California Environmental Protection Agency

AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

REGULATION FOR MOBILE CARGO HANDLING EQUIPMENT AT PORTS AND INTERMODAL RAIL YARDS

Stationary Source Division
Emissions Assessment Branch

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State of California
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

Public Hearing to Consider

ADOPTION OF THE PROPOSED REGULATION FOR MOBILE CARGO HANDLING EQUIPMENT AT PORTS AND INTERMODAL RAIL YARDS

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State of California
AIR RESOURCES BOARD

PROPOSED REGULATION FOR MOBILE CARGO HANDLING EQUIPMENT AT PORTS AND INTERMODAL RAIL YARDS

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EXECUTIVE SUMMARY

This executive summary presents the Air Resources Board (ARB or Board) staff's *Proposed Regulation for Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yards*. The proposed regulation is designed to reduce diesel particulate matter (PM) and oxides of nitrogen (NOx) emissions from mobile cargo handling equipment that operate at ports and intermodal rail yards in California.

Because of its geographical location and major ports and railways, California is a global gateway for goods movement. Some of the largest ports in the world are located in California, and with increases in trade and general goods movement, both the ports and intermodal rail yards stand to experience major growth over the next two decades. Cargo handling equipment at ports and intermodal rail yards is a significant source of emissions of diesel PM, as well as NOx, in California. In addition, these facilities are often located in or near densely populated areas and neighborhoods, exposing residents to unhealthy levels of pollutants.

In 1998, following the ARB's identification of diesel PM as a toxic air contaminant (TAC), California embarked on an ambitious strategy to reduce emissions from diesel-fueled engines. The <u>Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles</u> (Diesel Risk Reduction Plan), adopted by the Board in October 2000, outlined steps to reduce diesel emissions and associated potential cancer risks by 75 percent in 2010 and by 85 percent by 2020. Because of the potency and the large amount of emissions to California's air, diesel PM is the primary contributor to adverse health impacts, including an estimated 70 percent of all cancer risks, from TACs. Diesel exhaust is a major source of fine particulate pollution as well, and numerous studies have linked elevated particle levels in the air to increased hospital admissions, emergency room visit, asthma attacks and premature deaths. (ARB, 2000)

As part of the effort to reduce diesel PM, ARB staff is proposing this regulation, which would result in diesel PM and NOx emission reductions beginning in 2007. Additional reductions are phased in over the next eight years. Staff estimates that in 2015, diesel PM emissions from cargo handling equipment at ports and intermodal rail yards would be reduced by approximately 66 percent and NOx emissions by approximately 47 percent relative to the projected baseline, which includes the benefits of the new engine standards adopted by the U.S. EPA and ARB. These reductions are significant considering the growth in trade that is expected to occur over the same timeframe.

In recent years, the Board has adopted many regulations to reduce diesel PM emissions from other sources. These include stationary engines, portable equipment, transport refrigeration units, and solid waste collection vehicles. Additional regulations are being developed to address oceangoing ship auxiliary engines, commercial harbor craft, and general off-road equipment.

Presented below is an overview which briefly discusses the emissions from new and existing mobile cargo handling equipment, the proposed regulation, and the potential impacts from implementation as well as what our plans are for future activities. For simplicity, the discussion is presented in question-and-answer format using commonly asked questions about the regulation. It should be noted that this summary provides only brief discussion on these topics. The reader is directed to subsequent chapters in the main body of the report for more detailed information.

1. What is ARB staff proposing?

ARB staff is proposing a regulation that would reduce emissions of diesel PM and NOx from new and existing (in-use) mobile cargo handling equipment at ports and intermodal rail yards. Unlike mobile diesel-fueled compression ignition (CI) engines used in on-road applications, diesel-fueled engines used in off-road mobile cargo handling applications are currently required to meet much less stringent engine certification standards. The Federal Clean Air Act, Section 209(e), allows California to request and receive authority from the U.S. EPA to establish requirements for off-road mobile engines. (EPA, 1990)

The proposed regulation would establish requirements that affect the sellers, renters, lessors, owners, and operators of mobile cargo handling equipment that are used at California's ports or intermodal rail yards. Staff's approach in developing the performance standards was to establish requirements that are based on the application of the best available control technology (BACT).

For newly purchased, leased, or rented equipment, certified on-road engines would be required if available for the specific equipment type and application. Otherwise, the highest level certified off-road engine would be required, along with installation of the highest level verified diesel emission control strategy (VDECS) within one year of purchase, lease, or rent, or within six months of becoming available if after a year.

The proposed regulation would require in-use yard trucks to meet BACT performance standards primarily through accelerated turnover of older yard trucks to those equipped with cleaner, on-road engines (2007 model year or later). Owners or operators who have installed VDECS prior to the end of 2006, or who are already using certified on-road engines, are given additional time to comply. In addition, compliance is phased in for owners or operators who have more than three yard trucks in their fleet.

Non-yard truck equipment would also be required to meet BACT, which, for them, is a menu of options that includes replacement to cleaner on-road or off-road engines and/or the use of retrofits. For owners or operators that elect to use retrofits, a second compliance step, which would require replacement to Tier 4 off-road engines or installation of a Level 3 (85 percent diesel PM reduction) VDECS, may be required, depending on the equipment category and level of VDECS applied.

Owners and operators would also be required to meet recordkeeping and reporting requirements. A discussion of the proposed regulation and its requirements are in Chapter IV of this Staff Report.

2. What is mobile cargo handling equipment?

Mobile cargo handling equipment is any motorized vehicle used to handle cargo, or in some cases, may be used for other activities, such as maintenance. The type of equipment used usually depends on the type of cargo handled or the type of activity. Equipment that handles cargo containers includes, but is not limited to, yard trucks, top handlers, side handlers, reach stackers, forklifts, and rubber-tired gantry cranes. Equipment that is used to handle bulk cargo includes, but is not limited to, dozers, excavators, loaders, mobile cranes, railcar movers, and sweepers. While forklifts can be used in either container or bulk cargo operations, for the purposes of this regulation, they are considered to be container handling equipment. Forklifts, aerial lifts, mobile cranes, and sweepers may also be used in maintenance operations at ports and intermodal rail yards. There are approximately 3,700 cargo handling equipment vehicles at California's ports and intermodal rail yards.

3. Where is mobile cargo handling equipment used?

Mobile cargo handling equipment is used throughout California in almost all industries involved with the movement of goods. The most common use of cargo handling equipment occurs at intermodal facilities, including ports and rail yards, and distribution centers and warehouses. This proposed regulation will address mobile cargo handling equipment only at ports and intermodal rail yards. The ARB is in the process of developing another regulation to address other diesel-fueled off-road equipment, including those used at other intermodal facilities. More information on this effort is available at http://www.arb.ca.gov/msprog/ordiesel/ordiesel.htm.

There are several ports in California that would be affected by the proposal, including Antioch, Benicia, Crockett, Humboldt Bay, Hueneme, Long Beach, Los Angeles, Oakland, Pittsburg, Port Chicago, Redwood City, Richmond, Sacramento, San Diego, San Francisco, and Stockton. Most of the ports are controlled by port authorities, but several are independently operated. Two major railroad companies, BNSF Railway and Union Pacific Railroad, operate several intermodal rail yards in the state, located in cities such as Barstow, City of Industry, Commerce, Fresno, Lathrop, Long Beach, Los Angeles, Oakland, Richmond, San Bernardino, and Stockton. It is expected that, as the growth in trade continues, additional intermodal rail yards may be developed.

4. What are the emissions, exposures, and health risks from mobile cargo handling equipment?

ARB staff estimates mobile cargo handling equipment at ports and intermodal rail yards emit approximately 0.65 tons per day (237 tons per year) of diesel PM and 19.04 tons per day (6,950 tons per year) of NOx in 2004. Based on an average statewide NOx to

PM conversion factor, we estimate the secondary formation of PM_{10} nitrate from NOx emissions from mobile cargo handling equipment engines to be about 6 to 10 tons per day. Table ES-1 shows the distribution of cargo handling equipment by equipment type and the estimated emissions in 2004.

Table ES-1: Estimated Statewide 2004 Cargo Handling Equipment Population and Associated Emissions

Equipment Types	Numbers of Equipment	2004 Pollutant Emissions (tons per day)			
		NOx	HC	CO	PM
Cranes	321	1.93	0.15	0.58	0.07
Excavators	28	0.24	0.02	0.06	0.01
Forklifts	464	0.54	0.06	0.20	0.03
Container Handling Equipment	487	3.25	0.22	0.84	0.11
Other Equipment	40	0.08	0.01	0.02	0.00
Sweepers/Scrubbers	28	0.04	0.00	0.02	0.00
Tractors/Loaders/Backhoes	93	0.18	0.02	0.05	0.01
Yard Trucks	2277	12.78	1.14	8.98	0.42
Totals	**3738**	**19.04**	**1.61**	**10.76**	**0.65**

Yard trucks account for the majority of the diesel PM and NOx emissions, about 66 percent and 67 percent, respectively, from cargo handling equipment at ports and intermodal rail yards. Because ambient air monitoring techniques for diesel PM are still under development, it is difficult to measure the actual exposures to persons from the emissions of cargo handling equipment. However, because the equipment is distributed throughout the ports and intermodal rail yards in California, and because most of the facilities are located in urban centers near residential communities, we believe that several million Californians are impacted by diesel PM emissions from the operation of cargo handling equipment.

Exposure to these emissions results in increased cancer risk and other serious non-cancer health impacts, including premature death, irritation to the eyes and lungs, allergic reactions in the lungs, asthma exacerbation, blood toxicity, immune system dysfunction, and developmental disorders. Estimates of the level of cancer risk can be made using emission estimates and modeling techniques to predict ambient concentrations of diesel PM.

A health risk assessment was conducted for cargo handling equipment operated at the Ports of Long Beach and Los Angeles, which showed significant near-source risks. For example, nearby residents living within a 4,100-acre perimeter of the ports are estimated to have a potential cancer risk of over 100 in a million due to emissions from cargo handling equipment. Nearly 75 percent of the two million people living in the area around the ports have an estimated predicted risk of greater than 10 in a million. These risk values assume exposure duration of 70 years for a nearby individual.

ARB staff also estimated the potential non-cancer impacts associated with exposure to diesel PM from cargo handling equipment. The non-cancer health effects evaluated include premature death, asthma attacks, work loss days, and minor restricted activity days. Based on the analysis, staff estimates that the average number of cases statewide per year that would be expected from exposure to the 2004 cargo handling equipment diesel PM emission levels are as follows:

- 9 premature deaths (4 to 13, 95% confidence interval (CI))
- 219 asthma attacks (53 to 383, 95% CI)
- 1,907 work loss days (1,614 to 2,200, 95% CI)
- 10,127 minor restricted activity days (8,254 to 12,000, 95% CI)

5. Are the requirements proposed for cargo handling equipment technologically feasible?

Yes. Based upon extensive analysis and discussions with numerous stakeholders, staff has determined that the proposed requirements and performance standards are technologically feasible.

The proposal requires owners and operators of in-use yard trucks to accelerate the turnover to cleaner on-road or off-road engines. Yard trucks with on-road engines meeting the 2007 certified standards will be commercially available throughout the country beginning in 2007 when the proposed regulation takes effect. As the on-road engine standards become more stringent in 2010, yard truck manufacturers will continue to offer their equipment with certified on-road engines that meet the new standards. (ARB, 2005c) The option to select a comparable off-road engine is expected to be available beginning in 2011.

The in-use performance standards for non-yard truck equipment can be met through the application of retrofits, or verified diesel emission control strategies (VDECS), and/or replacement to cleaner on-road or off-road engines. The ARB has currently verified several VDECS that range from Level 1 to Level 3 for applicable cargo handling equipment, and more are expected in the future. Many of these technologies have been successfully used in mobile cargo handling equipment, particularly at California ports, and include diesel oxidation catalysts (DOCs), emulsified diesel fuel, and diesel particulate filters (DPFs). In addition, flow-through filters, sometimes referred to as enhanced DOCs, are relatively new to the market but also show promise in reducing diesel PM from these engines.

While several VDECS are currently available for non-yard truck cargo handling equipment, the verification extends only to select model years and engine families. As a result, the proposed regulation has several provisions to provide flexibility and to encourage the development of other emission control strategies. The proposal would allow owners and operators to apply for a compliance extension for the use of experimental diesel emission control technologies, which in turn, is expected to result in additional verifications. The proposal also includes an alternative compliance plan

(ACP) option for owners or operators of non-yard truck equipment. In order to receive approval for the ACP, owners or operators would be required to demonstrate that equivalent emission reductions can be achieved through the use of alternative strategies, which can include early engine or equipment replacement, alternative fuels or fuel additives, exhaust treatment controls, or equipment engine modifications.

As part of the implementation efforts for the proposed regulation, staff plan to create a technology workgroup, whose goal will be to monitor the available control strategies, address concerns regarding the use of the technologies in non-yard truck cargo handling equipment, and encourage manufacturers to apply for ARB verification.

6. What businesses will be affected by the proposed regulation?

The proposed regulation will affect any businesses operating mobile cargo handling equipment at ports and intermodal rail yards in California. Examples of businesses that potentially will be affected include terminal operators and owners at ports, railroad companies that operate intermodal rail yards, and renting or leasing companies that provide cargo handling equipment to these facilities. In general, public agencies will not be affected by this regulation. However, military installations that have cargo handling activities at military ports may be affected.

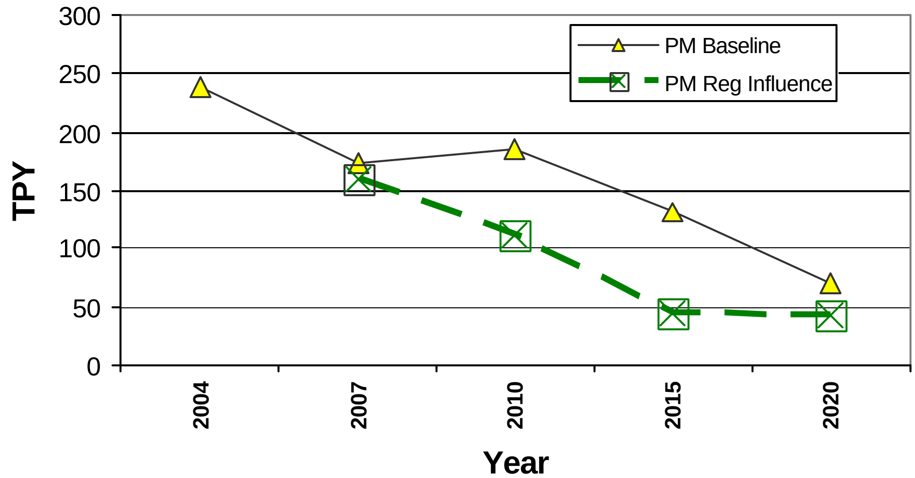
7. How will the regulation be enforced?

The proposal requires that owners or operators of cargo handling equipment at ports and intermodal rail yards provide access to the equipment to ARB employees or agents for the purposes of inspection. This includes access to records necessary to establish compliance with the requirements of the proposal.

8. What are the environmental impacts of the proposed regulation?

The proposed regulation will significantly reduce diesel PM emissions and the resulting exposures from mobile cargo handling equipment at ports and intermodal rail yards in California. ARB staff estimates that, with implementation of the regulation, diesel PM emissions will be reduced by approximately 40 percent or 75 tons per year in 2010 and 66 percent or 86 tons per year in 2015 relative to the projected 2010 and 2015 emissions, which includes an annual growth rate of six percent and estimated reductions from normal equipment turnover and voluntary programs. Figure ES-1 shows the projected diesel PM emissions with and without the regulation.

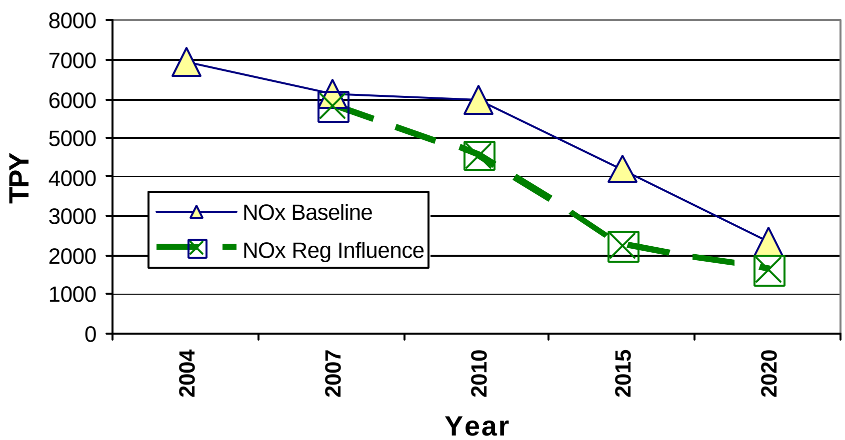
Figure ES-1: Projected Diesel PM Emissions with and without the Regulation



Note: Baseline includes estimated reductions from voluntary programs and the benefits from the new engine standards adopted by the U.S. EPA and ARB.

California's air quality will also benefit from reduced NOx emissions. As a result of the regulation, ARB staff estimates that NOx emissions will be reduced by 24 percent or 1,425 tons per year in 2010 and 47 percent or 1,991 tons per year in 2015, relative to the projected 2010 and 2015 emissions, which includes a growth rate of six percent each year and estimated reductions from voluntary programs. Figure ES-2 shows the projected NOx emissions with and without the regulation.

Figure ES-2: Projected NOx Emissions with and without the Regulation



Note: Baseline includes estimated reductions from voluntary programs and benefits from new engine standards adopted by the U.S. EPA and ARB.

We anticipate significant health benefits due to reduced mortality, incidences of cancer, PM related cardiovascular effects, chronic bronchitis, asthma, and hospital admissions for pneumonia and asthma-related conditions. These directly emitted diesel PM reductions are expected to reduce the number of premature deaths and other noncancer health effects from air pollution in California. Staff estimates that the implementation of this regulation will avoid between 2007 and 2020 approximately:

- 32 premature deaths (16 to 48, 95% CI);
- 820 asthma attacks (200 to 1,400, 95% CI);
- 7,100 work loss days (6,020 to 8,200, 95% CI); and
- 38,000 minor restricted activity days (31,000 to 45,000, 95% CI).

With respect to potential cancer risk, ARB staff believes there will be significant reductions in exposures and potential cancer risks to residents that live near ports and intermodal rail yards in California. For example, based on an analysis of the predicted 2010 and 2020 ambient diesel PM levels near the POLA and POLB, we estimate that in 2010 there will be a 56 percent reduction in the population-weighted average risk relative to the risk levels in 2002 from cargo handling equipment emissions and a 82 percent reduction in 2020.

9. What are the economic impacts of the proposed regulation?

ARB staff estimates the cost for compliance with the regulation to be approximately 71 million dollars for the total capital and recurring costs. This corresponds to about 5.1 million dollars annually on average for the years 2007 through 2020. This cost, which is based on 2004 dollars, represents the capital cost of equipment, maintenance and replacement, and reporting costs from 2007 through to 2020.

The cost for a business to comply with this regulation will vary depending on the number and type of cargo handling equipment and whether the equipment is equipped with a verified diesel exhaust control system (VDECS) and/or later replaced with a new Tier 4 engine in 2015. For example, the costs for a typical crane engine (rated at 210 hp operated 1370 hours per year) with a diesel particulate filter (DPF) is about $17,500 for equipment and installation. The estimated annual ongoing costs are based on a reporting cost of about $500 per terminal with the cost spread over many pieces of equipment. To determine the cost a typical business may incur, we used the ARB Survey data on the average number and type of equipment operated by a port container terminal, a port bulk handling terminal, and an intermodal rail yard and applied the annual average costs for the various equipment types. Based on our analysis, we estimate that the total 2007 to 2020 costs to a typical business will be in the range of $343,000 to $1,373,000.

Staff does not have access to financial records for most of the companies that responded to the survey. However, approximately 10 percent of the respondents identified themselves as small businesses (annual gross receipts of $1,500,000 or less for transportation and warehousing per California Government Code Section 11342.610).

Cost-effectiveness is expressed in terms of control costs (dollars) per unit of air emissions reduced (pounds). The cost-effectiveness for the proposed regulation is

12. How does the proposed regulation relate to ARB's goals for Environmental Justice?

Environmental Justice is defined as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies. ARB's Environmental Justice Policies are intended to promote the fair treatment of all Californians and cover the full spectrum of the ARB's activities.

The proposed regulation is consistent with the environmental justice policy to reduce health risks from toxic air contaminants in all communities, including those with low-income and minority populations, regardless of location. The regulation will reduce diesel PM emissions from mobile cargo handling equipment at ports and intermodal rail yards by requiring the use of the best available control technologies. The proposed regulation will provide air quality benefits for all Californians, particularly those residing in communities located near these facilities.

13. What future activities are planned?

After Board consideration and approval of the proposed regulation, ARB staff will work on a number of projects related to implementation, the collection and processing of engine-related data, and the improvement of the cargo handling equipment category of the off-road engine emission inventory. Specifically, resources will be devoted to the following:

- Seeking a Title I section 209(e) waiver from U.S. EPA

  Upon Office of Administrative Law approval of the proposed regulation, staff will submit a Title I section 209(e) waiver request to the U.S. EPA. Staff expect the U.S. EPA will act expeditiously to approve the waiver prior to the implementation dates of the regulation.

- Implementing the requirements of the regulation

  ARB staff will develop implementation guidance as appropriate and will work with industry groups and affected businesses to ensure owners and operators are aware of the regulatory requirements and compliance options. Staff will prepare fact sheets, a question and answer document regarding implementation, and work to provide electronic forms.

- Technology review

  A technology working group will be formed to monitor the feasibility of retrofit emission controls, encourage manufacturers to apply for ARB verification, and address concerns regarding the use of VDECS in non-yard truck cargo handling equipment. In addition, the workgroup will share information on successful applications of experimental emission control strategies.

- Monitoring implementation

  ARB staff will monitor implementation of the proposed regulation. This will include monitoring advancements in emission control technologies and evaluating BACT. In the event implementation reveals amendments to the regulation are warranted or that BACT has changed, ARB staff will propose amendments for the Board's consideration.

- Updating inventory with the reporting data

  A key requirement of the regulation is the initial reporting of information on the number of engines and their operating characteristics and compliance reporting. This information will be used to update the ARB's emission inventory for off-road equipment.

14. What is staff's recommendation?

We recommend the Board approve the proposed regulation presented in this report (Appendix A). The regulation will reduce diesel PM and NOx emissions from mobile cargo handling equipment at ports and intermodal rail yards by requiring the use of the best available control technologies, including accelerated turnover and/or retrofits. The proposed regulation will provide air quality benefits for all Californians, particularly those living in communities near ports and intermodal rail yards. ARB staff believes the proposed regulation is technologically feasible and necessary to carry out the Board's responsibilities under State law.

REFERENCES:

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

(EPA, 1990) United States Environmental Protection Agency. *Federal Clean Air Act, Title II, Part A, Sec. 209(e)*; 1990.

(ARB, 2005c) California Air Resources Board. Phone call with Mr. Don Lawrence, Ottawa (Kalmar Industries); September 22, 2005.

I. INTRODUCTION

A. Overview

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. 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. Diesel engine exhaust is a source of unhealthful air pollutants including gaseous- and particulate-phase toxic air contaminants (TAC), particulate matter, carbon monoxide, hydrocarbons, and oxides of nitrogen. Emissions from diesel-fueled mobile cargo handling equipment (cargo handling equipment) are a significant concern in communities near ports and intermodal rail yards. ARB staff are proposing a control measure to reduce emissions from cargo handling equipment used at ports and intermodal rail yards. These emissions contribute to ambient levels of particulate matter, result in community exposures to diesel PM, and contribute to oxides of nitrogen (NOx) levels and reactive organic compounds (ROG) levels, which are precursors to the formation of ozone.

This Staff Report for the proposed regulation includes:

- background regulatory information, discussion of the need for control of diesel particulate matter, and a summary of public outreach (Chapter I);
- discussion of cargo handling equipment at ports and intermodal rail yards (Chapter II);
- potential emissions, exposure, and risk from cargo handling equipment (Chapter III);
- summary and discussion of the proposed regulation, including alternative requirements considered (Chapter IV);
- availability and technological feasibility of potential control measures (Chapter V);
- environmental impact of the proposed control measure (Chapter VI);
- economic impacts of the proposed control measure (Chapter VII); and
- proposed text of the measure and other supplementary information (Appendices).

B. Purpose

The proposed regulation is designed to reduce levels of ambient particulate matter, the general public's exposure to diesel PM, and ozone precursor emissions from cargo handling equipment at ports and intermodal rail yards. The proposed regulation establishes best available control technology (BACT) for cargo handling equipment. The proposed regulation requires yard trucks that operate at a port or intermodal rail yard in California to meet in-use performance standards through accelerated turnover of older yard trucks to ones equipped with cleaner, on-road engines. Non-yard truck equipment would also be required to meet BACT, which, for them, could include retrofits and/or replacement to cleaner on-road or off-road engines. Owners or operators would be required to maintain records of their equipment, compliance method, and compliance dates, as well as report to the ARB compliance plans and a demonstration of compliance. Chapter IV of this Staff Report contains a discussion of the proposed regulation. Appendix A contains the full text of the proposed regulation.

C. Regulatory Authority

Under federal Clean Air Act (CAA) section 209(e)(2), California may adopt emission standards for off-road[1] engines that are not otherwise expressly preempted under section 209(e)(1). Section 209(e)(1) provides that no state, including California, or any political subdivision thereof may adopt or enforce emission standards or other requirements relating to the control of emissions for nonroad engines under 175 horsepower that are used in farm or construction equipment or used in locomotives or locomotive engines. CAA section 209(e)(2) provides California with sole authority among the states to adopt emission standards and requirements related to emission control for new and in-use nonroad engines that are not specifically preempted under section 209(e)(1). Section 209(e)(2) requires that California must obtain authorization from the Administrator of the United States Environmental Protection Agency (U.S. EPA) prior to the regulation becoming effective. As part of the authorization process, ARB must establish that the adopted regulations "will be, in the aggregate, at least as protective of public health and welfare as the applicable Federal standards." U.S. EPA is authorized by CAA section 213 to adopt emission standards and other regulations for only new non-road engines. In *Engine Manufacturers Association v. U.S. EPA* (D.C. Cir.1996) 88 F.3d 1075, the Court concluded that California is the only government body with authority to adopt emission standards and other regulations for in-use engines. (*Id*., at 1089-1091.)

ARB has been granted both general and specific authority under the Health and Safety Code (HSC) to adopt the proposed regulation. HSC sections 39600 (General Powers) and 39601 (Standards, Definitions, Rules, and Measures) confer to the ARB, the general authority and obligation to adopt rules and measures necessary to execute the Board's powers and duties imposed by State law. HSC sections 43013(b) and 43018(a) provide broad authority to achieve the maximum feasible and cost effective emission reductions from <u>all</u> mobile source categories, including off-road diesel engines and equipment.

With respect to toxic air contaminants (TAC), California's Air Toxics Program, established under California law by AB 1807 (Stats. 1983, Ch. 1047) and set forth in HSC sections 39650 through 39675, mandates that ARB identify and control air toxics emissions in California. The identification phase of the Air Toxics Program requires the ARB, with participation of other state agencies, such as the Office of Environmental Health Hazard Assessment (OEHHA), to evaluate the health impacts of, and exposure to, substances and to identify those substances that pose the greatest health threat as TACs. ARB's evaluation is then made available to the public and is formally reviewed by the Scientific Review Panel (SRP) established under HSC section 39670. Following

[1] The CAA refers to "nonroad engines" and California has historically referred to these same engines as "off-road engines." For purposes of this regulation the two terms are interchangeable.

the ARB's evaluation and the SRP's review, the Board may formally identify a TAC at a public hearing. Following the identification of a substance as a TAC, HSC sections 39658, 39665, 39666, and 39667 require ARB, with the participation of the air pollution control and air quality management districts (districts), and in consultation with affected sources and interested parties, to prepare a report on the need and appropriate degree of regulation for that substance. The mobile cargo handling equipment subject to this regulation are vehicular sources. As such, the proposed regulation would be adopted under the authority provided in HSC section 39667. The ARB is responsible for implementation and enforcement of the proposed regulation. Districts are not authorized to adopt requirements for equipment subject to the proposed regulation.

D. Need for Control of Diesel Particulate Matter

In 1998, the Board identified diesel PM as a TAC. Diesel PM is by far the most important TAC and contributes over 70 percent of the estimated risk from air toxics today. In September 2000, the ARB approved the "Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles" (Diesel Risk Reduction Plan). The goal of the Diesel Risk Reduction Plan is to reduce diesel PM emissions and the associated cancer risk by 85 percent in 2020. (ARB, 2000) In addition, in 2001, OEHHA identified diesel PM as one of the TACs that may cause children or infants to be more susceptible to illness pursuant to the requirements of Senate Bill 25 (Stats. 1999, ch. 731). Senate Bill 25 also requires the ARB to adopt control measures, as appropriate, to reduce the public's exposure to these special TACs (H&SC section 39669.5). In the following sections, we describe the physical and chemical characteristics of diesel PM and discuss the adverse health and environmental impacts from the suite of pollutants emitted by diesel-fueled engines.

E. Physical and Chemical Characteristics of Diesel PM

Diesel engines emit a complex mixture of inorganic and organic compounds that exist in gaseous, liquid, and solid phases. The composition of this mixture will vary depending on engine type, engine age and horsepower, operating conditions, fuel, lubricating oil, and whether or not an emission control system is present. The primary gas or vapor phase components include typical combustion gases and vapors such as carbon monoxide (CO), carbon dioxide (CO_2), sulfur dioxide (CO_2), oxides of nitrogen (NOx), reactive organic gases (ROG), water vapor, and excess air (nitrogen and oxygen).

Many of the diesel particles exist in the atmosphere as a carbon core with a coating of organic carbon compounds, or as sulfuric acid and ash, sulfuric acid aerosols, or sulfate particles associated with organic carbon. (Beeson, 1998) The organic fraction of the diesel particle contains compounds such as aldehydes, alkanes and alkenes, and high-molecular weight PAH and PAH-derivatives. Many of these PAHs and PAH-derivatives, especially nitro-PAHs, have been found to be potent mutagens and carcinogens. Nitro-PAH compounds can also be formed during transport through the atmosphere by reactions of adsorbed PAH with nitric acid and by gas-phase radical-initiated reactions in the presence of oxides of nitrogen. Fine particles may also be formed secondarily from gaseous precursors such as SO2, NOx, or organic compounds. Fine particles can remain in the atmosphere for days to weeks and travel through the atmosphere for hundreds to thousands of kilometers, while coarse particles deposit to the earth within minutes to hours and within tens of kilometers from the emission source.

Almost all of the diesel particle mass is in the fine particle range of 10 microns or less in diameter (PM_{10}). Approximately 94 percent of the mass of these particles are less than 2.5 microns ($PM_{2.5}$) in diameter. Diesel PM can be distinguished from noncombustion sources of $PM_{2.5}$ by the high content of elemental carbon with the adsorbed organic compounds and the high number of ultrafine particles (organic carbon and sulfate).

The soluble organic fraction (SOF) consists of unburned organic compounds in the small fraction of the fuel and atomized and evaporated lube oil that escape oxidation. These compounds condense into liquid droplets or are adsorbed onto the surfaces of the elemental carbon particles. Several components of the SOF have been identified as individual TACs.

F. Health Impacts of Exposure to Diesel PM, Ambient Particulate Matter, and Ozone

The proposed regulation will reduce the public's exposure to diesel PM as well as reduce ambient particulate matter. In addition, the proposed regulation is expected to result in reductions in emissions of NOx and ROG, which are precursors to the formation of $PM_{2.5}$ and ozone in the lower atmosphere. The primary health impacts of these air pollutants are discussed below.

Diesel Particulate Matter

Diesel PM is of specific concern because it poses a lung cancer hazard for humans as well as a hazard from noncancer respiratory effects such as pulmonary inflammation. (ARB, 1998a) Because of their small size, the particles are readily respirable and can effectively reach the lowest airways of the lung along with the adsorbed compounds, many of which are known or suspected mutagens and carcinogens. (ARB, 2002) More than 30 human epidemiological studies have investigated the potential carcinogenicity of diesel PM. On average, these studies found that long-term occupational exposures to diesel exhaust were associated with a 40 percent increase in the relative risk of lung cancer. (ARB, 1998b) However, there is limited specific information that addresses the variable susceptibilities to the carcinogenicity of diesel exhaust within the general human population and vulnerable subgroups, such as infants and children and people with preexisting health conditions. The carcinogenic potential of diesel exhaust was also demonstrated in numerous genotoxic and mutagenic studies on some of the organic compounds typically detected in diesel exhaust. (ARB, 1998b)

Diesel PM was listed as a TAC by ARB in 1998 after an extensive review and evaluation of the scientific literature by OEHHA. (ARB 1998c) Using the cancer unit risk factor developed by OEHHA for the TAC program, it was estimated that for the year

2000, exposure to statewide, average population-weighted, ambient concentrations of diesel (1.8 µg/m^3) could be associated with a health risk of 540 potential cancer cases per million people exposed over a 70-year lifetime.

Another highly significant health effect of diesel exhaust exposure is its apparent ability to act as an adjuvant in allergic responses and possibly asthma. (Dab, 2000) (Diaz-Sanchez, 1996) (Kittelson, 1999) However, additional research is needed at diesel exhaust concentrations that more closely approximate current ambient levels before the role of diesel PM exposure in the increasing allergy and asthma rates is established.

Ambient Particulate Matter

The key health effects categories associated with ambient particulate matter, of which diesel PM is an important component, include premature mortality; aggravation of respiratory and cardiovascular disease (as indicated by increased hospital admissions and emergency room visits, school absences, work loss days, and restricted activity days); aggravated asthma; acute respiratory symptoms, including aggravated coughing and difficult or painful breathing, chronic bronchitis, and decreased lung function that can be experienced as shortness of breath. (U.S. EPA 2000, U.S. EPA 2003)

Health impacts from exposure to the fine particulate matter ($PM_{2.5}$) component of diesel exhaust have been calculated for California, using concentration-response equations from several epidemiological studies. Both mortality and morbidity effects could be associated with exposure to either direct diesel $PM_{2.5}$ or indirect diesel $PM_{2.5}$, the latter of which arises from the conversion of diesel NO_x emissions to $PM_{2.5}$ nitrates. It was estimated that 2000 and 900 premature deaths resulted from long-term exposure to either 1.8 µg/m^3 of direct $PM_{2.5}$ or 0.81 µg/m^3 of indirect $PM_{2.5}$, respectively, for the year 2000. (Lloyd, 2001) The mortality estimates are likely to exclude cancer cases, but may include some premature deaths due to cancer, because the epidemiological studies did not identify the cause of death. Exposure to fine particulate matter, including diesel $PM_{2.5}$ can also be linked to a number of heart and lung diseases.

Ozone

Diesel exhaust consists of hundreds of gas-phase, particle-phase, and semi-volatile organic compounds, including typical combustion products, such as CO_2, hydrogen, oxygen, and water vapor, as well as CO, ROG, carbonyls, alkenes, aromatic hydrocarbons, PAHs, PAH derivatives, and sulfur oxides (SOx) - compounds resulting from incomplete combustion. Ozone is formed by the reaction of ROG and NOx in the atmosphere in the presence of heat and sunlight. The highest levels of ozone are produced when both ROG and NOx emissions are present in significant quantities on hot, clear summer days. This pollutant is a powerful oxidant that can damage the respiratory tract, causing inflammation and irritation, which can result in breathing difficulties.

Studies have shown that there are impacts on public health and welfare from ozone at moderate levels. Short-term exposure to high ambient ozone concentrations have been linked to increased hospital admissions and emergency visits for respiratory problems. (Peters, 2001) Repeated exposure to ozone can make people more susceptible to respiratory infection and lung inflammation and can aggravate preexisting respiratory diseases, such as asthma. Prolonged (six to eight hours), repeated exposure to ozone can cause inflammation of the lung, impairment of lung defense mechanisms, and possibly irreversible changes in lung structure, which over time could lead to premature aging of the lungs and/or chronic respiratory illnesses such as emphysema and chronic bronchitis.

The subgroups most susceptible to ozone health effects include individuals exercising outdoors, children and people with preexisting lung disease such as asthma, and chronic pulmonary lung disease. Children are more at risk from ozone exposure because they typically are active outside, during the summer when ozone levels are highest. Also, children are more at risk than adults from ozone exposure because their respiratory systems are still developing. Adults who are outdoors and moderately active during the summer months, such as construction workers and other outdoor workers, also are among those most at risk. These individuals, as well as people with respiratory illnesses such as asthma, especially asthmatic children, can experience reduced lung function and increased respiratory symptoms, such as chest pain and cough, when exposed to relatively low ozone levels during prolonged periods of moderate exertion.

G. Health and Environmental Benefits from the Proposed Regulation

Reducing diesel PM emissions from cargo handling equipment at ports and intermodal rail yards will have both public health and environmental benefits. The proposed regulation will reduce localized potential cancer risks associated with emissions from cargo handling equipment and will contribute to the reduction of the general exposure to diesel PM that occurs on a region-wide basis due to collective emissions from diesel-fueled engines. Additional benefits associated with the proposed regulation include further progress in meeting the ambient air quality standards for PM_{10}, $PM_{2.5}$, and ozone, and enhancing visibility.

Reduced Diesel PM Emissions

The estimated reductions in diesel PM emissions and the associated benefits from reduced exposure and risk are discussed in detail in Chapter VI.

Reduced Ambient Particulate Matter Levels

Reducing diesel PM will also help efforts to achieve the ambient air quality standards for particulate matter. Both the State of California and the U.S. EPA have established standards for the amount of PM_{10} in the ambient air. These standards define the maximum amount of PM that can be present in outdoor air. California's PM_{10} standards were first established in 1982 and updated June 20, 2002. It is more protective of human health than the corresponding national standard. Additional California and federal standards were established for $PM_{2.5}$ to further protect public health (Table I-1).

Table I-1: State and National PM Standards

California Standard		National Standard	
PM_{10}			
Annual Arithmetic Mean	20 $\mu g/m^3$	Annual Arithmetic Mean	50 $\mu g/m^3$
24-Hour Average	50 $\mu g/m^3$	24-Hour Average	150 $\mu g/m^3$
$PM_{2.5}$			
Annual Arithmetic Mean	12 $\mu g/m^3$	Annual Arithmetic Mean	15 $\mu g/m^3$
24-Hour Average	No separate State standard	24-Hour Average	65 $\mu g/m^3$

Particulate matter levels in most areas of California exceed one or more of current state PM standards. The majority of California is designated as non-attainment for the State PM_{10} standard (ARB 2002). Diesel PM emission reductions from diesel-fueled engines will help protect public health and assist in furthering progress in meeting the ambient air quality standards for both PM_{10} and $PM_{2.5}$.

The emission reductions obtained from the use of lower emission diesel engines will result in lower ambient particulate matter levels and significant reductions of exposure to primary and secondary diesel PM. Lower ambient particulate matter levels and reduced exposure mean reduction of the prevalence of the diseases attributed to diesel PM, reduced incidences of hospitalizations and prevention of premature deaths.

Reduced Ambient Ozone Levels

Emissions of NOx and ROG, precursors to the formation of ozone in the lower atmosphere, will also be reduced by the proposed regulation. In California, most major urban areas and many rural areas continue to be non-attainment for the State and federal 1-hour ambient air quality standard for ozone. Controlling emissions of ozone precursors would reduce the prevalence of the types of respiratory problems associated with ozone exposure and would reduce hospital admissions and emergency visits for respiratory problems. Ozone can also have adverse health impacts at concentrations that do not exceed the 8-hour NAAQS.

Table I-2: State and National Ozone Standards

	California Standard	National Standard
1 hour	0.09 ppm (180 $\mu g/m^3$)	-
8 hour	0.070 ppm (137 $\mu g/m^3$)	0.08 ppm (157 $\mu g/m^3$)

Note: The 8 hour California standard is expected to become effective in early 2006.

Improved Visibility

In addition to the public health effects of fine particulate pollution, inhalable particulates including sulfates, nitrates, organics, soot, and soil dust contribute to regional haze that impairs visibility.

In 1999, the U.S. EPA promulgated a regional haze regulation that calls for states to establish goals and emission reduction strategies for improving visibility in 156 mandatory Class I national parks and wilderness. California has 29 of these national parks and wilderness areas, including Yosemite, Redwood, and Joshua Tree National Parks. Reducing diesel PM from cargo handling equipment will help improve visibility in these Class I areas.

H. Public Outreach and Environmental Justice

Environmental Justice

The ARB is committed to integrating environmental justice in all of its activities. On December 13, 2001, the Board approved "Policies and Actions for Environmental Justice," which formally established a framework for incorporating Environmental Justice into the ARB's programs, consistent with the directive of California state law. (ARB, 2001) Environmental Justice is defined as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies. These policies apply to all communities in California, but recognize that environmental justice issues have been raised more in the context of low-income and minority communities.

The Environmental Justice Policies are intended to promote the fair treatment of all Californians and cover the full spectrum of the ARB's activities. Underlying these Policies is a recognition that the agency needs to engage community members in a meaningful way as it carries out its activities. People should have the best possible information about the air they breathe and what is being done to reduce unhealthful air pollution in their communities. The ARB recognizes its obligation to work closely with all communities, environmental and public health organizations, industry, business owners, other agencies, and all other interested parties to successfully implement these Policies.

During the development process, the ARB staff provided opportunities to present information about the proposed regulation at places and times convenient to stakeholders. For example, the meetings were held at times and locations that encouraged public participation, including evening sessions. Attendees included representatives from environmental community organizations, terminal operators, port and rail representatives, engine and diesel emission control associations, and other parties interested in mobile cargo handling equipment. These individuals participated both by providing data and reviewing draft regulations and by participating in open forum workshops, in which staff directly addressed their concerns. Table I-3 below provides meeting dates that were made to apprise the public about the development of the proposed regulation.

Table I-3: Workshop/Workgroup and Public Outreach Meetings

Date	Meeting	Location	Time
July 7, 2004	Public Workshop	Port of Los Angeles	1:30 p.m.
July 8, 2004	Public Workshop	Elihu Harris Building, Oakland	1:30 p.m.
September 9, 2004	San Pedro Conference on Air Quality, International Trade, & Transportation	Marina San Pedro Hotel, San Pedro	10:15 a.m.
September 22, 2004	Public Working Group	Cal/EPA Building, Sacramento (teleconference)	1:30 p.m.
October 27, 2004	No Net Increase Air Quality Task Force	Sheraton Los Angeles Harbor Hotel, San Pedro	1:00 p.m.
November 10, 2004	Public Workshop	Cal/EPA Building, Sacramento	10:45 a.m.
December 1, 2004	Public Working Group	Cal/EPA Building, Sacramento (teleconference)	1:30 p.m.
January 19, 2005	Port Community Advisory Committee: Air Quality Subcommittee	Port of Los Angeles	4:30 p.m.
February 24, 2005	California Air Resources Board: Board Meeting	Cal/EPA Building, Sacramento	9:00 a.m.
April 7, 2005	Environmental Law Super Symposium	Omni Hotel, Los Angeles	1:00 p.m.
May 18, 2005	Public Workshop	Cal/EPA Building, Sacramento	9:00 a.m.
August 11, 2005	Public Working Group	Cal/EPA Building, Sacramento (teleconference)	1:30 p.m.
August 24, 2005	Public Workshop	Port of Long Beach	10:00 a.m.
August 24, 2005	Public Workshop	Long Beach Senior Center	6:00 p.m.
October 4, 2005	Public Working Group	Cal/EPA Building, Sacramento (teleconference)	1:30 p.m.

The proposed regulation is consistent with the environmental justice policy to reduce health risks from TACs in all communities, including those with low-income and minority populations, regardless of location. The regulation will reduce diesel PM emissions from mobile cargo handling equipment at ports and intermodal rail yards by requiring accelerated turnover to cleaner engines and the use of the best available control technologies. The proposed regulation will provide air quality benefits for all Californians, particularly those living near ports and intermodal rail facilities where cargo handling equipment operate.

<u>Outreach Efforts</u>

Since the identification of diesel PM as a TAC in 1998, the public has been more aware of the health risks posed by the emissions of this TAC. At many of the ARB's community outreach meetings over the past few years, the public has raised questions regarding our efforts to reduce exposure to diesel PM. At these meetings, ARB staff told the public about the Diesel Risk Reduction Plan adopted in 2000 and described some of the measures in that plan, including those for off-road diesel-fueled engines such as cargo handling equipment.

The ARB has held six public workshops and four public working group meetings since July 2004 in developing this rule (see Table I-3). Over 700 individuals and/or companies were notified for each workshop/meeting through a series of mailings. Notices were posted to ARB's cargo handling equipment and public workshops web sites and e-mailed to subscribers of the cargo handling equipment electronic list server. The majority of the workshops were broadcast live via the internet, and working group meetings were held via teleconference, making them more easily accessible the public.

In addition to the public workshops and working group meetings presented in Table I-3, ARB staff and management participated in numerous industry, government agency, and community meetings over the past three years, presenting information on the Diesel Risk Reduction Plan and our proposed regulatory approach for cargo handling equipment at ports and intermodal rail yards. Some of the industry groups and environmental associations participating were railroad companies, California ports, the American Lung Association, the Wilmington Coalition for a Safe Environment, Citizens for a Better Environment, Coalition for Clean Air, the Manufacturers of Emission Controls Association, National Resources Defense Counsel, Environmental Defense, the Pacific Merchant Shipping Association, the Pacific Maritime Association, private businesses, and others. Staff also met periodically with a regulatory workgroup, comprised of representatives from local air pollution control or air quality management districts and the U.S. EPA.

As a way of inviting public participation and enhancing the information flow between the ARB and interested parties, staff created a cargo handling equipment Internet web site (http://www.arb.ca.gov/cargo) in March 2004. Since that time, staff has consistently made available on the web site all related documents, including meeting presentations and draft versions of the proposed regulatory language. The web site has also provided background information on diesel PM, workshop and meeting notices and materials, and other diesel related information, and has served as a portal to other web sites with related information.

Outreach efforts have also included hundreds of personal contacts via telephone, electronic mail, regular mail, surveys, facility visits, and individual meetings with interested parties. These contacts have included interactions with engine manufacturers and operators, emission control system manufacturers, local, national, and international trade association representatives, and environmental, community, and public health organizations.

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II. MOBILE CARGO HANDLING EQUIPMENT AT PORTS AND INTERMODAL RAIL YARDS

A. Definitions and Uses

Mobile cargo handling equipment at ports and intermodal rail yards is as diverse a group of equipment as the cargo that it handles. Cargo that arrives and/or departs by ship, truck, or train, can include liquid, bulk (break bulk and dry bulk), and containers. Liquid cargo, such as petroleum products and chemicals, are often transported via pipelines, and therefore, do not usually have mobile cargo handling equipment associated with their operation. Break bulk cargo, such as lumber, steel, machinery, and many types of palletized goods, and dry bulk cargo, such as cement, scrap metal, salt, sugar, sulfur, and petroleum coke, usually require equipment such as loaders, dozers, cranes, forklifts, and sweepers for their operations. Container cargo, which is the most common type of cargo at ports and intermodal rail yards, requires equipment such as yard trucks, rubber-tired gantry (RTG) cranes, top picks, side picks, forklifts, and straddle carriers. There are about 3,700 mobile cargo handling equipment vehicles at California's ports and intermodal rail yards. Below is a description of some of the most common equipment types.

Container Handling Equipment

<u>Yard Truck</u>

The most common type of cargo handling equipment is a yard truck. Yard trucks are also known as yard goats, utility tractor rigs (UTRs), hustlers, yard hostlers, and yard tractors. Yard trucks are very similar to heavy-duty on-road truck tractors, but the majority are equipped with off-road engines.

Yard Truck

Yard trucks are designed for moving cargo containers. They are used at container ports and intermodal rail yards as well as distribution centers and other intermodal facilities. Containers are loaded onto the yard trucks by other container handling equipment, such as rubber-tired gantry cranes, top picks, or side picks, and they are unloaded the same way. In addition to loading and unloading operations, yard trucks are used to move containers around a facility (yard) for stacking and storing purposes.

While most yard trucks are diesel-fueled, there is limited availability of those powered by liquefied petroleum gas (LPG), compressed natural gas (CNG), and liquefied natural gas (LNG), and the incremental costs of alternative fuel yard trucks is very high (between 20 and 66 percent). The Port of Los Angeles has approximately 60 LPG fueled yard trucks, and the Port of Long Beach has ordered five natural gas yard trucks to be delivered in the Fall 2005.

Yard trucks have a horsepower (hp) range of about 150 hp to 250 hp, with most being around 175 hp to 200 hp. There are approximately 2,300 yard trucks at California's ports and intermodal rail yards.

Top Handler

Another very common type of container handling equipment is the top handler. Also known as top picks, top handlers are large truck-like vehicles with an overhead boom which locks onto the top of containers in a single stack. They are used within a terminal to stack containers for temporary storage and load containers onto and off of yard trucks. Top handlers are capable of lifting loaded cargo containers weighing as much as 45,000 pounds. Top handlers have a horsepower range of about 250 hp to 400 hp, with most being between 250 hp and 350 hp.

Top Handler

Side Handler

Like the top handler, side handlers (or side picks) are used to lift and stack cargo containers. They look very similar to a top pick, but instead of grabbing the containers from the top, their boom arm extends the width of a container to lift it from the front face (or side). Side handlers are most often used to lift empty containers; however, some are manufactured to lift loaded containers. Side handlers have a horsepower range of about 120 hp to 400 hp, with most being between 160 hp and 250 hp.

Side Handler

Reach Stacker

Another member of the cargo container handling family is the reach stacker. Similar to a top pick, the reach stacker has a telescopic boom, usually attached behind the cab, that moves upward and outward in order to reach over two or more stacks of containers. Reach stackers lock onto the top of the containers in a similar fashion to top handlers. However, they are not nearly as common as top handlers and side handlers because their duties can similarly be performed by rubber-tired gantry cranes. They are most often found at port container terminals, but rarely at intermodal rail yards. Reach stackers have a horsepower range of about 250 hp to 400 hp, with most being between 230 hp and 300 hp.

Reach Stacker

Rubber-Tired Gantry Crane

Rubber-tired gantry cranes (or RTG cranes) are very large cargo container handlers that have a lifting mechanism mounted on a cross-beam supported on vertical legs which run on rubber tires. While the propulsion of the crane is very slow (about three miles per hour), the lifting mechanism can move quickly, and is therefore able to load and unload containers from yard trucks or from stacks at a very fast pace.

RTG Crane

RTG cranes have a horsepower range of about 200 hp to 1,000 hp, with most being between around 300 hp to 1,000 hp. There are approximately 300 RTG cranes at California's ports and intermodal rail yards.

Forklift

Used at both container facilities and bulk cargo facilities, forklifts are industrial trucks used to hoist and transport materials by means of one or more steel forks inserted under (or in the case of steel coils, in the middle of) the load. Forklifts are extremely diverse in both their size and custom cargo handling abilities. While they are designed to move and/or lift empty cargo containers or stacked or palletized cargo, they can also be designed to move or rotate (flip) truck chassis.

Forklift

Forklift engines can be powered by either electric motors or internal combustion engines, such as compression ignition (i.e., diesel or natural gas) or spark ignition (i.e., gasoline or propane) engines. Compression ignition forklifts are usually designed for higher lift capacity than their electric or spark ignited counterparts, and are therefore more likely to be used in cargo handling operations.

The cargo handling forklifts used at ports and intermodal rail yards have a horsepower range of about 45 hp to 280 hp. There are approximately 460 forklifts at California's ports and intermodal rail yards.

Bulk Cargo Handling Equipment

Loader

Loader

One of the most common dry bulk handling equipment, the loader is any type of off-road tractor, with either tracks or rubber tires, that uses a bucket on the end of movable arms to lift and move material. There are many different types of loaders, including but not limited to, front end, skid steer, backhoe, rubber tired, and wheeled. Loaders used in cargo handling operations range from 36 hp (for small, skid steer loaders) to over 1,000 hp (for large, rubber-tired loaders), with most being between 200 hp and 750 hp.

Dozer

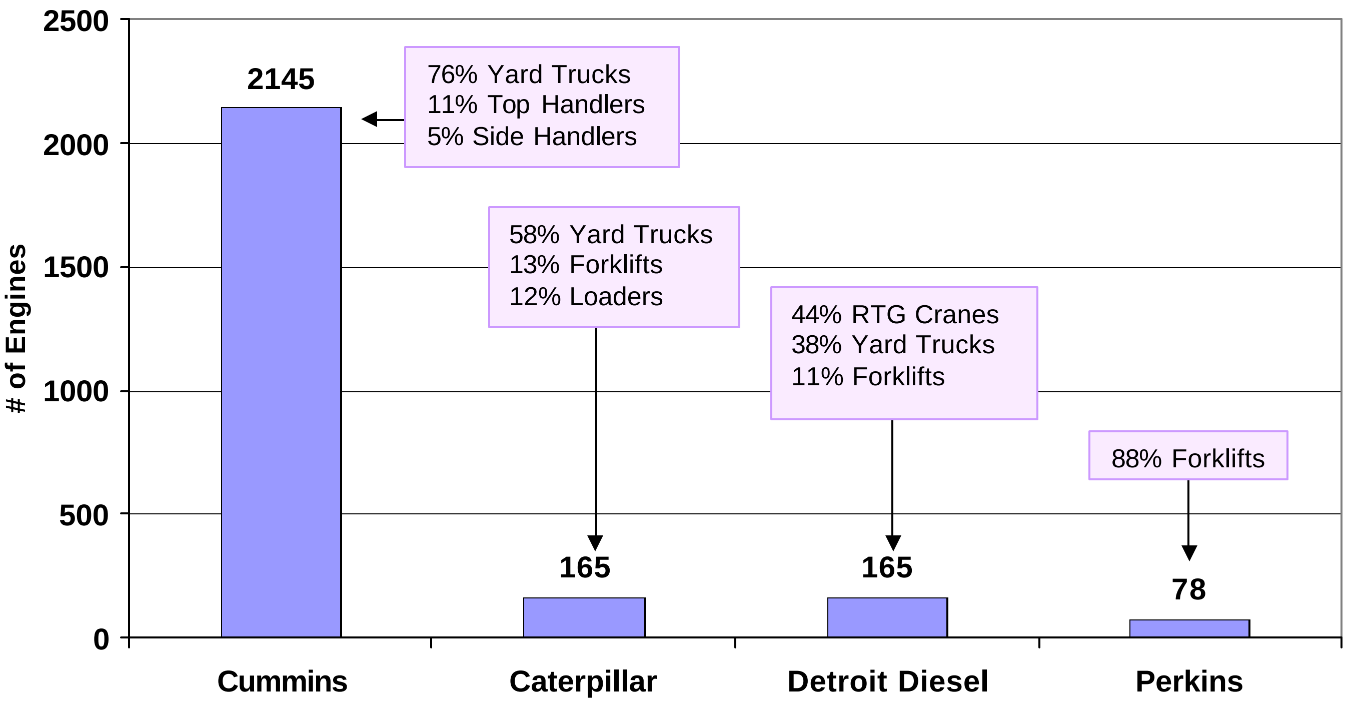
Dozer

The term dozer refers to an off-road tractor, either tracked or wheeled, equipped with a blade. Dozers at ports and intermodal rail yards are most often used in dry bulk or break bulk cargo handling operations. They range in size from 77 hp to 900 hp, with most being between 300 hp to 400 hp. Both loaders and dozers are among the approximately 250 bulk cargo handling equipment at California's ports and intermodal rail yards.

In 2004, the Port of Long Beach (POLB) and the Port of Los Angeles (POLA) published emission inventories, which included information on all mobile cargo handling equipment, for their respective ports. (POLB, 2004) (POLA, 2004) In addition to the data gathered in the two port inventories, ARB staff conducted a statewide survey of cargo handling equipment (survey) at ports and intermodal rail yards in December 2004. The completed surveys and the POLB and POLA inventory data gave staff important information regarding the equipment, such as equipment and engine make, model, model year, and fuel types. Additionally, the statewide survey included estimated useful life, and expected growth for the years 2010 and 2020. More information is available in the emissions inventory appendix (Appendix B).

Several engine manufacturers were prevalent in the cargo handling equipment that was surveyed and inventoried. The most common manufacturer was Cummins, which comprised about 80 percent of all of the mobile cargo handling equipment engines. Within the Cummins engine families, the 5.9 liter and the 8.3 liter models were the most common, and yard trucks made up the majority of the Cummins engines. About 10 percent of the engines were Caterpillar and Detroit Diesel models. Figure II-1 shows the distribution of the most common engine manufacturers and the most common equipment types using them.

Figure II-1: Engine Manufacturers and Equipment Types[2]



In addition to the statewide survey and the POLA and POLB inventories, ARB staff contacted equipment manufacturers to obtain approximate costs for new cargo handling equipment. Table II-1 shows the average reported new equipment costs for the most common types of mobile cargo handling equipment.

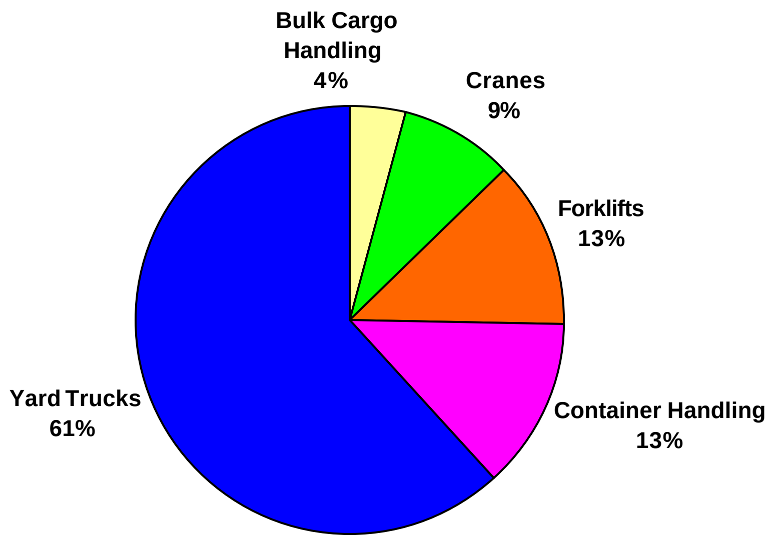
[2] The figure represents only the most common engine manufacturers of mobile cargo handling equipment from ARB's survey and the Ports of Los Angeles and Long Beach inventories and their corresponding distribution of equipment types. Therefore, not all manufacturers or equipment types are shown.

Table II-1: Average New Equipment Costs

Equipment Category	Equipment Type	Average New Cost (in thousands $)
Yard Trucks	Yard Truck	$60
Basic Container Handling	Top Handler	$400 - $460
	Side Handler	$240 - $460
	Forklift	$40 - $250
Bulk Cargo Handling	Dozer	$25 - $75 (50 – 100hp) up to $1,000 for 900hp
	Excavator	$200 - $300
	Mobile Crane	$60 - $400
	Loader	$15 - $100 (35 – 95hp) $125 - $500 (130 – 675hp)
RTG Cranes	RTG Crane	$1,000 +

The POLA and POLB data, along with the data collected from ARB's survey, were integral in developing a statewide population and emissions inventory for cargo handling equipment at ports and intermodal rail yards. The developed inventory revealed that container handling equipment, such as yard trucks, top handlers, side handlers, and RTG cranes, makes up the majority of the population (about 74 percent), with yard trucks being the most common equipment type (61 percent). Figure II-2 below shows the population by equipment type or category.

Figure II-2: 2004 Statewide Population Distribution of Cargo Handling Equipment at Ports and Intermodal Rail Yards



Detailed information on the statewide emissions inventory for cargo handling equipment is available in Appendix B.

B. Ports and Intermodal Rail Yards

California is a global gateway for the United States by virtue of its strategic location on the Pacific Rim, its border with Mexico, and its major ports and railways. Some of the largest ports in the world are located in California, and with the increases in trade and general goods movement, both the ports and intermodal rail yards stand to experience major growth over the next two decades.

Currently, the State has 16 primary ports that participate in waterborne commerce: Antioch, Benicia, Crockett, Humboldt Bay, Hueneme, Long Beach, Los Angeles, Oakland, Pittsburg, Port Chicago, Redwood City, Richmond, Sacramento, San Diego, San Francisco, and Stockton. While most of the ports fall under a port authority, the smaller ports, such as Antioch, Benicia, and Crockett, generally have docks or terminals controlled by the terminal owner(s) or operator(s). Additionally, other small, independent ports may exist, or other ports may be developed in the future, to which this regulation would be applicable. Figure II-3 shows the current primary ports in California and their approximate locations.

Figure II-3: California's Ports

Two major railroad companies, BNSF Railway (BNSF) and Union Pacific Railroad (UP), operate 14 intermodal rail yards in California. Additionally, other smaller railroad companies may own or operate intermodal rail yards in the state and would be subject to compliance with this regulation. The intermodal rail yards generally handle container cargo to and from trains, trucks, and in the case of the rail yards being located at the ports, to and from ships. Figure II-4 shows the intermodal rail yards operated by BNSF and UP in California and their approximate locations.

Figure II-4: California's Intermodal Rail Yards

C. Regulatory Status

This section provides a regulatory context for the proposed regulation by briefly discussing significant existing federal, state, and local air quality regulations and programs that apply to cargo handling equipment.

Federal and California Emission and Fuel Standards

In all states, off-road engines are required to meet federal standards. However, California is authorized under the federal Clean Air Act (CAA), Section 209(e)(2)(A), to adopt and enforce emission standards and other requirements for off-road engines and equipment not subject to federal preemption, provided California's standards are at least as health-protective as the federal standards. In order to receive this authorization, California must apply for and receive approval from the U.S. EPA. (EPA, 1990)

Federal nonroad (off-road) compression ignition engine emission standards are set forth for new engines in 40 Code of Federal Regulations (CFR) Part 89. California has harmonized with federal emission standards, as set forth in title 13 California Code of Regulations (CCR), Article 4, sections 2420-2427, under "Heavy Duty Off-road Diesel Cycle Engines." The off-road engine standards (Tiers) vary depending upon the engine model year and maximum rated power. The U.S. EPA adopted more stringent Tier 4 standards for the control of emissions from nonroad compression ignition engines in 2004 and ARB approved equivalent off-road standards in 2005. (ARB, 2005) Table II-2 shows the standards for Tier 1 through Tier 4.

Table II-2: Off-Road Compression-Ignition (Diesel) Engine Standards [NMHC+NOx/CO/PM in g/bhp-hr (g/kW-hr)]

<table>
<tr><th>HP (kW)</th><th>1995</th><th>1996</th><th>1997</th><th>1998</th><th>1999</th><th>2000</th><th>2001</th><th>2002</th><th>2003</th><th>2004</th><th>2005</th><th>2006</th><th>2007</th><th>2008</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th><th>2015+</th></tr>
<tr><td>< 11 (8)</td><td colspan="5" rowspan="2">See Table 2 footnote (a)</td><td colspan="5">7.8 / 6.0 / 0.75
(10.5 / 8.0 / 1.0)</td><td colspan="3">5.6 / 6.0 / 0.60
(7.5 / 8.0 / 0.80)</td><td colspan="8">5.6 / 6.0 / 0.30[a]
(7.5 / 8.0 / 0.40)</td></tr>
<tr><td>≥ 11 (8)
< 25 (19)</td><td colspan="5">7.1 / 4.9 / 0.6
(9.5 / 6.6 / 0.80)</td><td colspan="3">5.6 / 4.9 / 0.60
(7.5 / 6.6 / 0.80)</td><td colspan="8">5.6 / 4.9 / 0.30
(7.5 / 6.6 / 0.40)</td></tr>
<tr><td>≥ 25 (19)
< 50 (37)</td><td colspan="4">-</td><td colspan="5">7.1 / 4.1 / 0.60
(9.5 / 5.5 / 0.80)</td><td colspan="4">5.6 / 4.1 / 0.45
(7.5 / 5.5 / 0.60)</td><td colspan="5">5.6 / 4.1 / 0.22
(7.5 / 5.5 / 0.30)</td><td colspan="3">3.5 / 4.1 / 0.02
(4.7 / 5.5 / 0.03)</td></tr>
<tr><td>≥ 50 (37)
< 75 (56)</td><td colspan="3" rowspan="2">-</td><td colspan="6" rowspan="2">- / 6.9 / - / -[b]
(- / 9.2 / - / -)</td><td colspan="4" rowspan="2">5.6 / 3.7 / 0.30
(7.5 / 5.0 / 0.40)</td><td colspan="5">3.5 / 3.7 / 0.22[c]
(4.7 / 5.0 / 0.30)</td><td colspan="3">3.5 / 3.7 / 0.02[c]
(4.7 / 5.0 / 0.03)</td></tr>
<tr><td>≥ 75 (56)
< 100 (75)</td><td colspan="4">3.5 / 3.7 / 0.30
(4.7 / 5.0 / 0.40)</td><td colspan="3" rowspan="2">0.14/ 2.5/ 3.7/ 0.01[b,d]
(0.19/ 3.4 / 5.0 /0.02)</td><td rowspan="2">0.14 (0.19)
0.30 (0.40)
3.7 (5.0)
0.01[b] (0.02)</td></tr>
<tr><td>≥ 100 (75)
< 175 (130)</td><td colspan="2">-</td><td colspan="6"></td><td colspan="4">4.9 / 3.7 / 0.22
(6.6 / 5.0 / 0.30)</td><td colspan="5">3.0 / 3.7 / 0.22
(4.0 / 5.0 / 0.30)</td></tr>
<tr><td>≥ 175 (130)
< 300 (225)</td><td rowspan="3">-</td><td colspan="4" rowspan="3">1.0 / 6.9 / 8.5 / 0.40[b]
(1.3 / 9.2 / 11.4 / 0.54)</td><td colspan="3"></td><td colspan="3">4.9 / 2.6 / 0.15
(6.6 / 3.5 / 0.20)</td><td colspan="5" rowspan="3">3.0 / 2.6 / 0.15[e]
(4.0 / 3.5 / 0.20)</td><td colspan="3" rowspan="3">0.14 / 1.5 / 2.6 / 0.01[b,d]
(0.19/ 2.0 / 3.5 /0.02)</td><td colspan="2" rowspan="3">0.14 (0.19)
0.30 (0.40)
2.6 (3.5)
0.01[b] (0.02)</td></tr>
<tr><td>≥ 300 (225)
< 600 (450)</td><td colspan="2"></td><td colspan="4" rowspan="2">4.8 / 2.6 / 0.15
(6.4 / 3.5 / 0.20)</td></tr>
<tr><td>≥ 600 (450)
≤ 750 (560)</td><td colspan="2"></td></tr>
<tr><td>Mobile Machines
> 750 (560)</td><td colspan="5" rowspan="3">-</td><td colspan="6" rowspan="3">1.0 / 6.9 / 8.5 / 0.40[b]
(1.3 / 9.2 / 11.4 / 0.54)</td><td colspan="5" rowspan="3">4.8 / 2.6 / 0.15
(6.4 / 3.5 / 0.20)</td><td colspan="4" rowspan="2">0.30 / 2.6 / 2.6 / 0.07[b]
(0.40 / 3.5 / 3.5 / 0.10)</td><td>0.14 (0.19)
2.6 (3.5)
2.6 (3.5)
0.03[b] (0.04)</td></tr>
<tr><td>GEN >750 (560)
≤1207 (900)</td><td rowspan="2">0.14 (0.19)
0.50 (0.67)
2.6 (3.5)
0.02[b] (0.03)</td></tr>
<tr><td>GEN>1207 (900)</td><td colspan="4">0.30 / 0.50 / 2.6 / 0.07[b]
(0.40 / 0.67 / 3.5 / 0.10)</td></tr>
</table>

a) The PM standard for hand-start, air cooled, direct injection engines below 11 hp (8 kW) may be delayed until 2010 and be set at 0.45 g/bhp-hr (0.60 g/kW-hr).
b) Standards given are NMHC/NOx/CO/PM in g/bhp-hr (or g/kW-hr).
c) Engine families in this power category may alternately meet Tier 3 PM standards [0.30 g/bhp-hr (0.40 g/kW-hr)] in 2008-2011 in exchange for introducing final PM standards in 2012.
d) The implementation schedule shown is the three-year alternate NOx approach. Other schedules are available.
e) Certain manufacturers have agreed to comply with these standards by 2005.

: Tier 1 : Tier 2 : Tier 3 : Tier 4 Interim / Final

Federal and California fuel standards specifically apply to manufacturers and distributors rather than to mobile sources or their operators. Nevertheless, these standards directly affect the fuel used in mobile sources, including cargo handling equipment. Fuel standards for sulfur content, aromatic content, and other fuel components and parameters play a critical role in meeting emission standards. Federal commercial fuel standards are set forth in 40 CFR Part 80 and California fuel standards are set forth in title 13 California Code of Regulations sections 2281 and 2282 (diesel). In July, 2003, a revision to CCR title 13, section 2281 was adopted by the ARB which allows only very low sulfur diesel (<15 ppm) in diesel fuel starting in June 2006.

(ARB, 2004) Activities involving California nonvehicular diesel fuel are also subject to this requirement as if it were vehicular fuel. U.S. EPA plans to adopt a similar sulfur restriction that would go into effect in 2006 for on-road fuel use and in 2010 for nonroad fuel use. Fuel suppliers for California must meet both federal and California fuel standards.

Some types of cargo handling equipment, particularly yard trucks, have the option to use certified on-road engines. The on-road diesel engine standards are included below in Table II-3.

Table II-3: 2004 and Subsequent On-Road Heavy-Duty Diesel Engine Standards

Model Year	HC	CO	NMHC + NOx	NOx	PM
2004-2006 [A]	-	15.5	2.4 [B]	-	0.10
2007 and subsequent	0.14 [C]	15.5	-	0.2 [D]	0.01

[A] October 1, 2002, for EPA Consent Decree signers
[B] manufacturers can chose a 2.5 g/bhp-hr NMHC+NOx standard with a 0.5 g/bhp-hr NMHC cap
[C] non-methane hydrocarbons (NMHC)
[D] phase-in schedule: 50 percent from 2007 to 2009, 100 percent in 2010

California Statutes and Local Air District Rules

In addition to harmonized state/federal off-road/nonroad diesel engine emission standards, cargo handling equipment are subject to several other air quality-related statutes and regulations in the California Health and Safety Code.

HSC section 41700 is an important statutory requirement that applies to any source of air pollution whatsoever (with some very narrow exceptions), that prohibits any person from discharging such quantities of air contaminants which cause injury, detriment, nuisance, or annoyance to any considerable number of persons or the public, or which endanger the comfort, repose, health, or safety of any such persons or the public, or which cause or have the natural tendency to cause injury or damage to business or property."

HSC section 41701 also applies similarly to any source whatsoever and prohibits air contaminant emissions that obscure an observer's view to no more than Ringelmann 2 or an opacity of 40 percent.

Local air districts all have prohibitory rules that are at least as stringent as HSC sections 41700 and 41701. These two statutes and the local rules provide broad authority to air districts to enforce the statutory prohibition against any source whatsoever causing a nuisance or emitting excessive smoke.

Voluntary Retrofit Programs

Federal, State, and local programs have been developed to encourage less-polluting diesel engines. These programs include:

- ARB's Carl Moyer Program;
- Retrofit programs at the Ports of Long Beach, Los Angeles, and Oakland; and
- U.S. EPA's Voluntary Diesel Retrofit Program.

ARB's Carl Moyer Memorial Air Quality Standards Attainment Program (Moyer Program) provides funds on an incentive-basis for the incremental cost of cleaner than required engines and equipment. Eligible projects include cleaner on-road, off-road, marine, locomotive and stationary agricultural pump engines, as well as forklifts, airport ground support equipment, auxiliary power units, transport refrigeration units, and cargo handling equipment. The program achieves near-term reductions in emissions of oxides of nitrogen (NOx), which are necessary for California to meet its clean air commitments under the State Implementation Plan. In addition, local air districts use these NOx emission reductions to meet commitments in their conformity plans, thus preventing the loss of federal funding for local areas throughout California. The program also reduces particulate matter (PM), a component of diesel exhaust.

Several large ports in California have developed air quality improvement plans to reduce emissions from port-side diesel equipment. The Ports of Los Angeles, Long Beach, and Oakland have offered financial incentives to terminal operators to install emission control devices, such as diesel oxidation catalysts (DOCs) on cargo handling equipment, and to use cleaner-burning diesel fuels, such as ultra-low sulfur diesel and emulsified diesel fuel. Yard trucks, which are the largest emission source for this category of off-road equipment, have the ability of using certified on-road engines, which can reduce diesel PM emissions as much as 30 percent and NOx emissions as much as 70 percent. Some of the ports' incentive programs have helped to encourage terminal operators to purchase yard trucks equipped with on-road engines instead of those with off-road engines when adding to their fleets. As a result of these voluntary programs, more than 1,200 cargo handling equipment vehicles, primarily yard trucks, have been retrofitted with DOCs or replaced with new, cleaner engines in the last three years.

Although U.S. EPA plans to significantly reduce pollution from new diesel engines through several steps of new diesel engine emission standards, the effects of these rules will take many years to implement due to the long lives of diesel engines. U.S. EPA has developed the Voluntary Diesel Retrofit Program to help make a difference in the immediate future. The program addresses pollution from diesel construction equipment and heavy-duty vehicles that are currently on the road today. The Program is building a market for clean diesel engines by working with state, local and industry partners to create demonstration projects around the country. The Web site at http://www.epa.gov/otaq/retrofit is designed to help fleet operators, air quality planners in State/local government, and retrofit manufacturers understand this program, and to obtain the information they need to create effective retrofit projects.

More recently, on August 8, 2005, President Bush signed the Energy Policy Act of 2005. Subtitle G, Diesel Emissions Reduction, authorizes $200 million each year for fiscal years 2007 through 2011 to provide grants and low-cost revolving loans to achieve reductions in diesel emissions. These monies cannot be used to fund emission reduction measures mandated under Federal, State or local law. It is unknown at this time when the monies will be appropriated and how much funding will be made available to California. While the proposed regulation for cargo handling equipment is clearly a State mandate, the ARB would support the use of these monies by cargo handling equipment operators provided the funds are used to comply early or to achieve greater emissions benefits similar to the manner in which Carl Moyer funds can be used (see Executive Summary item # 10).

REFERENCES:

(ARB, 2005) California Air Resources Board. *Rulemaking on the Proposed Amendments to the California Off-Road Emissions Regulation for Compression-Ignition Engines and Equipment (December 9, 2004)*; September 29, 2005.

(ARB, 2004) California Air Resources Board. *Amendments to the California Diesel Fuel Regulations*; May 2004.

(EPA, 1990) United States Environmental Protection Agency. *Federal Clean Air Act, Title II, Part A, Sec. 209(e)*; 1990.

(POLB, 2004) Port of Long Beach. *2002 Baseline Emissions Inventory*; March 2004.

(POLA, 2004) Port of Los Angeles. *Baseline Air Emissions Inventory – 2001*; July 2004.

III. EMISSIONS, POTENTIAL EXPOSURES, AND RISK

This chapter presents the most recent emissions inventory for diesel-fueled cargo handling equipment engines operating at ports and intermodal rail yards in California as well as a discussion on the potential cancer and non-cancer health risks that may occur due to exposures to emissions from cargo handling equipment.

A. Estimated Emissions from Cargo Handling Equipment

To develop an emissions estimate of the emissions from diesel-fueled cargo handling equipment engines operating at ports and intermodal rail yards, the ARB staff developed a methodology that integrated information from the following sources:

- an ARB survey conducted in 2004 of cargo handling equipment owner/operators at California's ports and intermodal rail yards;
- emission inventories developed for the ports of Los Angeles and Long Beach for 2001 and 2002, respectively; and
- the ARB's OFFROAD model.

Baseline emission estimates of diesel PM and NOx for the year 2004 were developed and emission projections to 2010 and 2020 were also developed using estimates of expected growth, equipment turnover, and equipment age distribution. Details of the methodology are found in Appendix B. Based on the information available to date, we believe the methodology has resulted in a reasonable estimate of the emissions from cargo handling equipment. However, there are continuing efforts by the ARB and the major California ports to update and improve the cargo handling equipment inventories. As new information becomes available from these efforts, the cargo handling equipment emission inventory will be updated.

Current 2004 Emission Estimates for Diesel-fueled Cargo Handling Equipment

The ARB staff estimate that diesel-fueled cargo handling equipment engines operating at ports and intermodal rail yards result in approximately 0.65 tons per day or 237 tons per year of diesel PM emissions statewide. In addition, based on a range of statewide NOx to PM conversion factors of 0.3 – 0.5 g NH_4NO_3/g NOx, ARB staff estimate a secondary formation of PM_{10} nitrate from NOx emissions from diesel-fueled cargo handling equipment engines ranges from approximately 5.7 to 9.5 tons per day.[3] Estimates of statewide 2004 diesel PM and NOx from cargo handling equipment are presented in Table III-1.

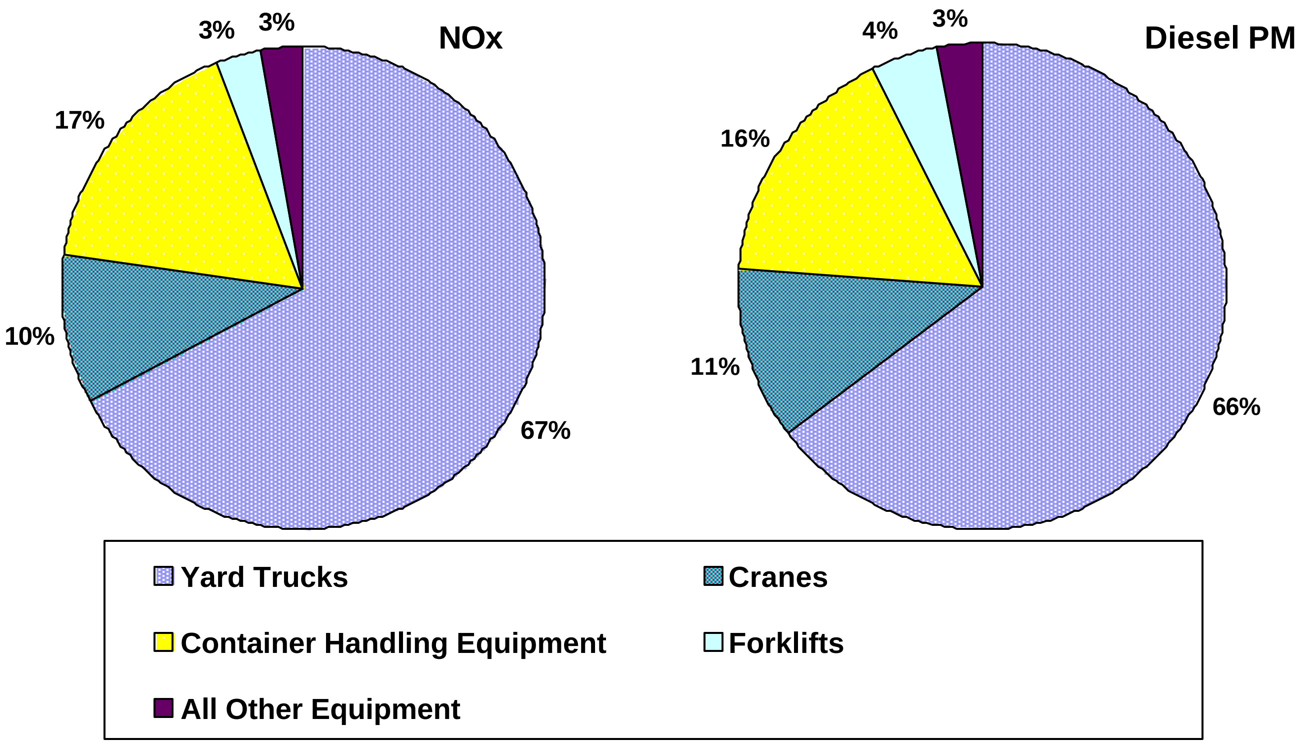
[3] The conversion factor for the transformation of NOx to NH_4NO_3 was based on an analysis of annual-average conversion factors for secondary formation of PM_{10} nitrate from NOx emissions at a number of urban sites in California. A more detailed description of the methodology used to evaluate the conversion of NOx to NH_4NO_3 is found in Appendix I.

Table III-1: Estimated Statewide 2004 Cargo Handling Equipment Emissions

Equipment Types	Numbers of Equipment	2004 Pollutant Emissions (tons per day)	
		NOx	PM
Cranes	321	1.93	0.07
Excavators	28	0.24	0.01
Forklifts	464	0.54	0.03
Container Handling Equipment	487	3.25	0.11
Other Equipment	40	0.08	0.00
Sweepers/Scrubbers	28	0.04	0.00
Tractors/Loaders/Backhoes	93	0.18	0.01
Yard Trucks	2277	12.78	0.42
Totals	**3738**	**19.04**	**0.65**

As shown in Table III-1, there are over 3,700 pieces of cargo handling equipment operating at ports and intermodal rail yards in California. Of these, the majority, or 61 percent, are yard trucks. As shown in Figure III-1, yard trucks represent approximately 66 percent of the diesel PM emissions and 67 percent of the NOx emissions for cargo handling equipment.

Figure III-1: 2004 NOx and Diesel PM Emission Distributions at California Ports and Intermodal Rail Yards



The ARB staff also estimated district-specific emissions associated with cargo handling equipment. The allocation of these estimates is based on the location of the port or intermodal rail yard. Table III-2 presents a district-by-district estimate of emissions from cargo handling equipment.

Table III- 2: Estimated 2004 Cargo Handling Equipment Emissions by District (tpd)[4]

District	NOx	Diesel PM
Bay Area	3.34	0.11
Mojave	0.08	<0.01
North Coast	0.06	<0.01
San Diego	0.75	0.03
San Joaquin	0.55	0.01
South Coast	13.38	0.45
Ventura	0.66	0.02
Yolo-Solano	0.08	<0.01

Note: The following districts did not have emissions allocated to them; Amador, Antelope Valley, Butte, Calaveras, Colusa, El Dorado, Feather River, Glenn, Great Basin Unified, Imperial, Kern, Lake, Lassen, Mariposa, Mendocino, Modoc, Monterey Bay, Unified, Northern Sierra, Northern Sonoma, Placer, Sacramento, San Luis Obispo, Santa Barbara, Shasta, Siskiyou, Tehama, and Tuolumne. The numbers may not match the statewide totals in Table III-1 due to rounding.

<u>Projected 2010 and 2020 Emission Estimates for Cargo Handling Equipment</u>

The projected emission estimates for the years 2010 and 2020 are presented in Table III-3. Based on information provided in the ARB Survey, annual growth rates for cargo handling equipment were determined. Additional details on the methodology and the growth rates for each equipment type are provided in Appendix B.

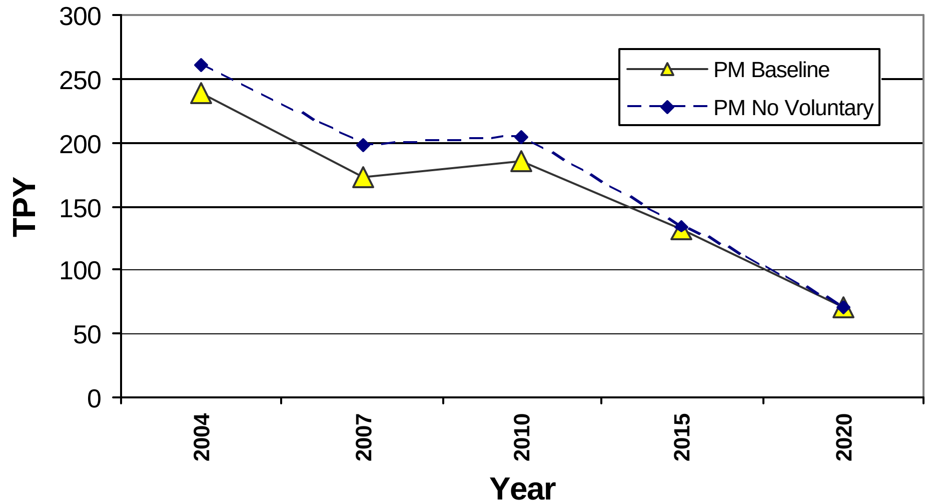
[4] The total emissions may vary slightly from the values shown in Table III-1 due to rounding.

Table III-3: Cargo Handling Equipment Engines Projected Year 2010 and 2020 Emission Estimates

Equipment Types	2010 Emission, Tons per Day			2020 Emission, Tons per Day		
	Numbers of Equipment	NOx	Diesel PM	Numbers of Equipment	NOx	Diesel PM
Cranes	470	1.83	0.06	602	1.33	0.03
Excavators	29	0.18	0.01	32	0.05	<0.01
Forklifts	530	0.39	0.02	607	0.17	0.01
Container Handling Equipment	738	3.43	0.12	1111	1.70	0.05
Other General Industrial Equipment	60	0.08	<0.01	93	0.04	<0.01
Sweepers/ Scrubbers	43	0.04	<0.01	64	0.02	<0.01
Tractors/ Loaders/ Backhoes	132	0.17	0.01	200	0.08	<0.01
Yard Trucks	2810	10.20	0.31	3790	3.02	0.09
Total	4811	16.34	0.53	6500	6.41	0.18

These estimates include benefits from new engine standards and benefits from pre-2005 voluntary efforts undertaken at California's ports and intermodal rail yards to reduce emissions from cargo handling equipment, but do not include the projected reductions expected from implementation of the proposed regulation. As can be seen from Table III-3 and Figure III-2, emissions are expected to decline significantly over the next 15 years, despite an increase in the number of equipment and operating hours at the ports and intermodal rail yards. The reductions of diesel PM can be attributed to fleet turnover to newer, cleaner engines and the voluntary emission reduction programs implemented prior to 2005 are demonstrated in Figure III-2.

Figure III-2: Baseline vs. Voluntary Programs Diesel PM Cargo Handling Equipment Emissions (tons per year)



Based on the emission projections, the ARB staff estimates that the voluntary efforts undertaken by ports and intermodal rail yards to implement emission control strategies, such as diesel oxidation catalysts, result in a reduction of approximately 13 percent in diesel PM emissions between 2004 and 2020.

Because the majority of the voluntary efforts involved the installation of diesel oxidation catalysts, the ARB staff estimates there are minimal reductions in NOx attributable to the voluntary installation of exhaust aftertreatment control devices on cargo handling equipment. While a small percentage of cargo handling equipment engines are using emulsified fuels, which result in some NOx reductions (up to 20 percent), the ARB staff is unable to quantify the benefits at this time.

Expected emission reductions and the impact on the cargo handling equipment emission estimates are discussed in Chapter VI, Environmental Impacts.

B. Potential Exposures and Risk from Diesel PM Emissions from Cargo Handling Equipment Engines

This section examines the exposures and potential cancer health risks associated with particulate matter (PM) emissions from diesel-fueled cargo handling equipment at ports and intermodal rail yards. A brief qualitative discussion is provided on the potential exposures of Californians to the diesel PM emissions from cargo handling equipment. In addition, a summary is presented of a health risk assessment conducted to determine the 70-year potential cancer risk associated with exposures to diesel PM emissions from cargo handling equipment operated at the Ports of Los Angeles and Long Beach. ARB staff believes that the results from this analysis provide quantitative results for exposures around the Ports of Los Angeles and Long Beach and are generally applicable to other ports and intermodal rail yards in California, providing a qualitative estimate for those areas.

Exposures to Diesel PM

As discussed previously, cargo handling equipment is used at ports and intermodal rail yards throughout California. The diesel PM emissions from cargo handling equipment contribute to ambient levels of diesel PM emissions. Based on the most recent emissions inventory, there are about 3,700 pieces of diesel-fueled cargo handling equipment operating at ports and intermodal rail yards in California. The majority of ports and intermodal rail yards are in urban areas and, in most cases, are located near where people live, work, and go to school. This results in substantial exposures to diesel PM emissions from the operation of diesel-fueled cargo handling equipment.

Because analytical tools to distinguish between ambient diesel PM emissions from cargo handling equipment and that from other sources of diesel PM do not exist, we cannot measure the actual exposures to emissions from diesel-fueled cargo handling equipment. However, modeling tools can be used to estimate potential exposures. To investigate the potential risks from exposures to the emissions from cargo handling equipment, ARB staff used dispersion modeling to estimate the ambient concentration of diesel PM emissions that result from the operation of cargo handling equipment at the Ports of Los Angeles and Long Beach. The potential cancer risks from exposures to these estimated ambient concentrations of diesel PM were then determined. The results from this study are presented below, and additional details on the methodology used to estimate the health risks are presented in Appendix C.

Health Risk Assessment

Risk assessment is a complex process that requires the analysis of many variables to simulate real-world situations. There are three key types of variables that can impact the results of a health risk assessment for cargo handling equipment: the magnitude of diesel PM emissions, local meteorological conditions, and the length of time of exposure. Diesel PM emissions are a function of the age and horsepower of the engine, the emissions rate of the engine, and the annual hours of operation. Older engines tend to have higher pollutant emission rates than newer engines, and the longer an engine operates, the greater the total pollutant emissions. Meteorological conditions can have a large impact on the resultant ambient concentration of diesel PM, with higher concentrations found along the predominant wind direction and under calm wind conditions. How close a person is to the emissions plume and how long he or she breathes the emissions (exposure duration) are key factors in determining potential risk, with longer exposures times typically resulting in higher risk.

To estimate potential cancer risks from cargo handling equipment, ARB staff conducted a risk assessment for cargo handling equipment operated at the Ports of Los Angeles and Long Beach. We evaluated the impacts from the 2002 estimated emissions for cargo handling equipment operated at the two ports. Meteorological data from

Wilmington was used for this study. The Wilmington site is about one mile away from the ports, and the measurements were collected in 2001. The U.S. EPA's ISCST3 air dispersion model was used to estimate the annual average offsite concentration of diesel PM in the area surrounding the two ports. The modeling domain (study area) spans a 20 x 20 mile area, which includes both the ports, the ocean surrounding the ports, and nearby residential areas in which about 2 million people live. The land-based portion of the modeling domain, excluding the property of the ports, comprises about 65 percent of the modeling domain. A Cartesian grid receptor network (160 x 160 grids) with 200 x 200 meter resolution was used in this study. While grids within the ports were included in the network, the risks within these grids were excluded from the final risk analyses. The elevation of each receptor within the modeling domain was determined from the United States Geological Service topographic data.

The potential cancer risks were estimated using standard risk assessment procedures based on the annual average concentration of diesel PM predicted by the model and a health risk factor (referred to as a cancer potency factor) that correlates cancer risk to the amount of diesel PM inhaled. The methodology used to estimate the potential cancer risks is consistent with the Tier-1 analysis presented in the Office of Environmental Health Hazard Assessment (OEHHA) Air Toxics Hot Spots Program Risk Assessment Guidelines. (OEHHA, 2002) (OEHHA, 2003) Following the OEHHA guidelines, we assumed that the most impacted individual would be exposed to modeled diesel PM concentrations for 70 years. This exposure duration represents an "upper-bound" of the possible exposure duration. The potential cancer risk was estimated by multiplying the inhalation dose by the cancer potency factor (CPF) of diesel PM (1.1 $(mg/kg\text{-}d)^{-1}$).

Cancer Risk Characterization

Emissions from cargo handling equipment resulted in significant risk impacts on the nearby residential areas. Figure III-3 shows the risk isopleths for diesel PM emissions from cargo handling equipment at the Ports of Los Angeles and Long Beach superimposed on a map that covers the ports and the nearby communities. As shown in Figure III-3, the area in which the risks are predicted to exceed 100 in a million has been estimated to be about 4,100 acres with a population of 82,000. For the highest risk level of over 500 in a million, the impacted areas have been estimated to be about 50 acres and about 3,200 people living around the ports who are exposed to the risk level. Overall, about 73 percent of the effective modeling domain (excluding the port property and the surrounding ocean area) has an estimated risk level of over 10 in a million.

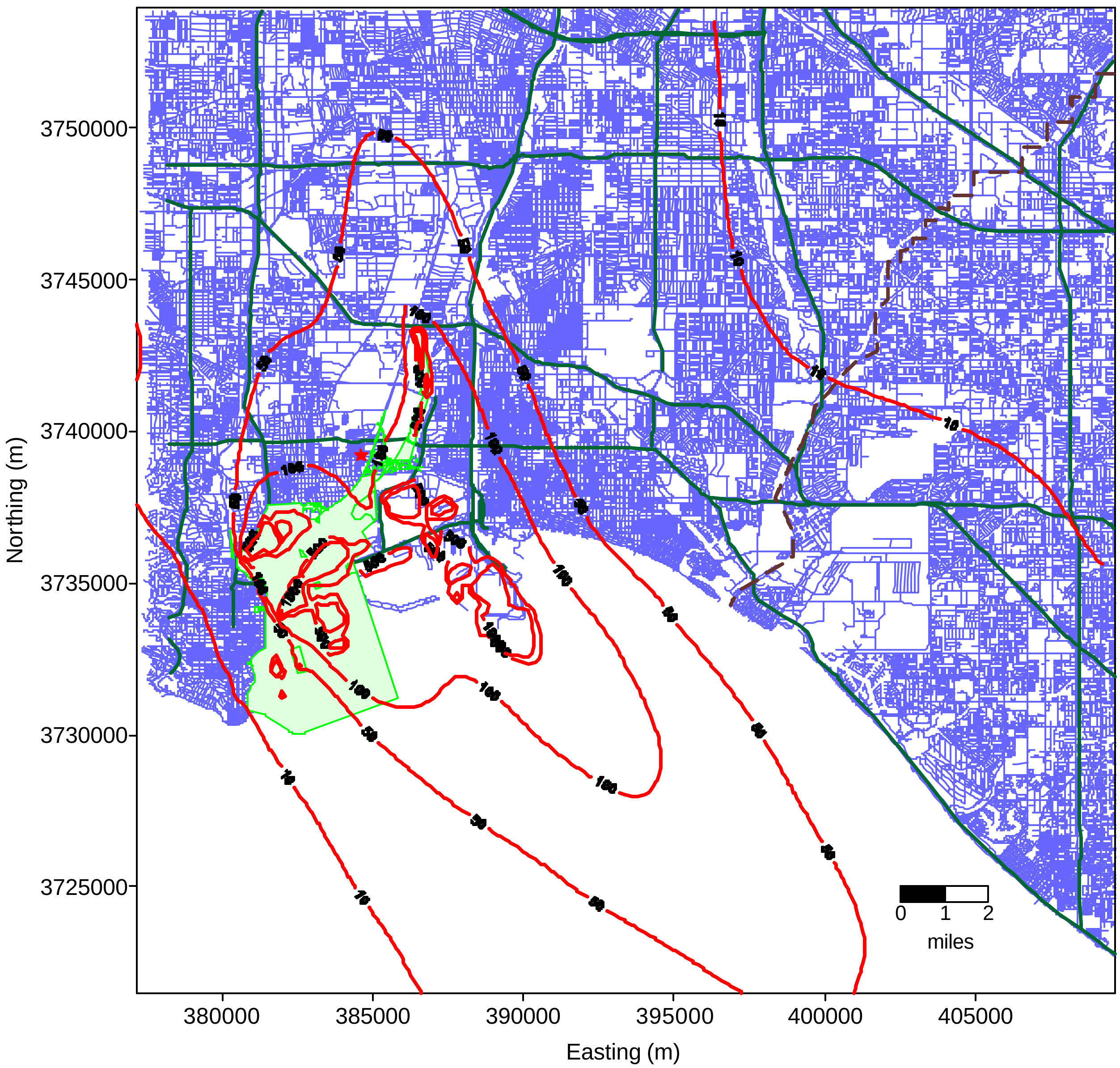
Using the U.S. Census Bureau's year 2000 census data, we estimated the population within the isopleth boundaries. The area impacted and the population affected for the risk ranges of 10-100, 100-200, 200-500, and over 500 are shown in Table III-4. As shown in the table, nearly three quarters of 2 million people live in the area around the ports that has predicted risks of greater than 10 in a million due to emissions from cargo handling equipment. Note that the size of the modeling domain was limited by the technical capabilities of the model. However, it is clear that a significant number of people outside the modeling domain are exposed to risks greater than 10 in a million.

Table III-4: Summary of Area Impacted and Population Affected by Risk Levels from Cargo Handling Equipment

Risk Level	Acres Impacted	Population Affected
Risk > 500	50	3,200
Risk > 200	410	11,100
Risk > 100	4,100	82,000
Risk > 10	119,000	1,444,000

Note: The effective modeling domain is about 255 square miles or 163,435 acres, and the total population within the domain is about 2 million. The area with predicted risks greater than 10 in a million extends beyond the modeling domain. As such, the actual acres impacted and population exposed to levels greater than 10 in a million are larger than those presented in Table III-4.

Figure III-3: Estimated Diesel PM Cancer Risk from Cargo Handling Equipment Activity at the POLA and POLB (**Wilmington Met Data, Urban Dispersion Coefficients, 80th Percentile Breathing Rate, Emission = 172 TPY, Modeling Domain = 20 mi x 20 mi, Resolution = 200 m x 200 m)**



C. Non-Cancer PM Health Effects

A substantial number of epidemiologic studies have found a strong association between exposure to ambient particulate matter and adverse health effects. (CARB, 2002) As part of this study, ARB staff conducted an analysis of the potential non-cancer health impacts associated with exposures to the model-predicted ambient levels of directly emitted diesel PM (primary diesel PM) discussed above and extrapolated them to the rest of the state. The non-cancer health effects evaluated include premature death, asthma attacks, work loss days, and minor restricted activity days.

Based on our analysis, we estimate that the average number of cases statewide in 2004 that would be expected due to emissions from cargo handling equipment are as follows:

- 9 premature deaths (for ages 30 and older), 4 to 13 deaths as 95% confidence interval (CI);
- 219 asthma attacks, 53 to 383 as 95% CI;
- 1,907 days of work loss (for ages 18-65), 1,614 to 2,200 as 95% CI; and
- 10,127 minor restricted activity days (for ages 18-65), 8,254 to 12,000 as 95% CI.

As stated previously, to estimate these statewide potential non-cancer health impacts from cargo handling equipment emissions, ARB staff estimated the non-cancer health impacts from cargo handling equipment in the area surrounding the ports of Los Angles and Long Beach and extrapolated these results to predict statewide values based on the ratio of the mass emissions at the POLB and POLA to those in the rest of the State. A brief discussion on the methodology used to generate these estimates is provided below. Additional information on the data inputs for the non-cancer health impacts analysis are provided in Appendix J.

<u>Non-Cancer Health Effects Methodology</u>

ARB staff assessed the potential non-cancer health impacts associated with exposures to the model-predicted ambient levels of directly emitted diesel PM (primary diesel PM) within each 200 meter by 200 meter grid cell within the modeling domain used for the POLA-POLB exposure assessment study. Because the study used the 2002 emissions estimates for cargo handling equipment at the ports, the ambient concentrations were adjusted to reflect the updated 2004 emissions inventory developed by ARB staff. The populations within each grid cell were determined from U.S. Census Bureau year 2000 census data. Using the methodology peer-reviewed and published in the Staff Report: Public Hearing to Consider Amendments to the Ambient Air Quality Standards for Particulate Matter and Sulfates, (PM Staff Report) (CARB, 2002), we calculated the number of annual cases of death and other health effects associated with exposure to the ambient PM concentrations modeled for each of the grid cells. For each grid cell, each health effect was estimated based on concentration-response functions derived from published epidemiological studies relating changes in ambient concentrations to changes in health endpoints, the population affected, and the baseline incidence rates. The total affected population was obtained by summing the results from each grid cell.

The selection of the concentration-response functions was based on the latest epidemiologic literature, as described in the PM Staff Report (CARB, 2002) and in Lloyd and Cackette (Lloyd, Cackette 2001). Staff estimated that the ports of Los Angeles and Long Beach account for approximately 70 percent of total statewide emissions related to cargo handling equipment activities. Hence, the statewide impact of the cargo handling emissions was estimated by dividing the estimated impacts in the modeling domain around the ports of Los Angeles and Long Beach by 0.70.

Several assumptions were used in quantifying the health effects of PM exposure. They include the selection and applicability of the concentration-response functions, exposure estimation, subpopulation estimation, baseline incidence rates, and the extrapolation from results in the modeling domain to the statewide results. These are briefly described below.

- Premature death calculations were based on the concentration-response function of Krewski et al. (Krewski et at, 2000) The ARB staff assumed that concentration-response function for premature mortality in the model domain is comparable to that in the Krewski study. It is known that the composition of PM can vary by region, and not all constituents of PM have the same health effects. However, numerous studies have shown that the mortality effects of PM in California are comparable to those found in other locations in the United States, justifying our use of Krewski et al's results. Also, the U.S. EPA has been using Krewski's study for its regulatory impact analyses since 2000. For other health endpoints, the selection of the concentration-response functions was based on the most recent and relevant scientific literature. Details are ARB's PM Staff Report (CARB, 2002).

- The ARB staff assumed the model-predicted exposure estimates could be applied to the entire population within each modeling grid. That is, the entire population within each modeling grid of 200 meter x 200 meter was assumed to be exposed uniformly to modeled concentration. This assumption is typical of this type of estimation.

- The ARB staff assumed the grid cell population had similar age distributions as the county in which it was located. The subpopulation used for each health endpoint was calculated by multiplying the all-age population for each grid cell by the county-specific ratio of the subpopulation used for the endpoint over the all-age population. For example, mortality estimates were based on subpopulations age 30 or more estimated from ratios of people over 30 over the entire population, specific for each county. For Los Angeles County, this value was 54 percent. These estimates were needed because information on the particular subpopulation in each modeling grid was not available.

- The ARB staff assumed the baseline incidence rates were uniform across each modeling grid, and, in many cases, across each county. This assumption is consistent with methods used by the U.S. EPA for its regulatory impact assessment. The incidence rates match those used by U.S. EPA.

- Because only impacts from directly emitted diesel PM are estimated and a subset of health outcomes is considered here, the estimates should be considered an underestimate of the total public health impact. In addition, the model domain for the study was 20 miles by 20 miles and did not capture all of impacts on the surrounding communities from the POLA and POLB emissions.

- Without readily available modeled concentrations at other ports in California, staff extrapolated the results based on the modeling domain around ports of Los Angeles and Long Beach to infer statewide effects. In doing so, it was assumed that the population density and the change in concentrations due to the regulation would be similar to those in the ports of Los Angeles and Long Beach.

REFERENCES:

(OEHHA, 2002) Office of Environmental Health Hazard Assessment. *The Air Toxics Hot Spot Program Risk Assessment Guidelines: Part II-Technical Support Document for Describing Available Cancer Potency Factors*; 2002.

(OEHHA, 2003) Office of Environmental Health Hazard Assessment. *Air Toxics Hot Spots Program Risk Assessment Guidelines: The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments*; 2003.

(CARB, 2002) California Air Resources Board and Office of Environmental Health Hazard Assessment. *Staff Report: Public Hearing to Consider Amendments to the Ambient Air Quality Standards for Particulate Matter and Sulfates*, available at http://www.arb.ca.gov/research/aaqs/std-rs/pm-final/pm-final.htm; 2002.

(Krewski et al. 2000) Krewski D.; Burnett R.; Goldberg M.; Hoover K.; Stemiatychi J.; Jerrett M.; Abrahamovicz M.; White W. Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality, Health Effects Institute, Cambridge, Massachusetts; 2000. http://es.epa.gov/ncer/science/pm/hei/Rean-ExecSumm.pdf

(Lloyd and Cackette. 2001) Lloyd, A.C.; Cackette, T.A.; Diesel Engines: Environmental Impact and Control; J Air Waste Manage. Assoc. 2001, 51: 809-847.
http://www.arb.ca.gov/research/seminars/lloyd/AWMA2001/JAWMADieselCriticalReview.pdf

IV. THE PROPOSED REGULATION AND ALTERNATIVES

In this chapter, we discuss the key requirements of the proposed regulation for mobile cargo handling equipment at ports and intermodal rail yards. This chapter begins with a general summary of the regulation, and each major requirement of the regulation is discussed and explained. This chapter is intended to satisfy the requirements of Government Code section 11343.2, which requires that a noncontrolling "plain English" summary of the regulation be made available to the public. Unless otherwise noted herein, all references to mobile cargo handling equipment include mobile cargo handling equipment at ports and intermodal rail yards, as defined in the regulation.

A. Summary of the Proposed Regulation

The proposed regulation for Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yards is included in Appendix A. The regulation is designed to use the best available control technology (BACT) to reduce the general public's exposure to diesel particulate matter (PM) and oxides of nitrogen (NOx) emissions from mobile cargo handling equipment. In addition, the regulation would include recordkeeping and reporting requirements to provide staff up-to-date information on cargo handling equipment and activities.

The requirements for newly purchased, leased, or rented equipment, as well as in-use equipment would affect owners and operators of mobile cargo handling equipment that operate at ports and intermodal rail yards in California. The requirements would also affect any person who sells, offers for sale, purchases, leases, or rents mobile cargo handling equipment for use at a port or intermodal rail yard in California. This would include shipping terminals at ports and intermodal rail yard terminals. Mobile cargo handling equipment that does not operate at a port or intermodal rail yard, portable compression-ignition engines, and cargo handling equipment used to transport personnel and deliver fuel would not be covered by the rule.

The proposed regulation would require, as of January 1, 2007, newly purchased, leased, or rented (new) equipment to meet performance standards, which vary depending on the classification of the new equipment (either off-road cargo handling equipment or a registered on-road cargo handling equipment vehicle), and the availability of certified on-road engines for the equipment type and application. For registered on-road vehicles, the new equipment must meet the certified on-road engine standards for the model year in which the engine is newly purchased, leased, or rented. New yard trucks that are not registered motor vehicles must meet either the current model year certified on-road engine standards or the certified off-road final Tier 4 standards for the rated horsepower. New non-yard truck equipment that are not registered motor vehicles must meet either the current model year certified on-road engine standards or the certified off-road Tier 4 standards for the rated horsepower and model year in which the equipment and engines were newly purchased, leased, or rented. However, if that is not available for the specific non-yard truck equipment type and application, the highest level certified off-road engine for the model year of the year purchased, leased, or rented and installation of the highest available level verified diesel emission control strategy (VDECS) within one year is required. If no VDECS is available during the initial year of operation, installation would be required within six months after VDECS becomes available.

The proposed regulation would require in-use yard trucks to meet performance standards based on BACT by choosing one of three options. One option is to meet the 2007 or later model year certified on-road engine standards, another option is to meet the certified final Tier 4 off-road standards, and the last option is to apply VDECS that would result in emissions less than or equal to the diesel particulate matter (PM) and oxides of nitrogen (NOx) emission standards of a certified final Tier 4 off-road engine. Compliance dates are soonest for pre-2003 model year yard trucks, and owners of more than three yard trucks are given additional time to comply. The proposal also provides more time for owners or operators who have installed VDECS prior to December 31, 2006, and for those currently using certified on-road engines, by delaying the compliance date one year.

The proposed regulation would require in-use non-yard truck equipment to use BACT to meet a selection of performance standards based on the category of equipment. Three categories exist:

- Basic Container Handling (including, but not limited to top handlers, side handlers, and forklifts[5]);
- Bulk Cargo Handling (including, but not limited to dozers, loaders, excavators, aerial lifts, and sweepers); and
- Rubber-Tired Gantry (RTG) Cranes.

Each category has three compliance options, based on BACT. One option is to use an engine or power system, including a diesel, alternative fuel, or heavy-duty pilot ignition engine, certified to the 2007 or current model year on-road engine standards or Tier 4 off-road engine standards. Another option is to use a pre-2007 model year certified on-road engine or a certified Tier 2 or Tier 3 off-road engine and apply the highest level VDECS available. The last option is to use a pre-Tier 1 off-road engine or a certified Tier 1 off-road engine and install the highest level VDECS available. If either of the two options requiring VDECS is chosen, an additional compliance step may be necessary, depending on the category of equipment and the level of VDECS used. For Basic Container Handling and Bulk Cargo Handling Equipment, the additional compliance requirement is to replace the engine with a Tier 4 off-road engine or install a Level 3 VDECS by December 31, 2015. For RTG cranes, the additional compliance requirement is the same, but the compliance date is either December 31, 2015, or model year plus 12 years, whichever is later. More detail is provided in the discussion of the requirements.

[5] While forklifts are used to handle both containerized and bulk cargo, for the purposes of this regulation, they are considered to be part of the Basic Container Handling equipment category.

The proposal includes provisions that allow qualified owners or operators to delay compliance with the in-use performance standards if an engine is within one year of retirement, if no VDECS are available, if an experimental diesel PM emission control strategy is used, if there are equipment manufacturer delivery delays, or for yard trucks that received incentive funding from public agencies to apply VDECS by the end of 2005 with minimum use requirements. The maximum delay depends on the compliance extension granted.

The proposal also includes an alternative compliance plan (ACP) option for owners and operators of non-yard truck cargo handling equipment that would allow them to demonstrate that equivalent emission reductions can be achieved through the use of alternative strategies.

Recordkeeping and reporting requirements are also defined in the proposed regulation. Owners and operators would be required to maintain records for all mobile cargo handling equipment, affix a label to each vehicle (or use an alternative method approved by the Executive Officer) with the compliance strategy used or planned compliance date, submit a compliance plan and annual statement of compliance for their mobile cargo handling equipment, and perform annual reporting by submitting to the ARB their contact information and location of their equipment. These requirements would allow staff to monitor the implementation of the regulation and provide more accurate estimates of pollutant reductions.

B. Discussion of the Proposed Regulation

Purpose

As specified in subsection (a) of the proposed regulation, the purpose of the regulation is to reduce diesel PM and criteria pollutant emissions from CI mobile cargo handling equipment that operate at ports and intermodal rail yards in California.

Applicability

As specified in subsection (b) of the proposed regulation, the regulation would apply to anyone who sells, offers for sale, leases, rents, purchases, owns, or operates any CI mobile cargo handling equipment that operates at a port or intermodal rail yard in California. This would include shipping terminal owners or operators and rail terminal owners or operators who either operate their own equipment or contract stevedoring or cargo handling services with a company that supplies its own cargo handling equipment. In addition, the regulation would apply to contracted companies that supply their equipment to terminal owners or operators.

Exemptions

Clarifications on applicability are included here in the discussion regarding exemptions. The regulation would not apply to mobile cargo handling equipment that is not operated at a port or intermodal rail yard in California. A port is defined in the regulation as a facility used for water-borne commerce. While there are many publicly owned or operated ports in California, there are also several that are owned and operated by private parties. A port can simply mean a terminal that has a dock or other means of accepting water-borne cargo or loading cargo onto a vessel that will travel via waterway. An intermodal rail yard is defined as a facility where cargo is transferred to or from a train and any other form of conveyance, such as train to ship, ship to train, train to truck, or truck to train. ARB staff are in the process of developing a general off-road engine regulation proposal that will apply to cargo handling equipment that operate at facilities other than ports and intermodal rail yards, such as distribution centers and warehouses.

Cargo handling equipment or vehicles that do no handle cargo at any time but are operated at a port or intermodal rail yard for purposes of transporting personnel or delivering fuel are exempt from meeting the performance requirements of the regulation. However, owners or operators of this equipment are still required to report the equipment to the Air Resources Board. Examples of equipment to which this exemption might apply may include fuel delivery trucks operating solely on the terminal to deliver fuel to terminal equipment and vans and buses used to transport personnel.

The requirements of the regulation also do not apply to portable CI engines. Portable engines are defined as engines that are designed and capable of being carried or moved from one location to another. Mobile cranes and sweepers may have auxiliary engines that would be considered portable CI engines.

Definitions

The proposed regulation provides definitions of all terms that are not self-explanatory. There are 56 definitions to help clarify and enforce the regulation requirements. Most of the definitions listed in subsection (d) of the proposed regulation were developed by staff, with input from the public during workshops and workgroup meetings. Staff working on this regulation also coordinated with staff working on other diesel PM regulations to provide consistency where it was practical. Please refer to Appendix A, subsection (d) for a list of definitions.

Requirements

As specified in subsection (e), the proposed regulation would require newly purchased, leased, or rented mobile cargo handling equipment to meet performance standards. In-use equipment would also be required to meet performance standards, which vary by equipment type. The requirements are briefly discussed below.

1. Newly Purchased, Leased, or Rented Equipment

As of January 1, 2007, newly purchased, leased, or rented (new) equipment that has been registered as an on-road vehicle with the Department of Motor Vehicles (DMV) would be required to meet the certified on-road emission standards, which are specified in title 13, California Code of Regulations (CCR), section 1956.8, for the year purchased, leased, or rented. New yard trucks that are not registered motor vehicles must meet either the 2007 or current model year certified on-road engine standards or the certified off-road final Tier 4 standards for the rated horsepower. New non-yard truck equipment that are not registered motor vehicles must meet either the 2007 or current model year certified on-road engine standards or the certified off-road Tier 4 standards for the rated horsepower and model year of the year purchased, leased, or rented. However, if that is not available for the specific non-yard truck equipment type and application, the highest level certified off-road engine for the rated horsepower and model year of the year purchased, leased, or rented, and installation of the highest available level VDECS within one year is required. If no VDECS is available during the initial year of operation, installation would be required within six months after VDECS becomes available.

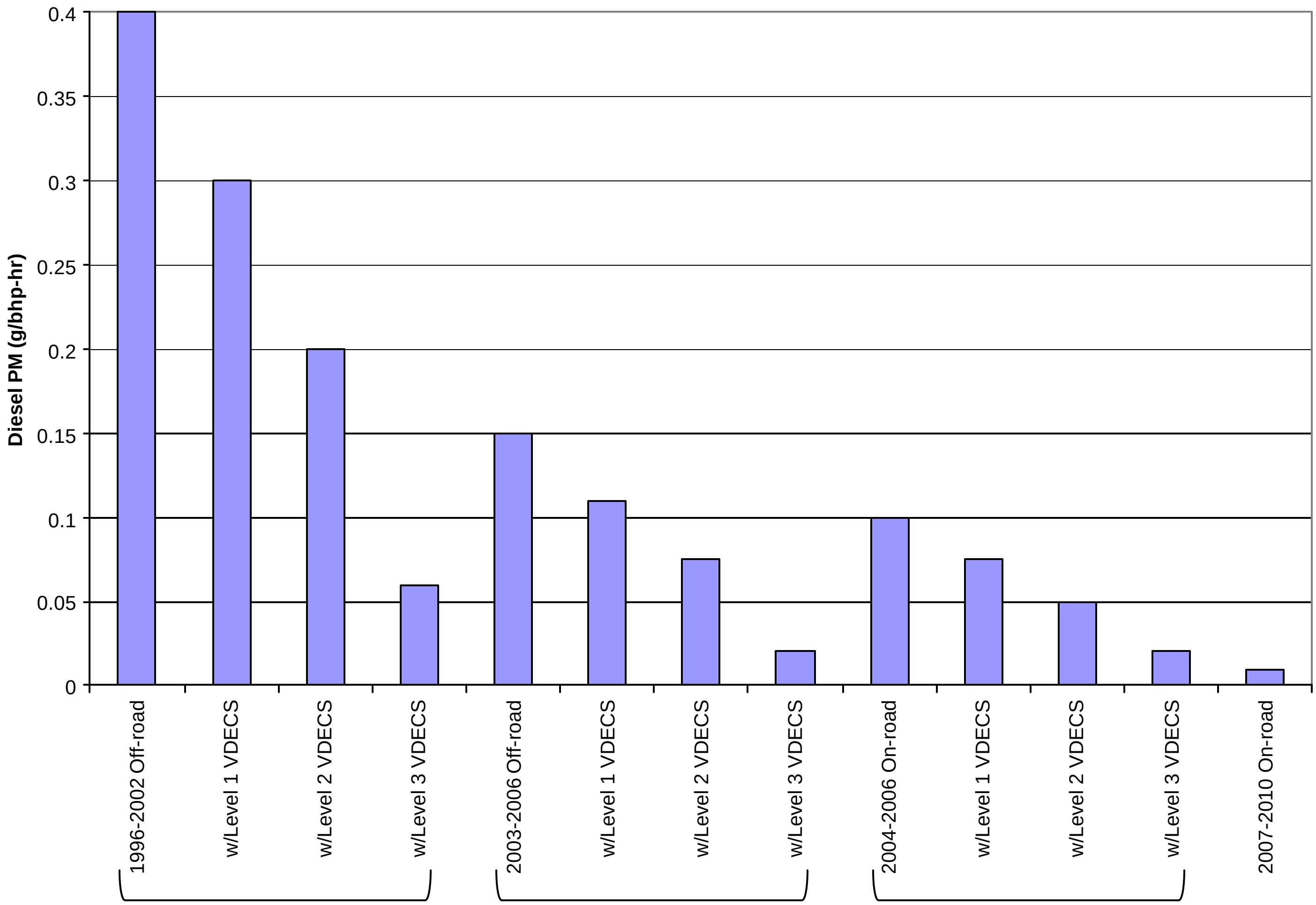
2. In-Use Yard Trucks

The proposed regulation would require owners or operators of in-use yard trucks to meet one of three performance standards, which are considered to be BACT for this type of mobile cargo handling equipment: 1) use an engine certified to the 2007 or later on-road emission standards for the model year purchased; 2) use an engine certified to the final Tier 4 off-road emission standards for the rated horsepower; or 3) install VDECS that would result in diesel PM and NOx emissions that are equivalent to or lower than the certified final Tier 4 off-road emission standards for an engine with same horsepower rating.

The performance standards are based on the 2007 certified on-road engines, with which the Tier 4 certified off-road engines eventually harmonize by 2015. Staff considered engine model year and diesel PM and NOx emission rates, with and without VDECS, when determining the performance standards and compliance dates for in-use yard trucks[6]. Figure IV-1 shows the diesel PM emission rate differences between the model years and configurations.

[6] Pre-2003 model year off-road yard trucks are considered to be either uncontrolled or Tier 1 engines, which means their diesel PM emission rates are 0.40 g/bhp-hr or greater. With a Level 1 VDECS (25 percent PM reduction) or Level 2 VDECS (50 percent PM reduction), their emission rates are at least 0.30 g/bhp-hr and 0.20 g/bhp-hr, respectively. In comparison, 2003-2006 model year off-road yard trucks (Tier 2 or Tier 3) have a diesel PM emission rate of 0.15 g/bhp-hr. With a Level 1 or Level 2 VDECS, the rates drop to 0.11 g/bhp-hr and 0.075 g/bhp-hr, respectively, which is equivalent to a pre-2007 certified on-road yard truck with a Level 1 VDECS. In comparison, a 2007 model year certified on-road yard truck emits only 0.01 g/bhp-hr PM.

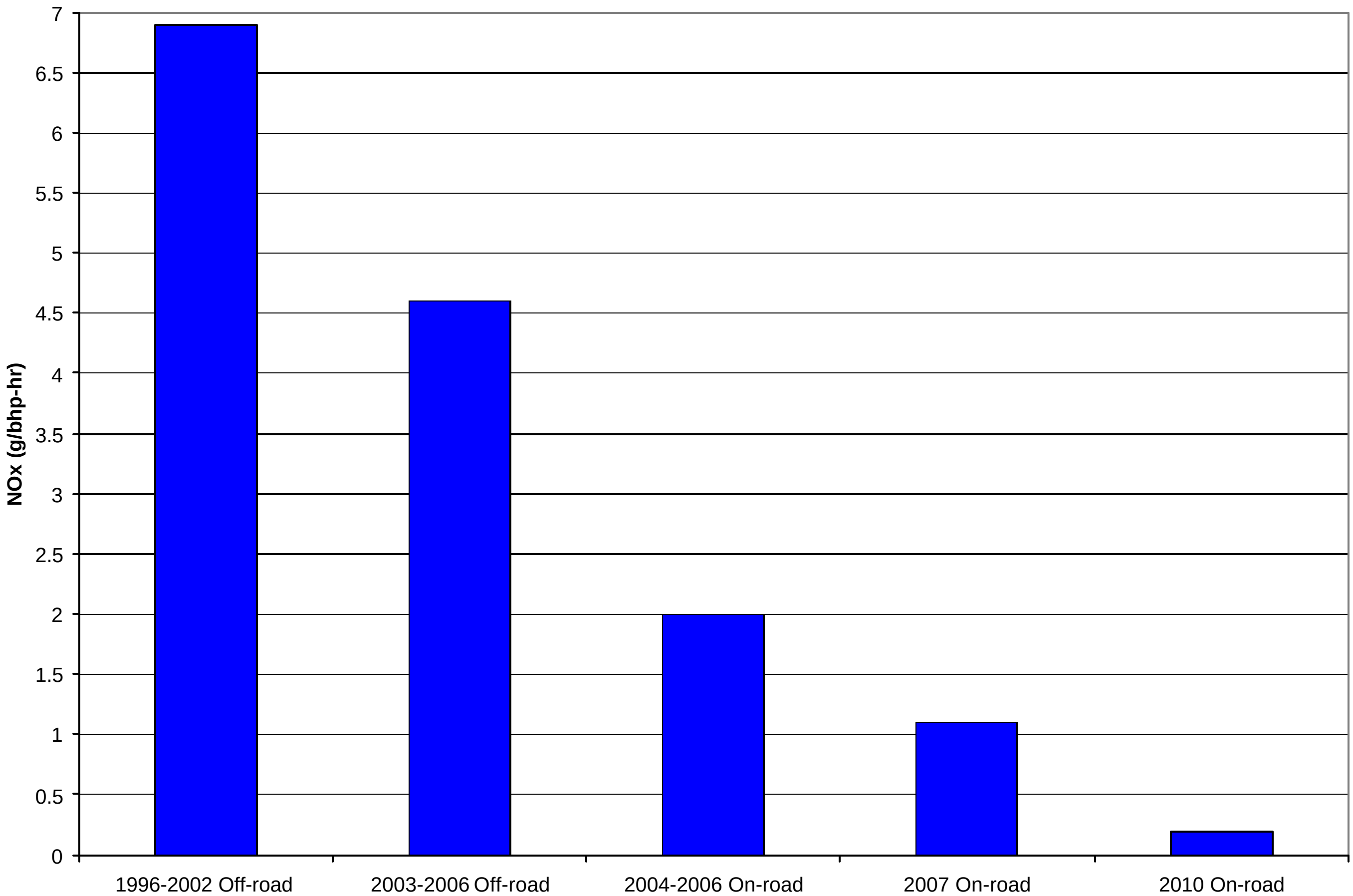
Figure IV-1: Diesel PM Emission Rates for Yard Trucks with Off-Road and On-Road Engines with and without VDECS



Note: The diesel PM emission standard for Tier 4 off-road engines is equivalent to the 2007 and later on-road engines. Tier 4 for yard truck engines begins in 2011.

In addition to large reductions in diesel PM emissions, the 2007 and 2010 on-road engines also have a large NOx benefit. NOx emission rates go from 6.9 g/bhp-hr for 1996 through 2002 model year off-road engines to 0.2 g/bhp-hr for 2010 model year on-road engines. Figure IV-2 shows the emission rates for the off-road and on-road engines for each model year group.

Figure IV-2: NOx Emission Rates for Yard Trucks with Off-Road and On-Road Engines



Notes:

1. The NOx standard for 2003 through 2005 model year off-road yard trucks is 4.6 g/bhp-hr. The NOx standard changes for 175-299 hp off-road engines in 2006 (Tier 3) to 2.7 g/bhp-hr.
2. The NOx standard shown for the 2007 on-road engines is a weighted average, since 50 percent of these engines must meet 0.2 g/bhp-hr NOx in 2007.
3. The NOx standard for early (interim) Tier 4 off-road yard truck engines is between 1.5 and 2.5 g/bhp-hr; the final Tier 4 NOx standard for yard trucks, which begins in 2014, is 0.30 g/bhp-hr.

The compliance dates for in-use yard trucks vary based on the engine certification (off-road or on-road), the model years, whether or not VDECS have been installed, and whether the owners or operators have more than three yard trucks in their fleets. Fleets of four or more yard trucks would have a phased-in compliance schedule, which would allow them to spread out the compliance over a period of one to three years. Yard trucks that have VDECS or certified on-road engines installed as of December 31, 2006, would be given an additional year to comply with the in-use performance standards.

The compliance schedules for in-use yard trucks are listed below in Tables IV-1 and IV-2. Fleets of four or more yard trucks have initial compliance dates that are the same as the compliance dates for fleets of three or less.

Table IV-1: Compliance Schedule for In-Use Yard Truck Fleets of Three or Less

Off-road without VDECS Installed by December 31, 2006

Model Year	Compliance Deadline
Pre-2003	Dec. 31, 2007
2003	Dec. 31, 2010
2004	Dec. 31, 2011
2005	Dec. 31, 2012
2006	Dec. 31, 2013

Off-road with VDECS Installed by December 31, 2006

Model Year	Compliance Deadline
Pre-2003	Dec. 31, 2008
2003	Dec. 31, 2011
2004	Dec. 31, 2012
2005	Dec. 31, 2013
2006	Dec. 31, 2014

On-road without VDECS Installed by December 31, 2006

Model Year	Compliance Deadline
Pre-2000	Dec. 31, 2007
2000	Dec. 31, 2008
2001	Dec. 31, 2009
2002	Dec. 31, 2010
2003	Dec. 31, 2011
2004	Dec. 31, 2012
2005	Dec. 31, 2013
2006	Dec. 31, 2014

On-road with VDECS Installed by December 31, 2006

Model Year	Compliance Deadline
Pre-2000	Dec. 31, 2008
2000	Dec. 31, 2009
2001	Dec. 31, 2010
2002	Dec. 31, 2011
2003	Dec. 31, 2012
2004	Dec. 31, 2013
2005	Dec. 31, 2014
2006	Dec. 31, 2015

Table VI-2: Compliance Schedule for In-Use Yard Truck Fleets of Four or More

Off-road without VDECS Installed by December 31, 2006

Model Year	% of Model Year	Compliance Deadline
Pre-2003	Greater of 3 or 50%	Dec. 31, 2007
	100%	Dec. 31, 2008
2003	Greater of 3 or 25%	Dec. 31, 2010
	50%	Dec. 31, 2011
	100%	Dec. 31, 2012
2004	Greater of 3 or 25%	Dec. 31, 2011
	50%	Dec. 31, 2012
	100%	Dec. 31, 2013
2005	Greater of 3 or 25%	Dec. 31, 2012
	50%	Dec. 31, 2013
	100%	Dec. 31, 2014
2006	Greater of 3 or 25%	Dec. 31, 2013
	50%	Dec. 31, 2014
	100%	Dec. 31, 2015

Off-road with VDECS Installed by December 31, 2006

Model Year	% of Model Year	Compliance Deadline
Pre-2003	Greater of 3 or 50%	Dec. 31, 2008
	100%	Dec. 31, 2009
2003	Greater of 3 or 25%	Dec. 31, 2011
	50%	Dec. 31, 2012
	100%	Dec. 31, 2013
2004	Greater of 3 or 25%	Dec. 31, 2012
	50%	Dec. 31, 2013
	100%	Dec. 31, 2014
2005	Greater of 3 or 25%	Dec. 31, 2013
	50%	Dec. 31, 2014
	100%	Dec. 31, 2015
2006	Greater of 3 or 25%	Dec. 31, 2014
	50%	Dec. 31, 2015
	100%	Dec. 31, 2016

On-road without VDECS Installed by December 31, 2006

Model Year	% of Model Year	Compliance Deadline
Pre-2000	Greater of 3 or 25%	Dec. 31, 2007
	50%	Dec. 31, 2008
	100%	Dec. 31, 2009
2000	Greater of 3 or 25%	Dec. 31, 2008
	50%	Dec. 31, 2009
	100%	Dec. 31, 2010
2001	Greater of 3 or 25%	Dec. 31, 2009
	50%	Dec. 31, 2010
	100%	Dec. 31, 2011
2002	Greater of 3 or 25%	Dec. 31, 2010
	50%	Dec. 31, 2011
	100%	Dec. 31, 2012
2003	Greater of 3 or 25%	Dec. 31, 2011
	50%	Dec. 31, 2012
	100%	Dec. 31, 2013
2004	Greater of 3 or 25%	Dec. 31, 2012
	50%	Dec. 31, 2013
	100%	Dec. 31, 2014
2005	Greater of 3 or 25%	Dec. 31, 2013
	50%	Dec. 31, 2014
	100%	Dec. 31, 2015
2006	Greater of 3 or 25%	Dec. 31, 2014
	50%	Dec. 31, 2015
	100%	Dec. 31, 2016

On-road with VDECS Installed by December 31, 2006

Model Year	% of Model Year	Compliance Deadline
Pre-2000	Greater of 3 or 25%	Dec. 31, 2008
	50%	Dec. 31, 2009
	100%	Dec. 31, 2010
2000	Greater of 3 or 25%	Dec. 31, 2009
	50%	Dec. 31, 2010
	100%	Dec. 31, 2011
2001	Greater of 3 or 25%	Dec. 31, 2010
	50%	Dec. 31, 2011
	100%	Dec. 31, 2012
2002	Greater of 3 or 25%	Dec. 31, 2011
	50%	Dec. 31, 2012
	100%	Dec. 31, 2013
2003	Greater of 3 or 25%	Dec. 31, 2012
	50%	Dec. 31, 2013
	100%	Dec. 31, 2014
2004	Greater of 3 or 25%	Dec. 31, 2013
	50%	Dec. 31, 2014
	100%	Dec. 31, 2015
2005	Greater of 3 or 25%	Dec. 31, 2014
	50%	Dec. 31, 2015
	100%	Dec. 31, 2016
2006	Greater of 3 or 25%	Dec. 31, 2015
	50%	Dec. 31, 2016
	100%	Dec. 31, 2017

For fleets of four or more yard trucks, the percentage of yard trucks (25 percent, 50 percent, or 100 percent) that must meet the performance requirements is determined based on the total population of yard trucks for a specific model year or model year group (i.e., pre-2003) that exist in the owner's or operator's yard truck fleet at the time of the first compliance deadline for that model year or model year group. If the number of yard trucks is not a whole number, conventional rounding practices apply (i.e., round down if less than 0.5; round up if 0.5 or greater).

3. In-Use Non-Yard Truck Equipment

The proposed regulation would require owners and operators of in-use non-yard truck equipment to meet a selection of performance standards (Compliance Options), which are based on BACT, and which vary based on the category of equipment. For the purpose of this regulation, BACT for non-yard truck cargo handling equipment is a menu of compliance options because these equipment types are diverse in their design, engines, operation, retrofit control technologies that are available to them, the level of risk posed, capital costs, and cost-effectiveness. As such, BACT can vary greatly even within each category or type of equipment.

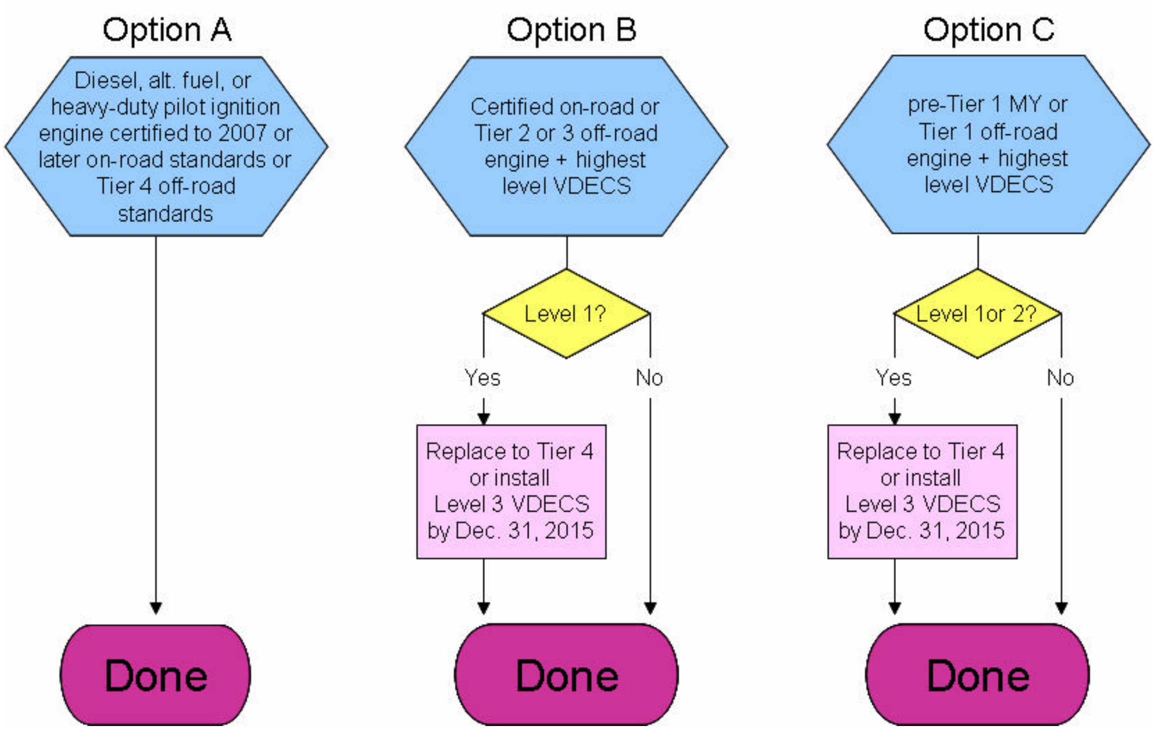
In determining the BACT compliance options, staff considered the feasibility of using certified on-road engines, technological feasibility of emission controls and availability of VDECS, ability for engine repowering, average useful life, associated health risks, and economic feasibility of replacing equipment. Staff has defined three categories of non-yard truck equipment, and for each category, three BACT compliance options are offered. The categories and their corresponding Compliance Options are discussed in the sections that follow.

Basic Container Handling Equipment

Basic Container Handling equipment consist of top handlers, side handlers, reach stackers, forklifts, straddle carriers, and any other equipment type (except RTG cranes) that handles cargo containers. The proposed regulation requires the owner or operator to select one of three BACT compliance options. One option is to use an engine or power system, including a diesel, alternative fuel, or heavy-duty pilot ignition engine, certified to the 2007 or later model year on-road engine standards or Tier 4 off-road engine standards for the rated horsepower and model year of the year manufactured. Another option is to use a pre-2007 model year certified on-road engine or a certified Tier 2 or Tier 3 off-road engine for the rated horsepower and model year of the year manufactured and apply the highest level VDECS available. If the highest level VDECS applied is a Level 1, then by December 31, 2015, the engine must either be replaced to a Tier 4 certified off-road engine or a Level 3 VDECS must be installed. Another option is to use a pre-Tier 1 off-road engine or a certified Tier 1 off-road engine for the rated horsepower and model year of the year manufactured and install the highest level VDECS available. If the highest level VDECS is a Level 1 or 2, then by December 31, 2015, the engine must either be replaced to a Tier 4 certified off-road engine, or a Level 3 VDECS must be installed. Figure IV-3 graphically displays the

Compliance Options for Basic Container Handling Equipment. The compliance dates for all non-yard truck cargo handling equipment are listed in Table IV-3.

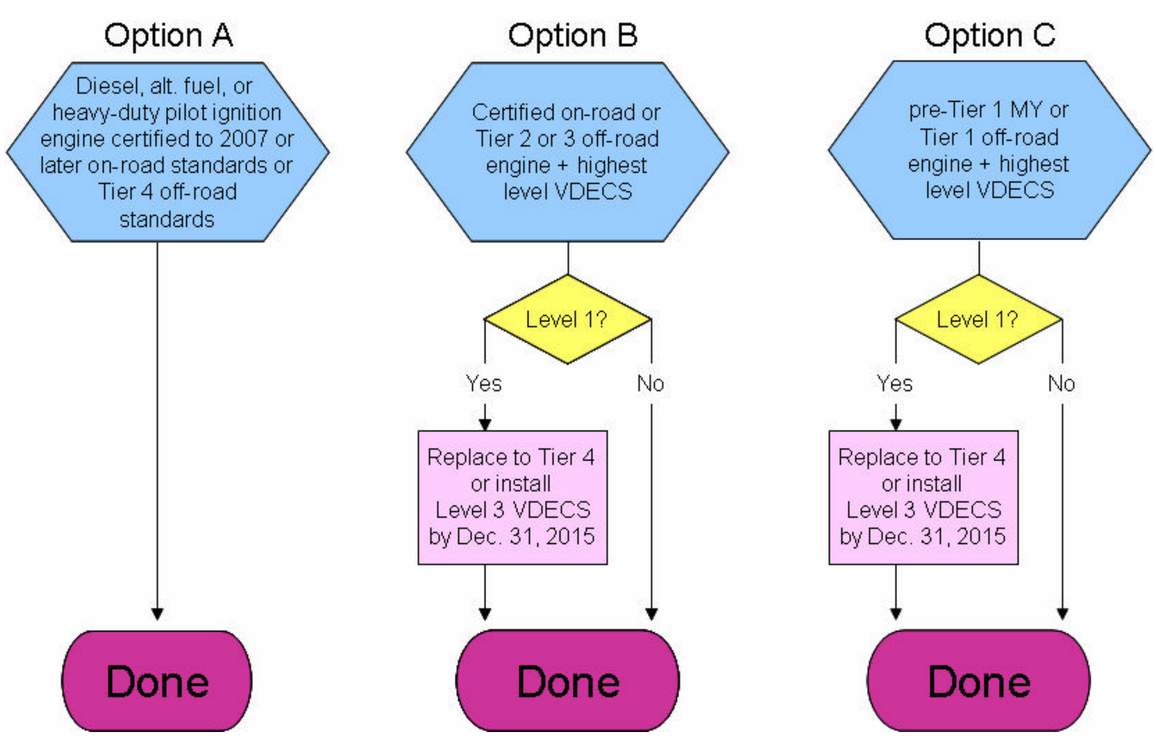
Figure IV-3: Basic Container Handling Equipment Compliance Options



Bulk Cargo Handling Equipment

Bulk Cargo Handling equipment consist of dozers, loaders, excavators, mobile cranes, sweepers, railcar movers, aerial lifts, and any other equipment type (except forklifts) that handles non-containerized or bulk cargo. The proposed regulation requires the owner or operator to select one of three BACT compliance options. One option is to use an engine or power system, including a diesel, alternative fuel, or heavy-duty pilot ignition engine, certified to the 2007 or later model year on-road engine standards or Tier 4 off-road engine standards for the rated horsepower and model year of the year manufactured. While the 2007 model year certified on-road engine is not available in high horsepower ranges, it may be available for some of the equipment in this category in the lower horsepower ranges. Another option is to use a pre-2007 model year certified on-road engine or a certified Tier 2 or Tier 3 off-road engine for the rated horsepower and model year of the year manufactured and apply the highest level VDECS available. If the highest level VDECS applied is a Level 1, then by December 31, 2015, the engine must either be replaced to a Tier 4 certified off-road engine or a Level 3 VDECS must be installed. Another option is to use a pre-Tier 1 off-road engine or a certified Tier 1 off-road engine for the rated horsepower and model year of the year manufactured and install the highest level VDECS available. If the highest level VDECS is a Level 1, then by December 31, 2015, the engine must either be replaced to a Tier 4 certified off-road engine, or a Level 3 VDECS must be installed. Figure IV-4 graphically displays the Compliance Options for Bulk Cargo Handling Equipment. The compliance dates for all non-yard truck cargo handling equipment are listed in Table IV-3.

Figure IV-4: Bulk Cargo Handling Equipment Compliance Options

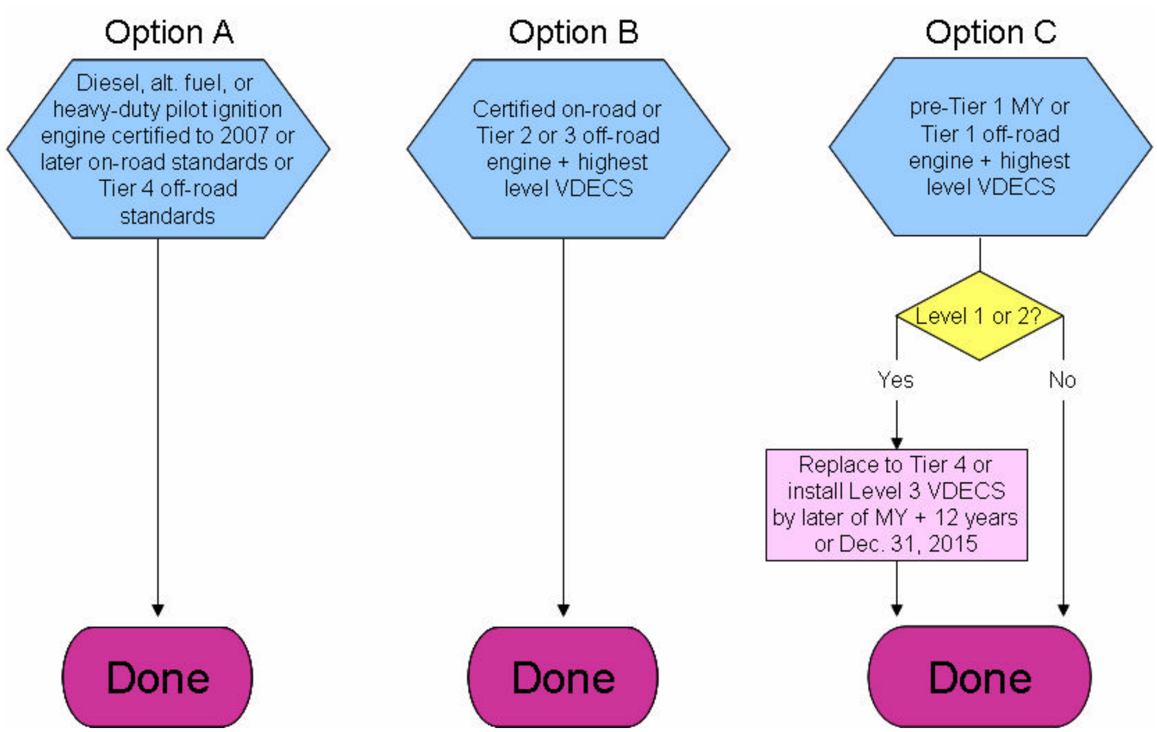


RTG Cranes

Because of their unique operation, size, costs, effective life, and retrofit options, RTG cranes are in a category of their own. While there is a limited selection of VDECS currently available to this category of equipment, the ARB is coordinating a study to identify and demonstrate high efficiency retrofit emission control systems for RTG cranes, top handlers, and side handlers that will lead to verification. Additional information on this project is available in Appendix H.

As with the other two categories of non-yard truck equipment, the proposed regulation requires the owner or operator to select one of three BACT compliance options for RTG cranes. One option is to use an engine or power system, including a diesel, alternative fuel, or heavy-duty pilot ignition engine, certified to the 2007 or later model year on-road engine standards or Tier 4 off-road engine standards for the rated horsepower and model year of the year manufactured. While the 2007 model year certified on-road engine is not available for most RTG cranes because of their high horsepower ranges, it may be available for some of the smaller horsepower RTG cranes. Another option is to use a pre-2007 model year certified on-road engine or a certified Tier 2 or Tier 3 off-road engine for the rated horsepower and model year of the year manufactured and apply the highest level VDECS available. Another option is to use a pre-Tier 1 off-road engine or a certified Tier 1 off-road engine for the rated horsepower and model year of the year manufactured and install the highest level VDECS available. If the highest level VDECS is a Level 1 or Level 2, then the engine must either be replaced to a Tier 4 certified off-road engine, or a Level 3 VDECS must be installed, by either December 31, 2015, or model year plus 12 years, whichever is later. Figure IV-5 graphically displays the Compliance Options for RTG Cranes. The compliance dates for all non-yard truck cargo handling equipment are listed in Table IV-3.

Figure IV-5: RTG Crane Compliance Options



The compliance schedule listed in Table IV-3 is based on engine model year and size of the fleet. The oldest engines would be replaced first, and owners or operators of more than three non-yard truck equipment would have a phased-in compliance schedule, allowing more time to achieve compliance for 100 percent of their fleet.

Table IV-3: Compliance Schedule for In-Use Non-Yard Truck Mobile Cargo Handling Equipment

Engine Model Years	Compliance Date[7]				
	Non-Yard Truck Fleets of 3 or Fewer	Non-Yard Truck Fleets of 4 or More			
		First 3 or 25% (whichever is greater)	50%	75%	100%
pre-1988	2007	2007	2008	2009	2010
1988-1995	2008	2008	2009	2010	2011
1996-2002	2009	2009	2010	2011	2012
2003-2006	2010	2010	2011	2012	2013

The percentage of non-yard truck equipment (25 percent, 50 percent, or 100 percent) that must meet the performance requirements is determined based on the total population of non-yard truck equipment for a specific model year group (i.e., pre-1988) that exist in the owner's or operator's non-yard truck fleet at the time of the first compliance deadline for that model year group. If the number of non-yard truck equipment is not a whole number, conventional rounding practices apply (i.e., round down if less than 0.5; round up if 0.5 or greater).

Fuel Requirements

The proposed regulation requires the use of specified fuels, including CARB diesel fuel, an alternative fuel, an alternative diesel fuel that meets the requirements of the Verification Procedure, CARB diesel fuel used with fuel additives that meets the requirements of the Verification Procedure, or any combination of the above. In addition, owners or operators who choose to use alternative diesel fuels in order to meet the performance requirements of the proposed regulation are required to meet the recordkeeping requirements, use only alternative diesel fuels that are VDECS, identify the fuel on a label near the vehicle's fill spout, and comply with the performance requirements within 10 days of discontinuing the use of the alternative diesel fuel.

Owners or operators that retrofit mobile cargo handling equipment with a VDECS that requires certain fuel properties to be met in order to achieve the required PM reductions or PM emissions must only use fuel that meets these specifications. The same applies to the use of a VDECS that requires certain fuel properties to be met in order to prevent damage to the VDECS or to prevent increases in pollutants.

Compliance Extensions

The proposed regulation includes several possible compliance extensions for specific circumstances. Subsection (f) of the proposed regulation in Appendix A details the

[7] Compliance date refers to December 31st of the year indicated.

requirements for each compliance extension. Unless specifically stated, compliance extensions may not be combined or used consecutively.

Engine Near Retirement

Engines that are within one year of retirement are eligible for a one-year compliance extension and, therefore, would not have to meet the in-use requirements of subsection (e). The owner or operator would have to demonstrate that their equipment did indeed retire on or before the assigned retirement date to avoid penalties for noncompliance.

No Verified Diesel Emission Control Strategy

Non-yard truck mobile cargo handling equipment that do not have the availability of VDECS may be eligible for an annual compliance extension up to two years. Owners or operators would be required to comply with the in-use requirements of subsection (e) for all other equipment before applying this extension.

Use of Experimental Diesel Particulate Matter Emission Control Strategies

Because the availability of VDECS is limited, and because those that are verified may not always be feasible for specific equipment types or applications, staff determined that a compliance extension for the use of non-verified emission control strategies was an appropriate option to maintain flexibility in complying with the performance standards, while at the same time, continuing to achieve emission reductions. If no VDECS is available for a non-yard truck mobile cargo handling equipment engine or if the available VDECS is not feasible for the specific equipment or application, the owner or operator can apply for a compliance extension to use an experimental diesel PM emission control strategy. Feasibility may be determined based on one or more criteria, which could include technology, economics, operations, safety, contractual agreements, infrastructure, systems compatibility, training, maintenance, and security issues. The application process includes submitting engine and emission control test data to demonstrate at least a Level 1 (25 percent diesel PM reduction) control. An owner or operator must apply each year if they wish to continue receiving the extension, but the experimental controls may not be used past December 31, 2015. At the end of the experiment, the owner or operator would be required to comply with the in-use non-yard truck equipment requirements in subsection (e) of the proposed regulation within six months of the end of the compliance extension period.

Equipment Manufacturer Delays

An owner or operator who has, at least six months prior to their required compliance date, purchased or entered into contractual agreement to purchase new equipment in order to meet the requirements of the regulation, but has not received the equipment by their compliance date due to manufacturer delays, would be considered to be in compliance until the equipment is received. This compliance extension can be used following any other compliance extension except for an engine near retirement.

Minimum Use Requirements

Yard trucks that were retrofitted with VDECS prior to December 31, 2005, using incentive funding from public agencies (i.e., NOx and PM Bank or Carl Moyer Program) may be eligible for a compliance extension if the funding program stipulated minimum use requirements that would expire after the required compliance date. The maximum compliance extension could not exceed three years from the VDECS installation date.

Diesel Emission Control Strategy Special Circumstances

For mobile cargo handling equipment that has VDECS installed in order to comply with the in-use requirements, the proposed regulation contains provisions in the event of a failure or damage to the VDECS. If the failure or damage occurs within the warranty period and cannot be repaired, the owner or operator would be required to replace the VDECS with either the same level VDECS, or choose another Compliance Option, within 90 days. If the failure or damage occurs outside of the warranty period and cannot be repaired, the owner or operator would be required to return to the original Compliance Options and bring the equipment into compliance within 90 days.

Alternative Compliance Plan for Non-Yard Truck Cargo Handling Equipment

As stated previously, the need for flexibility is important when considering options to reduce emissions from non-yard truck mobile cargo handling equipment. The proposed regulation includes an alternative compliance plan (ACP) option for owners and operators of non-yard truck cargo handling equipment that would allow them to demonstrate that equivalent emission reductions can be achieved through the use of alternative strategies. Alternative strategies can include equipment engine modifications, exhaust treatment control, engine repowering, equipment replacement, the use of alternative fuels or fuel additives, and operational controls. Applications for the ACP must be approved by the Executive Officer, and until such approval is granted, the owner or operator would be required to meet the performance requirements in subsection (e)(3).

Recordkeeping and Reporting Requirements

As specified in subsections (i) and (j) of the proposed regulation, the proposal includes provisions for mobile cargo handling equipment owner or operator recordkeeping and reporting that would allow staff to obtain more accurate information on the number of mobile cargo handling equipment in California, to monitor the implementation of the regulation, to estimate pollutant reductions based on compliance choices the owners or operators make, and to facilitate inspections by ARB's Enforcement Division. Beginning in 2007, owners or operators would be required to report mobile cargo handling equipment inventory information (e.g., make, model, serial number, etc.), where they operate, and how and when they come into compliance with the in-use requirements of the regulation. Owners or operators would also be required to affix a label to each equipment that will display information such as the engine model year, compliance strategy used or the planned compliance date, engine certification (e.g., off-road or on-road), or experimental diesel emission control strategy test dates. An alternative approach to using labels may be used if approved by the Executive Officer.

Beginning January 31, 2007, owners or operators would be required to submit a compliance plan to the Executive Officer. The plan would identify how the owner or operator plans to meet the in-use requirements of the regulation. The plan is not binding and can be changed prior to the compliance date(s).

For owners and operators of off-road mobile equipment that do not handle cargo at any time but is used to transport personnel or deliver fuel, a one-time reporting of that equipment is required by January 31, 2007. The information gathered from this reporting will help staff to determine if additional regulatory requirements are appropriate for this equipment.

The proposed regulation currently requires submittals to the ARB by mail, however, staff plans to develop the potential for electronic report submittals in time for owner or operator reporting deadlines. In addition, staff plans to conduct outreach to owners and operators to explain and clarify these reporting requirements.

Right of Entry, Prohibitions, and Severability

The proposed regulation includes Right of Entry, Prohibitions, and Severability clauses. As specified in subsection (k), the Right of Entry clause allows an ARB agent or employee to enter the premises of a port or intermodal rail yard where mobile cargo handling equipment operate in order to inspect the equipment that are subject to the regulation.

As specified in subsection (l) of the proposed regulation, the Prohibitions clause states that people engaged in the State in the business of selling, renting, or leasing new or used mobile cargo handling equipment are prohibited from selling, importing, delivering, purchasing, receiving, or otherwise acquiring a new or used mobile cargo handling equipment for the purpose of selling, renting, or leasing, that does not meet the performance requirements of the regulation.

As specified in subsection (m) of the proposed regulation, the Severability clause ensures that if any portion of the regulation is deemed invalid or unconstitutional, that portion would be deemed a separate, distinct, and independent provision, and will not affect the validity of the remaining portions of the regulation.

Submittal of Documents

Documents that are required to be submitted to the ARB may be submitted by mail or by an alternative method approved by the Executive Officer, which may allow for electronic submittals in the future. The address for mailing documents to the ARB is included in subsection (n) of the proposed regulation.

C. Alternatives Considered

The Government Code section 11346.2 requires the ARB to consider and evaluate reasonable alternatives to the proposed regulation and provide the reasons for rejecting those alternatives. ARB staff evaluated three alternative strategies to the current proposal. Based on the analysis, none of the alternative control strategies were considered more effective than the proposed regulation. Full implementation of the proposed regulation is necessary to achieve ARB's goal, as described in the Diesel Risk Reduction Plan, to reduce by 85 percent diesel PM emissions and associated potential cancer risks by 2020. (ARB, 2000) The proposed regulation provides owners or operators of mobile cargo handling equipment with flexibility in determining the most cost-effective control strategy that will meet the proposed emission standards and operational requirements for their operation.

This section discusses each of the three alternatives and provides reasons for rejecting those alternatives.

Do Not Adopt This Regulation: Rely on New Engine Standards and Voluntary Programs

One alternative would be to do nothing and rely on existing governmental programs and voluntary programs. Beginning in 1996, manufacturers and vendors of diesel engines have been subject to U.S. EPA's nonroad (off-road) diesel emission regulations (40 CFR Part 89). The standards are tiered and the date upon which each tier takes effect depends on the engine size. As of January 1, 2000, all engine sizes were subject to Tier 1 standards. In 2004, the U.S. EPA adopted new engine standards (Tier 4) for off-road diesel engines that will begin in 2008, but not be fully implemented until 2015. These stringent standards will significantly reduce emissions of PM and NOx, which contribute to adverse public health impacts. In addition, U.S. EPA's rule requires off-road diesel engines to use diesel fuel with a maximum sulfur content of 500 ppm in 2007 and 15 ppm in 2010. (EPA, 2003) California has harmonized its new engine standards for off-road diesel engines with the U.S. EPA off-road standards.

However, the U.S. EPA's Tier 4 new engine standards do not address existing in-use diesel engines, and the new standards would be implemented on a phased-in schedule based on engine size beginning in 2008 through 2015. Additionally, the federal standards offer various alternatives to demonstrate (use of emission reduction credits) or delay compliance to certain phase-in schedules. These critical implementation measures will not produce the greatest potential reductions in diesel PM emissions in the shortest timeframe. Further, the long useful life of diesel engines and the lack of stringent standards for in-use off-road diesel engines will significantly limit the potential reduction in ambient concentrations of diesel PM and associated cancer and noncancer health risks. ARB staff does not recommend this alternative because it would result in less reduction in diesel PM and NOx emissions and fewer public health benefits than the proposed regulation.

While federal, State, and local programs have been developed to encourage less-polluting diesel engines, the effects of these programs are expected to be far less significant than the proposed regulation. The U.S. EPA's Voluntary Diesel Retrofit Program, which addresses pollution from diesel construction equipment and heavy-duty on-road vehicles, applies only to a very small fraction of cargo handling equipment. ARB's Carl Moyer Incentive Funding Program, which provides funds on an incentive-basis for the incremental cost of cleaner than required engines and equipment, has focused primarily on agricultural equipment. And, while the voluntary retrofit programs at the Ports of Long Beach, Los Angeles, and Oakland have made great strides in reducing diesel PM emissions from the existing fleets of cargo handling equipment at their ports, they are local programs whose reductions will not be realized elsewhere in the State, and the level of emission reductions fall short of what is needed to protect public health.

It is estimated that the proposed regulation will achieve an additional 744 tons reduction in diesel PM and an additional 18,310 tons reduction in NOx emissions beyond what voluntary measures would achieve. Therefore, ARB staff does not recommend this alternative.

Adopt Requirements for Yard Trucks Only

Another option would be to adopt requirements only for yard trucks and not address the non-yard truck equipment. While this option achieves emission reductions for one equipment type, it does not address the cargo handling equipment emissions at bulk cargo facilities or other equipment types at container facilities, both of which pose significant health risks. The full regulation would reduce diesel PM emissions by an estimated additional 241 tons and NOx emissions by an estimated additional 1,233 tons. Therefore, ARB staff does not recommend this alternative.

REFERENCES:

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

(EPA, 2003) United States Environmental Protection Agency. *Regulatory Announcement, Summary of EPA's Proposed Program for Low Emission Nonroad Diesel Engines and Fuel*; April 2003.

V. TECHNOLOGICAL FEASIBILITY OF THE PROPOSED REGULATION

There are a variety of technologies available to reduce diesel PM emissions from cargo handling equipment engines. Since the 1970's, much of the diesel emission control has been achieved through emission-conscious engine design. For example, emission improvements have included modifications in combustion chamber geometry, increased fuel injection pressure, and design for better fuel atomization and mixing with the air. (DieselNet, 1998) In the past 15 years, more development effort has been put into catalytic exhaust emission control devices for diesel engines, especially in the areas of particulate matter control. These developments have made the widespread commercial use of diesel exhaust emission controls feasible. (ARB, 2003a)

In this chapter of the staff report, we provide descriptions of diesel PM emission control strategies currently available and projected to be available in the near future. We focus on those we believe will be employed to comply with the proposed regulation. Additional information on the wide variety of emission reduction options for diesel fueled engines is provided in the Diesel Risk Reduction Plan. (ARB, 2000) We also list actual in-use experience with diesel PM emission control strategies and clean fuels that cargo handling equipment engine operators are using currently.

A. New Engine Standards

Due to the efforts of the ARB and U.S. EPA in establishing new engine standards that reflect advanced technology options, replacing an older engine with a new one will usually result in significant emission reductions. The proposed regulation includes performance standards based on best available control technologies (BACT), which in many cases can include replacing an older engine with a cleaner, new engine through either repowering or equipment replacement. In the case of yard trucks in particular, accelerating the turnover to new on-road engines is a very effective means of achieving significant reductions in both diesel PM and NOx while maintaining economic feasibility (cost-effectiveness). Below we briefly discuss the current off-road and on-road new engine emission standards and how they can be part of the strategy for achieving emission reductions.

<u>Off-Road</u>

Because of advancements that have been made in combustion technology and engine design, diesel engines today emit over 80 percent less PM and over 60 percent less NOx than they did in 1988. (Diesel, 2003) Beginning in 1996, all compression ignition (diesel) engine manufacturers have been subject to U.S. EPA's nonroad (off-road) diesel emission regulation (40 CFR Part 89), which the ARB has subsequently adopted as well. The off-road engine emission standards are tiered (i.e., Tier 1, 2, 3, 4), and the date upon which each tier takes effect depends on the engine size (horsepower). As of January 1, 2000, all engine sizes were subject to Tier 1 standards. In 2006, all engine sizes will be subject to Tier 2, and in 2008, most engines sizes will be subject to Tier 3 standards (engines less than 75 horsepower or greater than 750 horsepower do not have a Tier 3 standard). These standards, which become increasingly more stringent with each subsequent tier, will result in the development of new, lower-emitting diesel engines in the future years.

Tier 4 standards are divided into two stages: interim, which begins between 2008 and 2012 for most engines, and final, which is effective for all off-road engines by 2015. The final Tier 4 standards will result in diesel engines that will be over 90 percent cleaner than 1988 vintage engines. Tier 4 requires most engines to meet a 0.01 g/bhp-hr diesel PM emission rate and a 0.3 to 0.5 g/bhp-hr NOx emission rate in the 2011-2015 timeframe. ARB staff has worked closely with U.S. EPA to develop a harmonized federal and California program to more effectively control emissions from off-road equipment. ARB's heavy-duty new engine regulation is found in title 13, California Code of Regulations, section 2423. When it has been feasible to do so, the Board has adopted a more stringent program than the federal program and adopted engine test procedures that more accurately measure emissions that occur during typical in-use driving conditions.

Repowering, or replacing an existing engine with a new one, can provide the same emissions benefits as replacing the equipment, particularly when the new engine is a higher tier level (i.e., replacing a pre-Tier 1 engine with a Tier 2 or Tier 3 engine). In addition, repowering is often an attractive strategy for owners or operators of cargo handling equipment whose engines have reached their useful life before the other equipment components are ready for retirement. Repowering is most often accomplished on non-yard truck equipment (e.g., top handlers, side handlers, railcar movers, and rubber-tired gantry cranes) because their equipment replacement costs are much higher than the costs of repowering. While repowering to a Tier 2 or Tier 3 engine does not get the same benefits as a Tier 4 engine, it can make the engine more suitable to aftertreatment emission controls, and is therefore, one compliance option for non-yard truck cargo handling equipment.

For owners or operators of some non-yard truck cargo handling equipment that choose to use retrofits for their initial compliance, an additional compliance step to replace the engines to meet Tier 4 standards at the end of 2015 is required. This strategy achieves both near-term and long-term reductions in diesel PM and NOx emissions.

<u>On-Road</u>

On-road engines are a step ahead of off-road engines and are an even better emission reduction strategy for cargo handling equipment that can utilize them. In January 2001, U.S. EPA finalized its rule for new emission standards for 2007 and later model year on-road heavy-duty diesel engines and vehicles[8]. The 2007 standards break new ground by setting emission standards that require aftertreatment-based technologies for all classes of heavy-duty diesel engines and vehicles. The adopted standards will reduce

[8] U.S. EPA's 2007 Final Rule on the Control of Emissions of Air Pollution from 2007 and Later Model Year Heavy-Duty Highway Engines and Vehicles; Revision of Light-Duty On-Board Diagnostics Requirements (66FR 5002, January 18, 2001). Referred to as U.S. EPA's 2007 Final Rule or 2007 Final Rule.

exhaust emissions from new diesel-cycle engines meeting the 2004 standards by 90 percent for NOx, 72 percent for NMHC, and 90 percent for PM. These emission standards, which are also applicable to both natural gas-fueled engines and liquefied petroleum gas-fueled engines derived from the diesel cycle engine, are shown below in Table V-1. The U.S. EPA adopted the requirements for heavy-duty gasoline-fueled engines (with implementation starting in 2008) at the same time it adopted emission standards for 2007 and later model year heavy-duty diesel engines. ARB adopted regulations to harmonize with the federal standards in 2002.

Table V-1: Exhaust Emission Standards for 2007 and Later Model Year On-Road Heavy-Duty Diesel Engines/Vehicles

Pollutant	Standard (g/bhp-hr)	Phase-In by Model Year*			
		2007	2008	2009	2010
NOx	0.20	50%			100%
NMHC	0.14	50%			100%
PM10	0.01	100%	100%	100%	100%

* represents percent of sales

The Board approved the same phase-in schedules for the NOx, PM, and NMHC emission standards as adopted by U.S. EPA. The phase-in schedules, shown in Table V-1, represent the percentage of new engines produced for sale in California that are required to meet the more stringent emission standards beginning in 2007. Full implementation is required starting with the 2009 model year.

On-road engines are currently available for some types of cargo handling equipment, particularly yard trucks. In fact, yard truck manufacturers have provided buyers the option to choose the on-road engine for several years with only a minor incremental cost differential. Since the 2007 on-road engines have the emission benefits up to eight years sooner than off-road engines, they are an effective strategy for achieving both near-term and long-term emission reductions.

Test methods used to certify on-road engines are different than those for off-road engines. On-road engine methods use a transient duty cycle while off-road engine methods use a steady state duty cycle. ARB staff conducted testing, in partnership with the Port of Los Angeles and through the University of Riverside, of yard trucks equipped with both on-road and off-road engines, using an off-road duty cycle (C1). The emission rates from the off-road duty cycle were compared to the U.S. EPA certified on-highway, transient emission rates for this engine family. The comparison indicated the on-road engine's emission rates were similar in both duty cycles, concluding that the off-road duty cycle did not increase the on-road engine emissions. Based on these results, staff believes the same will hold true for future model year on-road engines. Additional yard truck testing is being conducted which includes alternative fuels, data logging to evaluate the duty cycles, and in-use emission testing. Information on the test program can be found in Appendix E.

The proposed regulation provides an option for yard trucks and other applicable mobile cargo handling equipment types to use certified on-road engines. This is clearly technically feasible, as many yard trucks are already using on-road engines. Based on discussions with manufacturers, this option will continue to be available for future model year yard truck engines as well, even as the certified on-road engine standards strengthen in 2007 and again in 2010. (ARB, 2005c) Mobile cargo handling equipment operating with on-road engines are not required by the regulation to use any verified diesel emission control strategy. Chapter IV provides more information on the requirements of the proposed regulation.

B. Diesel PM Exhaust Aftertreatment Emission Controls

There are various advanced exhaust aftertreatment technologies commercially available that can provide significant reductions in diesel PM, particularly when combined with ultra low-sulfur diesel fuel. Several of these technologies have been verified by the ARB to reduce diesel PM emissions and are one option that owners and operators of non-yard truck cargo handling equipment can use to meet the performance requirements of the proposed regulation. (The verification procedure is discussed later in this chapter). While several VDECS are currently available for non-yard truck cargo handling equipment, the verification extends only to select model years and engine families. Therefore, flexibility in applying these and other emission control strategies is necessary and contributes to the technological feasibility of the proposed regulation. The proposal would allow owners and operators to apply for a compliance extension for the use of experimental diesel emission control technologies, which in turn, is expected to result in additional verifications.

The principal technologies that have been successfully used to reduce diesel PM from diesel-fueled engines are diesel oxidation catalysts (DOCs), emulsified diesel fuel, and diesel particulate filters (DPFs). Since 2002, more than a thousand DOCs have been installed on many types of cargo handling equipment, primarily yard trucks, at the ports of Los Angeles, Long Beach, and Oakland. (ARB, POLA; ARB, POLB; ARB, Port of Oakland) Additionally, several DPFs have been installed on top handlers at the Port of Oakland. Flow-through filters, sometimes referred to as enhanced DOCs, are relatively new to the market but also show promise in reducing diesel PM from diesel-fueled engines. These aftertreatment emission control systems are briefly described below.

<u>Diesel Oxidation Catalysts</u>

Diesel oxidation catalysts (DOCs) are the most common currently used form of diesel aftertreatment technology and have been used for compliance with the PM standards for some on-highway engines since the early 1990s. DOCs are generally referred to as "catalytic converters." DOCs are devices attached to the engine exhaust system. They have chemicals lining them which catalyze the oxidation of carbonaceous pollutants – some of the soot emissions and a significant portion of the soluble organic fraction. These carbon-containing pollutants are oxidized to CO_2 and water. The catalysts that are used are known as the platinum group metals (PGMs). These consist of platinum, iridium, osmium, palladium, rhodium, and ruthenium. Platinum is best suited as the catalyst for diesel engine control devices; therefore, it appears that it will be the main catalyst used in diesel catalytic converters. (Kendall, 2002/2003)

DOC effectiveness in reducing PM emissions is normally limited to about 30 percent of diesel PM. This is because the soluble organic fraction portion of diesel PM for modern diesel engines is typically less than 30 percent. Additionally, DOCs increase sulfate PM emissions by oxidizing the sulfur in fuel and lubricating oil, reducing the overall effectiveness of the catalyst. Limiting fuel sulfur levels to 15 ppm allows DOCs to be designed for maximum effectiveness (nearly 100 percent control of soluble organic fraction emissions). DOCs also reduce emissions of HC and CO with reported efficiencies of 76 percent and 47 percent respectively. (Khair, 1999)

DOCs are also very effective at reducing the air toxic emissions from diesel engines. Test data shows that emissions of toxics such as polycyclic aromatic hydrocarbons (PAHs) can be reduced by more than 80 percent with a DOC. (DieselNet, 2002)

Flow-Through Filters

Flow-through filter (FTF) technology is a relatively new technology for reducing diesel PM emissions. Unlike a DPF, in which only gasses can pass through the substrate, the FTF does not physically "trap" and accumulate PM. Instead, exhaust flows through a medium (such as wire mesh) that has a high density of torturous flow channels, thus giving rise to turbulent flow conditions. The medium is typically treated with an oxidizing catalyst that is able to reduce emissions of PM, HC, and CO, or used in conjunction with a fuel-borne catalyst. Any particles that are not oxidized with the FTF flow out with the rest of the exhaust and do not accumulate.

The filtration efficiency of an FTF is lower than that of a DPF, but the FTF is much less likely to plug under unfavorable conditions, such as high PM emissions, low exhaust temperatures and older engines. The FTF, therefore, is a candidate for use in applications that are unsuitable for Diesel Particulate Filters (DPF). Currently, there are no verified FTF technologies. If verified, FTF technology could potentially fill an emission reduction role on older RTG cranes, construction equipment, and other engines where DPF’s would easily clog.

Diesel Particulate Filters

DPFs have been successfully used in many applications, including on-road, off-road applications, and prime and emergency engines, use of DPF’s in CHE equipment has been limited. In general, a DPF consists of a porous substrate that permits gases in the exhaust to pass through but traps the diesel PM. Diesel PM emission reductions in excess of 85 percent are possible, depending on the associated engine's baseline emissions, fuel sulfur content, and emission test method or duty cycle. In addition, up to a 90 percent reduction in CO and a 95 percent reduction in HC can also be realized with DPFs. (Allansson, 2000) Most DPFs employ some means to periodically regenerate the filter, i.e., burn off the accumulated PM. In California, diesel-fueled school buses, emergency backup generators, solid waste collection vehicles, urban transit buses, medium-duty delivery vehicles, people movers, and fuel tankers trucks have been retrofitted with DPFs through various voluntary and regulatory mandated programs as well as demonstrations programs. Particulate filters can be either active or passive systems.

Active DPFs use a source of energy beyond the heat in the exhaust stream itself to help regeneration. Active DPF systems can be regenerated electrically, with fuel burners, with microwaves, or with the aid of additional fuel injection to increase exhaust gas temperature. Some active DPFs induce regeneration automatically onboard the vehicle or equipment when a specified back pressure is reached. Others simply indicate when to start the regeneration process. Some active systems collect and store diesel PM over the course of a full day or shift and are regenerated at the end of the day of shift with the vehicle or equipment shut off. A number of the smaller filters are removed and regenerated externally at a "regeneration station." Because they have control over their regeneration and are not dependent on the heat carried in the exhaust, active DPFs have a much broader range of application and a much lower probability of getting plugged than passive DPFs.

A passive DPF is one in which a catalytic material, typically a platinum group metal, is applied to the substrate. The catalyst lowers the temperature at which trapped PM will oxidize to temperatures periodically reached in diesel exhaust. No additional source of energy is required for regeneration, hence the term "passive."

Field experience has indicated that the success or failure of a passive DPF is primarily determined by the average exhaust temperature at the filter's inlet and the rate of PM generated by the engine. These two quantities, however, are determined by a host of factors pertaining to both the details of the application and the state and type of engine being employed. As a result, the technical information that is readily accessible can sometimes serve as a guide, but it may be insufficient to determine whether a passive DPF will be successful in a given application. (ARB, 2002)

With regard to estimating average exhaust temperature in actual use, commonly documented engine characteristics such as the exhaust temperature at peak power and peak torque are insufficient. The exhaust temperature at the DPF's inlet is highly application dependent in that the particular duty cycle experienced plays a prominent role, as do heat losses in the exhaust system. Very application-specific characteristics enter the heat loss equation, such as the length of piping the exhaust must travel through before it reaches the DPF. Lower average exhaust temperatures can also be the result of operating engines that are oversized for the application or run without a load applied. (ARB, 2002)

Staff believes that RTG cranes in particular are good candidates for DPFs because of their duty cycle and high operating temperatures at load. The ARB is currently participating in a study to identify and demonstrate high-efficiency retrofit emission control systems for RTG cranes, top handlers, and side handlers. The program will continue through Spring 2006 is expected to lead to ARB verification for controls such as DPFs. Appendix H contains more information on the demonstration program.

Combinations

Combinations of more than one technology are also being explored to maximize the amount of diesel PM and reducing other pollutants. For example, fuel-borne catalysts or emulsified fuel can be combined with any of the three main hardware technologies discussed above: DOC, FTF, or DPF's.

C. Cleaner Diesel Fuels, Alternative Diesel Fuels, and Alternative Fuels

Diesel PM emission reductions can also be realized through the use of cleaner diesel fuels, alternative diesel fuels, or alternative fuels. Using ultra low-sulfur diesel fuel (15 ppm) results in modest PM reductions and will also enable the use of advanced exhaust aftertreatment systems for those engines that use verified diesel emission control strategies (VDECS) to meet the performance standards in the proposed regulation. Alternative diesel fuels, such as emulsified diesel, can also reduce diesel PM emissions and has been used successfully in cargo handling equipment at the ports of Long Beach and Los Angeles. Using alternative fuels, such as compressed natural gas (CNG), liquefied natural gas (LNG), and liquefied petroleum gas (LPG) can often produce significantly fewer emissions than older diesel engines but there are operational and economic constraints associated with cargo handling equipment that utilize these fuels. However, while there are limitations to using alternative diesel-fuels and alternative fuels, particularly with higher power demanding engines, we believe they may provide a satisfactory route to compliance for many categories. Below we describe some fuel options for cargo handling equipment engines.

Ultra-Low Sulfur Diesel Fuel (CARB Diesel)

Lowering the sulfur content of diesel fuel is important to the performance of aftertreatment technologies, particularly DPFs. Sulfur affects filter performance by inhibiting the performance of catalytic materials upstream of or on the filter (i.e., catalyst "poisoning"). This phenomenon not only adversely affects the ability to reduce emissions, but also adversely impacts the capability of these filters to regenerate - there is a direct trade-off between sulfur levels in the fuel and the ability to achieve regeneration. Sulfur also competes with the chemical reactions intended to reduce pollutant emissions and creates particulate matter through catalytic sulfate formation. The availability of ultra low-sulfur fuel will enable these filters to be designed for improved PM filter regeneration and emission control performance, as well as to reduce sulfate emissions. Diesel fuel containing less than 15 ppm sulfur is required to ensure maximum emission control performance on the broadest range of off-road diesel engines. (MECA, 2003)

All diesel-fueled cargo handling equipment will be required to use ultra low-sulfur diesel fuel beginning in mid to late 2006 as a result of recently approved amendments to the California diesel fuel regulations. This reduced sulfur content will provide a small emission benefit because a portion of PM emissions is comprised of sulfates, the formation of which is a direct function of the level of sulfur in the fuel. (Diesel, 2003) Several port terminals (i.e., at the Port of Oakland) are already using ultra-low diesel fuel exclusively in their cargo handling equipment. Currently, this lower sulfur diesel fuel costs about 5 to 15 cents more per gallon than CARB off-road diesel fuel.

Alternative Diesel Fuels

Alternative diesel fuel is a fuel that can be used in a diesel engine without requiring engine or fuel system modifications for the engine to operate, although minor modifications (e.g., recalibration of the engine fuel control) may enhance performance. Examples of alternative diesel fuels include biodiesel, emulsified fuels, Fischer-Tropsch fuels, or a combination of these fuels with CARB diesel fuel. The emissions effects of these fuels can vary widely. A detailed discussion of alternative diesel fuels is provided in the Diesel Risk Reduction Plan. (ARB, 2000) These alternatives may result in significant benefits for higher-emitting categories, such as off-road engines. Synthetic or alternative diesel fuels may also prove to be part of the preferred control strategy for diesel-fueled engines that would otherwise result in relatively high risk, or where control retrofit options are very expensive or difficult to implement.

Several terminals at the ports of Long Beach and Los Angeles are currently using emulsified diesel fuel across their fleets of cargo handling equipment, with some of them using it in conjunction with a DOC. Engines that are using the fuel must be able to tolerate a power loss of up to 20 percent. In ARB's yard truck testing program that was mentioned earlier in this chapter, comparison testing using CARB diesel and emulsified diesel showed an overall increase in total hydrocarbon emission factors of 10 to 33 percent for the emulsified diesel. The reductions in NOx emission factors ranged from 18 to 22 percent for the emulsified diesel. PM emission factor reductions ranged from 17 to 53 percent. Additional information on the testing program and its results are available in Appendix E.

Alternative Fuels

Using alternative fuels is another option for reducing emissions from off-road diesel-fueled engines. Engines using alternative fuels have emission levels than are comparable or lower than new diesel engines operating on CARB diesel fuel. However, the availability of cargo handling equipment, particularly non-yard truck equipment, that use alternative fuels is very limited. In fact, there is no known availability of alternative-fueled top handlers, side handlers, RTG cranes, or many other non-yard truck equipment types. Yard trucks are commercially available with CNG/LNG or LPG engines, but the cost differential is significant, sometimes up to 70 percent more for an alternative-fueled yard truck versus the traditional diesel-fueled yard truck.

Currently, the Port of Los Angeles has over 50 LPG yard trucks that have been in use for several years as a result of a law suit settlement requiring alternative-fueled yard trucks. The experience with the LPG yard trucks has included high fuel infrastructure costs and a significant increase in required maintenance. (ARB, 2005a) Issues with LPG fuel quality can result in a residue build-up on certain engine components, such as vaporizers, carburetors, and injectors, which reduces the effectiveness of heat transfer and ultimately causes poor delivery of the fuel and inaccurate fuel-to-air ratios. (ARB, 2005b)

The ARB yard truck testing program, mentioned earlier in this chapter, has completed chassis dynamometer testing of a 2004 LPG-fueled yard truck. Results from earlier tests conducted with certified off-road and on-road diesel yard trucks were used for comparison. The test results indicated that both the total hydrocarbon (TCH) and NOx emissions were higher for the LPG engine compared to the same model year on-road diesel engine. Particulate matter emissions were significantly lower for the LPG engine than either the on-road or off-road engines, which was an expected result since LPG does not emit diesel PM.

Several terminals across the state use spark-ignited engine (i.e., electric and/or LPG) forklifts, often in addition to compression-ignition engine (i.e., diesel) forklifts. The fuel type for forklifts is usually determined by the desired lift capacity and the type of operation. Diesel forklifts usually start with a lift capacity above 6,000 pounds, while spark-ignited forklifts are generally used for lift capacities up to 16,000 pounds. (Moyer, 2003)

Staff is not recommending that alternative-fueled engines be considered BACT for the purposes of this regulation. This is based on staff's review of cost, cost-effectiveness, availability of both equipment and fuel, and applicability of these engines to the types of equipment covered by the regulation. However, for the purposes of complying with the in-use requirements for non-yard truck equipment, alternative-fueled engines that are certified to the appropriate on-road or off-road standard are an approved compliance option. Appendix F contains further discussion of alternative fuels.

D. Verification of Diesel Emission Control Devices

In support of the ARB's regulatory efforts to reduce diesel PM, the *Verification Procedure, Warranty and In-Use Compliance Requirements of In-Use Strategies to Control Emissions from Diesel Engines* (Verification Procedure) was adopted by the Board in March 2002. The Verification Procedure establishes a process through which manufacturers of emission control equipment can demonstrate and verify the emission reduction capabilities of control technologies. Examples of emission control technologies that can be considered for verification include diesel particulate filters, diesel oxidation catalysts, exhaust gas re-circulation, selective catalytic reduction systems, fuel additives and alternative diesel fuel systems. The Verification Procedure is voluntary and applies to emission control technologies for on-road, off-road and stationary applications. A brief discussion on the Verification Procedure is provided in this section.

The Verification Procedure requires emission control strategy applicants to establish the emissions reduction capabilities for an emission control device, conduct a durability demonstration, conduct a field demonstration and submit results along with other information in an application to the ARB following a prescribed format. The applicant verifies the product for a specific engine manufacturer, years produced, engine family and series. If the ARB approves the application, it will issue an Executive Order to the applicant stating the verified emission reduction and any conditions that must be met for the diesel emission control strategy to function properly. The Verification Procedure also requires that the applicants provide a warranty to the end-user and conduct in-use compliance testing.

The results of the Verification Procedure testing determine the control technology classification. The multi-level verification system consists of three PM reduction levels. The Verification Procedure also has provisions for verifying strategies that reduce NOx emissions. Control device verifications for both PM and NOx are classified by level as listed in Table V-2.

Table V-2: Verification Classifications for Diesel Emission Control Strategies

Pollutant	Reduction	Classification
PM	<25%	Not Verified
	≥ 25%	Level 1
	≥ 50 %	Level 2
	≥ 85% or ≤0.01 g/bhp-hr	Level 3
NOx	<15%	Not Verified
	≥15%	Verified in 5% increments

Once a device has been verified, the executive order and accompanying information is posted on the ARB's web site at http://www.arb.ca.gov/diesel/verdev/verdev.htm. The ARB has the Diesel Emission Control Strategy Verification Procedure and the U.S. EPA's Voluntary Retrofit Verification Program. Both programs share a common goal of verifying the emission reductions from diesel emission control systems. The agencies have made tremendous efforts to harmonize key requirements in both programs; still differences exist between the two programs. In general, the ARB Verification Procedure is designed to support regulatory requirements while the U.S. EPA's program is voluntary. For more detail of the program differences visit http://www.arb.ca.gov/diesel/verdev/frmlregdocs.htm.

There are currently three manufacturers offering Level 1, 2, and 3 VDECS for in-use off-road engines, including some engines used in cargo handling equipment. Level 1 DOC options include the Donaldson Series 6000 with spiracle closed crankcase filtration, Extengine Transport Systems Advanced Diesel Emission Control, and Lubrizol AZ Purifier and AZ Purimuffler. Lubrizol offers a Level 2 DOC, the AZ Purifier or an AZ Purimuffler, which requires the use of Lubrizol's emulsified diesel fuel, PuriNOx.

The Level 3 VDECS is a Lubrizol Unikat Combifilter, which is an actively regenerated uncatalyzed DPF that operates using either CARB diesel or ultra low-sulfur diesel fuel. Each of the technologies above have specific model year and engine requirements. Appendix G contains the executive orders for each of the verified devices.

As stated earlier, using VDECS is one possible compliance option for non-yard truck cargo handling equipment. The proposed regulation allows for compliance extensions to be granted in situations where VDECS are not available for a specific engine and equipment type, and/or if the owner or operator chooses to use an experimental diesel emission control strategies due to feasibility issues with an available VDECS. Because non-yard truck cargo handling equipment is so diverse, several factors can affect the feasibility of VDECS, such as duty cycle, load factor, speed, and idling time. Therefore, while verification may extend to specific engine families and model years, VDECS are not always the right fit for all applications or equipment types.

The ARB project (mentioned earlier in this chapter) to test and demonstrate high-efficiency control systems for RTG cranes, top handlers, and side handlers, along with the use of experimental diesel emission control strategies, are both intended to lead to the verification of more controls for cargo handling equipment and off-road engines in general. As part of the implementation efforts for the proposed regulation, staff plan to create a technology workgroup, whose goal will be to monitor the available control strategies, address concerns regarding the use of the technologies in non-yard truck cargo handling equipment, and encourage manufacturers to apply for ARB verification.

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VI. ENVIRONMENTAL IMPACTS

This chapter describes the potential environmental impacts of this proposed regulation. This proposed regulation is intended to protect the health of California's citizens by reducing diesel engine emissions from cargo handling equipment at ports and intermodal rail yards. An additional consideration is the impact that implementation of the proposed regulation may have on the environment. Based upon available information, the ARB staff has determined that no significant adverse environmental impacts should occur as the result of adopting the proposed regulation. This chapter describes the potential impacts that the proposed regulation may have on wastewater treatment, hazardous waste disposal, and air quality.

A. Legal Requirements

The California Environmental Quality Act (CEQA) and ARB policy require an analysis to determine the potential environmental impacts of proposed regulations. Because the ARB's program involving the adoption of regulations has been certified by the Secretary of Resources pursuant to Public Resources Code section 21080.5, the CEQA environmental analysis requirements may be included in the Initial Statement of Reasons (ISOR) for this rulemaking. In the ISOR, ARB must include a “functionally equivalent” document, rather than adhering to the format described in CEQA of an Initial Study, a Negative Declaration, and an Environmental Impact Report. In addition, staff will respond, in the Final Statement of Reasons for the regulation, to all significant environmental issues raised by the public during the public review period or at the Board public hearing.

Public Resources Code section 21159 requires that the environmental impact analysis conducted by ARB include the following:

- An analysis of reasonably foreseeable environmental impacts of the methods of compliance;
- An analysis of reasonably foreseeable feasible mitigation measures; and
- An analysis of reasonably foreseeable alternative means of compliance with the regulation.

Compliance with the proposed regulation is expected to directly affect air quality and potentially affect other environmental media as well. Our analysis of the reasonable foreseeable environmental impacts of the methods of compliance is presented below.

Regarding mitigation measures, CEQA requires an agency to identify and adopt feasible mitigation measures that would minimize any significant adverse environmental impacts described in the environmental analysis.

The proposed regulation is needed to reduce the risk from exposures to diesel PM as required by Health and Safety Code (HSC) section 39666 and 39667, and to fulfill the goals of the October 2000 Diesel Risk Reduction Plan. (ARB, 2000) The regulation is also necessary to fulfill ARB's obligations under HSC 43013 and 43018 to achieve the maximum feasible and cost effective emission reductions from all mobile source categories, including off-road diesel engines and equipment. The emission reductions from the proposed regulation in ambient levels of PM, NOx and reactive organic gases (ROG) will help make progress in meeting the State and Federal ambient air quality standards for ozone and PM in non-attainment areas of the State. Alternatives to the proposed regulation have been discussed earlier in Chapter IV of this report. ARB staff have concluded that there are no alternative means of compliance that would achieve similar diesel PM emission reductions at a lower cost.

B. Effects on Air Quality

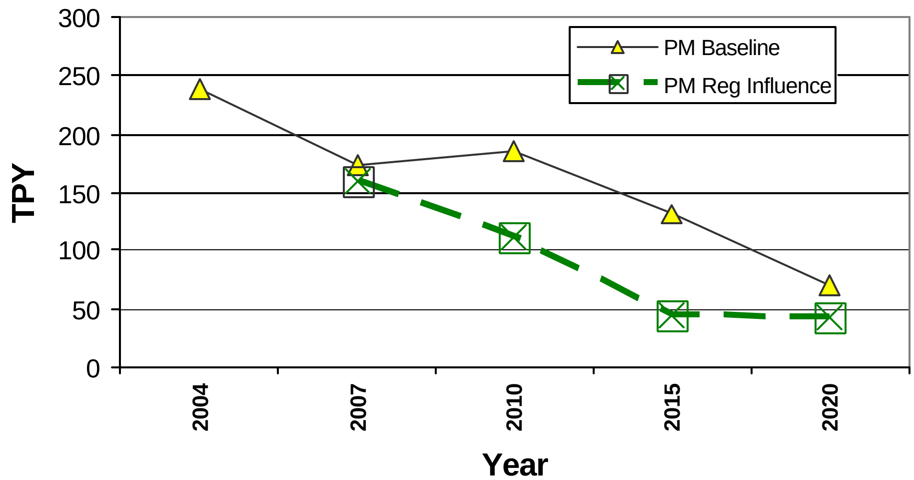
The proposed regulation will provide diesel PM and NOx emission reductions throughout California, especially in areas having ports and intermodal rail yards, areas which in most cases are non-attainment for the State and federal ambient air quality standards for ozone, PM_{10}, and $PM_{2.5}$. The projected controlled emissions from cargo handling equipment engines are presented in Table VI-1.

Table VI-1: Projected Annual Emissions for Cargo Handling Equipment Used in Ports and Intermodal Rail Yard Applications with Implementation of the Proposed Regulation

Category	2004 Emissions (Tons per Day)		2010 Emissions (Tons per Day)		2020 Emissions (Tons per Day)	
	PM	NOx	PM	NOx	PM	NOx
Cranes	0.07	1.93	0.04	1.75	0.02	1.32
Excavators	0.01	0.24	0.00	0.18	0.00	0.04
Forklifts	0.03	0.54	0.01	0.38	0.00	0.17
Container Handling Equipment	0.11	3.25	0.09	3.33	0.04	1.63
Other General Industrial Equipment	0.00	0.08	0.00	0.08	0.00	0.03
Sweepers / Scrubbers	0.00	0.04	0.00	0.04	0.00	0.02
Tractors / Loaders / Backhoes	0.01	0.18	0.01	0.17	0.00	0.07
Yard Trucks	0.42	12.78	0.15	6.49	0.05	1.12
Total	0.65	19.04	0.31	12.43	0.12	4.41

ARB staff estimates that, with implementation of the proposed regulation, diesel PM emissions from cargo handling equipment will be reduced by approximately 0.25 tons per day in 2010, and 0.24 tons per day in 2015 relative to uncontrolled levels. As shown in Figure VI-1, it is about a 40 and 66 percent reduction from the projected 2010 and 2015 baseline levels, respectively. In 2020, ARB staff expects a 39 percent reduction in PM. We also anticipate reductions in reactive organic compounds and carbon monoxide; however, the emission reductions from these pollutants are not yet quantified in the emissions inventory.

Figure VI-1: Projected Diesel PM Emissions with and without the Regulation

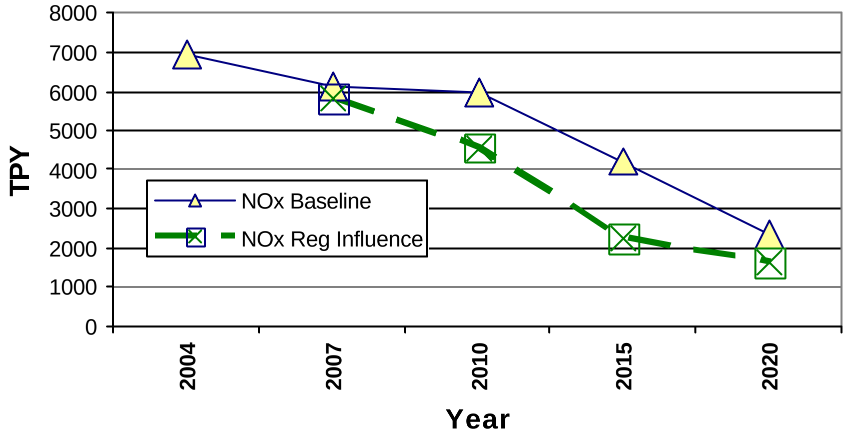


Between 2007 and 2020, we estimate approximately 865 tons of PM will be removed from California's air as a result of the regulation. As shown in Table VI-2, ARB staff estimates that, as older engines are replaced with new engines or retrofitted with diesel emission control strategies, there will also be a reduction in NOx of approximately 18,633 tons in the same time frame.

Table VI-2: Emission Benefits from Implementation of the Proposed Cargo Handling Equipment Regulation

	PM	NOx
Emissions Reduced 2007 to 2020 (Tons)	865	18,633
Annual Average Reductions (Tons per Year)	67	1,433

Figure VI-2: Projected NOx Emissions with and without the Regulation



C. Health Benefits Analysis

Reduced Ambient Particulate Matter Levels

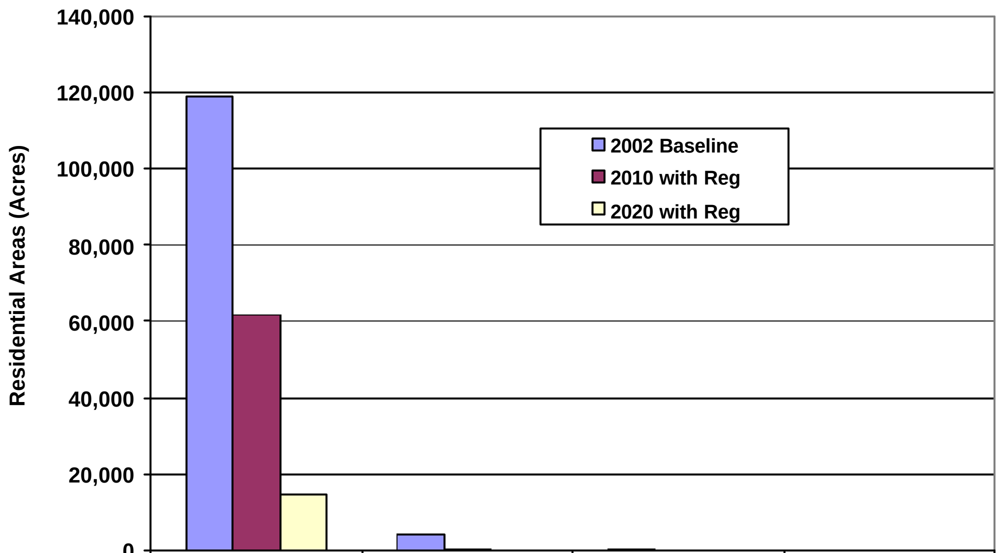
A substantial number of epidemiologic studies have found a strong association between exposure to ambient particulate matter (PM) and adverse health effects. (ARB, 2002) For this report, ARB staff evaluated the impacts the proposed regulation would have on potential cancer risks and conducted a quantitative analysis of four potential non-cancer health impacts associated with exposures to ambient levels of directly emitted diesel PM.

<u>Reduction in Potential Cancer Risks</u>

The reductions in diesel PM emissions that will result from implementation of the proposed regulation will reduce the public's exposures to diesel PM emissions and the potential cancer risks associated with those exposures. ARB staff used the air dispersion model and model inputs developed for the POLA and POLB health risk assessment to estimate the reductions in potential cancer risk that would result in the area surrounding the ports of POLA and POLB from implementation of the proposed regulation. ARB staff believes that the results from this analysis provide quantitative results for exposures around the Ports of Los Angeles and Long Beach and are generally applicable to other ports and intermodal rail yards in California, providing a qualitative estimate for those areas.

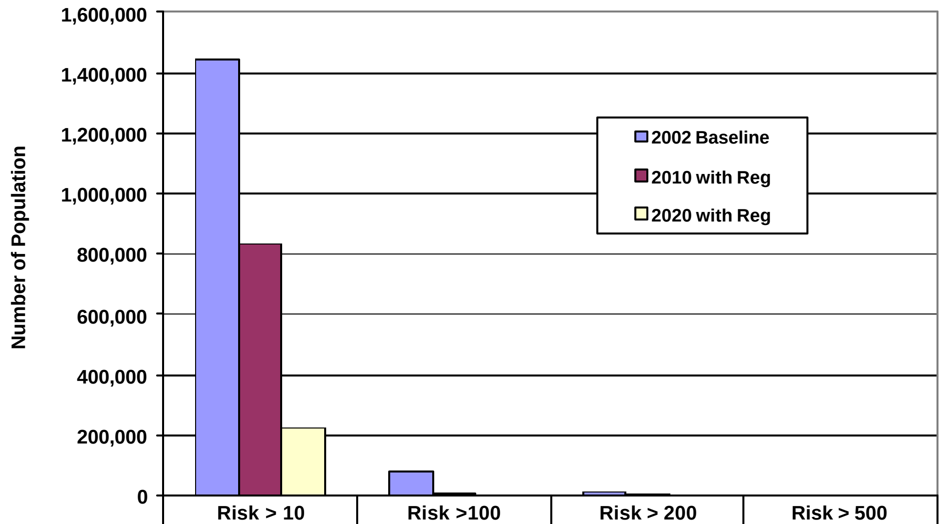
To investigate the reductions in potential risks that will result as emissions from cargo handling equipment decline, ARB staff used dispersion modeling and the projected 2010 and 2020 emissions inventories to estimate the ambient concentration of diesel PM emissions that result from the operation of cargo handling equipment at the Ports of Los Angeles and Long Beach in 2010 and 2020. The potential cancer risks from exposures to the projected 2010 and 2020 emissions were then estimated and compared to the 2002 levels to determine how the potential risks will change. As shown in Figures VI-3 and VI-4, we expect a significant decline in the number of people exposed to high risk levels from cargo handling equipment emissions and the acres impacted as the proposed regulation is implemented. Based on our analysis, which is summarized in Appendix K, we estimate that in 2010 there will be a 56 percent reduction in the population-weighted average risk relative to the risk levels in 2002 from cargo handling equipment emissions and an 82 percent reduction in 2020.

Figure VI-3: Residential Areas Impacted by the Proposed Regulation for Baseline Year (2002) and Predicted 2010 and 2020 at the POLA and POLB



	Risk > 10	Risk >100	Risk > 200	Risk > 500
2002 Baseline	119,000	4,100	410	50
2010 with Reg	61,700	300	80	10
2020 with Reg	14,640	40	10	< 1

Figure VI-4: Population Affected by the Proposed Regulation for Baseline Year (2002) and Predicted 2010 and 2020 at the POLA and POLB



	Risk > 10	Risk >100	Risk > 200	Risk > 500
2002 Baseline	1,444,000	82,000	11,100	3,200
2010 with Reg	832,400	9,000	3,630	960
2020 with Reg	224,650	2,770	960	40

Non-Cancer Health Impacts and Valuations

To determine the impacts from the proposed regulation on non-cancer health endpoints, ARB staff used the methodology described previously in Chapter III but evaluated the change in ambient PM levels that are expected due to implementation of the proposed regulation. This analysis shows that the statewide cumulative impacts of the emissions reduced through this regulation from year 2007 through 2020 are approximately:

- 32 premature deaths (16 to 48, 95% CI)
- 820 asthma attacks (200 to 1,400, 95% CI)
- 7,100 work loss days (6,020 to 8,200, 95% CI)
- 38,000 minor restricted activity days (31,000 to 45,000, 95% CI)

Value of Non-Cancer Effects

Premature Death: The U. S. EPA has established $6.3 million (in 2000 $) for a 1990 income level as the mean value of avoiding one death. (EPA, 2003) As real income increases, people may be willing to pay more to prevent premature death. The U.S. EPA further adjusted the $6.3 million value to $8 million (in 2000 $) for a 2020 income level. Assuming that real income grew at a constant rate from 1990 and will continue at the same rate until 2020, we adjusted the value of avoiding one death for income growth. We then updated the value to 2005 dollars and discounted values of avoiding a premature death in the future back to the year 2005. The U.S. EPA's guidance of social discounting recommends using both three and seven percent discount rates. (EPA, 2000)

Based on these rates, the total valuation of the avoided premature deaths is about $160 million at seven percent discount rate, and $220 million at three percent discount rate. Based on using the annual avoided deaths as weights, the weighted average value of reducing a future premature death, discounted back to the year 2005, is around $5 million at seven percent discount rate, and $7 million at three percent.

Non-Mortality Health Effects: To estimate the values of certain non-mortality health effects, we use U.S. EPA valuations, updated to 2005 dollars, for avoiding non-fatal health effects (EPA, 2003):

- $49 for acute asthma attack
- $180 for work loss day
- $58 for minor restricted activity day (MRAD)

The expected reduction in acute asthma attack is about 820 cases. The total valuation is about $25,000 using a seven percent discount rate, and $33,000 using a three percent discount rate.

For the 7,120 avoided work loss days, their valuation is about $0.8 million using a seven percent discount rate, and $1.1 million using a three percent discount rate. For the 37,820 avoided MRAD, their valuation is about $1.4 million using a seven percent discount rate, and $1.8 million using a three percent discount rate.

Reduced Ambient Ozone Levels

Emissions of NOx and ROG are precursors to the formation of ozone in the lower atmosphere. Exhaust from diesel engines contributes a substantial fraction of ozone precursors in any metropolitan area. Therefore, reductions in NOx and ROG from diesel engines would make a considerable contribution to reducing exposures to ambient ozone. Controlling emissions of ozone precursors would reduce the prevalence of the types of respiratory problems associated with ozone exposure and would reduce hospital admissions and emergency visits for respiratory problems.

D. Reasonably Foreseeable Environmental Impacts as a Result of Potential Compliance Methods

We have identified potential adverse environmental impacts from the use of diesel oxidation catalysts (DOCs) and diesel particulate filters (DPFs). These include a potential increase in sulfate PM, a potential increase in NO_2 from some DPFs, and the potential for creating hazardous wastes. As described below, options are available to mitigate these potential adverse impacts.

Diesel Oxidation Catalyst (DOC)

Two potential adverse environmental impacts of the use of diesel oxidation catalysts have been identified. First, as is the case with most processes that incorporate catalytic oxidation, the formation of sulfates increases at higher temperatures. Depending on the exhaust temperature and sulfur content of the fuel, the increase in sulfate particles may offset the reductions in soluble organic fraction emissions. Using low sulfur diesel fuel can minimize this effect. Starting in 2006 all off-road engines will be required to use CARB fuel (<15 ppm sulfur).

Second, a diesel oxidation catalyst could be considered a "hazardous waste" at the end of its useful life depending on the materials used in the catalytic coating. Because catalytic converters have been used on gasoline powered on-road vehicles for many years, there is a very well-established market for these items (see, for example, http://pacific.recycle.net – an Internet posting of buyers and sellers of various scrap materials). In the recycling process, the converters are broken down, and the metal is added to the scrap-metal stream for recycling, while the catalysts (one or a combination of the platinum group metals) are extracted and reused.

Because of platinum's high activity as an oxidation catalyst, it is the predominant platinum group metal used in the production of diesel oxidation catalysts. There is a very active market for reclaimed platinum for use in new catalytic converters, jewelry, fuel cells, cathode ray tube screens, catalysts used during petroleum refining operations, dental alloys, oxygen sensors, platinum electrode spark plugs, medical equipment, and platinum-based drugs for cancer treatment, to name a few. (Kendall, 2002) (Kendall, 2003)

Catalyzed Diesel Particulate Filters

These devices are composed of a ceramic diesel particulate filter along with a platinum catalyst to catalyze the oxidation of carbon-containing emissions and significantly reduce diesel PM emissions. This is an obvious positive environmental impact.

However, there are also inorganic solid particles present in diesel exhaust, which are captured by diesel particulate filters. These inorganic materials are metals derived from engine oil, diesel fuel, or engine wear and tear. While the PM filter is capable of capturing inorganic materials, these materials are not oxidized into a gaseous form and expelled.

Because these materials would otherwise be released into the air, the filters are benefiting the environment by capturing these metallic particles, known as "ash." However, the ash that is collected in the PM filter must be removed from the filter periodically to maintain the filter's effectiveness.

Ash collected from a diesel engine using a typical lubrication oil and no fuel additives has been analyzed and is primarily composed of oxides of the following elements:

calcium, zinc, phosphorus, silicon, sulfur, and iron. Zinc is the element of primary concern because, if present in high enough concentration, it can make a waste a hazardous waste. Title 22, CCR, section 66261.24 establishes two limits for zinc in a waste: 250 milligrams per liter for the Soluble Threshold Limit Concentration and 5,000 milligrams per kilogram for the Total Threshold Limit Concentration. The presence of zinc at or above these levels would cause a sample of ash to be characterized as a hazardous waste.

Under California law, it is the generator's responsibility to determine whether their waste is hazardous or not. Applicable hazardous waste laws are found in the HSC, division 20; title 22, CCR, division 4.5; and title 40 of the Code of Federal Regulations. Staff recommends owners that install a diesel particulate filter on an engine to contact both the manufacturer of the diesel emission control system and the California Department of Toxic Substances Control (DTSC) for advice on proper waste management.

ARB staff has consulted with personnel of the DTSC regarding management of the ash from diesel particulate filters. DTSC personnel have advised ARB that it has a list of facilities that accept waste from businesses that qualify as a conditionally exempt small quantity generator. Such a business can dispose of a specific quantify of hazardous waste at certain Household Hazardous Waste events, usually for a small fee. An owner who does not know whether or not he qualifies or who needs specific information regarding the identification and acceptable disposal methods for this waste should contact the California DTSC.[9]

Additionally, the technology exists to reclaim zinc from waste. For example, the Swedish company MEAB has developed processes for extracting zinc and cadmium from various effluents and industrial waste streams. Whether reclamation for reuse will be economically beneficial remains to be seen. (MEAB, 2003)

Because of the time and costs associated with filter maintenance, there are also efforts by industry to reduce the amount of ash formed. Most of the ash is formed from the inorganic materials in engine oil, particularly from zinc-containing additives necessary to control acidification of engine oil – due in part to sulfuric acid derived from sulfur in diesel fuel. As the sulfur content of diesel fuel is decreased, the need for acid neutralizing additives in engine oil should also decrease. A number of technical programs are ongoing to determine the impact of changes in oil ash content and other characteristics of engine oil on exhaust emission control technologies and engine wear and performance.

It may also be possible to reduce the ash level in diesel exhaust by reducing oil consumption from diesel engines. Diesel engine manufacturers over the years have reduced engine oil consumption in order to reduce PM emissions and to reduce

[9] Information can be obtained from local duty officers and from the DTSC web site at http://www.dtsc.ca.gov.

operating costs for engine owners. Further improvements in oil consumption may be possible in order to reduce ash accumulation rates in diesel particulate filters.

In addition, measurements of NOx emissions for heavy-duty diesel vehicles equipped with passive catalyzed filters have shown an increase in the NO_2 portion of total NOx emissions, although the total NOx emissions remain approximately the same. In some applications, passive catalyzed filters can promote the conversion of nitrogen oxide (NO) emissions to NO_2 during filter regeneration. More NO_2 is created than is actually being used in the regeneration process; and the excess is emitted. The NO_2 to NOx ratios could range from 20 to 70 percent, depending on factors such as the diesel particulate filter systems, the sulfur level in the diesel fuel, and the duty cycle. (DaMassa, 2002)

Formation of NO_2 is a concern because it irritates the lungs and lowers resistance to respiratory infections. Individuals with respiratory problems, such as asthma, are more susceptible to the effects. In young children, nitrogen dioxide may also impair lung development. In addition, a higher NO_2/NOx ratio in the exhaust could potentially result in higher initial NO2 concentrations in the atmosphere which, in turn, could result in higher ozone concentrations.

Model simulations have shown that a NO_2 to NO_X emission ratio of approximately 20 percent would nearly eliminate any impact of increased NO_2 emissions. (DaMassa, 2002). According to the model, at the NO_2 to NOx ratio of 20 percent, there will be a decrease of the 24-hour ozone exposure (greater than 90 parts per billion) by two percent while an increase of the peak 1-hour NO_2 by six percent (which is still within the NO_2 standard).

The health benefits derived from the use of PM filters are immediate and offset the possible adverse effects of increases in NO_2 emissions. For this reason, a cap of 20 percent NO_2 to NOx emission ratio was established for all diesel emission control systems through ARB's Verification Procedure.

<u>Alternative Fuels</u>

As discussed in Appendix F, a number of alternative fuels and alternative diesel fuels show great promise in their potential to reduce diesel PM emissions. These include alternative diesel fuels such as biodiesel, emulsified diesel fuel, and Fischer-Tropsch fuels, and alternative fuels such as natural gas. No significant negative environmental impacts have been determined from the use of alternative fuels. With respect to alternative diesel fuels, there may be a slight increase in NOx emissions as a result of biodiesel use. (Hofman and Solseng, 2002)

To ensure there are no adverse impacts from the use of alternative diesel fuels, the proposed regulation requires any alternative diesel-fuel or fuel additives used in a cargo handling equipment engine to be verified under the ARB's Verification Procedure. The Verification Procedure permits verification only if a multimedia evaluation of the use of the alternative diesel fuel or additive has been conducted. In addition, verification requires a determination by the California Environmental Policy Council that such use will not cause a significant adverse impact on public health or the environment pursuant to HSC section 43830.8 (see Public Resource Code, section 71017).

E. Reasonably Foreseeable Mitigation Measures

ARB staff has concluded that no significant adverse environmental impacts should occur from adoption of and compliance with the proposed regulation. Therefore, no mitigation measures would be necessary.

F. Reasonably Foreseeable Alternative Means of Compliance with the Proposed Regulation

Alternatives to the proposed regulation are discussed in Chapter IV of this report. ARB staff has concluded that the proposed regulation provides the most effective and least burdensome approach to reducing children's and the general public's exposure to diesel PM, NOx, and other air pollutants emitted from diesel-fueled cargo handling equipment.

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VII. ECONOMIC IMPACTS

In this chapter, we present the estimated costs and economic impacts associated with implementation of the proposed regulation for cargo handling equipment. The expected capital and recurring costs for potential compliance options are presented, the cost and associated economic impacts for businesses, as well as an analysis of the cost-effectiveness of the proposed regulation.

A. Summary of the Economic Impacts

Air Resources Board (ARB) staff estimates the cost for compliance with the regulation to be approximately 71 million dollars for the total capital and recurring costs. This corresponds to about 5.1 million dollars annually on average for the years 2007 through 2020. This cost, which is based on 2004 dollars, represents the capital cost of equipment, maintenance and replacement, and reporting costs from 2007 through to 2020.

The cost for a business to comply with this regulation will vary depending on the number and type of cargo handling equipment and whether the equipment is equipped with a verified diesel exhaust control system (VDECS) and/or later replaced with a new Tier 4 engine in 2015. For example, the costs for a typical crane engine (rated at 210 hp operated 1370 hours per year) with a diesel particulate filter (DPF) is about $17,500 for equipment and installation. The estimated annual ongoing costs are based on a reporting cost of about $500 per terminal with the cost spread over many pieces of equipment. To determine the cost a typical business may incur, we used the ARB Survey data on the average number and type of equipment operated by a port container terminal, a port bulk handling terminal, and an intermodal rail yard and applied the annual average costs for the various equipment types. Based on our analysis, we estimate that the total 2007 to 2020 costs to a typical business will be in the range of $343,000 to $1,373,000.

California businesses are affected by the proposed annual cost of the regulation to the extent that the implementation of the proposed regulation reduces their profitability. Overall, most affected businesses will be able to absorb the costs of the proposed regulation with no significant adverse impacts on their profitability. This finding is based on the staff's analysis of the estimated change in "return on owner's equity" (ROE). The analysis found that the overall change in ROE ranges from negligible to a decline of about 0.1 percent. Generally, a decline of more than ten percent in ROE suggests a significant impact on profitability. Because the proposed regulation would not alter significantly the profitability of most businesses, we do not expect a noticeable change in employment, business creation, elimination, or expansion, and business competitiveness in California. The change in ROE is expected to be a little larger for a small business, but still well below the 10 percent limit.

Staff does not have access to financial records for most of the companies that responded to the survey. However, the small business status of the survey respondents was determined by including a query on the ARB Survey for the owner of the equipment to indicate if their business was a small business (annual gross receipts of $1,500,000 or less for transportation and warehousing per California Government Code Section 11342.610). Approximately 10 percent (7 out of 69) of the respondents identified themselves as small businesses. Six of these small businesses provided sufficient data on their equipment inventory to allow an estimation of the estimated costs for compliance with the proposed regulation. Based on our analysis, the total 2007-2020 costs to small businesses ranged from $41,000 to $638,000 with an average cost of $227,000.

Cost-effectiveness is expressed in terms of control costs (dollars) per unit of air emissions reduced (pounds). The cost-effectiveness for the proposed regulation is determined by dividing the total capital costs plus the annual operation and maintenance and reporting costs by the total pounds of diesel PM reduced during the years 2007 to 2020. All costs are in 2004 equivalent expenditure dollars. With a total cost of 71 million dollars reducing approximately 1.73 million pounds of diesel PM, we estimate the overall cost-effectiveness of the proposed regulation to be about $41 per pound of diesel PM reduced, considering only the benefits of reducing diesel PM. Because the proposed regulation will also reduce NOx emissions, we could allocate half of the costs of compliance against these benefits, resulting in cost-effectiveness values of approximately $21/lb of diesel PM and $1/lb of NOx reduced.

The health benefits of implementing the proposed regulation are substantial. The estimated statewide benefit of reduced premature mortality is about $160 million using a seven percent discount rate or $220 million using a three percent discount rate (2005 dollars).

ARB staff performed the cost analysis relative to the year 2004 (current value of the control costs), and unless otherwise stated, all costs are given in 2004 dollars. Where future costs are mentioned in the cost-effectiveness and mortality sections, they are based on 2004 dollars. In addition, all cost estimates are based on currently available technology as described below; staff believes it is likely that the costs will decrease as technology improves and production and sales volumes increase. Additional details on the cost analysis can be found in Appendix D.

B. Legal Requirements

In this section, we explain the legal requirements that must be satisfied in analyzing the economic impacts of the regulation.

Section 11346.3 of the Government Code requires State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination or creation, and the ability of California business to compete with businesses in other states.

Also, State agencies are required to estimate the cost or savings to any State or local agency and school district in accordance with instructions adopted by the Department of Finance (DOF). The estimate shall include any non-discretionary cost or savings to local agencies and the cost or savings in federal funding to the State.

In addition, Health and Safety Code section 57005 requires the Air Resources Board to perform an economic impact analysis of submitted alternatives to a proposed regulation before adopting any major regulation. A major regulation is defined as a regulation that will have a potential cost to California business enterprises in an amount exceeding ten million dollars. Because the estimated cost of the regulation does exceed 10 million dollars, we have conducted an economic analysis of submitted alternatives to the proposal.

The following is a description of the methodology used to estimate costs as well as ARB staff's analysis of the economic impacts on California businesses and State and local agencies.

C. Methodology for Estimating Costs Associated with Implementation

In this section, we describe how we estimated the costs associated with the proposed regulation. Briefly, the methodology entailed:

- estimating capital and recurring costs in 2004 dollars associated with various compliance options i.e. purchasing a new engine, repowering, using a VDECS;

- identifying the preferred compliance option for the different equipment types and age of engine;

- projecting the 2004 emissions inventory to future years using the OFFROAD model to determine the number of new engines in each year and the number of pre-2007 engines remaining that need to comply with the regulation in that year; and

- assuming all terminals have 4 or more pieces of equipment, apply the estimated costs to the distribution of engines in each future year that need to come into compliance.

Based on the ARB Survey and updated emissions inventory, we estimate that in 2004 approximately 120 private companies having about 3,700 pieces of equipment using diesel engines will be affected by this regulation. Businesses will incur compliance costs to the extent that they have equipment that must meet the performance standards in the regulation. The compliance costs will vary depending on the number and operating parameters of the cargo handling equipment operated and the approach taken to comply with the proposed regulation. Costs were estimated for all categories of equipment except "other." The other category contains a diverse set of equipment such as aerial lifts, railcar movers, and other off-highway trucks. ARB staff believes that the costs for this equipment should fall within the range of costs estimated for the other more well-defined categories. Details of the cost analysis are provided in the following sections and in Appendix D.

Capital and Recurring Costs

The cost evaluation considers both capital and on-going or recurring operating costs. Costs associated with application of VDECS, early retirement of equipment and any incremental costs associated with the purchase of cleaner equipment were considered as described below.

VDECS: The capital investment costs for purchase and installation of VDECS were determined from actual costs of installing VDECS on cargo handling equipment diesel-fueled engines or similar equipment in California over the last 3-5 years as shown in Table VII-1. Costs were developed for each type of cargo handling equipment. The VDECS costs were estimated for those VDECS likely to be available for compliance in the regulation timeframe. (POLB DECS)

Table VII-1: Capital Costs Assumptions for VDECS

Equipment Category	VDECS*	Average Cost ($)
Crane	Passive DPF	$ 17,520
Excavator	DOC	$ 2,269
Forklift	Active DPF	$ 6,000
Container Handling Equip	DOC	$ 2,269
Sweeper/Scrubber	DOC	$ 2,269
Tractor/Loader/Backhoe	DOC	$ 2,269
Yard Tractor	NA	

*DPF means a diesel particulate filter and DOC is a diesel oxidation catalyst.

Fuel costs, in cases where operators of container handling equipment with 2003 to 2006 model year engines choose to install a Level 2 DECS that uses emulsified diesel, were also estimated. In some cases, this may be the preferred compliance option since by using a Level 2 DECS with 2003 to 2006 model year engines, the owner/operator would not have to replace the equipment in 2015. The 2003 to 2006 model year container handling equipment are candidates for this Level 2 DECS. The cost estimate assumed an additional cost of $0.20 per gallon of emulsified fuel applied to the average fuel consumption estimate of 9625 gallons per year. The resulting recurring additional fuel cost of $1925 per piece of equipment is applied.

Early Retirement: For many categories, one compliance option is for accelerated turnover (early retirement) of an engine to a cleaner engine. The cost associated with early equipment retirement is the remaining residual value of the old equipment based on straight line depreciation according to the following equation:

$$\text{Residual Value} = \frac{(\text{New Equipment Costs} - \text{Used Equipment Costs}) \times \#\ \text{Years Early Retirement}}{\text{Expected Useful Life}}$$

The assumptions used for the average costs for new and used equipment i.e. equipment at the end of its useful life, are presented in Table VII-2 below. These cost values are used to calculate the residual value of equipment subject to early retirement. For example, the residual value for a top pick (container handling equipment) being replaced 3 years before the end of its normal expected life (16 years) is estimated to be:

$$\$65,625 = \frac{(\$400,000 - \$50,000) \times 3 \text{ years}}{16 \text{ years/useful life}}$$

In this case, the early retirement costs attributed to compliance with the regulation for this top pick would be $65,625.

Table VII-2: Estimated Value of New and Used Equipment[10]

Equipment Type	New 2004 $	Used
Crane	$ 1,200,000	$ 0**
Excavator	$ 350,000	$ 50,000
Forklift*	NA	NA
Container Handling Equip	$ 400,000	$ 50,000
Sweeper/Scrubber	$ 50,000	$ 5,000
Tractor/Loader/Backhoe	$ 75,000	$ 10,000
Yard Tractor	$ 60,000	$ 6,000

*The estimated forklift values were difficult to establish due to the wide range of forklift sizes and costs. Only five forklifts in the state were estimated to be subject to early retirement near the end of their modeled natural attrition. The costs for these two forklifts are expected to be very low and were not included in the analysis.
** Transportation costs could be equal to or more than the resale value.

Incremental Costs Associated with Cleaner Engines: With the exception of yard trucks, it was assumed that there would be no additional incremental costs attributable to the regulation associated with purchasing a new cleaner off-road engine (i.e. replacing a tier 1 engine with a tier 3 engine). For yard trucks, which will be in most cases transitioning from an off-road engine to an on-road engine, we assumed an incremental cost differential of $1,500 per yard truck. This cost difference is based on the current cost difference quoted by manufacturers for yard trucks with an off-road engine versus specifying an on-road engine. It is assumed that after 2010, when Tier IV engines are expected to become available, there will be no capital costs attributed to the purchase of yard trucks with on-road engines.

Recurring Costs: Operating or recurring costs include expenditures for recordkeeping and reporting and possibly incremental fuel costs. Reporting costs for compliance with

[10] Various data sources; conversations with terminal operators (ARB, APL, 2005), equipment sales personnel inquiries (ARB, Ottawa, 2004), use internet sales websites.

the record keeping and reporting requirements in the proposed regulation was assumed to be $500 per terminal or business per year. Staff estimated approximately 5 hours would be needed to collect and send this information at a pay rate of $100 per hour. ARB staff believes this is a conservative assumption since many companies already keep these records. For both the passive and active DPF, additional operating and recurring costs for cleaning and replacement is expected to be $3,020 and $1,100 annually for the cranes and forklifts, respectively. This additional operating and recurring costs for the cranes and forklifts is based on a $300 cleaning once every three years and replacement every six years. Staff estimates that the passive and active DPFs will last longer than the 4200 hours given in the warranties and six years for cranes and eight years for forklifts is approximately two times this warranty period. The cost for periodic cleaning of DPFs was assumed to be $300. These recurring fuel, DPF replacement, and cleaning costs are included in the annual costs presented in Table VII-7, Table VII-8, and Table VII-9.

Preferred Compliance Option

Based on our understanding of the technology available to comply with the proposed regulation and the compliance options, we identified likely compliance pathways that were then assumed for the cost analysis. While the proposed regulation provides flexibility to operators in determining what compliance option to pursue and the costs will vary with the approach chosen, we believe that the assumptions used in this cost analysis provide a representative picture of the potential costs associated with compliance. Tables VII-3 and VII-4 below summarizes the assumptions for new and in-use equipment respectively.

Table VII-3: Compliance Assumptions for New Equipment

Equipment Category	Compliance Path Assumed in Cost Analysis
Cranes	Until 2011, purchase new crane with current model year off-road engine. Apply passive DPF within one year of purchase. After 2010, purchase crane equipped with Tier IV off-road engine.
Excavators	Until 2011, purchase new excavator with current model year off-road engine. Apply DOC within one year of purchase. After 2010, purchase excavator equipped with Tier IV off-road engine.
Forklifts	Until 2011, purchase new forklift with current model year off-road engine. Apply active DPF within one year of purchase. After 2010, purchase forklift equipped with Tier IV off-road engine.
Container Handling Equipment	Until 2011, purchase new container handling equipment with current model year off-road engine. Apply DOC within one year of purchase. After 2010, purchase container handling equipment equipped with Tier IV off-road engine.
Sweeper/Scrubber	Until 2011, purchase new sweeper/scrubber with current model year off-road engine. Apply DOC within one year of purchase. After 2010, purchase sweeper/scrubber equipped with Tier IV off-road engine.
Tractor/Loader/ Backhoes	Until 2011, purchase new tractor/loader/backhoe with current model year off-road engine. Apply DOC within one year of purchase. After 2010, purchase tractor/loader/backhoe equipped with Tier IV off-road engine.
Yard Trucks	Purchase yard truck with current model year on-road engine until 2010. After 2010, purchase Tier IV off-road engine equipped yard truck.

Table VII-4: Compliance Assumptions for In-Use Equipment

Equipment Category	Compliance Path Assumed in Cost Analysis
Cranes	For Tier 0 engines, early retirement, either the equipment or just the engine depending on age. For Tier 1-3, assume 91% apply passive DPF and 9% early retirement until 2012 when Tier IV engines become available.
Excavators	For Tier 0 engines, early equipment retirement. For Tier 1-3, assume 100% apply DOC until 2012 when Tier IV engines become available.
Forklifts	For Tier 0 engines, early equipment retirement. For Tier 1-3, assume 100% apply Active DPF until 2012 when Tier IV engines become available.
Container Handling Equipment	For Tier 0 engines, early equipment retirement. For Tier 1-3, assume 100% apply DOC until 2012 when Tier IV engines become available.
Sweeper/Scrubber	For Tier 0 engines, early equipment retirement. For Tier 1-3, assume 100% apply DOC until 2012 when Tier IV engines become available.
Tractor/Loader/Backhoes	For Tier 0 engines, early equipment retirement. For Tier 1-3, assume 100% apply DOC until 2012 when Tier IV engines become available.
Yard Trucks	Early equipment retirement following the compliance phase-in schedule starting in 2007 replacing with new on-road engine yard trucks. Assume 65% of the 1996 – 2005 model years yard trucks are offroad engines with an ECS, 10% have offroad engines without any ECS, and 25% have on-road engines.

Future Year Equipment Populations Subject to the Regulatory Requirements

To determine the distribution of engines in future years and the number of engines needing to come into compliance in each year, the 2004 port and intermodal rail yard cargo handling equipment inventory was projected to future years using the OFFROAD model. The OFFROAD model calculates equipment growth, annual use, age distribution, and attrition for eight categories of equipment at ports and intermodal rail yards. Built into the model is the estimate of equipment by model year, by engine type (on-road or off-road) and with emissions control systems. Because the proposed regulation phases in compliance over several years, compliance with the proposed regulation in the early years will modify the distribution of engines in future years. To ensure the cost analysis was representative of future year equipment populations once the regulation takes effect, equipment populations in each year were evaluated after the compliance schedule for the previous year(s) had been incorporated into the model.

When determining the percent of engines needing to come into compliance in a given year, it was assumed that all facilities had four or more pieces of equipment. For example, in 2007, 50 percent of yard trucks without VDECS which are 2002 model year or older need to come into compliance. To estimate the number of yard trucks in this group required to come into compliance, the population of yard trucks remaining in 2007 with model years 2002 or older, that do not have VDECS, is multiplied by 0.50. Tables VII-5 and VII-6 below provide summaries of the yard truck and non yard truck equipment populations in each year (2007-2015) that resulted in compliance costs attributable to the proposed regulation. Additional details on the population distributions are provided in Appendix D.

Table VII-5: Population of Yard Trucks Having Compliance Costs Associated with the Proposed Regulation

Year	Yard Truck Population	
	New	In-Use
2007	290	83
2008	213	329
2009	195	259
2010	192	46
2011	201	89
2012	218	266
2013	215	303
2014	215	218
2015	226	83

Notes: New includes new yard trucks added to the fleet due to growth and new yard trucks added due to replacement of yard trucks at the end of their life (not required by the regulation)

Table VII-6: Population of Non-Yard Truck Equipment Having Compliance Costs Associated with the Proposed Regulation

Year	Population											
	Crane		Excavator		Forklift		Container Handling Equipment		Sweeper/ Scrubber		Tractor/ Loader/ Backhoe	
	New	IU	New	IU	New	IU	New	IU	New	IU	New	IU
2007	35	3	3	0	39	0	71	0	4	0	10	0
2008	37	14	5	0	34	4	70	5	4	0	12	1
2009	37	29	5	3	29	27	78	55	4	3	14	15
2010	41	86	4	5	30	99	88	107	5	6	15	20
2011	21	88	4	5	29	95	73	98	4	6	24	17
2012*	26	81	4	5	31	90	69	90	4	5	20	13
2013*	28	46	5	3	35	59	76	55	4	3	13	6
2014*	25	0	5	0	39	0	81	0	4	0	12	0
2015*	28	0	18	0	46	0	138	0	20	0	51	0

Notes: IU = In-Use. New includes new equipment added to the fleet due to growth and new equipment added due to replacement at the end of their life (not required by the regulation) except in 2015 New includes compliance replacement.

* No associated cost for New due to available of Tier IV engines.

Estimated Capital and Recurring Costs 2007-2020

The costs for compliance with the proposed regulation were estimated using the cost estimates outlined previously, the compliance assumptions provided in Table VII-3 and VII-4, and the populations of equipment subject to the requirements for each year. The detailed annual costs are provided in Appendix D and a summary of the total annual costs for the various types of equipment at ports and intermodal rail yards is provided in Table VII-7.

Table VII-7: Estimated Statewide Annual Costs for Businesses

Annual Costs ($)														
Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Port														
Crane	657,449	1,267,413	1,444,345	2,304,489	2,069,158	1,756,177	1,396,157	792,553	792,553	792,553	792,553	792,553	792,553	792,553
Excavator	4,791	16,222	13,385	16,811	15,906	10,420	5,773	-	1,086,971	-	-	-	-	-
Forklift	224,202	222,383	335,599	835,529	890,455	769,044	650,304	303,132	303,132	303,132	303,132	303,132	303,132	303,132
Container Handling Equip	150,604	324,865	321,960	536,765	582,917	516,350	543,034	423,533	2,134,138	423,533	423,533	423,533	423,533	423,533
Sweeper/ Scrubber	9,228	11,884	16,396	23,841	20,641	11,868	7,336	-	210,910	-	-	-	-	-
Tractor/ Loader/ Backhoe	22,624	35,133	66,701	79,509	90,851	29,989	13,854	-	650,386	-	-	-	-	-
Yard Tractor	1,694,673	6,668,378	4,787,993	964,678	1,762,313	4,500,234	4,976,988	3,201,918	1,083,030	-	-	-	-	-
Port Total:	2,763,570	8,546,278	6,986,378	4,761,623	5,432,242	7,594,081	7,593,446	4,721,135	6,261,119	1,519,217	1,519,217	1,519,217	1,519,217	1,519,217
Rail														
Crane	165,493	227,327	255,086	452,529	450,616	368,748	287,177	160,313	160,313	160,313	160,313	160,313	160,313	160,313
Forklift	8,327	25,270	37,533	46,096	47,500	36,247	22,686	14,318	14,318	14,318	14,318	14,318	14,318	14,318
Container Handling Equip	10,090	89,300	42,306	26,154	21,429	9,630	6,170	-	1,950,325	-	-	-	-	-
Sweeper/ Scrubber	299	337	545	932	1,002	496	348	-	9,171	-	-	-	-	-
Tractor/ Loader/ Backhoe	299	349	548	932	1,002	496	348	-	13,247	-	-	-	-	-
Yard Tractor	124,077	266,602	134,197	96,825	154,285	31,232	38,446	-	-	-	-	-	-	-
Rail Total:	308,585	609,185	470,215	623,469	675,835	446,849	355,177	174,631	2,147,374	174,631	174,631	174,631	174,631	174,631
Reporting Cost	1,200,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Reporting, Port & Rail Total:	4,272,155	9,215,463	7,516,593	5,445,091	6,168,077	8,100,930	8,008,623	4,955,766	8,468,493	1,753,848	1,753,848	1,753,848	1,753,848	1,753,848

D. Estimated Costs to Businesses

In this section, we summarize the costs and economic impacts on businesses. The analysis estimates the overall total statewide cost to businesses and the total costs to different sectors of the industry. We also estimate the overall impact on business competitiveness, employment, and other business impacts as required by state law.

Using the available information from the ARB Survey on the engine population and current in-use and expected PM emission rates, staff determined the percent of engines that would potentially incur capital costs (either from installing a DECS or purchasing new cargo handling equipment) when complying with the proposed regulation.
We estimate the statewide total costs to businesses to be approximately $71 million dollars. The annual costs range from $1.8 million to about $9.2 million per year. The total statewide cost to businesses is derived from the combined capital and installation costs, using 2004 capital cost values, reporting costs and equipment operating and maintenance costs associated with compliance with the regulation. A summary of the expected annual costs was presented previously presented in Table VII-7.

Costs to a Typical Business

For those businesses that operate at ports or intermodal rail yards and have diesel powered cargo handling equipment, the cost will vary depending on the age, number and type of equipment operated. To provide some perspective on the costs that may be incurred by a business, ARB staff estimated the average annual costs to comply with the regulation for the various types of equipment per year. This average annual cost is calculated by dividing the total annual statewide cost for each equipment type by the statewide inventory of that equipment type in a given year. This average annual cost can be used to determine the expected costs to a business for compliance with the regulation (2007-2020). The annual average reflects the fact that, while a single piece of equipment may incur a higher cost during a particular year if it needs to be retrofitted or replaced, not all pieces of equipment need to be retrofitted or replaced. To estimate the costs for a business, the average annual cost is summed over the consecutive 2007 to 2020 years and multiplied by the number of pieces of equipment a business operates. For example, a business with 4 cranes would potentially incur a cost of 14yrs X $4,736/yr X 4 cranes or approximately $265,200. The annual average values used to estimate the costs for businesses are provided in Table VII-8.

Table VII-8: Estimated Statewide Average Costs per Equipment Type

Annual Costs ($)															
Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Annual Avg**
Port															
Crane	2,651	5,111	5,824	9,292	8,343	7,081	5,630	3,196	3,196	3,196	3,196	3,196	3,196	3,196	4,736
Excavator	171	579	478	600	568	372	206	0	38,820	0	0	0	0	0	2,985
Forklift	508	504	761	1,895	2,019	1,744	1,475	687	687	687	687	687	687	687	980
Container Handling Equip	327	705	698	1,164	1,264	1,120	1,178	919	4,629	919	919	919	919	919	1,186
Sweeper/ Scrubber	342	440	607	883	764	440	272	0	7,811	0	0	0	0	0	826
Tractor/ Loader/ Backhoe	246	382	725	864	988	326	151	0	7,069	0	0	0	0	0	768
Yard Tractor	852	3,353	2,407	485	886	2,263	2,502	1,610	545	0	0	0	0	0	1,064
Rail															
Crane	2,267	3,114	3,494	6,199	6,173	5,051	3,934	2,196	2,196	2,196	2,196	2,196	2,196	2,196	3,257
Forklift	362	1,099	1,632	2,004	2,065	1,576	986	623	623	623	623	623	623	623	1,006
Container Handling Equip	388	3,435	1,627	1,006	824	370	237	0	75,013	0	0	0	0	0	5,921
Sweeper/ Scrubber	299	337	545	932	1,002	496	348	0	9,171	0	0	0	0	0	938
Tractor/ Loader/ Backhoe	299	349	548	932	1,002	496	348	0	13,247	0	0	0	0	0	1,230
Yard Tractor	431	926	466	336	536	108	133	0	0	0	0	0	0	0	210
Reporting Cost	10,000	500	500	500	500	500	500	500	500	500	500	$500	500	500	1,179

Using these average costs, we estimated the costs that would be incurred by typical businesses. To determine a typical business, we used the ARB Survey to determine the average number and type of equipment operated by a port container terminal, a port bulk handling terminal and an intermodal rail yard. As shown in Table VII-9, total costs to a typical business can range from about $343,000 to $1,373,000 depending on the type and numbers of equipment.

Table VII-9: Estimated Costs for Typical Businesses

Equipment Type	Port Container Terminal		Port Bulk Terminal		Intermodal Rail Yard	
	Pop	2007-2020 Cost ($)	Pop	2007-2020 Cost ($)	Pop	2007-2020 Cost ($)
Crane	4	265,211	2	132,605	4	265,211
Excavator	0	-	2	83,591	0	-
Forklift	5	68,588	4	54,870	1	13,718
Container Handling Equipment	13	215,778	1	16,598	2	33,197
Sweeper/ Scrubber	1	11,559	1	11,559	0	-
Tractor/ Loader/ Backhoe	0	-	2	21,501	0	-
Yard Truck	54	804,711	1	14,902	17	253,335
Reporting Costs		7,000		7,000		7,000
Total	77	1,372,847	13	342,627	24	572,460

Potential Business Impacts

In this section, we analyze the potential impacts of the estimated costs of the proposed regulation on business enterprises in California. Section 11346.3 of the Government Code requires that, in proposing to adopt or amend any administrative regulation, state agencies shall assess the potential for adverse economic impact on California business enterprises and individuals. The assessment shall include a consideration of the impact of the proposed or amended regulation on the ability of California businesses to compete with businesses in other states, the impact on California jobs, and the impact on California business expansion, elimination, or creation.

This analysis is based on a comparison of the annual return on owner's equity (ROE) for affected businesses before and after the inclusion of the equipment costs, associated recurring costs, and fees. The analysis also uses publicly available information to assess the impacts on competitiveness, jobs, and business expansion, elimination, or creation. ARB staff does not have access to financial records for most of the privatelyowned companies that responded to the ARB Survey. However, the small business status of the survey respondents was determined by including a query on the ARB Survey for the respondent to indicate if their business was a small business (annual gross receipts of $1,500,000 or less for transportation and warehousing per California Government Code Section 11342.610). Based on the ARB Survey responses, staff identified approximately 10 percent of the businesses (7 out of 69 of the respondents) identified themselves as small businesses.

The types of businesses that may be impacted include stevedoring, major shipping lines, rail lines, and equipment rental. Based on the ARB Survey, staff estimates approximately 120 businesses will be affected by this regulation.

The approach used in evaluating the potential economic impact of the proposed regulation on California businesses is as follows:

(1) Affected businesses were identified from responses to the ARB survey. ARB staff identified four publicly traded companies representing various terminal types and Standard Industrial Classification (SIC) codes for evaluation. See Table VII-10.

(2) Annual costs for the regulation are estimated for each of these businesses based on the estimated annual costs of typical businesses.

(3) The total annual cost for each business is adjusted for both federal and states taxes.

(4) These adjusted costs are subtracted from net profit data and the results used to calculate the Return on Owners' Equity (ROE). The resulting ROE is then compared with the ROE before the subtraction of the adjusted costs to determine the impact on the profitability of the businesses. A reduction of more than 10 percent in profitability is considered to indicate a potential for significant adverse economic impacts. This threshold is consistent with the thresholds used by the U.S. EPA and others.

Using Dun and Bradstreet financial data from 2001 to 2004, staff calculated the ROEs, both before and after the subtraction of the adjusted annual costs, for the typical businesses from each industry category. These calculations were based on the following assumptions.

- All affected businesses are subject to federal and state tax rates of 35 percent and 9.3 percent, respectively.

- An affected business neither increases the prices of their products nor lowers their costs of doing business through cost-cutting measures because of the regulation.

These assumptions, though reasonable, might not be applicable to all affected businesses.

Table VII-10: Representative Affected Businesses

Co	SIC	Sales – 3 yr. Ave (million $)	Cost ($)	Net Income (million $)	Net Worth (million $)	Adj. Fee ($)	Adj. Net Income ($)	ROE - Before	ROE - After	% Change
A	4412	3,279.8	98,061	350.37	1,265.40	57,812	350,312,188	27.688%	27.684%	-0.017%
B	4424	1,269.4	98,061	80.10	812.87	57,812	80,042,188	9.854%	9.847%	-0.072%
C	4789	9,823.3	31,928	1,657.30	10,027.70	18,823	1,657,281,177	16.527%	16.527%	-0.001%
D	4821	12,085.7	36,351	1,176.70	11,886.70	21,431	1,176,678,569	9.899%	9.899%	-0.002%

California businesses are affected by the proposed annual cost of the regulation to the extent that the implementation of the proposed regulation reduces their profitability. Overall, most affected businesses will be able to absorb the costs of the proposed regulation with no significant adverse impacts on their profitability. This finding is based on the staff's analysis of the estimated change in "return on owner's equity" (ROE). The analysis found that the overall change in ROE ranges from negligible to a decline of about 0.1 percent. Generally, a decline of more than ten percent in ROE suggests a significant impact on profitability. Because the proposed regulation would not alter significantly the profitability of most businesses, we do not expect a noticeable change in employment, business creation, elimination, or expansion, and business competitiveness in California.

Small Business Costs

Staff does not have access to financial records for most of the companies that responded to the survey. However, the small business status of the survey respondents was determined by including a query on the ARB Survey for the owner of the equipment to indicate if their business was a small business (annual gross receipts of $1,500,000 or less for transportation and warehousing per California Government Code Section 11342.610). Approximately 10 percent (7 out of 69) of the respondents identified themselves as small businesses. Looking at these seven businesses, six provided sufficient data on their equipment inventory to estimate the costs using the average equipment cost data presented in Table VII-8. Based on our analysis, the total 2007-2020 costs to small businesses ranged from $41,000 to $638,000 with an average cost of $227,000. The company with the highest cost identified on the survey as owning nine cranes and four forklifts. The cranes are assumed to be rubber tired gantry cranes with the potential high cost of retrofitting a DPF. The company with the lowest cost has only three forklifts. Based on the overall change in ROE found for a typical business, which ranges from negligible to a decline of about 0.1 percent, the change in ROE is expected to be a little larger for a small business, but still well below the 10 percent limit.

Potential Impact on Employment, Business Creation, Elimination or Expansion

The proposed regulation is expected to have no noticeable impacts on employment and business' status. Businesses that manufacture, sell, install, repair, or clean diesel particulate emission control systems may experience an increase in demand for their products or services, resulting in an expansion of those businesses or the creation of new businesses. Staff believes used engine dealers would not be eliminated; instead, we believe the dealers would adapt to incorporate additional refurbishment and upgrading of the engines for resale.

ARB staff believes jobs will not be eliminated as a result of the regulation, but it may lead to the augmentation or alteration of job duties, leading to no net result change in the number of jobs. For example, a mechanic who previously worked on muffler installation would now be installing a VDECS. Staff believes additional training and emissions testing may be required for these additional duties, if not provided by the VDECS manufacturers. To the extent that VDECS are manufactured in California, some jobs may also be created. Some jobs will be created to install, repair, or clean DECS.

E. Potential Costs to Local, State, and Federal Agencies

This regulation does not directly affect any local, State, or Federal agencies. We anticipate some costs to the ARB to assist in implementation of the regulation; however, we believe these costs can be absorbed in our current and future budgets.

F. Cost-Effectiveness

In this section, the cost-effectiveness of the regulation is estimated. Cost-effectiveness is expressed in terms of control costs (dollars) per unit of air emissions reduced (pounds). As described below, for example, the cost-effectiveness for the proposed regulation is determined by dividing the total capital costs plus the annual operation and maintenance costs by the total pounds of diesel PM reduced during the years 2007 to 2020. All costs are in 2004 equivalent expenditure dollars.

Expected Emission Reductions

We estimated the projected total emission reductions under the regulation using the statewide inventory. The following Table VII-11 provides a summary of the annual statewide diesel PM reductions that will result from the proposed regulation. The total diesel PM reduced by this regulation is expected to be 1.73 million pounds over the calendar years 2007 to 2020. Table VII-12 provides a summary of the annual statewide diesel NOx reductions that will result from the proposed regulation. Negative values in the table represent NOx increases compared to the baseline. These slight NOx increases represent slight changes in the equipment age distribution and the resulting increased activity for newer equipment and little change in NOx emission factors. The total NOx reduced by this regulation is expected to be 37.3 million pounds over the calendar years 2007 to 2020.

Table VII-11: Estimated Statewide Diesel PM Annual Emission Reductions

Annual Diesel PM Reductions (lbs)														
Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Port														
Crane	1,952	4,636	7,520	11,672	13,792	13,845	13,781	13,066	12,128	12,006	11,621	11,184	10,863	10,531
Excavator	57	294	528	739	765	848	871	794	1,751	1,520	1,201	914	641	460
Forklift	381	944	1,516	2,486	3,165	3,701	3,896	3,701	3,413	3,173	2,976	2,605	2,131	1,831
Container Handling Equip	1,588	5,161	9,967	16,076	19,257	22,072	23,685	22,284	24,953	21,972	18,067	15,160	12,280	9,960
Sweeper/ Scrubber	27	83	173	275	331	378	385	350	759	647	515	400	280	199
Tractor/ Loader/ Backhoe	68	213	531	891	1,032	956	946	892	1,321	1,210	1,136	954	682	567
Yard Tractor	22,664	63,316	97,848	106,072	106,200	113,659	120,423	126,311	114,189	94,279	75,621	58,115	42,706	28,010
Port Total:	26,737	74,646	118,082	138,212	144,542	155,460	163,987	167,399	158,516	134,807	111,137	89,333	69,583	51,558
Rail														
Crane	361	1,008	1,586	2,167	2,329	2,525	2,580	2,332	2,262	2,178	2,103	2,033	1,942	1,820
Forklift	11	89	165	203	224	233	218	191	161	139	129	122	118	105
Container Handling Equip	99	750	1,024	1,272	1,430	1,460	1,170	1,165	1,883	1,758	1,638	1,555	1,428	1,234
Sweeper/ Scrubber	1	3	5	9	11	12	13	13	27	24	19	15	11	8
Tractor/ Loader/ Backhoe	0	1	3	6	8	9	10	9	21	18	13	10	7	5
Yard Tractor	1,210	3,517	5,436	7,255	9,551	9,964	9,987	9,300	7,919	6,238	4,326	2,221	705	(0)
Rail Total:	1,682	5,368	8,219	10,911	13,552	14,203	13,977	13,009	12,273	10,354	8,229	5,955	4,212	3,171
Port & Rail Total:	28,419	80,014	126,300	149,123	158,094	169,662	177,964	180,408	170,789	145,162	119,366	95,288	73,795	54,729

Table VII-12: Estimated Statewide Cargo Handling Equipment NOx Annual Emission Reductions

Annual NOx Reductions (lbs)														
Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Port														
Crane	11204	22919	34214	53154	69561	42473	28739	16391	0	0	0	0	0	0
Excavator	0	2657	3651	3103	567	-515	-511	-499	53427	44209	32218	21984	13141	8236
Forklift	0	2184	1980	997	446	-81	-79	-74	-70	-59	-50	-53	-39	-17
Container Handling Equip	0	27842	37884	66627	88567	111192	146843	143493	325862	245301	156578	103168	50901	30566
Sweeper/ Scrubber	0	372	510	433	157	-31	-30	-29	10796	9146	7156	5210	3157	1947
Tractor/ Loader/ Backhoe	0	914	1044	1291	1452	-193	-192	-189	24985	21854	19630	14556	7745	5632
Yard Tractor	636829	1738421	2540635	2585306	2518664	2999365	3446610	3694956	3182828	2468170	1972152	1627953	1423547	1265214
Port Total:	648033	1795310	2619918	2710911	2679412	3152209	3621380	3854049	3597828	2788621	2187685	1772819	1498451	1311578
Rail														
Crane	0	4245	7084	6395	4196	3283	2557	-1950	-1917	-1896	-1865	-1813	-1788	-1753
Forklift	0	783	1375	1274	1192	938	714	355	-5	-172	-169	-159	-156	-156
Container Handling Equip	0	7130	8658	9955	11585	10711	5853	5818	47142	42072	37269	33864	29193	22571
Sweeper/ Scrubber	0	10	11	12	7	-2	-2	-2	853	723	552	390	255	154
Tractor/ Loader/ Backhoe	0	2	3	3	2	0	0	0	201	169	127	89	59	34
Yard Tractor	18571	62796	88214	120082	176468	246560	306195	337829	314572	292611	261241	219205	168871	118722
Rail Total:	18571	74965	105346	137721	193449	261490	315316	342051	360847	333506	297156	251575	196434	139572
Port & Rail Total:	666605	1870275	2725263	2848633	2872861	3413699	3936696	4196100	3958675	3122128	2484841	2024394	1694885	1451150

Cost-Effectiveness

To determine the cost-effectiveness of the proposed regulation, we divided the annual costs by the diesel PM emission reductions attributable to the regulation. The resulting cost-effectiveness in each year of implementation up to 2020 is listed in Table VII-13. The estimated overall annual cost-effectiveness, total PM reduced divided by total cost, is $41 per pound of diesel PM reduced, if all the costs of compliance are allocated to diesel PM reduction. The annual range is from $12 to $150 per pound of diesel PM reduction.

Table VII-13: Summary of Annual Diesel PM Cost-Effectiveness for the Cargo Handling Equipment Regulation

Annual Cost-Effectiveness ($/lbs)														
Years	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Port														
Crane	$337	$273	$192	$197	$150	$127	$101	$61	$65	$66	$68	$71	$73	$75
Excavator	$84	$55	$25	$23	$21	$12	$7	$0	$621					
Forklift	$589	$236	$221	$336	$281	$208	$167	$82	$89	$96	$102	$116	$142	$166
Container Handling Equip	$95	$63	$32	$33	$30	$23	$23	$19	$86	$19	$23	$28	$34	$43
Sweeper/ Scrubber	$336	$142	$95	$87	$62	$31	$19	$0	$278					
Tractor/ Loader/ Backhoe	$334	$165	$126	$89	$88	$31	$15	$0	$492					
Yard Tractor	$75	$105	$49	$9	$17	$40	$41	$25	$9					
Port Total:	$103	$114	$59	$34	$38	$49	$46	$28	$39	$11	$14	$17	$22	$29
Rail														
Crane	$459	$226	$161	$209	$194	$146	$111	$69	$71					
Forklift	$749	$285	$228	$227	$212	$156	$104	$75	$89	$103	$111	$118	$121	$137
Container Handling Equip	$102	$119	$41	$21	$15	$7	$5	$0	$1,035					
Sweeper/ Scrubber	$329	$133	$113	$110	$95	$41	$27	$0	$344					
Tractor/ Loader/ Backhoe	$615	$302	$195	$167	$132	$55	$36	$0	$620					
Yard Tractor	$103	$76	$25	$13	$16	$3	$4	$0	$0					
Rail Total:	$182	$113	$57	$57	$50	$31	$25	$13	$172	$17	$21	$29	$41	$55
Port & Rail Total:	$150	$115	$59	$36	$39	$48	$45	$27	$49	$12	$15	$18	$24	$32

A summary of the overall average cost-effectiveness for the period 2007 through 2020 is presented in Table VII-14. Overall, the cost-effectiveness for all equipment averages about $41 per pound of PM reduction. Since the regulation will also result in reductions in oxides of nitrogen (NOx) emissions, staff conducted a second cost-effectiveness analysis in which half of the cost of compliance was allocated to PM benefits and half the cost was allocated to NOx benefits. This results in cost-effectiveness values of $21/lb diesel PM and $1/lb of NOx.

Table VII-14: Summary of Average Cost-Effectiveness for the Period 2007-2020

Equipment Type	Total Capital Cost 2007 – 2020	Total PM Reduced (lbs) 2007 - 2020	Total PM Cost-Effectiveness ($/lb)	Total NOx Reduced (lbs) 2007 - 2020
Port				
Cranes	$ 16,443,058	148,598	$111	278,655
Excavators	$ 1,170,277	11,383	$103	181,668
Forklifts	$ 6,049,440	35,918	$168	5,085
Container Handling Equipment	$ 7,651,828	222,482	$34	1,534,823
Sweeper/ Scrubber	$ 312,102	4,803	$65	38,793
Tractor/ Loader/ Backhoes	$ 989,047	11,401	$87	98,530
Yard Tractor	$ 29,640,206	1,169,414	$25	32,100,651
Intermodal Rail				
Crane	$ 3,329,164	27,227	$122	14,779
Forklift	$ 323,886	2,107	$154	5,815
Container Handling Equip	$ 2,155,406	17,864	$121	271,820
Sweeper/Scrubber	$ 13,131	169	$78	2,961
Tractor/Loader/ Backhoes	$ 17,222	120	$144	686
Yard Tractor	$ 845,664	77,627	$11	2,731,939
Reporting	$ 1,980,000			
Total	$ 70,920,430	1,729,113	$41	37,266,204

The cost-effectiveness of the proposed regulation for diesel PM is somewhat higher than other regulations recently adopted by the Board (see Table VII-15 below). For example, the diesel PM cost-effectiveness of the solid waste collection vehicle rule was estimated at $28 per pound, excluding the benefits of NOx and hydrocarbon reductions (ARB, 2003a). The cost-effectiveness of the stationary diesel engine airborne toxic control measure (ATCM) was estimated to range from $4 to $26 per pound of diesel PM reduced (ARB,2003b). Finally, the transport refrigeration unit ATCM was estimated to have a cost-effectiveness of $10 to $20 per pound of diesel PM reduced (ARB, 2003c). The cost-effectiveness of the proposed regulation for diesel PM is influenced by the adopted new engine standards which reduce the future emission reductions and thus results in higher cost-effectiveness values. Nevertheless, the proposed regulation is an important step in reducing the serious public health impacts from diesel PM emissions in communities near ports and intermodal rail yards.

Table VII-15: Diesel PM Cost-Effectiveness of the Proposal and Other Regulations/Measures (Attributes All Costs to Each Pollutant Individually)

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

G. Analysis of Alternatives

In this section, we compare the cost-effectiveness of the proposed regulation to two alternative control options. As described below, the two alternatives analyzed would achieve significantly less emission reductions and associated health benefits. However, the cost of these alternatives would also be lower, resulting in lower cost-effectiveness compared to the proposal.

Alternative 1: Continue Voluntary Efforts

For alternative 1, it was assumed that the voluntary efforts would continue with newly purchased equipment until 2012 when new equipment would have Tier 4 off-road engines. The estimated costs to the equipment owners is approximately $1.9 million during the five years from 2007 to 2011 with an average annual cost of $380,000, if terminals and intermodal facilities continued to voluntarily continue their efforts to change-over their existing fleets at past rates. The total PM reduction associated with this alternative is 121 tons during the same 2007 to 2020 timeframe. The cost-effectiveness for this alternative is lower than the regulation at $8 per pound of diesel PM reduced. Voluntary efforts would result in emission reductions, however, the emissions benefits would be substantially less than that predicted from the proposed regulation. The voluntary efforts would forego about 744 tons of PM and 18,215 tons of NOx that the proposed regulation would reduce.

Alternative 2: Regulate Yard Trucks Only

Alternative 2 is similar to the proposed regulation, but would only affect the yard trucks. This reduction in the scope of the regulation reduces the cost by 50 percent and cost-effectiveness by about 30%. The total cost would be $32.5 million with a diesel PM reduction of 1,247,140 pounds resulting in a cost-effectiveness of $26 per pound PM reduced. The NOx reduction would be 17,400 tons, about 1,230 tons less than the regulation's NOx reduction. The full regulation will cost $71 million and reduce diesel PM by 1,729,100 pounds. The full regulation is more costly at $41 per pound PM reduced, but reduces PM by an additional 481,970 pounds (241 tons) and NOx by an additional 1,230 tons during the same 2007 to 2020 timeframe

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