750 to <5000 hp

^A The U.S. EPA has proposed Tier 3 and Tier 4 standards, which, if adopted, will update Category 1 to < 7.0 L/cyl. and Category 2 to 7.0 to 30 L/cyl.

^B The proposed Category 1 Tier 3 standards include engines rated less than 50 hp.

The emission limits for Category 1 and 2 engines used in commercial harbor craft are summarized in Table 4.

Table 4: U.S. EPA Marine Engine Standards Effective Dates and Emission Limits for Category 1 and Category 2 Engines Used in Harbor Craft

Category	Tier Level	Adoption Date	Effective Date	PM (g/bhp-hr)	NOx (g/bhp-hr)
1	1	IMO 1997 U.S EPA 2003	2000 2004	N/A	7.3 – 12.7 ^B
	2	U.S. EPA 1999	2004-2007	0.15-0.3	5.4-5.6 ^C
	3	U.S. EPA proposed 2007	2009-2114	0.08-0.3	3.5-5.6 ^C
	4 ^A	U.S. EPA proposed 2007	2017	0.03	1.3
2	1	IMO 1997 U.S EPA 2003	2000 2004	N/A	7.3 – 12.7 ^B
	2	U.S. EPA 1999	2007	0.2	5.8 ^C
	3	U.S. EPA proposed 2007	2013	0.1	4.6 ^C
	4 ^A	U.S. EPA proposed 2007	2016-2017	0.03	1.3

(40 CFR Part 94)

^A Applies only to engines with maximum horsepower rating of 800 hp (600 kW) or more.

^B Standard is a function of engine speed, revolutions per minute (rpm). Standard=12.7 for engines with engine speed = 2000 rpm. Standard=7.3 for engines with engine speed =130 rpm. For engines between 130 and 2000 rpm, standard = 33.57 X rpm^{-0.2}.

^C NOx is NOx + total HC.

The U.S. EPA has proposed but not finalized its rulemaking for establishing Tier 3 and Tier 4 marine engine standards. The limits and effective dates shown in Table 3 are based on the proposal set forth in their April 3, 2007, Draft Locomotive and Marine Notice of Proposed Rule Making (U.S. EPA, 2007). The U.S. EPA proposal would initiate Tier 3 standards between 2009 and 2014 for most commercial harbor craft engines. The Tier 3 standards are expected to be achievable without after-treatment; however, the Tier 4 standards will require after-treatment technology. The U.S. EPA has proposed Tier 4 standards only for engines over about 800 horsepower (hp) starting

in 2016 for the largest commercial harbor craft engines and a year later, 2017, for 800 to 1,880 hp engines.

The U.S. EPA is expected to finalize their Tier 3 and Tier 4 marine engine standards by the end of 2007. These proposed standards are incorporated by reference in the proposed commercial harbor craft regulatory language. If these standards are not adopted as proposed, it will be necessary for staff to return to the Board to amend the regulatory language such that the standards incorporated by reference are consistent with those in the U.S. EPA's final rulemaking.

B. In-Use Requirements

Compliance Options

Staff is proposing that in-use Tier 0 (pre-Tier 1) and Tier 1 marine engines on ferries, excursion vessels, tugboats, and towboats meet emission limits equal to or cleaner than the U.S. EPA marine engine Tier 2 or Tier 3 emission standards applicable on the compliance date. The proposed regulation does not require compliance with Tier 4 (after-treatment based) standards for in-use engines due to issues with the additional weight and space requirements associated with applying after-treatment technologies to existing vessels.

While we expect the primary method for compliance with the proposal is the replacement of in-use engines with certified Tier 2 or Tier 3 engines, the proposed regulation includes other options for compliance. These options include:

- demonstrating that the current engine meets the applicable U.S. EPA marine engine standards;
- demonstrating that the current engine has not been operating 300 hours or more per calendar year and will continue to operate at this low usage rate in the future.

If the engine is replaced with a Tier 2 or 3 engine or can be shown to meet the applicable standards, all compliance requirements for that engine will have been met.

The ARB staff anticipates that, in most cases, engine replacement will be the option chosen by vessel owners and operators to meet the proposed emission standards for vessels. Ferries, excursion vessels, tugboats, and towboats are good candidates for repowering because these vessel types have an extensive history of being repowered. Almost 50 ferries, excursion vessels, tugboats, and towboats statewide have been repowered over the last six years through the Carl Moyer Program.

Compliance Schedule

The compliance schedules in the proposed regulation are shown in Table 5 and Table 6. Compliance dates are based on the model year of the engine and the hours of operation.

The engine model year would be determined by one of three methods. In most cases, the engine’s actual model year of manufacture would be used to determine the required compliance date. However, if certain steps have been taken to reduce the emissions of the engine, an “effective model year” may be calculated based on the following:

- implementing an emission control strategy that obtains at least a 25 percent reduction in either PM or NOx, would extend the engine model year by five years. This is referred to as the “Engine’s Model Year + 5” method. The date at which the engine must meet the U.S. EPA marine engine standards would be based on the engine model year plus five years;
- demonstrating that the engine has been rebuilt to Tier 1 standards or cleaner prior to January 1, 2008 would allow the date of rebuild to be used as the engine’s model year for determining when the engine must meet the U.S. EPA marine engine standards. This is referred to as the “Engine’s Tier 1 Rebuild Model Year.”

Table 5 shows the statewide schedule for compliance. This compliance schedule applies to all ferries, excursion vessels, tugboats, and towboats operating in regulated California waters, except those with homeports in SCAQMD. The compliance schedule for vessels with homeports in SCAQMD is shown in Table 6.

Table 5: Compliance Dates for Vessels with Homeports outside SCAQMD

Engine Model Year	Total Annual Hours of Operation	Compliance Year
1975 and earlier	= 1500	12/31/2009
1975 and earlier	= 300 and < 1500	12/31/2010
1976 - 1985	=1500	12/31/2011
1976 - 1985	= 300 and < 1500	12/31/2012
1986 - 1995	= 1500	12/31/2013
1986 - 1995	= 300 and < 1500	12/31/2014
1996 - 2000	=1500	12/31/2015
1996 - 2000	= 300 and < 1500	12/31/2016
2001 - 2002	= 300	12/31/2017
2003	= 300	12/31/2018
2004	= 300	12/31/2019
2005	= 300	12/31/2020
2006	= 300	12/31/2021
2007	= 300	12/31/2022

[Note: For example, if a 1982-model year diesel engine on a tugboat operating in Regulated California Waters is used for 750 hours in 2011, the owner or operator must bring the engine into compliance with the emission standards by December 31, 2012.]

Table 6: Compliance Dates for Vessels with Homeports in SCAQMD

Engine Model Year	Total Annual Hours of Operation	Compliance Date
1979 and earlier	≥ 300	12/31/2009
1980 – 1985	≥ 300	12/31/2010
1986 – 1990	≥ 300	12/31/2011
1991 – 1995	≥ 300	12/31/2012
1996 – 2000	≥ 300	12/31/2013
2001	≥ 300	13/31/2014
2002	≥ 300	12/31/2015
2003	≥ 300	12/31/2016
2004	≥ 300	12/31/2017
2005	≥ 300	12/31/2018
2006	≥ 300	12/31/2019
2007	≥ 300	12/31/2020

[Note: For example, if a 1982-model year diesel engine on a tugboat operating in Regulated California Waters is used for 300 or more hours in 2009, the owner or operator must bring the engine into compliance with the emission standards by December 31, 2010.]

Early compliance dates for the SCAQMD are proposed in order to provide emission reduction commitments for harbor craft, as contained in the 2003 Statewide Strategy of the California State Implementation Plan (SIP), and to assist the SCAQMD in meeting its attainment goals. The South Coast Air Basin is non-attainment for the federal annual PM2.5 and PM10 ambient air quality standards and 8-hour ozone standard.

For harbor craft with homeports in the SCAQMD, the compliance schedule begins December 31, 2009, similar to the statewide schedule, but it is accelerated by two years for future compliance deadlines. Engines brought into compliance the first year also include a wider range of model years, through 1979, than the statewide schedule. Accelerating the compliance schedule for SCAQMD would provide early benefits for the South Coast Air Basin to assist in meeting their air quality attainment goals.

C. Newly Acquired and New Harbor Craft Engines and Vessels – All Harbor Craft

The proposed regulation includes requirements regarding newly acquired and new harbor craft and engines that apply to all harbor craft vessel types.

Acquisition of Engines for All In-Use Harbor Craft

A newly acquired engine for any in-use harbor craft would be required to meet the U.S. EPA marine engine emission standards in effect on the date that the vessel owner acquires the engine. This provision ensures that retired engines are replaced with the cleanest engines available.

Acquisition of In-Use Harbor Craft

The acquisition of in-use harbor craft is unrestricted; however, engine compliance, monitoring, reporting, and recordkeeping requirements apply.

Acquisition of New Harbor Craft

The engines on all new harbor craft vessels would be required to meet the U.S. EPA marine engine standard in effect at the time of vessel acquisition. The propulsion engines on new ferries would be subject to additional requirements. The propulsion engines on all new ferries, with the capacity of more than 75 passengers and built after January 1, 2009, would be required to meet the U.S. EPA marine engine standard in effect at the time of vessel acquisition and would also be required to be equipped with the best available control technology (BACT) for the engine and application. New build ferries would be required to submit a plan to the ARB defining the emission reduction technology and expected emission reductions for the ferry to be built. The ARB Executive Officer would make a case-by-case determination as to whether the planned control technology meets the BACT requirement.

D. In-Use Requirements for All Harbor Craft

There are additional in-use requirements in the regulation that apply to all harbor craft. These include a requirement for harbor craft to use clean fuel, as discussed in the next section, and mandatory monitoring, reporting, and recordkeeping requirements.

Fuel Use Requirement

This proposal would require that harbor craft diesel engine be fueled with CARB diesel or an approved alternative diesel fuel. Examples of alternative fuels that could be used are biodiesel, biodiesel blends, Fischer-Tropsch fuel, emulsions of water in diesel fuel, and fuels with an additive. This provision would also allow alternative diesel fuels and CARB diesel fuel used with a fuel additive that meet the requirements of the ARB Verification Procedure.

Monitoring, Reporting, and Recordkeeping

Owners and operators of harbor craft operating in Regulated California Waters would be required to keep records for each vessel and install a non-resettable hour meter on each engine. Vessel owners/operators would also need to keep a copy of the initial reporting form and the yearly records on the vessel or in a central dockside location to be made available upon request of the ARB enforcement staff. Initial reporting would be required for all vessels starting February 28, 2009. The initial reporting would provide ARB staff with information including contact information, and vessel and engine information. Compliance reporting would be required for ferries, excursion vessels, tugboats, and towboats in the commercial harbor craft fleet. Ferry, excursion vessel, tugboat, and towboat operators would specify how they plan to comply with the

proposed regulation in the initial report, and how they have complied in the final reporting.

Historically, harbor craft engines have not been subject to statewide or local air district permitting or registration programs. As a result, limited data on the marine engines used aboard harbor craft are available from district permitting programs. The mandatory reporting required by the proposed regulation would provide more complete information on California's harbor craft fleet for both implementing the current regulation and developing any further regulatory requirements.

E. Compliance Extensions

The proposed regulation includes a provision by which the ARB Executive Officer may grant a vessel owner or operator a compliance extension beyond the deadlines specified in the regulation. The reasons included in the proposed regulation for granting an extension are:

- change in hours of operation of vessel during the year prior to the anticipated engine compliance date such that the effective compliance date would be accelerated by one year;
- no suitable engine replacement for a particular engine;
- delay in engine delivery due to the engine manufacturer;
- installation difficulties; and,
- owner with multiple vessels whose engines would need to comply in the same year.

If an extension is required because there is no suitable engine replacement for a particular engine, the owner or operator is required to apply for this extension at least six months prior to the engine regulatory compliance date. The approval process for this extension includes a public review and comment period.

F. Exemptions

The proposed regulation includes a low-use exemption from the engine compliance requirements for ferries, excursion vessels, tugboats, and towboats for engines that are not operated more than 300 hours per year within Regulated California Waters. These low-use engines would be subject to the other requirements of the proposed regulation, including the clean fuel use, a mandatory non-resettable hour meter, and reporting and recordkeeping. Increased operation of a low-use engine on a ferry, excursion vessel, tugboat, or towboat would make the engine subject to the engine compliance requirements.

Vessels traveling through Regulated California Waters without entering California internal or estuarine water or calling at a port are provided an exemption from the requirements of the proposed regulation.

Temporary replacement vessels and registered historic vessels are also exempt from the engine compliance requirements. A temporary replacement vessel must be a vessel whose homeport is not within California and is brought into California to be used for no longer than 12 months to perform the work of a California vessel that has been temporarily taken out of service. A California vessel with a homeport outside the SCAQMD may also be brought into the SCAQMD as a temporary replacement vessel to perform the work of an out of service vessel for a limited term and remain subject to the statewide schedule rather than the SCAQMD accelerated schedule.

Vessel types that are exempt from the regulation in its entirety include:

- recreation vessels;
- ocean-going vessels, except ocean-going tugboats or towboats;
- military tactical support vessels;
- all Coast Guard vessels; and,
- temporary emergency rescue/recovery vessels.

A temporary emergency rescue/recovery vessel is defined as a vessel whose homeport is outside California and is brought into California for the immediate use of emergency rescue or recovery and returns to its homeport outside of California at the conclusion of its rescue/recovery mission.

Engines that are exempt from the regulation either in portion or in entirety include:

- vessel engines with a maximum horsepower rating of less than 50 hp - exempt from the in-use engine compliance requirements,
- vessel engines currently registered with the ARB's Portable Engine Registration Program (sections 2450 through 2465, title 13, CCR) - exempt from the regulation in its entirety, and
- vessel engines on a vessel that is to be retired within one year of the engines' compliance date are exempt from the in-use engine compliance requirements.

Low horsepower engines are being exempted for administrative reasons and their minimal contribution to the emission inventory.

5. EMISSION REDUCTIONS

The ARB staff has estimated that by requiring early engine replacement for these vessel types and implementing an accelerated schedule for the SCAQMD, the reductions necessary for meeting the Goods Movement Action Plan goals for harbor craft can be met and significant early benefits for the South Coast can be achieved. As shown in Figure 2 and Figure 3, in 2025, after full implementation of the proposed regulation, the statewide diesel PM emissions from commercial harbor craft would be reduced from the 2004 baseline by nearly 2.5 tpd and NOx emissions would be reduced by about 45 tpd.

Figure 2: Projected Statewide PM Emissions for Harbor Craft Diesel Engines

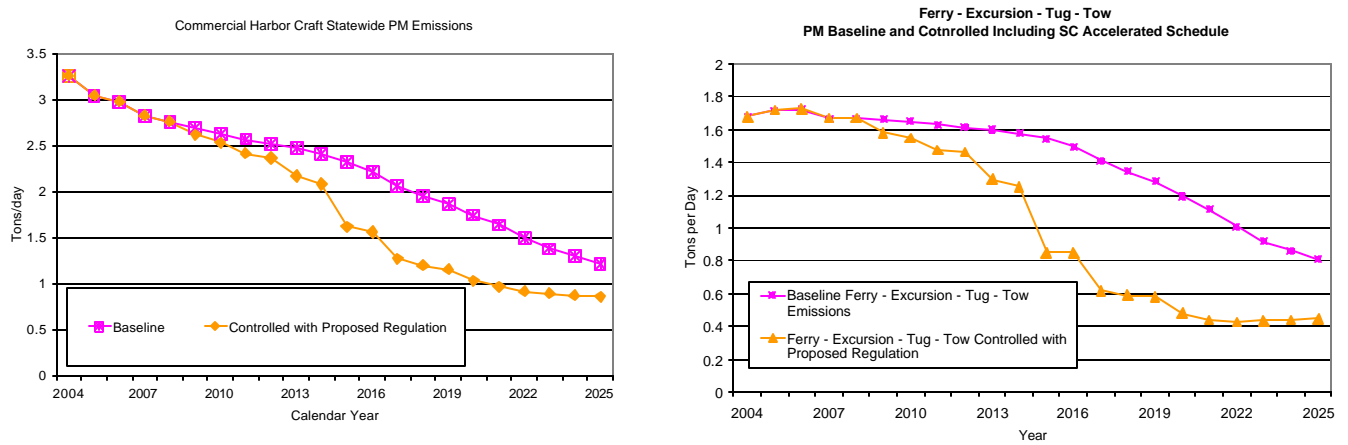
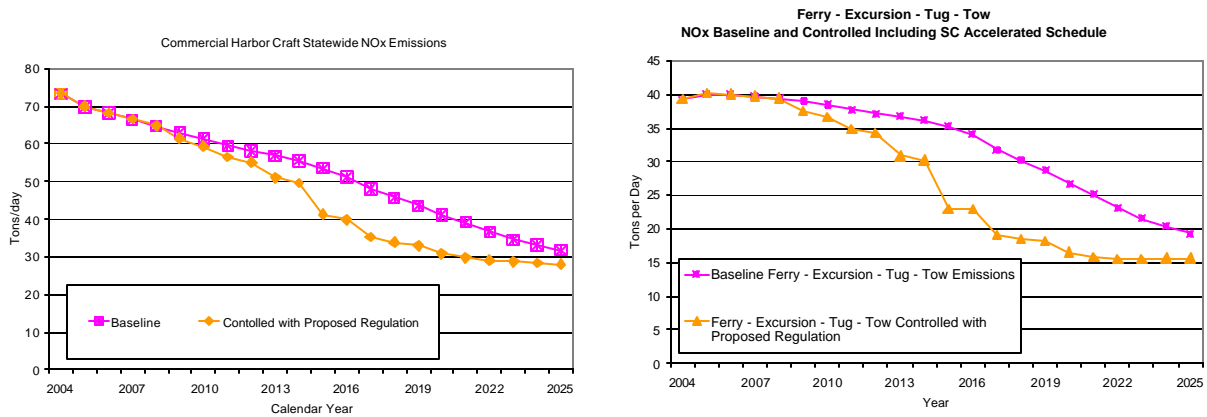


Figure 3: Projected Statewide NOx Emissions Harbor Craft Diesel Engines



Both the overall harbor craft fleet projected emission and those generated specifically from the vessel engines subject to the in-use engine compliance schedule are shown in the figures above. The baseline projected emissions decrease over time due to the following efforts and factors:

- U.S. EPA cleaner marine new engine standards;
- California’s requirement for the sale of ultra low sulfur diesel fuel for harbor craft;
- port clean air plans;
- engine replacement incentive programs; and,
- a negative growth factor for California’s fishing fleet.

ARB staff estimates that the proposed measure, in conjunction with these other efforts and factors, would reduce diesel PM emissions from harbor craft diesel engines by

about 50 percent by 2015 and nearly 70 percent by 2020. The ARB staff also estimates that NOx emissions would be reduced by about 45 percent by 2015 and nearly 60 percent by 2020. Both the baseline and controlled projected emissions include the benefit of the U.S. EPA proposed Tier 3 and Tier 4 marine engine standards for new engines. The U.S. EPA is expected to finalize these standards by the end of 2007. The projected reduction in both the baseline and controlled emissions are dependent on the U.S. EPA adopting standards at least as stringent as those they proposed in April 2007.

Although both PM and NOx uncontrolled emissions are projected to drop through 2025, the proposed regulation would accelerate the anticipated emission reductions. For example, without the proposed regulation, we would not achieve the 50 percent drop (relative to 2004) in PM emissions projected for the 2015 inventory until about 2021 (see Table 7 below). The reductions from all actions, including the proposed regulation, are summarized in Table 7 and Table 8 below.

Table 7: Projected Statewide PM Benefits for Harbor Craft from All Actions^A

Year	PM without Regulation (tons/day)	PM with Regulation (tons/day)	Emission Reductions from 2004 (tons/day)	% Emission Reductions from 2004
2004	3.3	3.3	0.0	0%
2010	2.6	2.5	0.7	22%
2015	2.3	1.6	1.6	50%
2020	1.7	1.0	2.2	68%
2025	1.2	0.9	2.4	74%

^A All actions include the proposed regulation, U.S. EPA marine new engine standards, low sulfur fuel requirement, port clean air plans, incentive programs, and negative growth factor for fishing fleet.

Table 8: Projected Statewide NOx Benefits for Harbor Craft from All Actions^A

Year	NOx without Regulation (tons/day)	NOx with Regulation (tons/day)	Emission Reductions from 2004 (tons/day)	% Emission Reductions from 2004
2004	73	73	0	0%
2010	61	59	14	19%
2015	54	41	32	44%
2020	41	31	42	58%
2025	32	28	45	62%

^A All actions include the proposed regulation, U.S. EPA marine new engine standards, low sulfur fuel requirement, port clean air plans, incentive programs, and negative growth factor for fishing fleet.

The SCAQMD accelerated schedule would provide early NOx and PM benefits, with an estimated 35 percent reduction in PM emissions and 25 percent reduction in NOx emissions, due to the proposed regulation, in 2014. These projections are shown in Table 9.

Table 9: Projected SCAQMD NOx and PM Benefits for Harbor Craft in 2014

South Coast NOx and PM Emissions in 2014 (tons/day)		
Pollutant	PM	NOx
Year	2014	2014
Without regulation	0.63	14.4
With regulation	0.40	10.4
Benefits of regulation	0.2	3.9
Percent reduction due to regulation	36%	27%

Note: Numbers may not add up due to rounding

The regulation benefits in 2014 would be significantly less if the SCAQMD in-use engine compliance schedule were not accelerated and aligned with the statewide schedule. This is illustrated by Figure 4 and Figure 5, below.

Figure 4: South Coast AQMD PM Benefits with Accelerated and Statewide In-Use Harbor Craft Engine Compliance Schedules

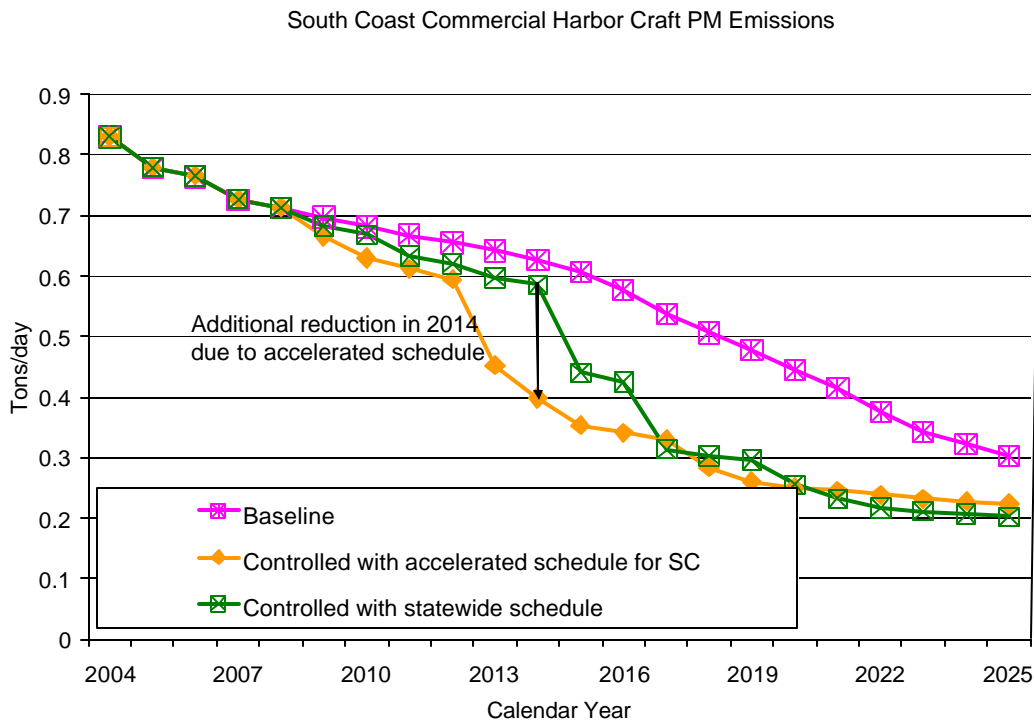
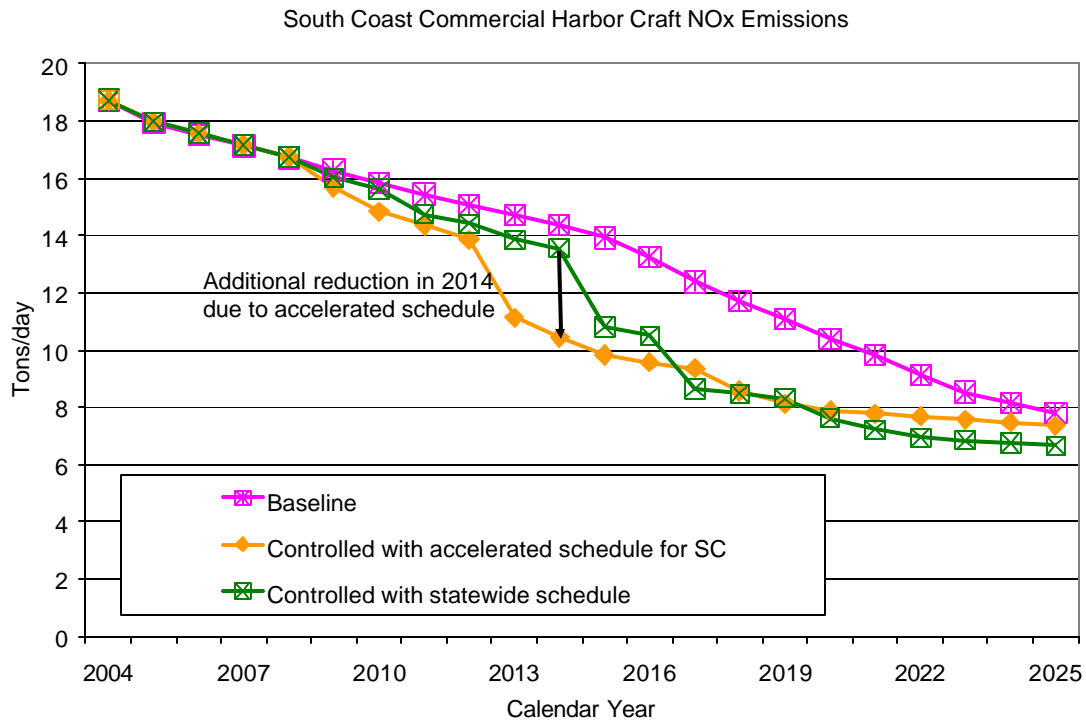


Figure 5: South Coast AQMD NOx Benefits with Accelerated and Statewide In-Use Harbor Craft Engine Compliance Schedules



6. RISK REDUCTION

A. Cancer Risk

The emission reductions obtained from the proposed regulation would result in lower ambient PM levels and reductions in exposure to diesel PM. These reductions would result in a corresponding reduction in potential cancer risk. Based upon our analysis of harbor craft in the Ports of Los Angeles and Long Beach, the estimated reduction in cancer risk is shown on a residential area impacted basis in Figure 6 and, on a population basis, in Figure 7. The population impacted by a risk of 10 in a million would be reduced from 1.7 million persons, in 2004, down to 0.6 million persons by 2020, due to reductions from the proposed regulation as well as other factors.

Figure 6: Reduction Due to Proposed Harbor Craft Regulation in Residential Areas Impacted by Increased Potential Cancer Risk (POLA/LB)

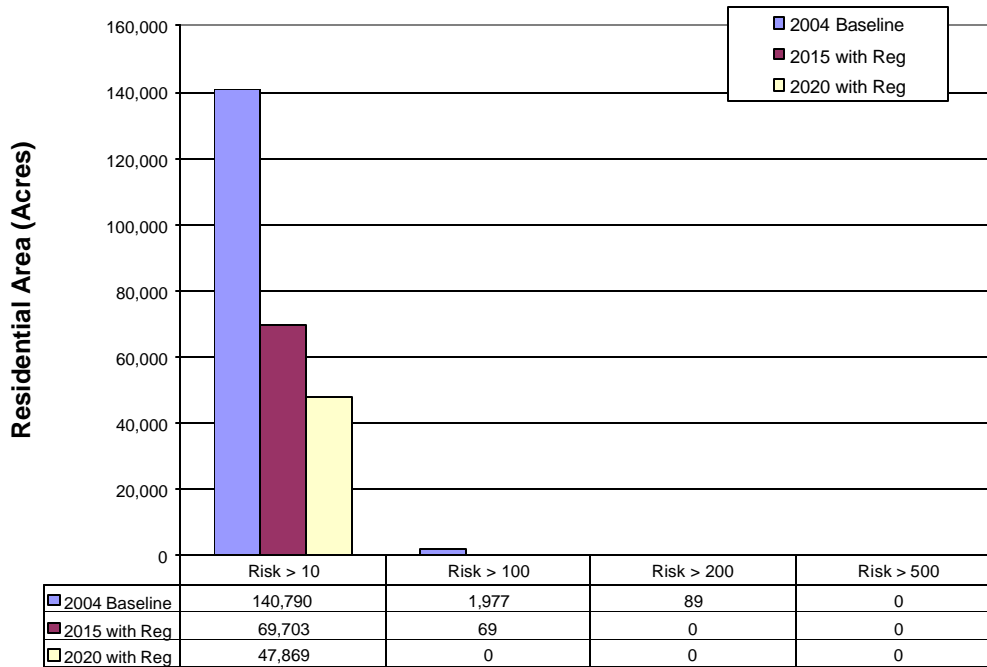
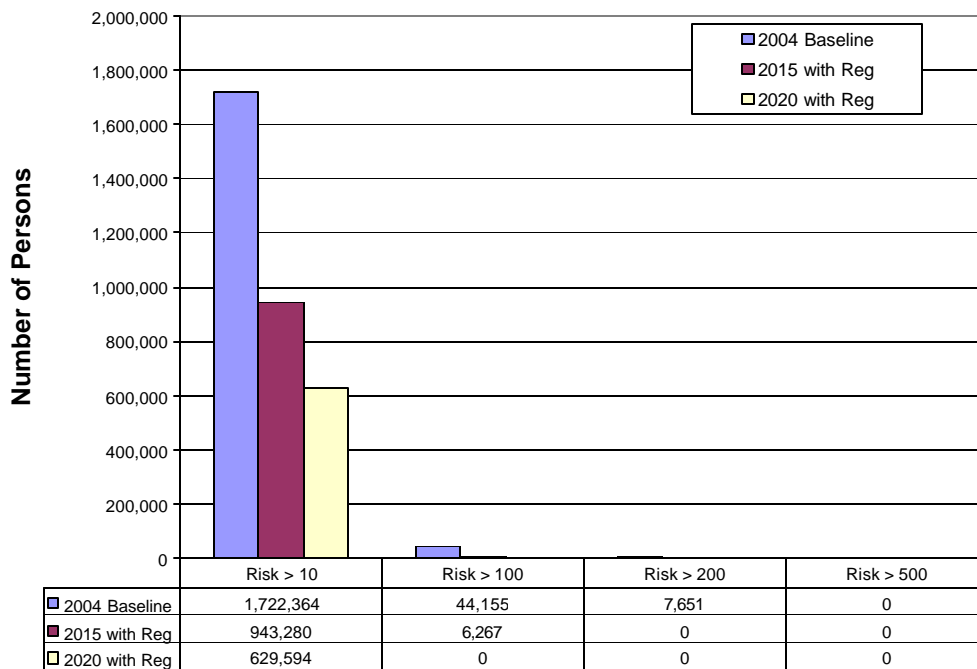


Figure 7: Reduction Due to Proposed Harbor Craft Regulation in Population Impacted by Increased Potential Cancer Risk (POLA/LB)



B. Non-Cancer Risk

The emission reductions obtained from this regulation will result in lower ambient PM levels and reduced exposure to diesel PM. Staff estimates that, based on the incremental benefits of the proposed regulation, approximately 310 premature deaths [(90 to 530, 95 percent confidence interval (95% CI))] statewide will be avoided by the year 2025 from the implementation of the commercial harbor craft regulation. Estimates of other health effects avoided statewide include:

- 70 hospital admissions due to respiratory causes (40 to 90, 95% CI)
- 120 hospital admissions due to cardiovascular causes (80 to 190, 95% CI)
- 8,100 cases of asthma-related and other lower respiratory symptoms (3,100 to 13,000, 95% CI)
- 670 cases of acute bronchitis (0 to 1,500, 95% CI)
- 53,000 work loss days (45,000 to 61,000, 95% CI)
- 300,000 minor restricted activity days (250,000 to 360,000, 95% CI)

7. ENVIRONMENTAL IMPACT

No significant adverse environmental impacts are expected to occur from adoption of, and compliance with, the proposed requirements for commercial harbor craft engines. Implementation from the proposed amendments would reduce directly emitted and secondarily formed PM levels, provide both near source and regional risk reduction, and contribute to the overall effort of reducing PM mortality, hospital admissions, and lost work days.

8. IMPACT ON GLOBAL WARMING

Some actions required by the proposed regulations could result in slightly increased carbon dioxide (CO₂) for some applications. For example, the design for new ferries would be required to include the best available control technology (after-treatment) to be used with propulsion engines. An increase in CO₂ could occur if vessel operators choose to comply by using exhaust treatment technologies that use vessel power (e.g., scrubbers, selective catalytic reduction), increase the weight of the vessel, or require a larger engine to be installed on the vessel. However, other actions required by the rule will likely offset this effect. For instance, the accelerated phase-in of newer engines, which employ modern, less polluting technologies, should reduce greenhouse gas emissions from each new engine relative to the older, in-use engines. In addition, the proposed regulations will reduce emissions of black carbon (a component of diesel PM and a likely contributor to global warming), which will further offset the minor increases in CO₂ emissions that may occur in some applications. Thus, staff expects the proposed regulations to have an overall negligible effect on global warming.

9. ECONOMIC IMPACTS

In assessing the costs associated with the proposed regulation, ARB staff developed two different estimates, one for regulatory costs and another for new equipment costs.

Regulatory costs are the estimated costs resulting from the proposed regulations due to the early replacement of in-use engines, the additional costs associated with adding aftertreatment to new ferry propulsion engines, and recordkeeping and reporting. The costs considered for the early replacement of engines includes the residual value of the engine being replaced, the residual value of the most recent engine rebuild work, and the time value of money. These regulatory costs are those directly attributable to compliance with the proposed regulation. New equipment costs are the estimated total out-of-pocket costs for purchasing and installing a new engine (engine replacement cost), new ferry costs associated with adding aftertreatment technology, and recordkeeping and reporting. A large portion of the new equipment costs, primarily the engine replacement costs, are an existing cost of doing business that would occur with or without the regulation when an engine reaches the end of its service life.

Staff estimates the regulatory cost for complying with the proposed regulation to be approximately \$140 million (2006 dollars). This corresponds to about \$10 million annually from 2009 through 2022. Industry costs for new equipment are estimated at approximately \$460 million dollars (2006 dollars) over the lifetime of the proposed regulation (2009 – 2022).

Staff evaluated the economic impact of complying with the in-use engine requirements on the affected ferry, excursion, tugboat, and towboat businesses by evaluating the impact of the regulatory cost on typical business's "return on owner's equity" (ROE).

Using the ROE approach, we found that the overall change in ROE ranges from a negligible decline of about 0.5 percent for a typical tow company, to a decline of 3.5 percent for a ferry or tug company. Staff's analysis indicates that the change in ROE could be larger for small businesses. A decline of 0.5 to 3.5 percent in ROE is not considered to represent a significant impact on profitability. Additionally, businesses with compliance dates in the future may be eligible for incentive grant funds if they choose to comply early. Incentive funding opportunities are discussed in the Technical Support Document, Chapter VIII.

10. COST TO LOCAL, STATE, AND FEDERAL AGENCIES

Multiple federal, State, and local agencies would be impacted by the proposed regulation. The majority of the agencies would not be affected by the in-use compliance requirements and would only be subject to the reporting requirement, resulting in costs of approximately \$100 per engine. One State agency, the California Department of Transportation (Caltrans), and three local agencies would be impacted by the in-use engine requirements. Regulatory costs to these agencies range from about \$2,000 to \$2 million.

There would be significant costs to the ARB to implement and enforce the regulation. Staff estimates that ARB's cost to implement the reporting program (initial report) would be approximately \$25 to \$50 per engine. An additional annual cost of \$10 to \$100 per engine (after the first year) is estimated to cover an inspection and report update at the

time of final compliance with the regulation. These total costs are estimated to be \$200,000 to \$400,000 over the life of the regulation. The ARB's administrative costs for outreach, educational efforts, and technical assistance would be absorbed within existing budgets and resources.

11. COST-EFFECTIVENESS

Cost-effectiveness is expressed in terms of costs in dollars per unit of emissions reduced (pounds or tons). The cost-effectiveness for the proposed regulation is determined by dividing the regulatory costs (cost specifically due to compliance with the proposed regulation) by the total pounds of diesel PM reduced during the years 2009 to 2022. All costs are in 2006 equivalent expenditure dollars. Table 10 shows the cost-effectiveness estimate for the proposed regulation expressed three ways.

Table 10: Summary of Average Cost-Effectiveness for the Period 2009-2022

Emissions	Total Regulatory Cost 2009 – 2022	Total Emissions Reduced 2009 - 2022	Total Cost - Effectiveness
<i>All Costs Assigned to PM</i>			
PM	\$140,000,000	4,900,000 lbs	\$29/lb
<i>Divide Costs Equally Between PM and NOx</i>			
PM	\$70,000,000	4,900,000 lbs	\$14.50/lb
NOx	\$70,000,000	39,000 tons	\$1,800/ton
<i>Combine PM and NOx Emissions</i>			
PM + NOx	\$140,000,000	83,000,000 lbs	\$1.70/lb

All values rounded

The cost-effective ness values are well within the range of cost effectiveness for other diesel engine regulations adopted by the Board, as shown in Table 11.

Table 11: Diesel PM Cost-Effectiveness of the Proposal and Other Regulations/Measures (When All Costs Attributed to PM Reduction)

Regulation or Airborne Toxic Control Measure	Diesel PM Cost-Effectiveness
	Dollars/ Pound PM
Commercial Harbor Craft	\$29
Cargo Handling Equipment	\$41
Solid Waste Collection Vehicle Rule	\$28
Stationary Diesel Engine ATCM	\$4 - \$26
Transport Refrigeration Unit ATCM	\$10 - \$20

The estimated value of the health benefits associated with the proposed regulation is substantial. Following standard U.S. EPA practice, ARB staff estimates the statewide benefits to be nearly \$2.0 billion using a 3 percent discount rate, or \$1.3 billion using a

7 percent discount rate. Nearly all of the monetized benefits result from avoiding premature death.

12. FEASIBILITY OF PROPOSED REGULATION

The ARB staff believes that engine replacement will be the primary compliance option chosen to meet the proposed in-use engine requirements. As of the 2003-2004 fiscal year, about 400 propulsion and 50 auxiliary engines have been replaced in approximately 300 harbor craft through California's Carl Moyer Memorial Air Quality Standards Attainment Program. Almost 50 of these vessels have been ferries, excursion vessels, tugboats, and towboats, illustrating the feasibility of repowering these vessels.

Staff has determined that the number of engine replacements that likely would occur due to the proposed regulation's compliance schedule would be achievable with the State's current capacity for engine replacements. Staff estimates that, under the proposed compliance schedule, an average of 128 replacements of both auxiliary and propulsion engines per year will occur over the 14-year compliance period. Of the 128 engine replacements, over 60 percent, or about 80, are propulsion engine replacements. Because auxiliary engine replacements are less involved and do not necessarily require a dry dock facility, staff assumed dry docking for the propulsion engine replacements would be the limiting factor for the State's capacity. While the 14-year average for propulsion engine replacement is 80 engines, the maximum number of propulsion engine repowers required in one year (2015) is estimated to be about 150.

Staff conducted a phone survey of boat yards, boat building, and boat repair facilities in California to determine the annual statewide capacity for harbor craft engine replacements. Based on the survey, staff has estimated the State's current capacity at about 220 to 270 repowers per year. However, capacity is also required for routine engine maintenance, repowers due to natural engine attrition, and repowers funded through incentive programs. Because the maximum 150 repowers required in a single year (2015) is between 60 and 70 percent of the maximum capacity, we believe there is sufficient remaining capacity even at the maximum repower rate to still allow current facilities to conduct other repowering and non-repowering activities. Additional facilities and capacity that may be built in response to this regulation would further ensure that the State will have sufficient capacity to conduct the expected number of repowers.

13. ALTERNATIVES CONSIDERED

The ARB staff considered two alternatives to the proposed harbor craft regulation. The first alternative would make all Tier 0 and Tier 1 diesel engines on ferries, excursion vessel, tugboats, and towboats throughout the State subject to a single statewide compliance schedule, as provided in Table 5. This compliance schedule replaces engines at a 15 year service life. The estimated regulatory cost for this alternative is \$135 million. The total PM emissions reduced with this alternative would be about

10 percent less than with the proposed schedule, 4.4 million pounds during the 14 years from 2009 to 2022. The resulting cost-effectiveness for this alternative is slightly higher than the proposed regulation, \$30 per pound of diesel PM reduced. The total NOx reduction of this same time period would be 36,000 tons, about 7 percent less than with the proposed regulation. However, this alternative would reduce the number of SCAQMD engine replacements in the first six years. Consequently, as previously shown in Figure 4 and Figure 5, SCAQMD would not receive the early reductions with this alternative that are necessary to help meet its PM2.5 attainment goals by 2014.

The second alternative would require that all Tier 0 and Tier 1 diesel engines on ferries, excursion vessel, tugboats, and towboats throughout the State be subject to the accelerated SCAQMD compliance schedule, as provided in Table 6. This compliance schedule replaces engines at a 13 year service life. This alternative would result in many engines replaced earlier than the proposed regulation. The estimated regulatory cost to the equipment owners, \$170 million, from this alternative is greater than the proposed regulation's \$140 million regulatory cost. Additionally, this alternative's cost affects the rest of the State two years earlier. The total PM emissions reduced with this alternative would be significantly more than with the proposed schedule, 6.0 million pounds during the 14 years from 2009 to 2022. The resulting cost-effectiveness for this alternative is nearly identical to that of the proposed regulation, \$29 per pound of diesel PM reduced. The total NOx reduction of this same time period would be 46,000 tons, nearly 20 percent more than with the proposed regulation. This alternative would produce earlier reductions than the current proposal, with a cost-effectiveness similar to the current proposal. However, staff determined that this alternative would not be feasible because it would require more engines to be replaced in some years than statewide capacity would allow.

14. KEY ISSUES

A. BACT Requirement for New Ferries

The proposed regulation requires that all new build ferries comply with an additional propulsion engine requirement. The engines must be equipped with BACT for the engine and application. Staff is recommending that a case-by-case BACT determination be made by ARB for the new ferry propulsion engines rather than setting a specific reduction level in the proposed regulation. Staff is recommending this approach because of the unique features of each ferry and limited data on successful application of aftertreatment on ferries similar to those used in California.

The San Francisco Bay Area Water Transit Authority (WTA) has instituted a requirement for all ferries under their jurisdiction that the propulsion engines must be 85 percent cleaner than U.S. EPA marine engine standards. The 85 percent reduction can be met through a combination of NOx or PM reductions. A new ferry is currently under construction that is expected to meet this requirement through the use of compact selective catalytic reduction technology (SCR) combined with a diesel oxidation catalyst (DOC).

Staff considered including a similar 85 percent reduction requirement for new ferries in the proposed regulation. However, staff was not able to locate data that would support a successful durability demonstration of the required technology on smaller passenger ferries that are typical for California use. The recent failure of an SCR demonstration unit on a small high speed ferry, typical of many California ferries that would be subject to this requirement, illustrates the need for successful durability demonstration data.

B. Ocean-Going Tugboats

The proposed regulation includes all ocean-going tugboats in its engine compliance requirements. These tugboats are the same size and have similar operational characteristics as harbor tugboats and may be used interchangeably as an ocean-going tugboat or a harbor tugboat. We estimate that there are about 25 out-of-state ocean-going tugboats operating in California.

Owner and operators of out-of-state ocean-going tugboats that provide service to California have requested that their vessels not be included in the regulation and instead remain subject to the auxiliary engine rule for ocean-going vessels (13 CCR 2299.1, 17 CCR 93118). Under that regulation's definition for "ocean-going vessel" (see 13 CCR 2299.1(d)(21)(A)), these tugboats would be classified as "ocean-going vessel" only because they have a foreign trade registry. However, as noted before, these ocean-going tugboats are functionally equivalent or otherwise very similar to their harbor tugboat counterparts. Therefore, staff has proposed to include ocean-going tugboats in the proposed harbor craft regulation because of their functional equivalence to harbor tugboats and the frequency of their visits to California ports. Based on available data, we estimate these ocean-going tugboats made over 500 visits to California ports last year.

C. U.S. EPA Tier 4 Engines on In-Use Vessels

During our public workshops, engine owners and manufacturers raised an issue about the proposed regulation's originally proposed requirement to install Tier 4 engines on existing vessels. The U.S. EPA's proposed marine engine standards would require Tier 4 engines to have exhaust after-treatment (i.e., selective catalytic reduction and diesel particulate filter). Owners and manufacturers stated that installing Tier 4 engines and the additional exhaust aftertreatment equipment would create space, weight, and stability issues on existing vessels. After consideration of these issues, staff modified the proposal so that engines meeting Tier 4 standards are not required for engine repowers (i.e., on in-use vessels), but they would be required for new vessels.

15. OUTREACH

ARB has worked extensively with the various stakeholders over the past four years to identify issues, find ways to address these issues, and develop appropriate regulatory language. The proposed regulation has been discussed with the California Air Pollution Control Officers Association (CAPCOA) during several joint CAPCOA-ARB conference

calls. Additionally, ARB staff made extensive contacts with industry representatives, local air districts, environmental/pollution prevention and public health advocates, and other interested parties through meetings, telephone calls, and electronic mail. Staff has held 12 public workshops and 3 community outreach meetings (some specifically geared to fishermen and their concerns) to discuss the proposed regulation. Further, staff made several visits to vessel owners, representing a variety of vessel types. Finally, staff made information available via ARB's web site (<http://www.arb.ca.gov/harborcraft>) to further expand public outreach opportunities and reach the widest possible audience.

16. ENVIRONMENTAL JUSTICE

A public process that involves all parties affected by the proposed regulation is an important component of ARB rulemaking activities. The proposal is consistent with the ARB's environmental justice policy to reduce health risks from toxic air contaminants in all communities, including low-income and minority communities. The proposed regulation would reduce diesel PM and other emissions from harbor craft engine in all areas of the State where these engines are located. However, the vast majority of these engines operate within the Los Angeles/Long Beach and Bay Area ports, which are surrounded by densely populated areas, including some in low-income and minority communities. Therefore, the proposal will help address environmental justice concerns by reducing emissions and health risks in the areas where harbor craft emissions have the greatest impacts.

17. IMPLEMENTATION AND ENFORCEMENT

We believe that ARB staff needs to take the following actions to efficiently and effectively implement the proposed regulation:

- develop an outreach program to inform harbor craft owners and operators and suppliers of the requirements of the proposed regulation, as well as provide information about incentive programs such as the Carl Moyer programs, the Port of Los Angeles Air Quality Mitigation Funds, and the upcoming Proposition 1B air quality mitigation funds;
- develop recordkeeping and reporting guidance; and,
- provide implementation guidance and assistance as needed.

18. RECOMMENDATION

We recommend the Board approve the proposed harbor craft regulation presented in Appendix A of the staff report. The early turnover of in-use, pre-Tier 1 and Tier-1 certified ferries, excursion vessels, tugboats, and towboats to lower emitting Tier 2 and Tier 3 engines would reduce diesel PM, NO_x, and other air pollutant emissions, exposure, and health risk across California, particularly along the shoreline. The ARB staff believes the proposed regulation is technologically feasible, cost-effective, and necessary to carry out the Board's responsibilities under State law and implement provisions of the Emission Reduction Plan for Ports and Goods Movement approved by the Board in April 2006.

REFERENCES:

(40 CFR Part 94) U.S. Environmental Protection Agency, *Control of Emissions from Marine Compression – Ignition Engines*.

(U.S. EPA, 2007) U.S. Environmental Protection Agency, *Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression-Ignition Engines Less Than 30 Liters Per Cylinder*, 72 Fed.Reg. 15937 et seq. (April 3, 2007).

(ARB, 2000) California Air Resources Board, *Risk Reduction Plan to Reduce Particulate Matter Emission fro Diesel-Fueled Engines and Vehicles*, October 2000.

(ARB, 2006) California Air Resources Board, *Emission Reduction Plan for Ports and Goods Movement in California*; March 2006.