Air Resources Board

PUBLIC MEETING AGENDA

December 08, 2005

9:00 a. m

Agenda Items to be heard;

05-12-1: 05-12-2: 05-12-3:

05-12-8: 05-12-4: 05-12-5:

05-12-6: 05-12-7

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California Environmental Protection Agency

ELECTRONIC BOARD BOOK

California Environmental Protection Agency

Air Resources Board

PUBLIC MEETING AGENDA

LOCATION:
Air Resources Board
Byron Sher Auditorium, Second Floor
1001 I Street
Sacramento, California 95814

This facility is accessible by public transit. For transit information, call (916) 321-BUSS, website: http://www.sacrt.com
(This facility is accessible to persons with disabilities.)

December 8, 2005
9:00 a.m.

Item #

05-12-1: Report to the Board on a Health Update – Results of a Study on the Long-Term Effects of Ambient Particulate Matter on the Risk of Fatal Coronary Heart Disease

Staff will present a recent study that found an association between the risk of fatal heart disease in women and particulate matter (PM) concentrations.

05-12-2: Public Hearing to Consider 8 Research Proposals

"Economic Value of Reducing Cardiovascular Disease Associated with Air Pollution," San Diego State University.

"Fine-Scale Spatial and Temporal Variability of Particle Number Concentrations within Communities and in the Vicinity of Freeway Sound Walls," University of Southern California.

"Physicochemical and Toxicological Assessment of the Semi-Volatile and Non-Volatile Fractions of PM from Heavy- and Light-Duty Vehicles Operating with and without Emissions Control Technologies," University of Southern California.

"Ultrafine Particle Concentrations in Schoolrooms and Homes," University of California, Berkeley.

"Augmentation to Ventilation and Indoor Air Quality in New Homes," Indoor Environmental Engineering.

"Light Duty Gasoline PM: Characterization of High Emitters and Valuation of Repairs for Emission Reduction," University of California, Riverside.

"CO_2 Emission Quantification from Vehicle Air Conditioning Operation in California-Specific Conditions," California State University, Northridge.

"Improving the Carbon Dioxide Emission Estimates from the Combustion of Fossil Fuels in California," University of California, Berkeley.

05-12-3: Public Meeting to Consider the Approval of Grants under the Innovative Clean Air Technologies (ICAT) Program

Staff is recommending ICAT grants for four proposed projects: 1) "Cost-Effective NOx Control for Stationary Diesel Engines" by Catalytica Energy Systems, Inc.; 2) "Orbital Scythe Prototype Development and Testing" by O-Sage Power Equipment, LLC; 3) "Integrated CHP Using Ultra-Low-NOx Supplemental Firing" by Gas Technology Institute; and 4) "Freedom Air Commercial Field Demonstration Project w/ Long Beach Transit" by Rotec Design, Ltd.

05-12-8: Report to the Board on the Goods Movement Action Plan

Staff will update the Board on the Business Transportation & Housing and California Environmental Protection Agency's joint Goods Movement Action Plan, including how that plan relates to ongoing programs at the Air Resources Board and to the estimation of public health impacts.

05-12-4: Public Hearing to Consider the Adoption of a Proposed Regulation for Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yards

The staff is proposing a regulation for Board consideration that would reduce emissions of diesel particulate matter and oxides of nitrogen from mobile cargo handling equipment used at ports and intermodal rail yards in California.

05-12-5: Public Hearing to Consider the Adoption of Proposed Regulations to Reduce Emissions from Auxiliary Diesel Engines and Diesel-Electric Engines Operated on Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baseline

The staff is proposing a regulation for Board consideration that would reduce emissions of particulate matter, oxides of nitrogen, and sulfur oxides from the use of auxiliary diesel engines and diesel-electric engines operated on ocean-going vessels located within 24 nautical miles of the California coastline. The proposed regulation would apply to both U.S.-flagged vessels and foreign-flagged vessels.

05-12-6: Public Hearing to Consider the Adoption of a Diesel Particulate Matter Control Measure for On-Road Heavy-Duty Diesel-Fueled Vehicles Owned or Operated by Public Agencies and Utilities

Diesel vehicles owned and operated by public agencies and utilities operate in residential communities on a regular basis, resulting in an increase in the communities' risk of exposure to toxic emissions and oxides of nitrogen. The proposed regulations would require that these fleets reduce their diesel emissions through application of best available control technology as specified.

05-12-7: Report to the Board on the Final Modifications to the 2005 Revisions to the Carl Moyer Program Guidelines

At its November 17, 2005 meeting, the Board adopted the 2005 revisions to the Carl Moyer Program Guidelines with various modifications identified at the meeting. The Executive Officer will report to the Board on the final drafting of these modifications.

OPEN SESSION TO PROVIDE AN OPPORTUNITY FOR MEMBERS OF THE PUBLIC TO ADDRESS THE BOARD ON SUBJECT MATTERS WITHIN THE JURISDICTION OF THE BOARD.

Although no formal Board action may be taken, the Board is allowing an opportunity to interested members of the public to address the Board on items of interest that are within the Board's jurisdiction, but that do not specifically appear on the agenda. Each person will be allowed a maximum of five minutes to ensure that everyone has a chance to speak.

TO SUBMIT WRITTEN COMMENTS ON AN AGENDA ITEM IN ADVANCE OF THE MEETING:

CONTACT THE CLERK OF THE BOARD, 1001 I Street, 23rd Floor, Sacramento, CA 95814 (916) 322-5594
FAX: (916) 322-3928
ARB Homepage: www.arb.ca.gov

To request special accommodation or language needs, please contact the following:

- TTY/TDD/Speech-to-Speech users may dial 7-1-1 for the California Relay Service.
- Assistance for Disability-related accommodations, please go to http://www.arb.ca.gov/html/ada/ada.htm or contact the Air Resources Board ADA Coordinator, at (916) 323-4916.
- Assistance in a language other than English, please go to http://www.arb.ca.gov/as/eeo/languageaccess.htm or contact the Air Resources Board Bilingual Coordinator, at (916) 324-5049.

THE AGENDA ITEMS LISTED ABOVE MAY BE CONSIDERED IN A DIFFERENT ORDER AT THE BOARD MEETING.

SMOKING IS NOT PERMITTED AT MEETINGS OF THE CALIFORNIA AIR RESOURCES BOARD

California Environmental Protection Agency

Air Resources Board

PUBLIC MEETING AGENDA

INDEX

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December 8, 2005
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State of California

AIR RESOURCES BOARD

Research Resolutions

Research Division

December 8, 2005

INTRODUCTION

Contained herein for Board review are 8 resolutions and accompanying summaries from the Extramural Research Program recommended to the Board by the Research Screening Committee.

Item 1 is a research proposal from San Diego State University, entitled "Economic Value of Reducing Cardiovascular Disease Associated with Air Pollution". The principal investigator will be Dr. Mark Thayer. Resolution No. 05-69

Item 2 is a research proposal from the University of Southern California, entitled "Fine-Scale Spatial and Temporal Variability of Particle Number Concentrations within Communities and in the Vicinity of Freeway Sound Walls and Tree Lines". The principal investigator will be Professor Constantinos Sioutas. Resolution No. 05-70

Item 3 is a research proposal from the University of Southern California, entitled "Physicochemical and Toxicological Assessment of the Semi-Volatile and Non-Volatile Fractions of PM from Heavy- and Light-Duty Vehicles Operating with and without Emissions Control Technologies". The principal investigator will be Professor Constantinos Sioutas. Resolution No. 05-71

Item 4 is a research proposal from the University of California, Berkeley, entitled, "Ultrafine Particle Concentrations in Schoolrooms and Homes". The principal investigator will be Professor William Nazaroff. Resolution No. 05-72

Item 5 is a research contract augmentation from the Indoor Environmental Engineering, entitled "Augmentation to Ventilation and Indoor Air Quality in New Homes". The principal investigator will be Mr. Francis Offerman, III. Resolution No. 05-73

Item 6 is a research proposal from the University of California, Riverside, entitled, "Light Duty Gasoline PM: Characterization of High Emitters and Valuation of Repairs for Emission Reduction". The principal investigators will be Professor John Collins and Dr. Thomas Durbin. Resolution No. 05-74

Item 7 is a research proposal from California State University, Northridge, entitled, "CO_2 Emission Quantification from Vehicle Air Conditioning Operation in California-Specific Conditions." The principal investigator will be Dr. Timothy Fox. Resolution No. 05-75

Item 8 is a research proposal from the University of California, Berkeley, entitled, "Improving the Carbon Dioxide Emission Estimates from the Combustion of Fossil Fuels in California". The principal investigators will be Dr. Michael Hanemann and Ms. Lynn Price. Resolution No. 05-76

PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 05-69

December 8, 2005

Agenda Item No.: 05-12-2

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2599-250, entitled "Economic Value of Reducing Cardiovascular Disease Morbidity Associated with Air Pollution", has been submitted by San Diego State University Research Foundation;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2599-250 entitled "Economic Value of Reducing Cardiovascular Disease Morbidity Associated with Air Pollution", submitted by San Diego State University Research Foundation, for a total amount not to exceed $349,632.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2599-250 entitled "Economic Value of Reducing Cardiovascular Disease Morbidity Associated with Air Pollution", submitted by San Diego State University Research Foundation, for a total amount not to exceed $349,632.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $349,632.

ATTACHMENT A

"Economic Value of Reducing Cardiovascular Disease Morbidity Associated with Air Pollution"

Background

Biological and epidemiological research continues to uncover new associations between airborne pollutants and human health. Recent health effects studies indicate that pollution exposure is a risk factor for developing cardiovascular disease, not just for aggravating existing disease. This is an extremely serious health risk and one that will be important to include in benefits assessment for pollution control.

Previous health benefits analyses have estimated COI (cost of illness) values for cardiovascular hospitalizations and heart attacks, based on medical costs and work loss during the episode. However, these episodes represent only a small component of an entire lifetime profile of cardiovascular disease. The economic significance, in terms of the monetary value of the total effect on the well-being of the affected individuals, of reducing the chances that cardiovascular disease will develop is probably significantly understated by the monetary estimates currently used in health benefits analysis.

Objective

The objective of this study is to estimate the economic value of reducing new cases of cardiovascular disease using willingness to pay (WTP) estimation methods. Viscusi et al. (1991) developed a valuation instrument for chronic bronchitis, and a variation on this approach was implemented by Krupnick and Cropper (1992). The proposed study will use this approach as a starting point, adapting it to cardiovascular disease and updating the instrument to reflect current approaches used in the non-market valuation literature.

Methods

WTP is estimated using a survey method. The contractor will design a survey instrument to collect data on WTP values to reduce a respondent's risk of developing cardiovascular disease. The target population will be adults who do not currently have cardiovascular disease because this is the population that benefits from reduced pollution exposures that result in lowered risks of developing cardiovascular disease.
The survey instrument will include a description of the lifetime profile for cardiovascular disease. The most cost-effective way to implement this survey will be through an established web-based survey panel. This will allow efficient identification of a survey sample and delivery of the instrument via computer. It also permits customization of the instrument to the survey respondent and flexibility to program various versions of the instrument.

Expected Results

The results of this study will include estimates of both the direct medical cost (COI) for an individual lifetime of cardiovascular disease morbidity and individual WTP to reduce the risk of a lifetime of cardivascular disease morbidity. WTP for an individual reflects how much of other goods and services the individual is willing to give up to obtain a reduction or prevent an increase in adverse health effects. This yields a dollar measure of the change in well-being that the individual expects to experience.

Significance to the Board

This study will extend both the empirical and the methodological basis for economic benefit valuation of air quality control measures and increase ARB's ability to assess the benefits of reducing air pollution exposure. A WTP estimate for CVD morbidity, along with established mortality estimates, can be combined with exposure data and relevant dose-response functions to more accurately determine the health benefits of California regulations that reduce exposure to air pollutants associated with cardiovascular disease.

Contractor:

San Diego State University Research Foundation

Contract Period:

30 months

Principal Investigator (PI):

Mark Thayer, Ph.D.

Contract Amount:

$349,632

Basis for Indirect Cost Rate:

San Diego State University Research Foundation's federally negotiated indirect cost rate for research projects is 52 percent. However, the University agreed to reduce its rate to 26 percent in support of this project.

Past Experience with this Principal Investigator:

Dr. Mark Thayer was the PI for two ARB contracts: "Economic Value of Hospitalizations Associated with Particulate and Ozone Air Pollution," and "Development of Methods to Estimate the Benefits of Visibility Improvement." Dr. Thayer completed both of his previous ARB-funded studies in a competent, timely and professional manner.

Prior Research Division Funding to SDSU:

Year	2005	2004	2003
Funding	$0	$0	$0

BUDGET SUMMARY

San Diego State University Research Foundation

"Economic Value of Reducing Cardiovascular Disease Morbidity Associated with Air Pollution"

DIRECT COSTS AND BENEFITS		
1.	Labor and Employee Fringe Benefits	$ 83,881
2.	Subcontractors	$ 219,120[1]
3.	Equipment	$ 0
4.	Travel and Subsistence	$ 3,000
5.	Electronic Data Processing	$ 0
6.	Reproduction/Publication	$ 0
7.	Mail and Phone	$ 700
8.	Supplies	$ 3,000
9.	Analyses	$ 0
10.	Miscellaneous	$ 0
	Total Direct Costs	$309,701
INDIRECT COSTS		
1.	Overhead	$ 39,931
2.	General and Administrative Expenses	$ 0
3.	Other Indirect Costs	$ 0
4.	Fee or Profit	$ 0
	Total Indirect Costs	$ 39,931
TOTAL PROJECT COSTS		**$349,632**

[1] Includes $101,120 for Stratus Consulting, Inc., $105,000 for Knowledge Networks Inc., $10,000 for James Murdoch, University of Texas, Dallas (Econometrician), and $3,000 for three survey reviewers.

Attachment 1

SUBCONTRACTOR'S BUDGET SUMMARY

Subcontractor: Stratus Consulting

Stratus Consulting will be primarily responsible for: Task 1, (literature review), Task 3 (Survey Instrument Development), and Task 7 (report writing), as well as portions of study plan design, survey pre-test, implementation, and data analysis.

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 96,820	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 1,600	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 400	
8.	Supplies	$ 400	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 1,900	
	Total Direct Costs		$101,120
INDIRECT COSTS			
1.	Overhead	$ 0	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 0
TOTAL PROJECT COSTS			**$ 101,120**

Attachment 2

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: Knowledge Networks Inc.

Knowledge Networks Inc. will be responsible for survey pretest and survey implementation, and will provide access to a pre-qualified, representative panel of survey respondents.

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 105,000	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 0	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 0	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 0	
	Total Direct Costs		$105,000
INDIRECT COSTS			
1.	Overhead	$ 0	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$0
TOTAL PROJECT COSTS			**$ 105,000**

PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 05-70

December 8, 2005

Agenda Item No.: 05-12-2

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2600-250, entitled "Fine Scale Spatial and Temporal Variability of Particle Number Concentrations within Communities and in the Vicinity of Freeway Sound Walls and Tree Lines" has been submitted by the University of Southern California;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2600-250 entitled "Fine Scale Spatial and Temporal Variability of Particle Number Concentrations within Communities and in the Vicinity of Freeway Sound Walls and Tree Lines," submitted by University of Southern California, for a total amount not to exceed $461,334.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2600-250 entitled "Fine Scale Spatial and Temporal Variability of Particle Number Concentrations within Communities and in the Vicinity of Freeway Sound Walls and Tree Lines," submitted by University of Southern California, for a total amount not to exceed $461,334.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $461,334.

ATTACHMENT A

"Fine Scale Spatial and Temporal Variability of Particle Number Concentrations within Communities and in the Vicinity of Freeway Sound Walls and Tree Lines"

Background
Particulate matter (PM) appears to be the most significant contributor to the adverse health effects of air pollution, due to its links to excess mortality and cardiovascular and respiratory illness. The strongest links between PM and adverse effects are for the mass-based measures, PM2.5 and PM10, but there is growing concern that particle number, usually dominated by the particles in the ultrafine (UF) size range (<0.1 µm), may also have important health effects. They appear to be of potentially greater relative toxicity than larger particles because of their ability to directly penetrate cell membranes, their relatively high adsorption of organic components, and their relatively high deposition efficiency in the lung.

Particle numbers typically show poor correlation with PM mass measures and appear to decline more sharply with distance from the source than do PM10 or PM2.5 mass concentrations. For example, one study found little or no correlation between particle number and mass in the South Coast Air Basin. Another study found very sharp UF number concentration gradients downwind and adjacent to both the gasoline vehicle-dominated 405 freeway and the heavily diesel-traveled 710 freeway in Los Angeles, with 3 to 4 times higher concentrations near the freeways compared to 100 meters away. In general, UF particle numbers in urban ambient air appear to be driven by combustion of fossil fuels, particularly motor vehicles.

Besides primary combustion sources, a recent study suggests that photochemical secondary formation of UF particles can be a primary UF particle source during summer months, leading to significant long-range transport well away from primary sources.

Objective
The overall objective of this study is to better characterize the spatial and temporal variability of UF particles near sources at the community level and in locations of interest in Southern California. Specific objectives include:

1. Quantifying the effect of specific local sources and evaluating their relative importance compared to urban background
2. Developing predictive models based on meteorological and source characteristics, and,
3. Determining if freeway sound walls and tree lines themselves have an important impact.

Methods
Researchers at USC propose to use 10 to 12 ARB-owned 3022A condensation particle counters (CPCs) to measure UF particle number variability at 10 to 12 sites clustered within a 3000 meter radius. This will be done in both the Wilmington area of Los

Angeles and in Riverside. The Wilmington area measurements will be used to determine the importance of mobile source, refinery, and port activity on UF particle concentrations, relative to urban background, while the Riverside measurements will investigate the importance of secondary UF particle formation and transport. Each of the two communities will be monitored for two separate three-month periods, in both summer and winter seasons. Wilmington measurements will coincide with other concurrent Wilmington projects. Each CPC will be accompanied by its own, low-cost meteorological station, collecting time-resolved wind speed and direction, temperature, and humidity. These meteorological measurements will allow more accurate triangulation and back-trajectory calculations to evaluate specific sources

The effect of sound walls and tree lines on UF particle concentrations will also be studied. Two 2-week periods of intensive monitoring campaigns will be conducted, one two-week period at a freeway at ground level and another at a tree line. Measurements will be conducted at locations near breaks in the freeway wall or tree line, close enough together to have similar conditions, but far enough away to avoid edge conditions for the wall impacted side. Upwind and several downwind locations will be measured with CPCs, along with CO/CO2 measurements and nephelometers for relative PM mass concentration changes.

Expected Results
Results from this study will determine the relative importance compared to background of local and regional UF particle sources in the Wilmington/Long Beach area and the relative importance of local, regional, and secondary formation of UF particles in the Riverside area. Also, the study will produce predictive models that will define the most important associations between UF concentrations and source types, source strengths, meteorological conditions, and distance. Results will also characterize the effect of freeway sound walls and tree lines on the downwind UF particle concentrations due to mobile sources.

Significance to the Board
Results from this study will help the ARB understand the relative importance compared to background of specific UF particle sources and their concentrations at the community level. It will also aid the ARB in predicting UF particle concentrations in other urban areas of California. These are both important first steps in better understanding UF particle exposures and the resulting health impacts, both being prerequisites in the eventual determination of whether an UF air quality standard would be justifiable. Results from the freeway sound wall and tree line investigations will determine whether measures taken to reduce freeway noise impacts and aesthetic impacts also have any air quality benefits.

Contractor:
University of Southern California

Contract Period:
24 months

Principal Investigator (PI):
Costas Sioutas, Sc.D.

Contract Amount:
$461,334

Cofunding:
USC has secured separate US EPA funding that will enhance specific source evaluations for this project.

Basis for Indirect Cost Rate:
The State and the University of Southern California have agreed to a 30 percent indirect cost rate. This is the lowest rate they offer to any funding organization.

Past Experience with this Principal Investigator:
ARB staff have extensive previous experience with Dr. Sioutas. His expertise is based on developing technologies for measuring the physicochemical characteristics of air pollutants and determining their toxic properties. Staff's past experience with Dr. Sioutas has been positive and productive.

Prior Research Division Funding to USC:

Year	2005	2004	2003
Funding	$0	$0	$0

BUDGET SUMMARY

University of Southern California

"Fine Scale Spatial and Temporal Variability of Particle Number Concentrations within Communities and in the Vicinity of Freeway Sound Walls and Tree Lines"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 231,840	
2.	Subcontractors	$ 0	
3.	Equipment	$ 24,000	
4.	Travel and Subsistence	$ 4,340	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 105,200[1]	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 0	
	Total Direct Costs		$365,380
INDIRECT COSTS			
1.	Overhead	$ 95,954	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 95,954
TOTAL PROJECT COSTS			**$461,334**

[1] Materials and Supply Details:

CPC servicing and calibration, 18 at $3,500 ea	$63,000
Laptop computers to log data, 12 at $1600	$19,200
Meteorological stations, 12 at $500	$ 6,000
Siting costs for power, security, compensation	$12,000
Hardware and spare parts	$ 5,000
TOTAL	$105,200

PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 05-71

December 8, 2005

Agenda Item No.: 05-12-2

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2592-250, entitled "Physicochemical and Toxicological Assessment of the Semi-Volatile And Non-Volatile Fractions of PM from Heavy- and Light-Duty Vehicles Operating with and without Emissions Control Technologies", has been submitted by the University of Southern California;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the South Coast Air Quality Management District has agreed to co-sponsor this proposal for a total amount not to exceed $338,975; and

WHEREAS, the Air Resources Board will fund this proposal for a total amount not to exceed $338,975; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2592-250 entitled "Physicochemical and Toxicological Assessment of the Semi-Volatile and Non-Volatile Fractions of PM from Heavy- and Light-Duty Vehicles Operating with and without Emissions Control Technologies", submitted by the University of Southern California, for a total amount not to exceed $677,950.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2592-250 entitled "Physicochemical and Toxicological Assessment Of The Semi-Volatile And Non-Volatile Fractions of PM from Heavy- and Light-Duty Vehicles Operating with and without Emissions Control Technologies", submitted by the University of Southern California, for a total amount not to exceed $677,950.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $677,950.

ATTACHMENT A

Physicochemical and Toxicological Assessment of the Semi-Volatile and Non-Volatile Fractions of PM from Heavy- and Light-Duty Vehicles Operating with and without Emissions Control Technologies

Background

Recent emissions testing in either dynamometer or on-road testing facilities have shown that particles emitted from vehicles are externally mixed; i.e., different particles of the same size can have different chemical compositions. Depending on vehicle type, age, and ambient conditions, between 70-90 percent of the particles by number (10-30% by mass) may consist of more volatile material (known as semi-volatile) than the other particles, and upon heating, will partially or completely evaporate. The exposure and health implications of these findings have not yet been investigated. There are several factors in regulatory development that require knowledge of the relative toxicities of these non-volatile and semi-volatile particles. They include: 1) based on particle number, people's exposure during commute is dominated by semi-volatile particles; 2) some control technologies for diesel PM, such as diesel particulate filters, effectively remove the non-volatile PM, but have a mixed impact on the semi-volatile fraction; and 3) European authorities are moving ahead with a particle number standard for diesel and some gasoline engines, considering only non-volatile particles. As California considers its own need to augment the current mass-based standards, the association between any proposed number-based standard and toxicity must be better understood.

Objective

The objective of this project is to determine the physicochemical and toxicological properties of the semi-volatile and non-volatile fractions of PM from heavy- and light-duty vehicles operating with and without emissions control technologies.

Methods

Heavy- and light-duty vehicle emission PM samples will be collected from vehicles operated on chassis dynamometers using filters and bio-samplers. Thermal denuders will be used to separate the volatile and non-volatile fractions. Particle concentrators will be employed to allow collection of sufficient amounts of exhaust PM for subsequent biological analysis. Gaseous emissions will also be measured. The heavy-duty technologies to be tested will include a diesel with no after-treatment, a diesel with an oxidation catalyst, a diesel with a diesel particulate filter, and a diesel with SCRT, possibly a diesel fueled with biodiesel, a CNG bus without exhaust after-treatment, a CNG bus with an oxidation catalyst, and a gasoline truck. Light-duty vehicles to be tested will include an old high-emitting vehicle and a new low-emission vehicle. The collected samples will be analyzed for toxicity using assays developed by Dr. Froines at the University of California, Los Angeles. These assays measure the collected samples' potential to induce redox chemistry and oxidative stress in biological tissues.

Expected Results

This study will provide data on the toxicities of the volatile and non-volatile PM fractions of vehicle exhaust. The study will also provide data on the relative toxicities of PM from different automotive and control technologies.

Significance to the Board
The study will examine the relative toxicities of the volatile and non-volatile fractions of PM emissions from vehicular exhaust. Several different control technologies will be evaluated. These results should provide insight into how best to reduce the toxic effects of these mobile sources on road and in the choice of control technology.

Contractor:
University of Southern California

Contract Period:
48 months

Principal Investigator (PI):
Constantinos Sioutas, Sc.D.

Contract Amount:
$677,950

Cofunding:
The South Coast Air Quality Management District is contributing $338,975 to the cost of this study.

Basis for Indirect Cost Rate:
The State and the University of Southern California have agreed to a 30 percent indirect cost rate. This the lowest overhead rate offered to any funding organization.

Past Experience with this Principal Investigator:
ARB staff have extensive previous experience with Dr. Sioutas. His expertise is based on developing technologies for measuring the physicochemical characteristics of air pollutants and determining their toxic properties. Staff's past experience with Dr. Sioutas has been positive and productive.

Prior Research Division Funding to USC:

Year	2005	2004	2003
Funding	$0	$0	$0

BUDGET SUMMARY

University of Southern California

"Physicochemical and Toxicological Assessment of the Semi-Volatile and Non-Volatile Fractions of PM from Heavy- and Light-Duty Vehicles Operating with and without Emissions Control Technologies"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 250,058	
2.	Subcontractors	$ 279,999	
3.	Equipment	$ 12,000	
4.	Travel and Subsistence	$ 1,600	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 1,500	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 2,825	
9.	Analyses	$ 12,600	
10.	Miscellaneous	$ 29,293	
	Total Direct Costs		$589,875
INDIRECT COSTS			
1.	Overhead	$ 88,075	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 88,075
TOTAL PROJECT COSTS			**$677,950**

Attachment 1

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: University of California at Los Angeles.

Description of subcontractor's responsibility: Perform toxicological analysis on collected PM samples.

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 229,229	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 3,316	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 22,000	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 0	
	Total Direct Costs		$ 254,545
INDIRECT COSTS			
1.	Overhead	$ 25,454	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 25,454
TOTAL PROJECT COSTS			**$279,999**

PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 05-72

December 8, 2005

Agenda Item No.: 05-12-2

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2597-250, entitled "Ultrafine Particle Concentrations in Schoolrooms and Homes", has been submitted by the University of California, Berkeley;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2597-250 entitled "Ultrafine Particle Concentrations in Schoolrooms and Homes", submitted by the University of California, Berkeley, for a total amount not to exceed $300,000.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2597-250 entitled "Ultrafine Particle Concentrations in Schoolrooms and Homes", submitted by the University of California, Berkeley, for a total amount not to exceed $300,000.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $300,000.

ATTACHMENT A

"Ultrafine Particle Concentrations in Schoolrooms and Homes"

Background

Many studies have shown an association between airborne particulate matter and adverse cardiovascular health effects. It has been hypothesized that these effects may be due to ultrafine particles (UFP, particles smaller than 100 nm) rather than larger particles (PM2.5 to PM10). Characterizing UFP concentrations in indoor environments and the factors that influence them is critical for accurately estimating people's exposures to UFP, because people spend most of their time indoors. Sources of indoor UFP include infiltration from outdoors, particularly for homes near busy roadways; cooking with gas stoves and ovens; other combustion sources such as fireplaces and other gas appliances; and burning candles and incense. The reaction of ozone with terpenes in cleaning products and air fresheners has also been shown to generate UFP indoors.

A limited number of studies have measured UFP levels in residences, including a study of 17 homes in the Los Angeles area which was co-funded by ARB and U.S. EPA. In this study, investigators found that indoor UFP concentrations in the 20 – 100 nm fraction varied by three orders of magnitude throughout the day. In another ARB-sponsored study, investigators measured UFP emissions during cooking experiments in a test home and determined that ultrafine particles ranged from approximately 2,000 to more than 200,000 particles/cm^3. However, the information provided by these studies is very limited, and UFP concentrations have not been studied in California schools.

Objective

The main objective of this research is to increase the knowledge base of UFP concentrations in California schoolrooms and residences. A second objective is to advance our understanding of the factors that influence UFP levels in these environments, including the presence and use of indoor sources, infiltration of UFP generated by outdoor sources, building ventilation, particle deposition rates, and other factors.

Methods

Investigators would continuously measure UFP, ozone, carbon monoxide, carbon dioxide, and nitric oxide indoors and outdoors at six homes and six classrooms in the San Francisco Bay Area. A pilot study would be conducted in two homes to test protocol design and the performance of the monitors in residential environments.

In the main field study, homes and classrooms will be monitored on a 24-hour basis for a total of six days at each location. Homes will be selected to provide a range of potential UFP sources. For example, at least two homes will be close to major transportation emissions. One home will be selected as "urban background", meaning it is in the urban environment but not close to major roadways. Homes will also be selected based on the presence and use of gas-cooking appliances, other combustion appliances, use of cleaning products or air fresheners that contain terpenes, and use of candles or incense. At least one school will be near a major roadway, and the other schools and classrooms will be selected to gain information on other sources or conditions that might influence indoor UFP concentrations.

Expected Results
This study will increase our knowledge of UFP concentrations in homes and schools. It will measure the infiltration of UFP from the outdoors, particularly in locations near heavily traveled roadways. The study will also document the generation of UFP from known indoor sources and measure their impact on the indoor environment, as well as identify deposition rates for UFP generated indoors and outdoors.

Significance to the Board
UFP concentrations resulting from motor vehicle emissions have been studied in the ambient environment. However, the extent that these particles infiltrate to indoor environments and the contribution from indoor sources are relatively unknown. The level of infiltration from outdoors and the peak and duration of indoor emissions have important implications for exposure assessment and mitigation.

Contractor:
University of California, Berkeley

Contract Period:
33 months

Principal Investigator (PI):
William Nazaroff, Ph.D.

Contract Amount:
$300,000

Basis for Indirect Cost Rate:
The State and the UC system have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
Dr. Nazaroff is currently completing another ARB-funded project on emissions from cleaning products and their indoor reaction with ozone to produce toxic air contaminants. Air Resources Board staff have been very pleased with the quality of his work on this project. He has previously completed several other successful projects for ARB as well.

Prior Research Division Funding to UCB:

Year	2005	2004	2003
Funding	$543,997	$1,021,876*	$715,194

** Approximately $780,000 was funded by the California Energy Commission.*

BUDGET SUMMARY

University of California, Berkeley

"Ultrafine Particle Concentrations in Schoolrooms and Homes"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 157,070	
2.	Subcontractors	$ 75,000	
3.	Equipment	$ 12,000	
4.	Travel and Subsistence	$ 2,208	
5.	Electronic Data Processing	$ 1,500	
6.	Reproduction/Publication	$ 300	
7.	Mail and Phone	$ 566	
8.	Supplies	$ 26,000	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 6,000	
	Total Direct Costs		$280,644
INDIRECT COSTS			
1.	Overhead	$ 19,356	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$19,356
TOTAL PROJECT COSTS			**$300,000**

Attachment 1

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: Aerosol Dynamics Inc.

Description of subcontractor's responsibility: Aerosol Dynamics will play a key scientific role in the assembly of the instrumentation package, in the acquisition of all experimental data and in the interpretation of the ultrafine particle concentration data.

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 41,636	
2.	Subcontractors	$ 2,250	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 0	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 1,969	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 0	
	Total Direct Costs		$45,855
INDIRECT COSTS			
1.	Overhead	$ 29,145	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$29,145
TOTAL PROJECT COSTS			**$75,000**

PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 05-73

December 8, 2005

Agenda Item No.: 05-12-2

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2607-250, entitled "Augmentation to Ventilation and Indoor Air Quality in New Homes", has been submitted by Indoor Environmental Engineering;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the California Energy Commission has agreed to fund this proposal in its entirety for a total amount of $96,861; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2607-250 entitled "Augmentation to Ventilation and Indoor Air Quality in New Homes", submitted by Indoor Environmental Engineering, for a total amount not to exceed $96,861.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2607-250 entitled "Augmentation to Ventilation and Indoor Air Quality in New Homes", submitted by Indoor Environmental Engineering, for a total amount not to exceed $96,861.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $96,861.

ATTACHMENT A

"Augmentation to Ventilation and Indoor Air Quality in New Homes"

Background

Concerns have been raised over the health risks of indoor air pollutants in new California homes, and whether they have adequate ventilation for removing indoor air pollutants and excess moisture. In March 2005, ARB approved a study to obtain information on ventilation characteristics and indoor air quality (IAQ) in new, single-family, detached homes. The California Energy Commission (Commission) has funded this study, entitled "Ventilation and Indoor Air Quality in New Homes." The specific objectives of this study include: determining the occupants' use of windows, doors, exhaust fans and central heating and cooling systems; measuring indoor air pollutant levels, environmental conditions, building ventilation rates, and fan and central system use; and examining the relationships among home ventilation characteristics, indoor air quality, and house and household characteristics. The Contractor will measure indoor and outdoor air concentrations of several volatile organic compounds, formaldehyde, PM2.5, nitrogen dioxide, carbon monoxide, and carbon dioxide (for assessing ventilation adequacy). Another study objective is to identify incentives and barriers that influence household actions to improve ventilation and indoor air quality. The current study is in the planning stages for the pilot and main field study. Additional Commission funding has become available, and the Commission has agreed to fund certain improvements to the study.

Objective

The objectives of this augmentation are: 1) to increase the number of study homes with whole house mechanical (fresh air) ventilation systems from 12 to 20 homes; 2) to use an improved method for measuring home air exchange rates; 3) to provide lock boxes on homes to allow researcher access while maintaining the security of the study homes; 4) to deploy canisters to obtain data on acrylonitrile concentrations in new homes, and 5) to fund the Contractor's participation in the annual meeting of the Commission's Public Interest Environmental Research Program. The augmentation also includes Quantum Consulting, a well-qualified replacement for RLW Analytical, the subcontractor responsible for recruiting study participants and managing and analyzing data. This replacement was necessitated by the departure of the original RLW project manager, and is by mutual consent of the contractor and RLW.

Methods

In the current field study, the contractor is studying 100 new, single family homes from two climatic regions of the state and in two seasons. Included is a subset of 12 homes with mechanical (fresh-air) ventilation systems for the whole house. The Contractor will extensively measure and record ventilation characteristics, indoor and outdoor pollutant concentrations, residents' ventilation practices, residents' IAQ perceptions, and residents' decision factors for ventilation and IAQ-related actions. The contractor will also examine relationships among ventilation characteristics, measured and perceived IAQ, and house and household characteristics.

Through the Augmentation, 8 more homes with mechanical ventilation will be tested and inspected in the same manner as the other homes, making a total of 20 mechanical ventilation homes in the study and a total of 108 homes altogether. In addition, air exchange rates will be measured in all 108 study homes over 24 hours using a safe, non-toxic tracer gas and sampling tubes. The method originally proposed was a calculation method based on a one-hour measurement with a different tracer gas. The augmentation also will provide lockboxes, to allow access by the investigators while retaining security when homeowners cannot be home on a test day but are willing to grant access. Finally, canisters or other appropriate samplers will be deployed for air sampling of acrylonitrile in 50 homes, plus quality control and outdoor air samples; ARB will provide the samplers, shipping, and laboratory analyses.

Expected Results

This study will provide representative, accurate, and current information on both IAQ and ventilation in new California homes. This augmentation will substantially increase the number and diversity of study homes with mechanical ventilation, thereby improving our understanding of home ventilation system performance. This augmentation will also provide more accurate ventilation rate measurements during the 24 hours of indoor air sampling. This will improve the contractor's assessment of the impacts of indoor pollutant sources and the comparison to results from other studies. The use of lock boxes is expected to increase homeowner response rates and increase the efficiency of field teams and recruiters. The collection of acrylonitrile samples is expected to yield current measurements of acrylonitrile concentrations in California homes, which can be used to assess the risk posed by acrylonitrile, a compound with high cancer potency.

Significance to the Board

ARB will use the study results to improve its ability to identify current sources of indoor air pollutants; to assess Californians' current exposure to measured toxic air contaminants; and to recommend effective strategies for reducing indoor air pollution. The Commission will use the study results to revise the state's building energy efficiency standards in order to provide more healthful, energy-efficient homes in California. The augmentation will improve the quality and quantity of information produced by this study, and will allow ARB to cost-effectively obtain needed information on acrylonitrile exposures and sources.

Contractor:

Indoor Environmental Engineering

Contract Period:

25 months.

Principal Investigator (PI):

Francis J. Offermann III

Contract Amount:
Augmentation of $96,861 to original contract for $1,042,935.

Cofunding:
The California Energy Commission is contributing the total cost of this Augmentation, which is $96,861.

Basis for Indirect Cost Rate:
Rates are similar to those of other firms performing similar work in northern California.

Past Experience with this Principal Investigator:
In the 1990's, the Principal Investigator performed well in conducting a small study to develop and test an indoor monitoring method for polycyclic aromatic hydrocarbons.

Prior Research Division Funding to IEE:

Year	2005	2004	2003
Funding	$0	$1,042,935*	$0

* Funded by the California Energy Commission

BUDGET SUMMARY

Indoor Environmental Engineering

"Augmentation to Ventilation and Indoor Air Quality in New Homes"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 8,255	
2.	Subcontractors	$ 42,688[1]	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 98	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 960	
9.	Analyses	$ 29,688[2]	
10.	Miscellaneous	$ 1,700	
	Total Direct Costs		$83,389
INDIRECT COSTS			
1.	Overhead	$ 4,666	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 8,806	
	Total Indirect Costs		$13,472
TOTAL PROJECT COSTS			**$96,861**

1. The majority of this expense ($38,080) is for Davis Energy Group, a subcontractor in the current study, to install tracer gas sources for the air exchange rate measurements and to conduct additional field work for window and fan ventilation measurements. Other subcontractors will manage and analyze the data and assist in the additional field work.
2. The addition of 8 more mechanical ventilation homes, including quality control samples, requires laboratory analyses of 14 more samples for volatile organic compounds ($4,790), formaldehyde ($1,411), nitrogen dioxide ($722), and PM2.5 ($257). The air exchange rate measurements for 143 home tests and quality control samples requires tracer gas sources ($3,132), analysis of samplers ($28,380), and data analyses and reporting ($3,396); the cost of the tracer tests originally proposed ($12,400) is subtracted. Berkeley Analytical, DataChem, and Brookhaven National Laboratory will perform these analyses.

Attachment 1

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: Davis Energy Group

Ventilation team leader: Will deploy tracer gas sources in all homes and ventilation data loggers and questionnaires. They will also inspect homes, and download logger data for 8 additional homes.

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$15,239	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 9,256	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 713	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 0	
	Total Direct Costs		$25,208
INDIRECT COSTS			
1.	Overhead	$ 9,410	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 3,462	
	Total Indirect Costs		$12,872
TOTAL PROJECT COSTS			**$38,080**

PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 05-74

December 8, 2005

Agenda Item No.: 05-12-2

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2603-250, entitled "Light Duty Gasoline PM: Characterization of High Emitters and Valuation of Repairs for Emission Reduction", has been submitted by the University of California, Riverside;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2603-250 entitled "Light Duty Gasoline PM: Characterization of High Emitters and Valuation of Repairs for Emission Reduction", submitted by University of California, Riverside, for a total amount not to exceed $249,827.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2603-250 entitled "Light Duty Gasoline PM: Characterization of High Emitters and Valuation of Repairs for Emission Reduction", submitted by University of California, Riverside, for a total amount not to exceed $249,827.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $249,827.

ATTACHMENT A

"Light Duty Gasoline PM: Characterization of High Emitters and Valuation of Repairs for Emission Reduction"

Background
Light-duty gasoline vehicles (LDGV) are currently estimated to emit a large portion of the total particulate matter (PM) emissions attributable to mobile sources. The emissions may be comparable to PM emissions from diesel vehicles. More stringent diesel vehicle PM regulations will take effect in 2007 and, along with existing diesel retrofit strategies, will result in significantly lower PM emissions from diesel engines. With this reduction in the diesel PM emission burden, it is anticipated that PM emissions from LDGVs, particularly high PM emitters, may contribute disproportionately to the total on-road PM inventory.

Objective
The work proposed in this study will evaluate new means to identify high PM emitters on the highway and at inspection/maintenance (I/M) locations, evaluate the potential costs and benefits of repair and other emission reduction strategies, and try to characterize the importance of high PM emitters to the inventory.

Methods
The contractors will evaluate the reliability and accuracy of remote sensing device (RSD) methods for characterizing LDGV PM emissions by performing a pilot study. They will use suitable RSD and/or visual surveys to characterize PM emissions from a large sample of in-use LDGVs in California and procure chassis dynamometer emissions test for a fleet of in-use LDGVs to determine their mass emissions. The contractors will also perform engine repairs on selected high PM emitters and conduct after-repairs emissions tests to determine the effectiveness of the engine repairs.

Expected Results
This program is expected to improve the ability of the ARB to identify high PM emitters and to provide the data on frequency, emission levels, repair effectiveness and repair costs to guide development of PM control strategies.

Significance to the Board
The results of the program should provide the ARB with tools to identify high-PM emitters and to pursue cost-effective emission reduction strategies. The tools will also provide a means to estimate the frequency of occurrence of high PM emitters and potentially estimate the contribution of high emitters to the PM inventory.

Contractor:
University of California, Riverside

Contract Period:
18 months

Co-Principal Investigators (PIs):
John Collins, Ph.D. and Thomas Durbin, Ph.D.

Contract Amount:
$249,827

Basis for Indirect Cost Rate:
The State and the UC system have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigators:
ARB staff have extensive prior experience with both PIs. This experience has been positive.

Prior Research Division Funding to UCR:

Year	2005	2004	2003
Funding	$0	$1,717,466	$1,036,130

BUDGET SUMMARY

University of California, Riverside

"Light Duty Gasoline PM: Characterization of High Emitters and Valuation of Repairs for Emission Reduction"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 100,023	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 4,708	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 10,500	
9.	Analyses	$ 64,344[1]	
10.	Miscellaneous	$ 51,414[2]	
	Total Direct Costs		$ 230,989
INDIRECT COSTS			
1.	Overhead	$ 18,838	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 18,838
TOTAL PROJECT COSTS			**$ 249,827**

[1] Costs are for 42 experimental analyses, including smog checks, unified cycle (criteria gases, PM, EC, OC, MOUDI), and speciation media.

[2] Costs include: Vehicle recruitment and repairs, Graduate Student Fees, and Facilities Fee. Because CE-CERT is a permanent off-campus facility, federal regulations requires the accounting for facilities rental as a direct cost. Facilities rental is charged based on 20.9% of Modified Total Direct Costs (MTDC).

PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 05-75

December 8, 2005

Agenda Item No.: 05-12-2

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2604-250, entitled "CO_2 Emission Quantification from Vehicle Air Conditioning Operation in California-Specific Conditions", has been submitted by California State University, Northridge;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2604-250 entitled "CO_2 Emission Quantification from Vehicle Air Conditioning Operation in California-Specific Conditions", submitted by California State University, Northridge, for a total amount not to exceed $400,000.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2604-250 entitled "CO_2 Emission Quantification from Vehicle Air Conditioning Operation in California-Specific Conditions", submitted by California State University Northridge, for a total amount not to exceed $400,000.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $400,000.

ATTACHMENT A

"CO_2 Emission Quantification from Vehicle Air Conditioning Operation in California-Specific Conditions"

Background
In the Board's recently adopted greenhouse gas regulation, credits are awarded for a limited group of air conditioning (A/C) system modifications that reduce CO_2 emissions ("indirect emissions") during operation. The value of the credits is now based only on estimates from vehicle simulation modeling because a reliable and comprehensive test method has not been developed for measuring the impact that vehicle A/C system operation has on CO_2 emissions under "real-world" conditions. Since actual measured test values representative of real-world operation are likely to be more accurate and encompassing than model estimates, it is desirable to develop an appropriate vehicle test and credit certification procedure.

Objective
The project's objective is to develop a whole vehicle test procedure for measuring the impact that vehicle A/C system operation has on CO_2 emissions in "real-world" California operating conditions. It is intended that the resulting procedure can then be incorporated into ARB's greenhouse gas regulation and will be used to quantify CO_2 emission reductions from technological advances in A/C system design and from features that reduce vehicle solar load.

Methods
The project methodology consists of two major parts: 1) Acquisition of data on operator behavior and A/C system operation from vehicles operating in California under a wide range of climate and traffic conditions; to be conducted by the principal investigator (PI) at California State University, Northridge (CSUN); and, 2). Developing, analyzing and verifying options for vehicle and A/C system testing, including an add-on test procedure to the existing FTP, based on the data from CSUN, for determining with regulatory rigor the indirect CO_2 emissions due to A/C system operation under California-specific conditions; to be conducted by the co-investigators at University of Illinois, Urbana-Champaign (UIUC).

Expected Results
Staff expects that the project will develop a viable test procedure that will enable ARB to realistically replicate "California average" conditions (weather, driving conditions, etc.) during emissions testing of vehicles with A/C. The procedure will also be designed to accommodate upcoming technological innovations that could reduce CO_2 emissions, including modifications consistent with superior A/C systems. Such an ideal test would allow the regulation to apply realistic credit to new technological innovations that reduce CO_2 emissions

Significance to the Board
An improved test procedure would provide increased accuracy in making estimates of the mobile A/C contribution to California's GHG inventory, an important tool in developing climate change policy. This improved procedure could also be used to enhance the current estimates vehicle manufacturers now are allowed to use to meet their GHG requirements under the recently approved regulations resulting from AB1493.

Contractor:
California State University Northridge

Contract Period:
24 months

Principal Investigator (PI):
Timothy Fox, Ph.D.

Contract Amount:
$400,000

Basis for Indirect Cost Rate:
The State and CSU Northridge have agreed to a ten-percent indirect cost rate.

Past Experience with this Principal Investigator:
The PI has 3 years experience in over-the-road vehicle testing focused on radiator and ozone-reduction catalysts as applied to A/C condensers. He has a further 8 years experience supervising alternative fueled and hybrid electric vehicle development/demonstrations for DOE/SAE/Big Three sponsored University Student Design Competitions as faculty advisor with significant focus on hybrid electric vehicle air conditioning. He designed and developed CSUN's temperature-humidity environmental test chamber, with automotive chassis dynamometer. He worked for 6 years on NASA-sponsored Space and Solar Simulation, developing an infra-red solar/thermal simulation capability for environmental testing of spacecraft in thermal vacuum environments (such space simulation testing required complex data acquisition systems with over 300 measurement channels per test).

Prior Research Division Funding to CSUN:

Year	2005	2004	2003
Funding	$0	$0	$0

BUDGET SUMMARY

California State University, Northridge

"CO_2 Emission Quantification from Vehicle Air Conditioning Operation in California-Specific Conditions"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 102,041	
2.	Subcontractors	$ 147,709	
3.	Equipment	$ 13,535	
4.	Travel and Subsistence	$ 6,200	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 33,461	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 72,400[1]	
	Total Direct Costs		$ 375,346
INDIRECT COSTS			
1.	Overhead	$ 24,654	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 24,654
TOTAL PROJECT COSTS			**$ 400,000**

[1] Costs include vehicle-dealer installation support and vehicle maintenance, fuel costs to operate test fleet, modem/cell phone communication link between CSUN and vehicles on the road, stipends, four test vehicle leases and environmental temperature-humidity chamber test fees.

Attachment 1

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: Air Conditioning Research Center, University of Illinois

Description of subcontractor's responsibility: The subcontractor will provide an assessment of mobile a/c system operation and correlation with measured operating environment parameters.

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 122,490	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 4,000	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 540	
7.	Mail and Phone	$ 450	
8.	Supplies	$ 4,800	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 2,000	
	Total Direct Costs		$ 134,280
INDIRECT COSTS			
1.	Overhead	$ 13,429	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 13,429
TOTAL PROJECT COSTS			**$ 147,709**

PROPOSED

State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 05-76

December 8, 2005

Agenda Item No.: 05-12-2

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2594-250, entitled "Improving the Carbon Dioxide Emission Estimates from the Combustion of Fossil Fuels in California", has been submitted by the University of California, Berkeley;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2594-250, entitled "Improving the Carbon Dioxide Emission Estimates from the Combustion of Fossil Fuels in California", submitted by the University of California, Berkeley, for a total amount not to exceed $75,000.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2594-250, entitled "Improving the Carbon Dioxide Emission Estimates from the Combustion of Fossil Fuels in California", submitted by the University of California, Berkeley, for a total amount not to exceed $75,000.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $75,000.

ATTACHMENT A

"Improving the Carbon Dioxide Emission Estimates from the Combustion of Fossil Fuels in California"

Background
Central to any study of climate change is the development of an emission inventory that identifies and quantifies the primary anthropogenic sources and sinks of greenhouse gas (GHG) emissions. Fossil fuel combustion accounted for 98 percent of gross California carbon dioxide (CO_2) emissions. The transportation sector accounted for the largest portion of emissions, averaging 59 percent of the total CO_2 emissions from fossil fuel combustion in California for the period 1990-1999. Carbon dioxide emissions are one of the best-characterized emissions in the existing state inventory, but there still exist significant sources of uncertainties. Improved emission estimates for greenhouse gases are needed for evaluating the effects of existing and planned air quality programs on carbon dioxide emissions in the state. More accurate fuel consumption data may also allow improving the estimation of criteria pollutant emissions.

Objective
This project has three main objectives: 1) estimating the level of uncertainty related to emissions from fuel consumption in the existing inventory, 2) investigating the development of new or improved methodologies for estimating the consumption of specific fuels for which data are scarce or unreliable, and 3) providing recommendations regarding initiation of new data collection activities to improve the accuracy of the California CO_2 emissions inventory.

Methods
The project team will examine the factors contributing to uncertainty in the data sources used in the current Energy Balance and GHG inventory and contrast the existing data with alternate state and federal sources. The range of discrepancy in the consumption data for fuels will be documented. The project team will also focus efforts on obtaining additional data on the distribution and use of fossil fuels in California. The proposal states that the most important priority for improving California's CO_2 estimates concerns the consumption of petroleum products. For this study, the project team will estimate feedstock use in the chemical industry and will investigate alternative methodologies for allocating bunker fuel consumption for air transport and maritime shipping. Although uncertainties regarding the consumption of natural gas and coal appear to be much less pronounced, the project team will also explore opportunities for improving data on these two fuels.

Expected Results
The project deliverables will include a final report quantifying the uncertainties with the existing data, identifying new sources of fossil fuel data (if these sources are identified during this project), and making recommendations on methodological and testing improvements as well as development of improved data collection activities that the state should implement to improve its CO_2 emission estimates. The project team will

also submit an article based on this work to a peer-reviewed journal and will hold a technical seminar on the results of the project.

Significance to the Board
The key areas of uncertainty related to CO_2 emissions in the California inventory include differences between various data sets, estimates of bunker fuel consumption for international transport, estimates of petroleum products used as feedstocks in refineries and chemical plants, and estimates of the heat and carbon content of the various fossil fuels combusted in California. Clearly understanding these uncertainties and developing new methodologies or data collection activities to reduce these uncertainties can significantly improve the characterization of California's CO_2 emissions. Improved emission estimates for greenhouse gases are needed for evaluating the effects of existing and planned air quality programs on carbon dioxide emissions in the state. More accurate fuel consumption data may also allow improving the estimation of criteria pollutant emissions.

Contractor:
University of California, Berkeley

Contract Period:
18 months

Co-Principal Investigators (PIs):
Michael Hanemann Ph.D. and Lynn Price

Contract Amount:
$75,000

Basis for Indirect Cost Rate:
The State and the UC system have agreed to a ten percent indirect cost rate.

Past Experience with these Principal Investigators:
These Principal Investigators have performed successfully on past contracts with ARB and California Energy Commission.

Prior Research Division Funding to UCB:

Year	2005	2004	2003
Funding	$543,997	$1,021,876*	$715,194

* Approximately $780,000 was funded by the California Energy Commission.

BUDGET SUMMARY

University of California, Berkeley

"Improving the Carbon Dioxide Emission Estimates from the Combustion of Fossil Fuels in California"

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 4,545	
2.	Subcontractors	$ 70,000[1]	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 0	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 0	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 0	
	Total Direct Costs		$74,545
INDIRECT COSTS			
1.	Overhead	$ 455	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$455
TOTAL PROJECT COSTS			**$75,000**

[1] Both the PI and the subcontractor, Lawrence Berkeley National Laboratory (LBNL), are well qualified to undertake this research project. However, ARB can not contract directly with LBNL due to non-reconcilable differences on contract provisions. Thus, UC Berkeley was selected to lead this project because the UCB PI is currently being funded by the CEC for ongoing development of the Berkeley Energy and Resources (BEAR) model, and he is highly qualified in examining the factors contributing to uncertainty in the data sources used in the current Energy Balance and greenhouse gases inventory.

Attachment 1

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: Lawrence Berkeley National Laboratory

Description of subcontractor's responsibility: 1) Estimating the level of uncertainty related to emissions from fuel consumption in the existing inventory, 2) investigating the development of new or improved methodologies for estimating the consumption of specific fuels for which data are scarce or unreliable, and 3) providing recommendations regarding initiation of new data collection activities to improve the accuracy of the California CO_2 emissions inventory.

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 37,253	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 1,796	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 0	
7.	Mail and Phone	$ 0	
8.	Supplies	$ 0	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 2,488	
	Total Direct Costs		$41,537
INDIRECT COSTS			
1.	Overhead	$ 21,310	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 7,153	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$ 28,463
TOTAL PROJECT COSTS			**$70,000**

CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC MEETING TO CONSIDER THE APPROVAL OF GRANTS UNDER THE INNOVATIVE CLEAN AIR TECHNOLOGIES (ICAT) PROGRAM

DATE: December 8, 2005

TIME: 9:00 a.m.

PLACE: California Environmental Protection Agency
Byron Sher Auditorium
1001 I Street
Sacramento, California

This item will be considered at a two-day meeting of the Board, which will commence at 9:00 a.m., December 8, 2005, and may continue at 8:30 a.m., December 9, 2005. This item may not be considered until December 9, 2005. Please consult the agenda for the meeting, which will be available at least 10 days before December 8, 2005, to determine the day on which this item will be considered.

If you have a disability-related accommodation need, please go to http://www.arb.ca.gov/html/ada/ada.htm for assistance or contact the ADA Coordinator at (916) 323-4916. If you are a person who needs assistance in a language other than English, please go to http://inside.arb.ca.gov/as/eeo/languageaccess.htm or contact the Bilingual Coordinator at (916) 324-5049. TTY/TDD/Speech-to-Speech users may dial 7-1-1 for the California Relay Service.

The Board's ICAT program co-funds demonstrations of new technologies that can improve air quality in California and support ARB programs while helping to stimulate the state's economy. The ARB staff will recommend that the Board approve co-funding for four projects that were received in response to a public solicitation. These projects were selected because they address important ARB program needs, are technically sound, can reduce emissions, and can succeed commercially within a few years. The Board will consider proposed resolutions to approve co-funding for these projects at its meeting.

The ARB staff will provide an oral presentation at the meeting. The projects to be considered are the following:

Proposal Number 05b-23, entitled "Orbital Scythe Prototype Development and Testing," submitted by O-Sage Power Equipment LLC for a total amount not to exceed $47,000.

Proposal Number 05b-25, entitled "FreedomAir-Commercial Field Demonstration Project w/ Long Beach Transit," submitted by Rotec Design Ltd, for a total amount not to exceed $225,000.

Proposal Number 05b-36, entitled "Cost-Effective NOx Control for Stationary Diesel Engines," submitted by Catalytica Energy Systems, Inc., for a total amount not to exceed $300,000.

Proposal Number 05b-07, entitled "Integrated CHP Using Ultra-Low-NOx Supplemental Firing," submitted by the Gas Technology Institute, for a total amount not to exceed $249,274.

Additional details on these projects can be found at the following webpage: http://www.arb.ca.gov/research/icat/icat.htm. Interested members of the public may present comments orally or in writing at the meeting and in writing or by email before the meeting. To be considered by the Board, written submissions not physically submitted at the meeting must be received no later than **12:00 noon, December 7, 2005**, and be addressed to the following.

Postal mail is to be sent to:

Clerk of the Board
Air Resources Board
1001 "I" Street, 23rd Floor
Sacramento, California 95814

Electronic mail is to be sent to icat05@listserv.arb.ca.gov and received at the ARB no later than **12:00 noon, December 7, 2005.**

Facsimile submissions are to be transmitted to the Clerk of the Board at (916) 322-3928 and received at the ARB no later than **12:00 noon, December 7, 2005**.

The Board requests, but does not require, 30 copies of any written submission. Also, the ARB requests that written and email statements be filed at least ten days prior to the meeting so that ARB staff and Board members have time to fully consider each comment. Further inquiries regarding this matter should be directed to Mr. Bart E. Croes, P.E., Chief, Research Division, P.O. Box 2815, Sacramento, California 95812, (916) 445-0753.

CALIFORNIA AIR RESOURCES BOARD

Catherine Witherspoon
Executive Officer

Date: November 16, 2005

TITLE 13. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER THE ADOPTION OF A PROPOSED REGULATION FOR MOBILE CARGO HANDLING EQUIPMENT AT PORTS AND INTERMODAL RAIL YARDS

The Air Resources Board (ARB or Board) will conduct a public hearing at the time and place noted below to consider adopting a regulation to reduce emissions of diesel particulate matter (PM) and oxides of nitrogen (NOx) from mobile cargo handling equipment that operate at ports and intermodal rail yards in the State of California. Any person who sells, offers for sale, leases, purchases, rents, owns or operates any mobile cargo handling equipment that operates at ports or intermodal rail yards in California would be subject to and have responsibilities under the regulation. This notice summarizes the proposed regulation. The staff report presents the regulation and information supporting the adoption of the regulation in greater detail.

DATE:	December 8, 2005
TIME:	9:00 a.m.
PLACE:	California Environmental Protection Agency Air Resources Board Byron Sher Auditorium, Second Floor 1001 I Street Sacramento, California 95814

This item will be considered at a two-day meeting of the ARB, which will commence at 9:00 a.m., December 8, 2005, and may continue at 8:30 a.m., December 9, 2005. This item may not be considered until December 9, 2005. Please consult the agenda for the meeting, which will be available at least 10 days before December 8, 2005, to determine the day on which this item will be considered.

If you have a disability-related accommodation need, please go to http://www.arb.ca.gov/html/ada/ada.htm for assistance or contact the ADA Coordinator at (916) 323-4916. If you are a person who needs assistance in a language other than English, please contact the Bilingual Coordinator at (916) 324-5049. TTY/TDD/Speech-to-Speech users may dial 7-1-1 for the California Relay Service.

INFORMATIVE DIGEST OF PROPOSED ACTION AND POLICY STATEMENT OVERVIEW

Sections Affected: Proposed adoption of new section 2479, title 13, California Code of Regulations (CCR).

Background:

HSC sections 43013(b) and 43018 provide broad authority for ARB to adopt emission standards and other regulations to reduce emissions, including those from toxic air contaminants (TACs), and other air pollutant emissions from vehicular and other mobile sources.

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 the identification and control of air toxics 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. The ARB's evaluation is made available to the public and is formally reviewed by the Scientific Review Panel (SRP) established under HSC section 39670. Following 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, Health and Safety Code sections 39658, 39665, 39666, and 39667 require the 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.

In 1998, the Board identified diesel particulate matter (diesel PM) as a toxic air contaminant with no Board-specified threshold exposure level. A needs assessment for diesel PM was conducted between 1998 and 2000, which resulted in ARB developing a Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles (Diesel RRP). The Diesel RRP presented information that identified the available options for reducing diesel PM and recommended regulations to achieve further reductions. The scope of the Diesel RRP was broad, addressing all categories of engines, both mobile and stationary.

Once the ARB has evaluated the need and appropriate degree to regulate a TAC, HSC section 39666(c) requires the ARB to adopt regulations to reduce emissions of the TAC from nonvehicular sources to the lowest level achievable through the application of best available control technology (BACT) or a more effective control method, in consideration of cost, risk, environmental impacts, and other specified factors. In developing the proposed regulation, State law also requires an assessment of the appropriateness of substitute products or processes. The mobile cargo handling equipment subject to this regulation are vehicular sources. As such, the proposed regulation will be adopted under the authority provided in HSC section 39667.

Presently, no federal law has been promulgated addressing emission reductions from in-use cargo handling equipment engines. Unless specifically preempted under

Section 209(e)(1)[1], California is the only state allowed to adopt emission requirements for off-road engines that are different from those of the federal government. Section 209(e)(2)(A) of the federal Clean Air Act (CAA) authorizes California to adopt and enforce emission standards and other requirements for off-road engines and equipment not subject to federal preemption, so long as the California standards "will be, in the aggregate, at least as protective of public health and welfare as the applicable Federal standards." However, California must apply for, and receive authorization from, the administrator of the United States Environmental Protection Agency (U.S. EPA) before ARB may enforce its regulations.

The proposed regulation would reduce emissions of diesel PM and NOx. The regulation would also result in future reductions of reactive organic gases (ROG) due to accelerated turnover of the equipment. Diesel PM emission reductions are needed to reduce the potential cancer risk and other adverse impacts from exposure to this TAC for the people who live in the vicinity of California's major ports and intermodal rail yards. The regulation would also reduce diesel PM and NOx emissions that contribute to regional PM and will assist California in its goal of achieving state and federal air quality standards. Reductions in NOx and ROG, precursors in the formation of ozone pollution, would help reduce regional ozone levels.

The proposed regulation would provide 711 tons of diesel PM emission reductions and 13,781 tons of NOx emission reductions throughout California between the years of 2007 and 2020. These emission reductions will occur in areas near ports and intermodal rail yards, many of which are non-attainment for the State and federal ambient air quality standards for PM_{10}, $PM_{2.5}$ and ozone.

Description of the Proposed Regulatory Action:

The proposed regulation for Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yards is designed to use the best available control technology (BACT) to reduce the general public's exposure to diesel PM and NOx emissions from mobile cargo handling equipment at ports and intermodal rail yards. Mobile cargo handling equipment is any motorized vehicle used to handle cargo and includes, but is not limited to, yard trucks, top handlers, side handlers, rubber-tired gantry (RTG) cranes, forklifts, dozers, and loaders. In addition to required performance standards, the regulation would include recordkeeping and reporting requirements to provide staff up-to-date information on cargo handling equipment and activities and to aid in enforcement of the regulation.

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

[1] CAA Section 209(e)(1) prohibits all states, including California, from adopting emission standards or other requirements related to the control of emissions from new nonroad engines less than 175 horsepower used in farm and construction equipment and vehicles and for new locomotives and engines used in locomotives.

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 and portable compression-ignition engines are not subject to this regulation.

The proposed regulation would require, beginning January 1, 2007, newly purchased, leased, or rented (new) cargo handling equipment to meet performance standards, which vary depending on the classification of the new equipment (either an off-road equipment or a registered on-road vehicle), and the availability of certified on-road engines for the equipment type and application. For registered on-road vehicles, the new equipment would be required to meet the certified on-road engine standards for the model year in which the engine is purchased. For new off-road equipment where a certified on-road engine is available, the equipment must meet either the on-road engine certification standards or the off-road Tier 4 final certification standards for the model year of the year purchased and the rated horsepower of the engine.

For new off-road equipment for which a certified on-road engine is unavailable, the owner or operator must use the highest level certified off-road engine for the model year of the year purchased and install the highest available level verified diesel emission control strategy (VDECS) within one year of acquiring the new equipment. If no VDECS are available for the new cargo handling equipment during the initial year of operation, the owner or operator would be required to install the highest level VDECS within six months after it 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 would be to meet the 2007 or later model year certified on-road engine standards; another option would be to meet the certified Tier 4 off-road standards; and the last option would be to apply VDECS that would result in emissions that are less than or equal to the diesel PM and NOx standards of a certified final Tier 4 off-road diesel engine of the same horsepower rating. Pre-2003 model year yard trucks would be required to comply first, beginning December 31, 2007. Owners or operators of more than three yard trucks would be given additional time to comply. The proposal would allow owners or operators who have installed VDECS or a certified on-road engine prior to December 31, 2006, to delay the compliance date one year.

The proposed regulation would require in-use non-yard truck equipment to use BACT to meet specified 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[2]), Bulk Cargo Handling (including, but not limited to dozers, loaders, excavators, and sweepers), and RTG cranes. Each category would have three

[2] 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.

compliance options, based on BACT. One option would be 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. Another option would be 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 would be 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 these last 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 would be 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 would be the same, but the compliance date would be either December 31, 2015, or the model year plus 12 years, whichever is later. More detail is provided in the Staff Report: Initial Statement of Reasons (ISOR or Staff Report).

The proposal would include 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 for an engine used in a particular type of cargo handling equipment, 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. The maximum delay would depend on the compliance extension granted.

The regulation contains an alternative compliance plan option which would allow an owner or operator to submit for approval by the EO an alternative compliance approach as long as it would achieve emission reduction equal to or greater than what would occur under the regulation. The regulation also provides for the experimental use of emissions control technology that has not yet received approval under ARB retrofit verification process. The regulation also allows the owner or operator to demonstrate that the highest VDECS is not feasible for their application.

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 with the compliance strategy used or planned compliance date (or an alternative method approved by the Executive Officer), 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.

COMPARABLE FEDERAL REGULATIONS

As stated above, there are no federal regulations for in-use mobile cargo handling equipment that are comparable to the proposed regulation. However, the proposed regulation relies heavily on the implementation of U.S. EPA's Tier 4 nonroad emission standards for new diesel engines, with which the ARB has harmonized, since engine replacement is one of many compliance pathways. While under CAA Section 213, U.S. EPA may only adopt new emission standards for nonroad engines; California is the only government agency in the nation that may adopt in-use emission standards for non-road engines.

AVAILABILITY OF DOCUMENTS AND AGENCY CONTACT PERSONS

The Board staff has prepared an ISOR for the proposed regulatory action, which includes a summary of the potential environmental and economic impacts of the proposal, if any. The ISOR is entitled, "Staff Report: Initial Statement of Reasons for the Proposed Regulation for Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yards."

Copies of the ISOR and the full text of the proposed regulatory language may be obtained from the Public Information Office, Air Resources Board, 1001 I Street, Visitors and Environmental Services Center, 1st Floor, Sacramento, CA 95814, (916) 322-2990 at least 45 days prior to the December 8, 2005, hearing. The ISOR is also available on the internet at the web site listed below, or by contacting the staff listed below.

Upon its completion, the Final Statement of Reasons (FSOR) will be available and copies may be requested from the agency contact persons in this notice, or may be accessed on the web site listed below.

Inquiries concerning the substance of the proposed regulation may be directed to the designated agency contact persons, Peggy Taricco, Manager of the Technical Analysis Section, at (916) 327-7213 or by email at ptaricco@arb.ca.gov, or Lisa Williams, Air Pollution Specialist, at (916) 327-1498 or by email at lwilliam@arb.ca.gov.

Further, the agency representative and designated back-up contact persons to whom nonsubstantive inquiries concerning the proposed administrative action may be directed are Artavia Edwards, Manager, Board Administration & Regulatory Coordination Unit, (916) 322-6070, or Alexa Malik, Regulations Coordinator, (916) 322-4011. The Board has compiled a record for this rulemaking action, which includes all the information upon which the proposal is based. This material is available for inspection upon request to the contact persons.

This notice, the ISOR and all subsequent regulatory documents, including the FSOR, when completed, are available on the ARB Internet site for this rulemaking at http://www.arb.ca.gov/regact/cargo2005/cargo2005.htm.

COSTS TO PUBLIC AGENCIES AND TO BUSINESSES AND PERSONS AFFECTED

The determinations of the Board's Executive Officer concerning the costs or savings necessarily incurred by public agencies and private persons and businesses in reasonable compliance with the proposed regulations are presented below.

ARB staff estimates the cost for compliance with the regulation to be approximately 61 million dollars for the total capital and recurring costs. This corresponds to about 6.8 million dollars annually on average for the years 2007 through 2015. This cost, which is based on 2004 dollars, represents the capital cost of equipment, maintenance and replacement, and reporting costs from 2007 through 2015. ARB staff believe the costs associated with the proposed regulation after 2015 will be substantially less.

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 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 information from a 2004 ARB survey (survey) 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 2015 costs to a typical business will be in the range of $153,000 to $1,344,000.

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 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 68) 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 2007-2015 costs to small businesses ranged from $33,800 to $458,000 with an average cost of $180,000.

Pursuant to Government Code sections 11346.5(a)(5) and 11346.5(a)(6), the Executive Officer has determined that the proposed regulatory action will not create costs or savings to any state agency or in federal funding to the state, costs or mandate to any local agency or school district whether or not reimbursable by the state pursuant to part 7 (commencing with section 17500), division 4, title 2 of the Government Code, except as discussed below, or other nondiscretionary savings to state or local agencies.

The Executive Officer has made an initial determination pursuant to Government Code 11346.5(a) that the proposed regulatory action will not have a significant statewide adverse economic impact directly affecting businesses, including the ability of California businesses to compete with businesses in other states, or on representative private persons. A number of businesses are integrally linked to the goods that travel through California ports. However, we do not believe that the added costs of the proposed regulation are high enough for ship operators to consider alternative ports outside of California.

The agency is not aware of any cost impacts that a representative private person would necessarily incur in reasonable compliance with the proposed regulation.

In accordance with Government Code section 11346.3, the Executive Officer has determined that the proposed regulatory action will not affect the creation or elimination of jobs within the State of California, the creation of new businesses or elimination of existing businesses within the State of California, or the expansion of businesses currently doing business within the State of California.

The Executive Officer has also determined, pursuant to title 1, CCR, section 4, that the proposed regulatory action will have no significant impact on small businesses. The analysis found that the overall change in ROE 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.

In accordance with Government Code sections 11346.3(c) and 11346.5(a) (11), the ARB's Executive Officer has found that the reporting requirements of the regulation that apply to businesses are necessary for the health, safety, and welfare of the people of the State of California.

In accordance with HSC 43013(a) and (b), the Executive Officer has determined that the standards and other requirements in the proposed regulation are necessary, cost-effective, and technologically feasible for mobile cargo handling equipment at ports and intermodal rail yards.

Before taking final action on the proposed regulatory action, the Board must determine that no reasonable alternative considered by the agency or that has otherwise been identified and brought to the attention of the agency would be more effective in carrying out the purpose for which the action is proposed or would be as effective and less burdensome to affected private persons than the proposed action.

A detailed assessment of the economic impacts of the proposed regulatory action can be found in the Staff Report.

SUBMITTAL OF COMMENTS

The public may present comments relating to this matter orally or in writing at the hearing, and in writing or by e-mail before the hearing. To be considered by the Board, written submissions must be received **no later than 12:00 noon, December 7, 2005**, and addressed to the following:

Postal mail is to be sent to:

Clerk of the Board
Air Resources Board
1001 I Street, 23rd Floor
Sacramento, California 95814

Electronic mail is to be sent to: cargo2005@listserv.arb.ca.gov, and received at the ARB **no later than 12:00 noon, December 7, 2005.**

Facsimile submissions are to be transmitted to the Clerk of the Board at (916) 322-3928 and received at the ARB **no later than 12:00 noon, December 7, 2005**.

The Board requests but does not require 30 copies of any written submission. Also the ARB requests that written, facsimile, and e-mail statements be filed at least 10 days prior to the hearing so that ARB staff and Board Members have time to fully consider each comment. The ARB encourages members of the public to bring to the attention of staff in advance of the hearing any suggestions for modification of the proposed regulatory action.

Additionally, the Board requests but does not require, that persons who submit written comments to the Board reference the title of the proposal in their comments to facilitate review.

STATUTORY AUTHORITY AND REFERENCES

This regulatory action is proposed under the authority granted to the ARB in Health and Safety Code sections 39002, 39600, 39515, 39516, 39600, 39601, 39602, 39650, 39655, 39656, 39658, 39659, 39665, 39666, 39667, 39674, 39675, 40000, 41511, 43000.5, 43013, and 43018. This action is proposed to implement, interpret, or make specific Health and Safety Code sections 39002, 39515, 39516, 39600, 39601, 39602, 39650, 39655, 39656, 39657, 39658, 39659, 39665, 39666, 39667, 39674, 39675, 40000, 41511, 43000.5, 43013, and 43018.

HEARING PROCEDURES

The public hearing will be conducted in accordance with the California Administrative Procedure Act, Title 2, Division 3, Part 1, Chapter 3.5 (commencing with section 11340) of the Government Code.

Following the public hearing, the ARB may adopt the regulatory language as originally proposed or with non-substantial or grammatical modifications. The Board may also adopt the proposed regulatory language with other modifications if the text as modified is sufficiently related to the originally proposed text that the public was adequately placed on notice that the regulatory language as modified could result from the proposed regulatory action. In the event that such modifications are made, the full regulatory text, with the modifications clearly indicated, will be made available to the public for written comment at least 15 days before it is adopted.

The public may request a copy of the modified regulatory text from the ARB's Public Information Office, Air Resources Board, 1001 I Street, Visitors and Environmental Services Center, 1st Floor, Sacramento, California 95814, (916) 322-2990. The document will also be posted on the web site listed above.

CALIFORNIA AIR RESOURCES BOARD

Catherine Witherspoon
Executive Officer

Date: October 11, 2005

"The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our Web-site at www.arb.ca.gov."

State of California
AIR RESOURCES BOARD

ERRATA

TITLE 13. CALIFORNIA AIR RESOURCES BOARD

By notice dated October 11, 2005, and published in the October 21, 2005, California Regulatory Notice Register, Register No.Z-05-1011-6, the Air Resources Board (the "Board" or "ARB") provided Notice of Public Hearing to Consider the Adoption of a Proposed Regulation for Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yards.

PLEASE BE ADVISED there was an error in the notice regarding the expected emission benefits in the proposal. The following sentence currently appears in paragraph 3 on page 3 of the notice:

> The proposed regulation would provide 711 tons of diesel PM emission reductions and 13,781 tons of NOx emission reductions throughout California between the years of 2007 and 2020.

This sentence was corrected to read as follows:

> The proposed regulation would provide 620 tons of diesel PM emission reductions and 13,244 tons of NOx emission reductions throughout California between the years of 2007 and 2015.

PLEASE ALSO BE ADVISED that the notice provides information regarding the cost or savings associated with compliance with the proposed regulation for the years 2007 through 2015, while the Initial Statement of Reasons provides a more comprehensive cost analysis for the years 2007-2020.

The complete text of the notice and the Initial Statement of Reasons are available on the ARB Internet site for this rulemaking at http://www.arb.ca.gov/regact/cargo2005/cargo2005.htm.

Any questions regarding these corrections should be directed to Artavia Edwards, Manager, Board Administration & Regulatory Coordination Unit at (916) 322-6070 or Amy Whiting, Regulations Coordinator at (916) 322-6533.

If you have a disability-related accommodation need, please go to http://www.arb.ca.gov/html/ada/ada.htm for assistance or contact the ADA Coordinator at (916) 323-4916. If you are a person who needs assistance in a language other than

English, please contact the Bilingual Coordinator at (916) 324-5049. TTY/TDD/Speech-to-Speech users may dial 7-1-1 for the California Relay Service.

CALIFORNIA AIR RESOURCES BOARD

Catherine Witherspoon
Executive officer

Date: October 20, 2005

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

To be considered by the Air Resources Board on December 8-9, 2005, at:

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

Stationary Source Division:
Robert D. Fletcher, Chief
Daniel E. Donohoue, Chief,
Emissions Assessment Branch
Peggy Taricco, Manager,
Technical Analysis Section

State of California
AIR RESOURCES BOARD

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

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Acknowledgements

This report was prepared with the assistance and support from the other divisions and offices of the Air Resources Board. In addition, we would like to acknowledge the assistance and cooperation that we have received from many individuals and organizations.

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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.

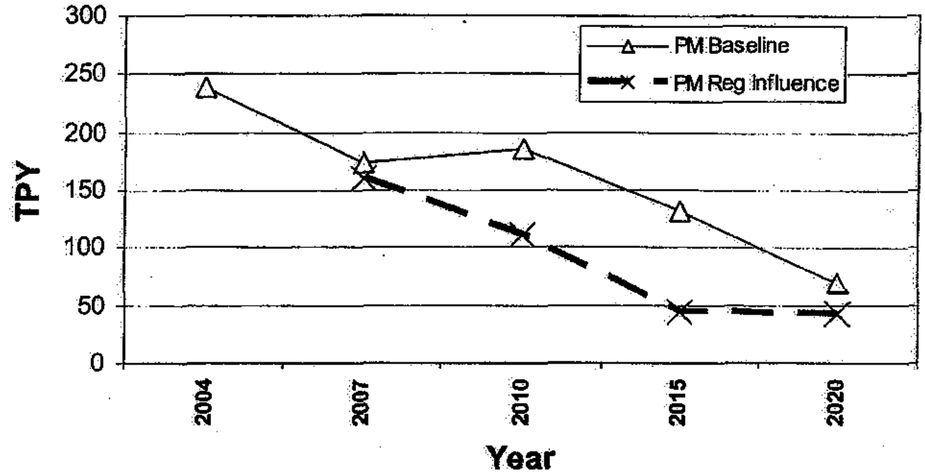
7. How will the regulation be enforced?

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.

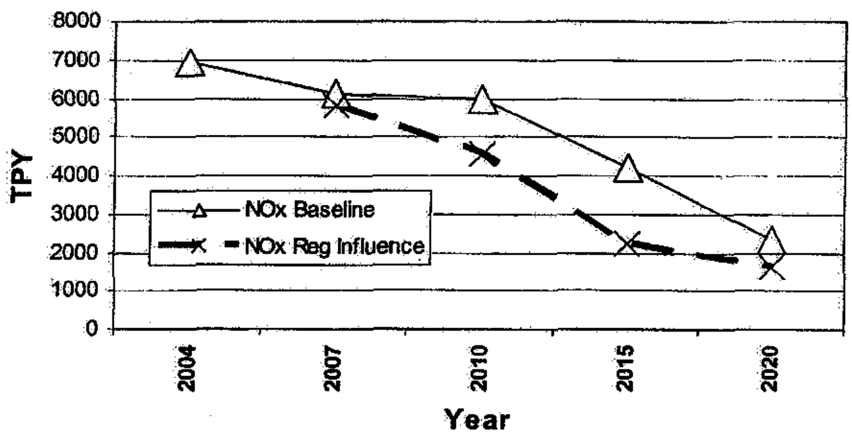
Figure ES-1: Projected Diesel PM Emissions with and without the Regulation



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 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, staff estimates the overall cost-effectiveness of the proposed regulation to be about 41 dollars 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 dollars per pound of diesel PM and 1 dollar per pound of NOx reduced.

10. Will Carl Moyer Program funds be available for cargo handling equipment if the regulation is adopted?

Yes. Although the bulk of the emission reductions from cargo handling equipment would be obtained through the regulatory requirements, Carl Moyer Program funds may be available for owners or operators that can comply early. The incremental cost of new purchase, repower, and retrofit projects would be eligible for funding. In order to qualify for Carl Moyer Program funding, the project would have to start at least three years before the required implementation date in the regulation, all of the owner or operator's cargo handling equipment for the specific model year or model year group would have to be brought into early compliance at the same time, and the project would have to meet a cost-effectiveness cap. The percent of the owner or operator's fleet eligible for Carl Moyer Program funding would be based on how early the fleet is brought into compliance.

11. How does the proposed regulation fulfill the goals of the Diesel Risk Reduction Plan and the State Implementation Plan as they pertain to these engines?

The proposed regulation is consistent with the goals of the Diesel Risk Reduction Plan. The requirements and standards in the regulation are based on the application of BACT for diesel PM. ARB staff estimates that with implementation of the regulation, diesel PM emissions will be reduced by approximately 53 percent in 2010 and 81 percent in 2020 relative to the 2004 baseline, with a cumulative reduction of 1.73 million pounds by 2020.

The proposed regulation is also consistent with the goals of the State Implementation Plan (SIP) as it relates to the in-use fleet of off-road heavy-duty compression ignition engines and equipment. The requirements and standards in the regulation utilize the strategies suggested in the SIP by reducing emissions through the application of verified diesel emission control strategies and replacing older, dirtier engines with new, lower-emission models. In addition to the reductions in diesel PM stated above, NOx emissions will also be reduced by approximately 35 percent in 2010 and 77 percent in 2020 relative to the 2004 baseline, with a cumulative reduction of 37.3 million pounds by 2020.

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 all 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 $\mu g/m^3$) 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 $\mu g/m^3$ of direct $PM_{2.5}$ or 0.81 $\mu g/m^3$ 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 μg/m³	Annual Arithmetic Mean	50 μg/m³
24-Hour Average	50 μg/m³	24-Hour Average	150 μg/m³
$PM_{2.5}$			
Annual Arithmetic Mean	12 μg/m³	Annual Arithmetic Mean	15 μg/m³
24-Hour Average	No separate State standard	24-Hour Average	65 μg/m³

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 μg/m³)	-
8 hour	0.070 ppm (137 μg/m³)	0.08 ppm (157 μg/m³)

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.

Outreach Efforts

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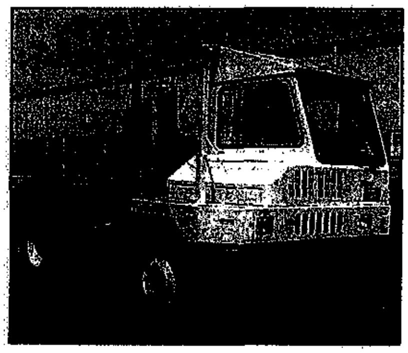
II. MOBILE CARGO HANDLING EQUIPMENT AT PORTS AND INTERMODAL RAIL YARDS

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

Yard Truck



Yard Truck

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.

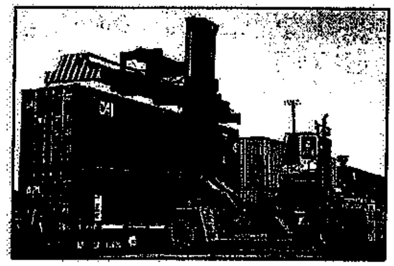
Yard trucks are designed for moving cargo containers. They are used at container ports and intermodal rail yards as well as distribution centers and other intermodal facilities. Containers are loaded onto the yard trucks by other container handling equipment, such as rubber-tired gantry cranes, top picks, 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

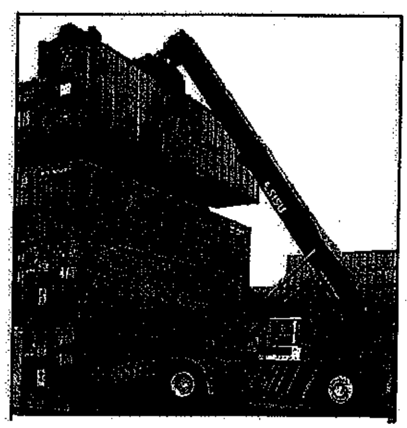
Side Handler

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

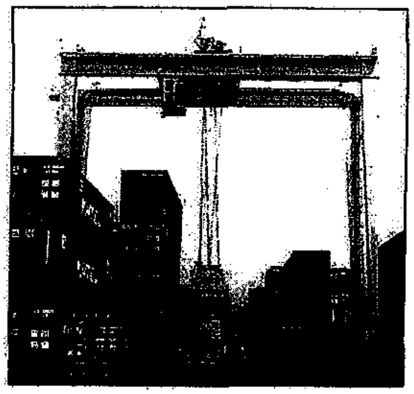
Another member of the cargo container handling family is the reach stacker. Similar to a top pick, the reach stacker has a telescopic boom, usually attached behind the cab, that moves upward and outward in order to reach over two or more stacks of containers. Reach stackers lock onto the top of the containers 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.

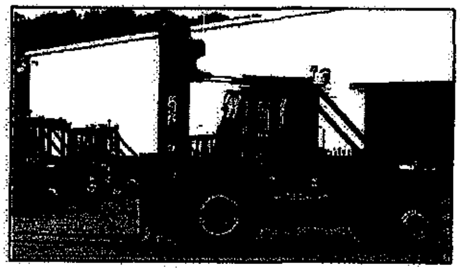


RTG Crane

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.

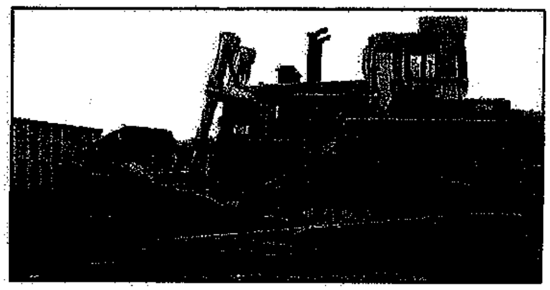
Bulk Cargo Handling Equipment

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

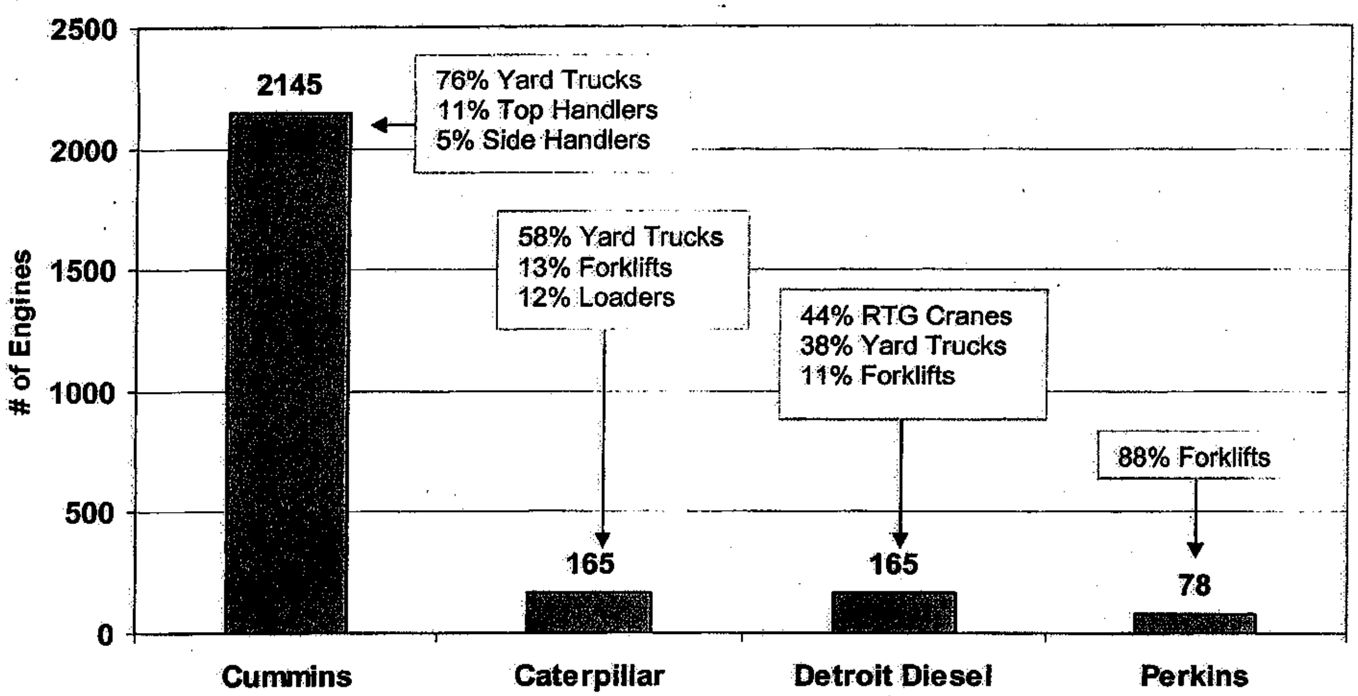

Dozer

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.

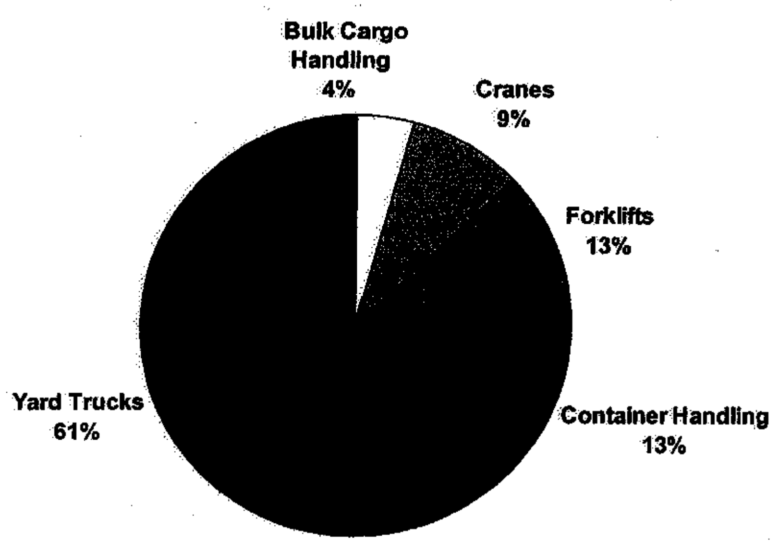
[2] The figure represents only the most common engine manufacturers of mobile cargo handling equipment from ARB's survey and the Ports of Los Angeles and Long Beach inventories and their corresponding distribution of equipment types. Therefore, not all manufacturers or equipment types are shown.

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



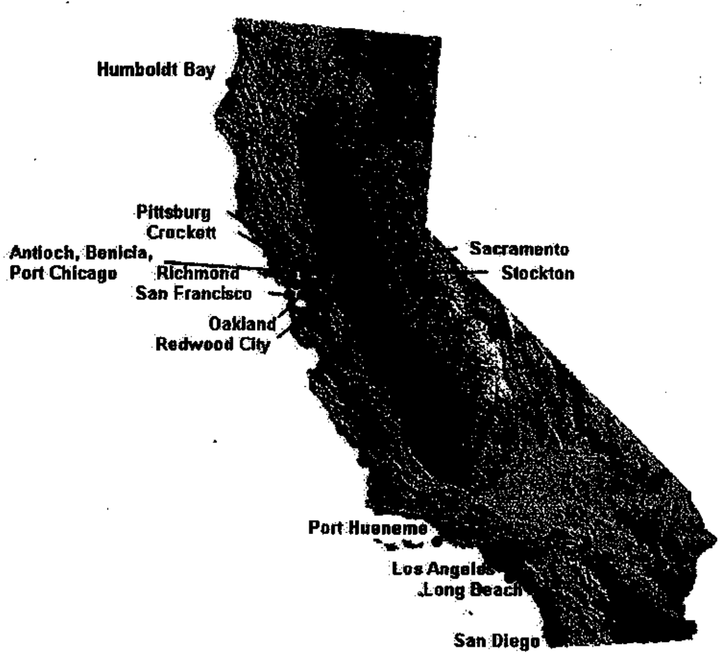
Detailed information on the statewide emissions inventory for cargo handling equipment is available in Appendix B.

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.

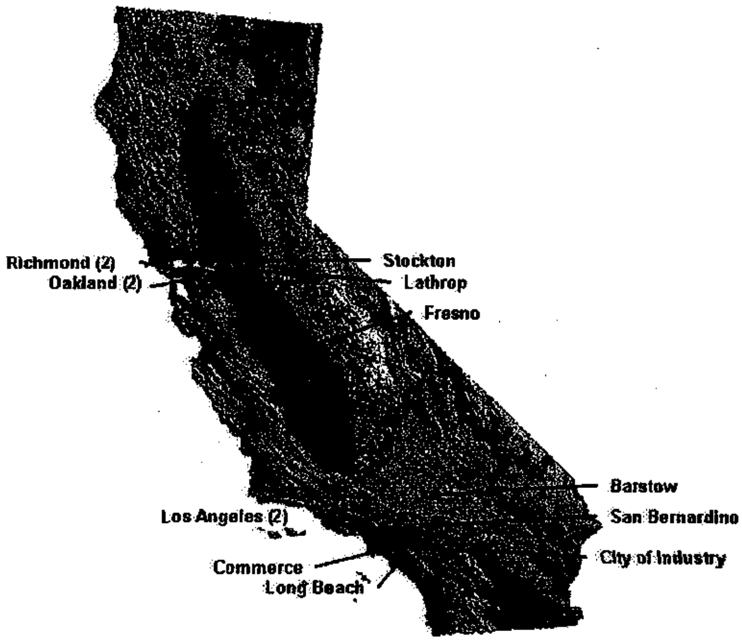
Currently, the State has 16 primary ports that participate in waterborne commerce: Antioch, Benicia, Crockett, Humboldt Bay, Hueneme, Long Beach, Los Angeles, Oakland, Pittsburg, Port Chicago, Redwood City, Richmond, Sacramento, San Diego, San Francisco, and Stockton. While most of the ports fall under 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)]

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

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).

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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.

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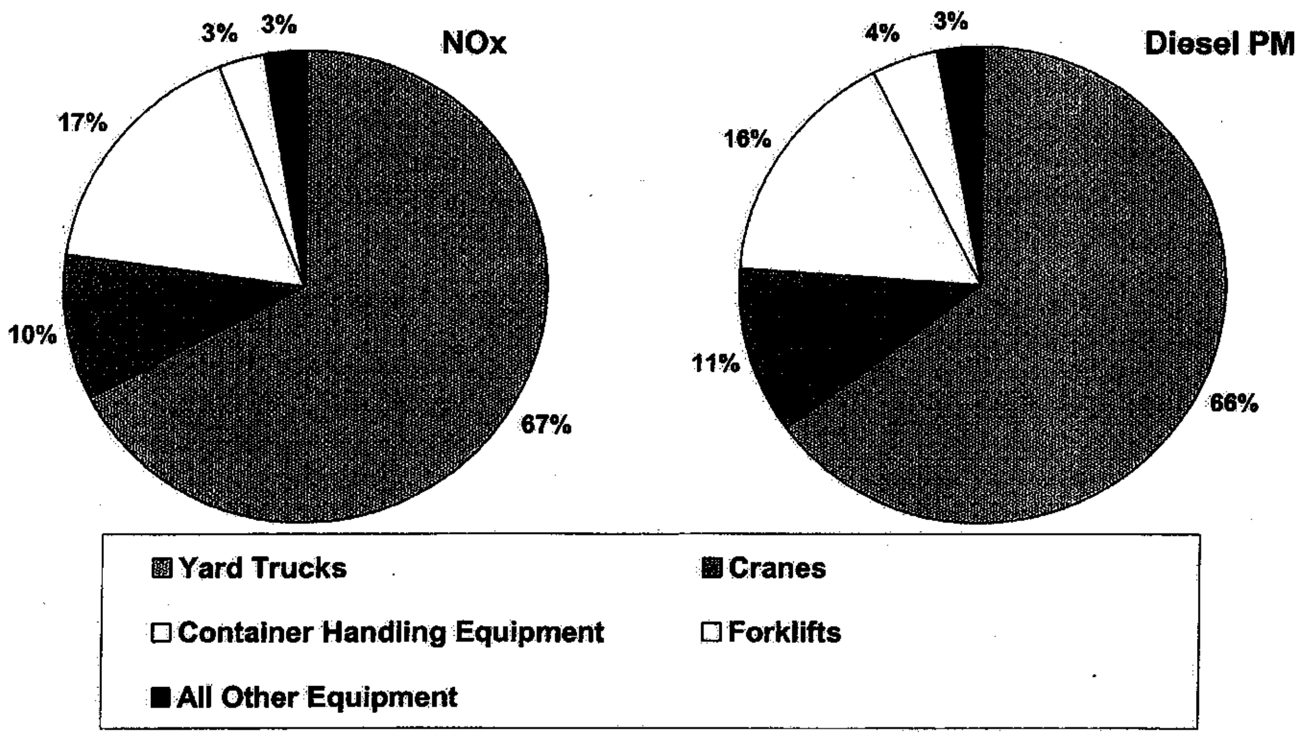
[3] The conversion factor for the transformation of NOx to NH_4NO_3 was based on an analysis of annual-average conversion factors for secondary formation of PM_{10} nitrate from NOx emissions at a number of urban sites in California. A more detailed description of the methodology used to evaluate the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

Projected 2010 and 2020 Emission Estimates for Cargo Handling Equipment

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.

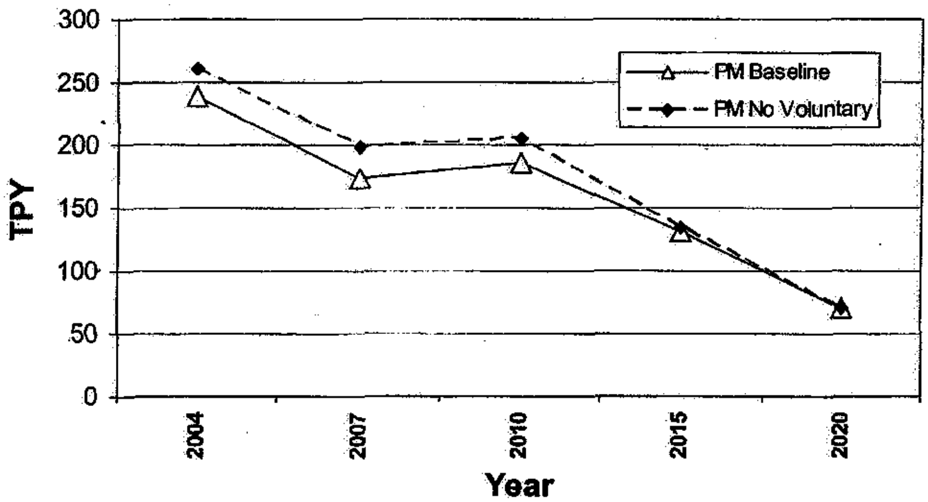
[4] The total emissions may vary slightly from the values shown in Table III-1 due to rounding.

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 $(mg/kg\text{-}d)^{-1}$).

<u>Cancer Risk Characterization</u>

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.

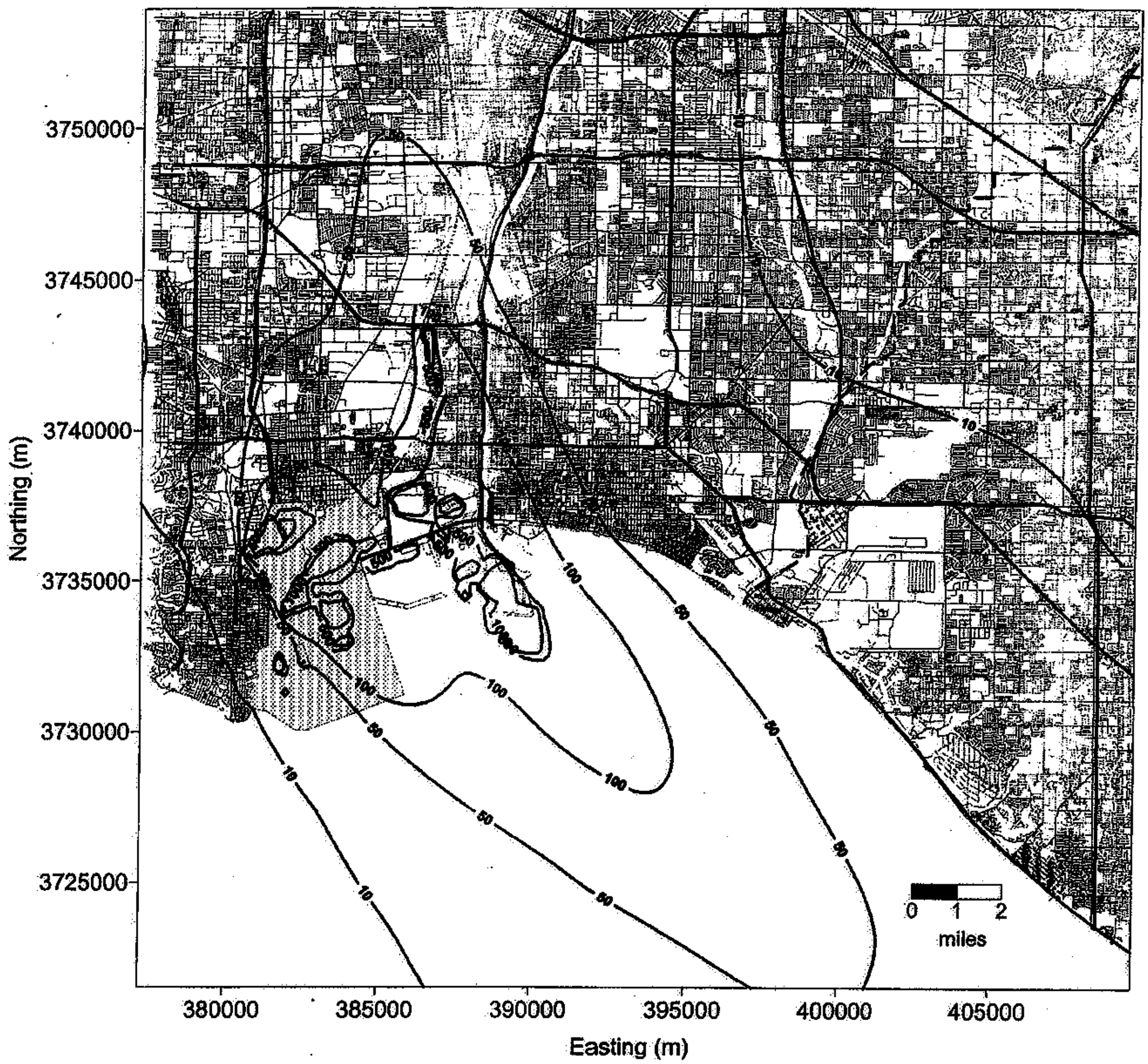
Using the U.S. Census Bureau's year 2000 census data, we estimated the population within the isopleth boundaries. The area impacted and the population affected for the risk ranges of 10-100, 100-200, 200-500, and over 500 are shown in Table III-4. As shown in the table, nearly three quarters of 2 million 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.

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(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/JAWMADieselCritical Review.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.

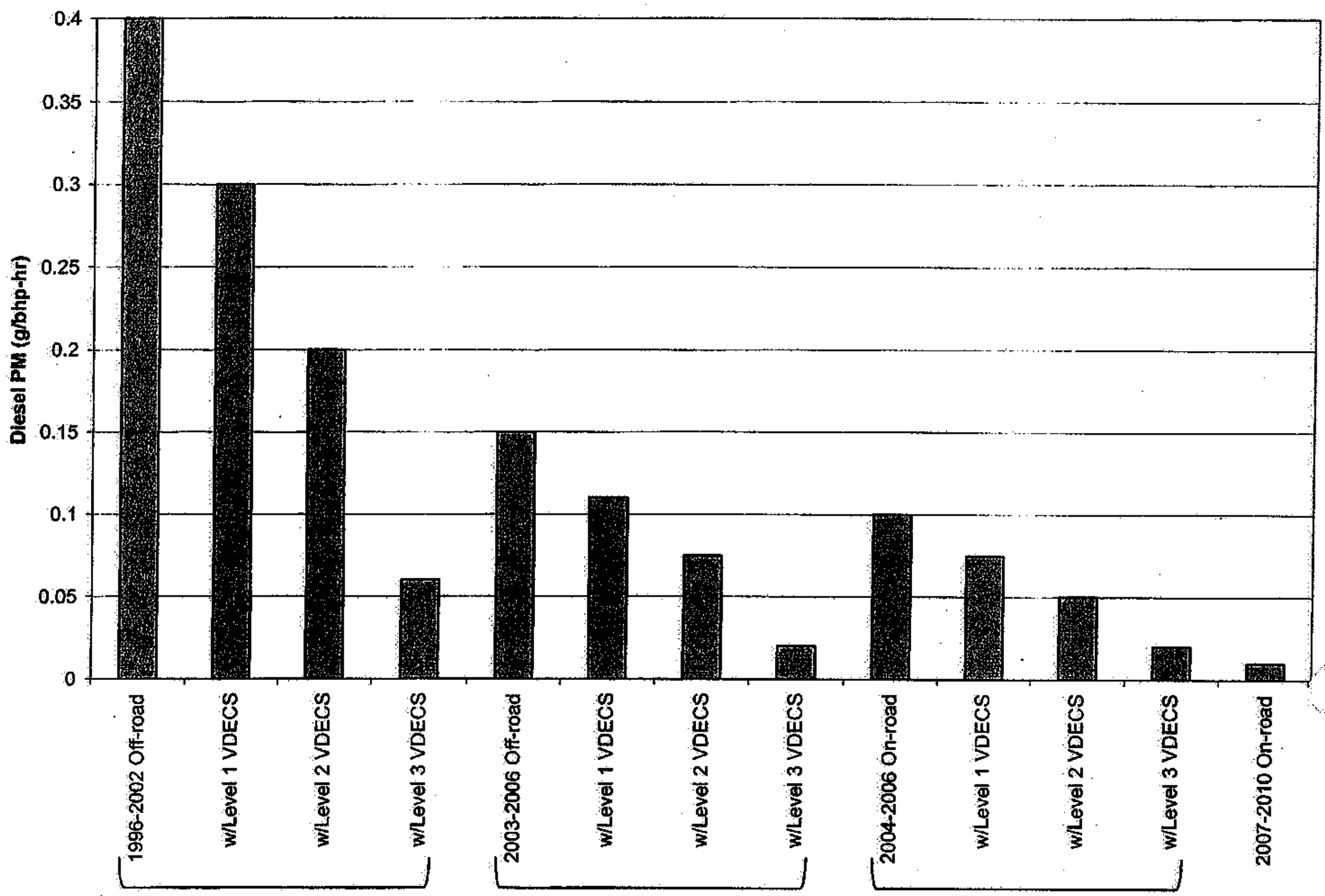
2. In-Use Yard Trucks

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.

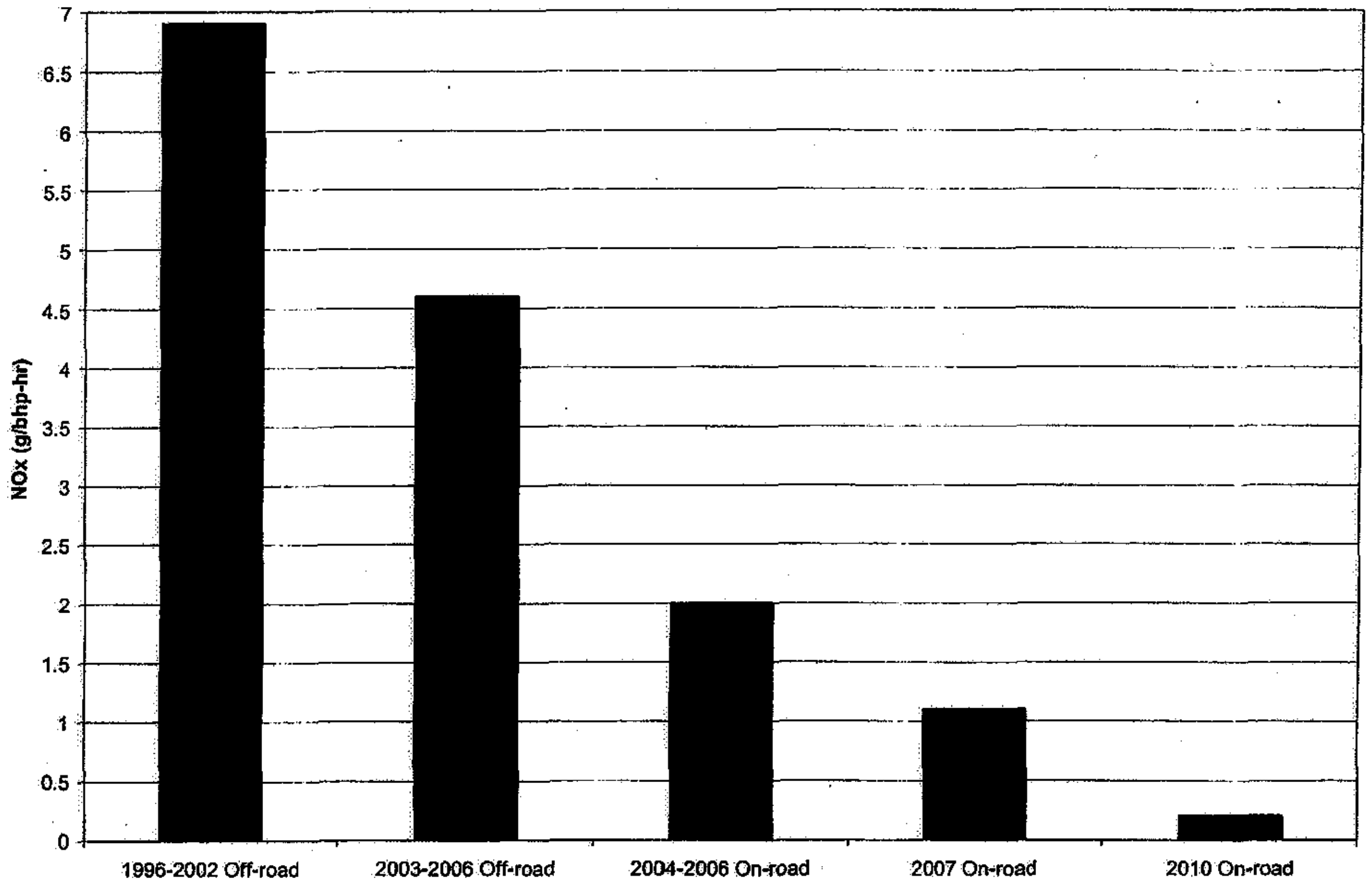
Figure IV-1: Diesel PM Emission Rates for Yard Trucks with Off-Road and On-Road Engines with and without VDECS



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.

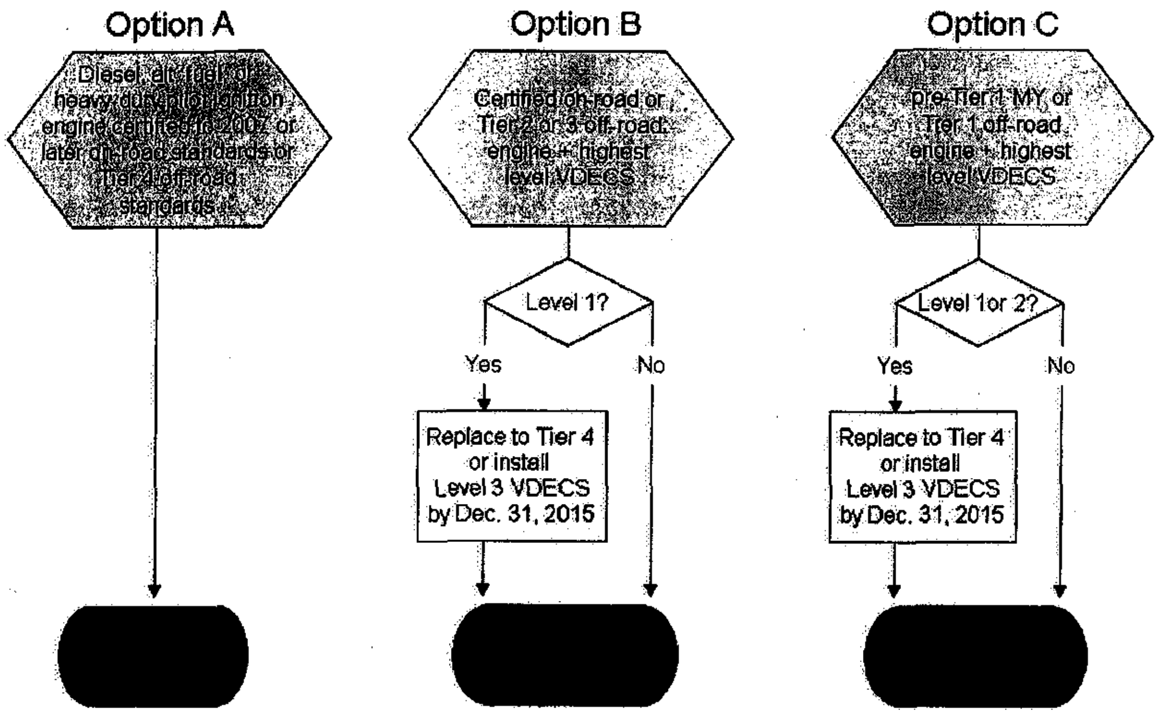
In determining the BACT compliance options, staff considered the feasibility of using certified on-road engines, technological feasibility of emission controls and availability of VDECS, ability for engine repowering, average useful life, associated health risks, and economic feasibility of replacing 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.

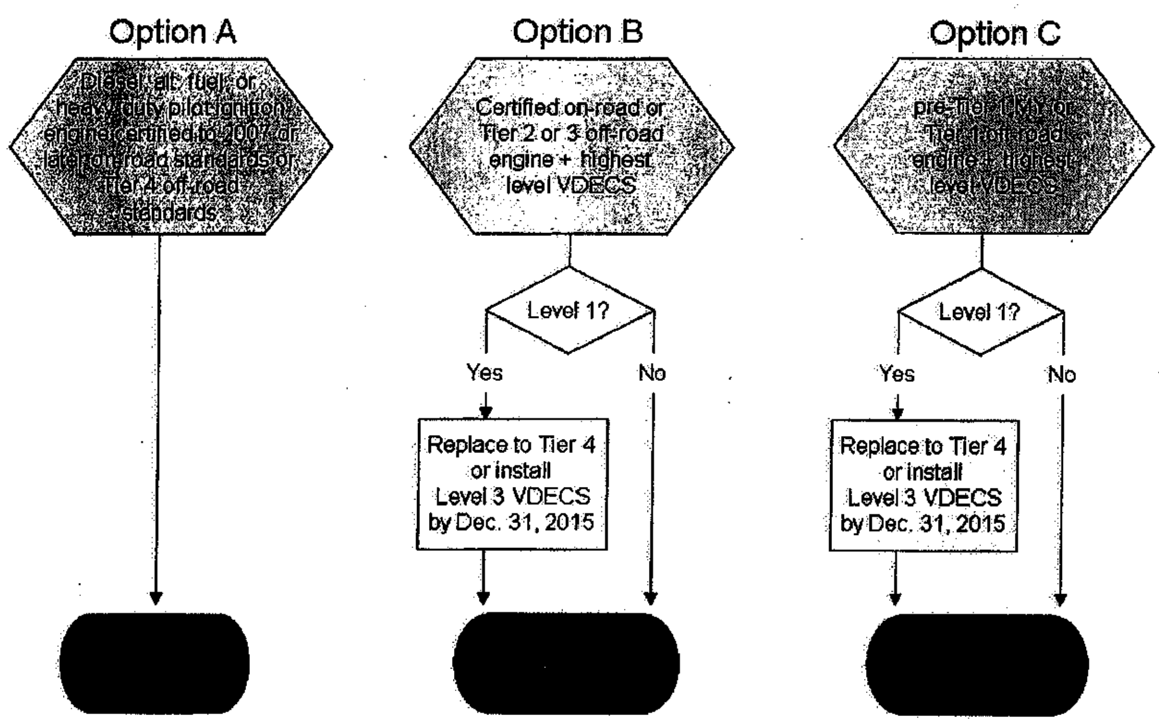
Figure IV-3: Basic Container Handling Equipment Compliance Options



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

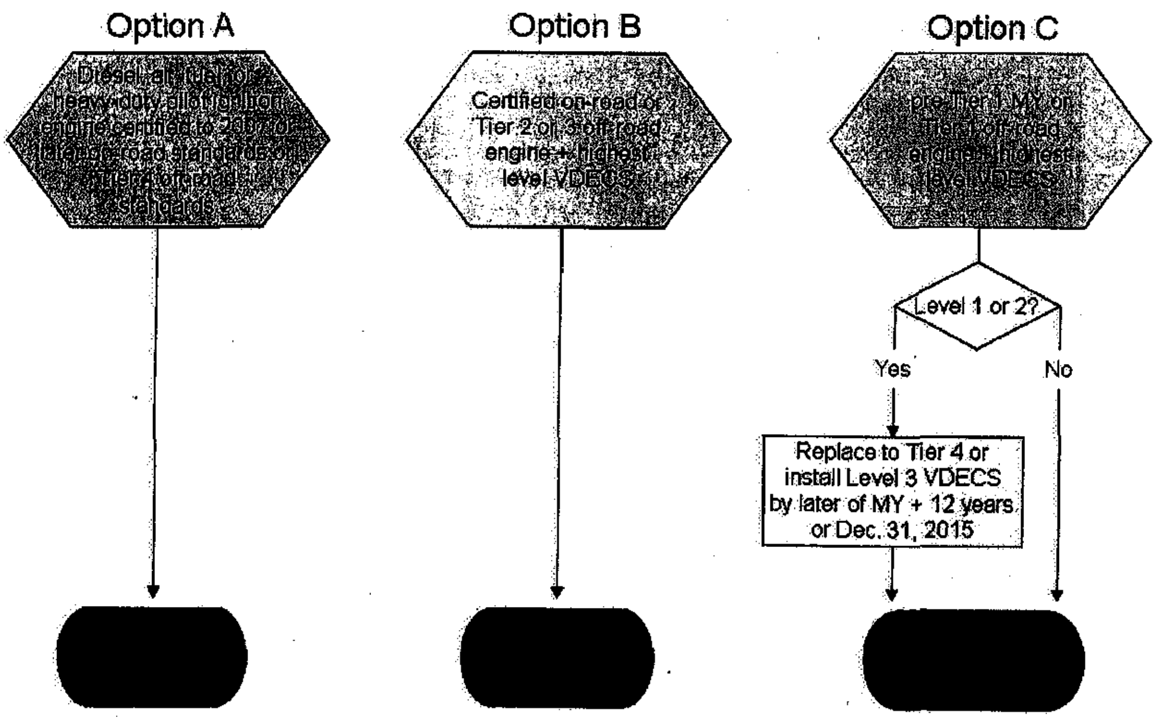


RTG Cranes

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.

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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.

Off-Road

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.

Diesel Oxidation Catalysts

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

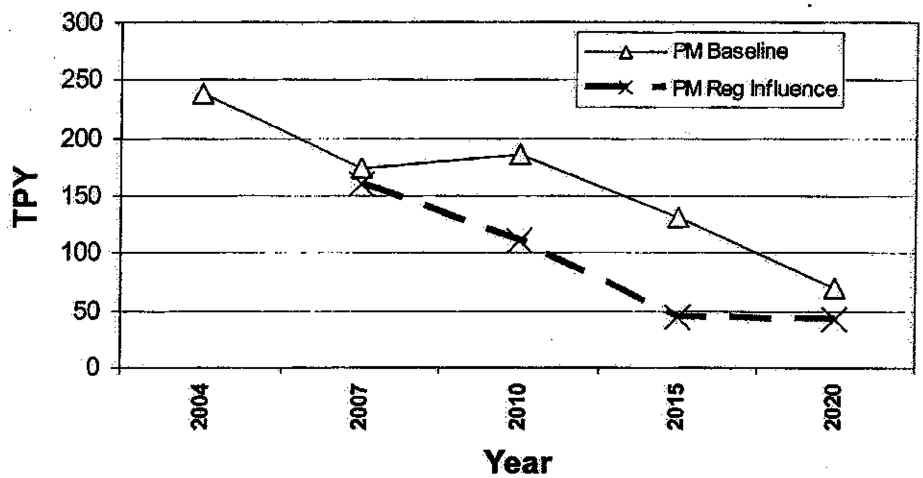
The proposed regulation will provide diesel PM and NOx emission reductions throughout California, especially in areas having ports and intermodal rail yards, areas which in most cases are non-attainment for the State and federal ambient air quality standards for ozone, PM_{10}, and $PM_{2.5}$. The projected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

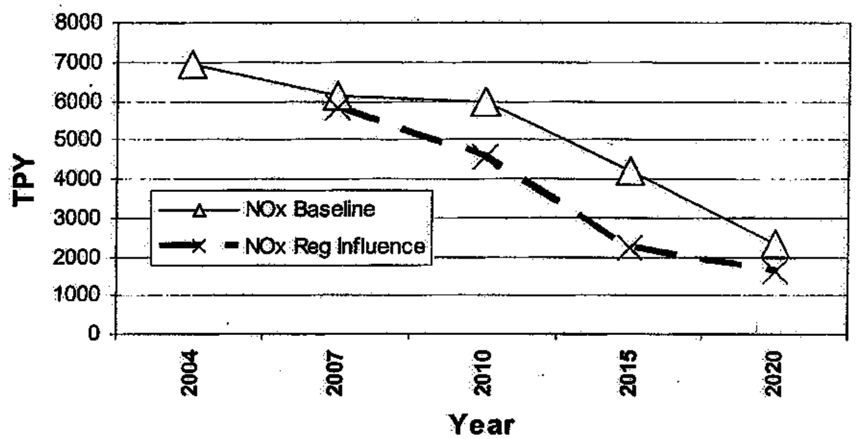


Between 2007 and 2020, we estimate approximately 865 tons of PM will be removed from California's air as a result of the regulation. As shown in Table VI-2, ARB staff estimates that, as older engines are replaced with new engines or retrofitted with diesel emission control strategies, there will also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

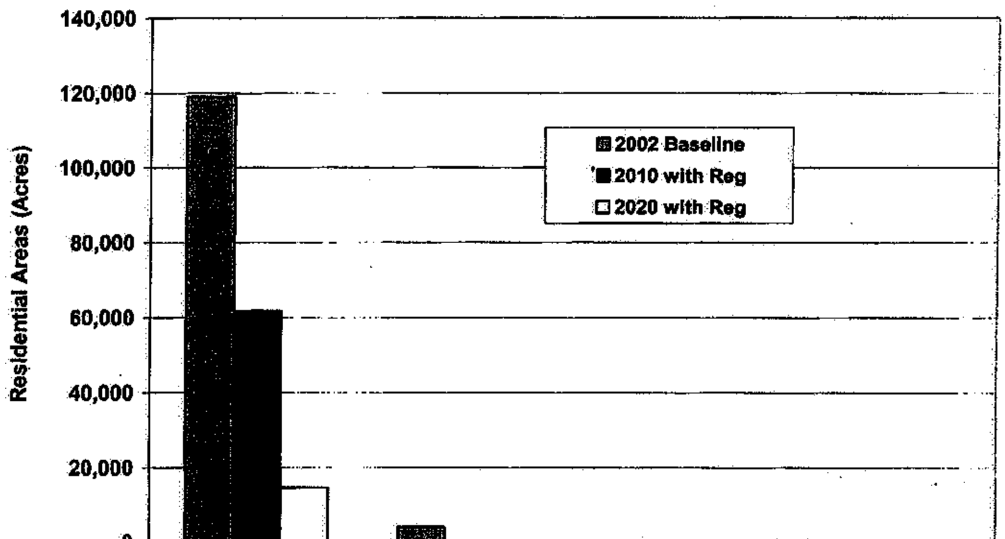
A substantial number of epidemiologic studies have found a strong association between exposure to ambient particulate matter (PM) and adverse health effects. (ARB, 2002) For this report, ARB staff evaluated the impacts the proposed regulation would have on potential cancer risks and conducted a quantitative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

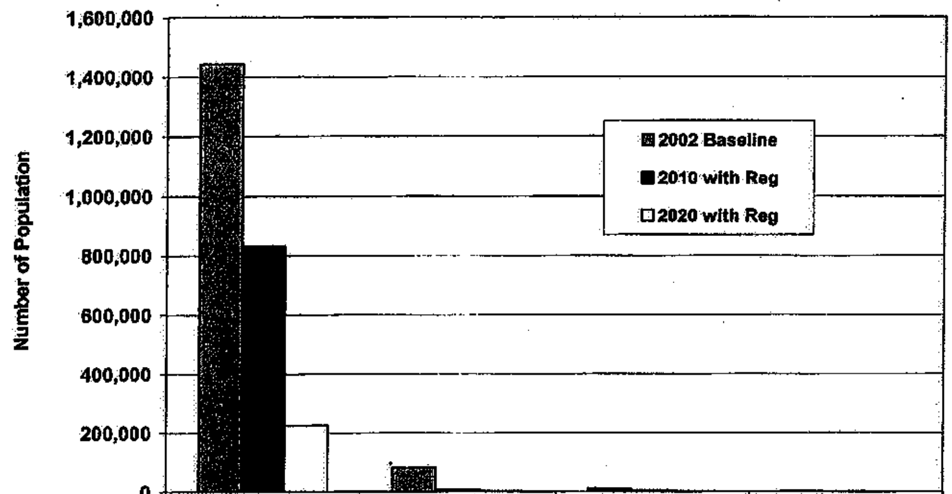
To investigate the reductions in potential risks that will result as emissions from cargo handling equipment decline, ARB staff used dispersion modeling and the projected 2010 and 2020 emissions inventories to estimate the ambient concentration of diesel PM emissions that result from the operation of 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

<u>Non-Cancer Health Impacts and Valuations</u>

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)

<u>Value of Non-Cancer Effects</u>

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.

Alternative Fuels

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:

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

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:

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

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

	Yard Truck Population	
Year	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.

<u>Estimated Capital and Recurring Costs 2007-2020</u>

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 privately-owned 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.

<u>Alternative 1: Continue Voluntary Efforts</u>

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.

<u>Alternative 2: Regulate Yard Trucks Only</u>

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

REFERENCES:

(ARB, APL, 2005) California Air Resources Board. Phone call with Mr. Michael Gedney, APL Terminal in Oakland, CA; Used yard truck and RTG crane values; May 2005.

(ARB, Ottawa, 2004) California Air Resources Board. Conversation with Mr. Donald Lawerence, Ottawa; RTG Crane Costs, new and used, and yard truck cost differential for on-road engine; November, 3 2004.

(POLB DECS) Port of Long Beach diesel emission reduction program retrofit cost data. Emission control device costs for different equipment. July 26, 2005.

(ARB, 2003a) Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Diesel Particulate Matter Control Measure for On-Road Heavy-Duty Residential and Commercial Solid Waste Collection Vehicles*, June, 2003.

(ARB, 2003b) Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Airborne Toxic Control Measure for Stationary Compression-Ignition Engines*, September, 2003.

(ARB, 2003c) Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Airborne Toxic Control Measure for In-Use Diesel-Fueled Transport Refrigeration Units (TRU) and TRU Generator Sets, and Facilities Where TRUs Operate*, October, 2003.

Appendix A

Proposed Regulation for Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yards

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

Adopt new section 2479, title 13, California Code of Regulations, to read as follows: (Note: The entire text of section 2479 set forth below is new language proposed to be added to the California Code of Regulations.)

Section 2479. Regulation for Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yards.

(a) Purpose

The purpose of this regulation is to reduce diesel particulate matter (PM) and criteria pollutant emissions from compression ignition (CI) mobile cargo handling equipment that operate at ports and intermodal rail yards in the state of California.

(b) Applicability

Except as provided in subsection (c), the regulation would apply to any person who conducts business in California who sells, offers for sale, leases, rents, purchases, owns or operates any CI mobile cargo handling equipment that operates at any California port or intermodal rail yard.

(c) Exemptions

(1) The requirements of this section do not apply to mobile cargo handling equipment that do not operate at a port or intermodal rail yard;

(2) The requirements of this section do not apply to portable CI engines; and

(3) The requirements of subsections (e), (f), (g), (h), and (i) do not apply to mobile cargo handling equipment that are not used to handle cargo at any time but are used for transporting personnel or fuel delivery. Examples include, but are not limited to, fuel delivery trucks operating solely at the terminal to deliver fuel to terminal equipment and vans and buses used to transport personnel.

(d) Definitions

For purposes of this section, the definitions of Health and Safety Code section 39010 through 39060 shall apply except to extent that such definitions may be modified by the following definitions that apply specifically to this regulation:

(1) "Alternative Diesel Fuel" means any fuel used in a CI engine that is not commonly or commercially known, sold, or represented by the supplier as diesel fuel No. 1-D or No. 2-D, pursuant to the specifications in ASTM D975-81, "Standard Specification for Diesel Fuel Oils," as modified in May 1982, which is incorporated herein by reference, or an alternative fuel, and does not require

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 but are not limited to biodiesel; Fischer-Tropsch fuels; emulsions of water in diesel fuel; and fuels with a fuel additive, unless:

(A) the additive is supplied to the engine fuel by an on-board dosing mechanism, or

(B) the additive is directly mixed into the base fuel inside the fuel tank of the engine, or

(C) the additive and base fuel are not mixed until engine fueling commences, and no more additive plus base fuel combination is mixed than required for a single fueling of a single engine.

(2) "Alternative Fuel" means natural gas, propane, ethanol, methanol, gasoline (when used in hybrid electric mobile cargo handling equipment only), hydrogen, electricity, fuel cells, or advanced technologies that do not rely on diesel fuel. "Alternative fuel" also means any of these fuels used in combination with each other or in combination with other non-diesel fuel.

(3) "Basic Container Handling Equipment" means mobile cargo handling equipment, other than yard trucks, bulk cargo handling equipment, and RTG cranes, used to handle cargo containers. Basic Container Handling Equipment includes but is not limited to top handlers, side handlers, reach stackers, straddle carriers, and forklifts.

(4) "Bulk Cargo Handling Equipment" means mobile cargo handling equipment, other than yard trucks, basic container handling equipment, and RTG cranes, generally used to move non-containerized cargo, including but not limited to dozers, excavators, loaders, tractors, mobile cranes (excluding rubber-tired gantry cranes), aerial lifts, and sweepers.

(5) "Carbon Monoxide (CO)" is a colorless, odorless gas resulting from the incomplete combustion of hydrocarbon fuels.

(6) "Cargo Handling Equipment" means any off-road, self-propelled vehicle or equipment used at a port or intermodal rail yard to lift or move container, bulk, or liquid cargo carried by ship, train, or another vehicle, or used to perform other non-cargo handling operations. Equipment includes, but is not limited to, mobile cranes, rubber-tired gantry cranes, yard trucks, top handlers, side handlers, reach stackers, forklifts, loaders, sweepers, aerial lifts, excavators, and dozers.

(7) "Certified Off-road Diesel Engine" means an engine certified to California off-road engine emission standards under title 13 CCR, section 2423.

(8) "Certified On-road Diesel Engine" means an engine certified to California on-road diesel engine emission standards under title 13 CCR, section 1956.8.

(9) "Compression Ignition (CI) Engine" means an internal combustion engine with operating characteristics significantly similar to the theoretical diesel combustion cycle. The regulation of power by controlling fuel supply in lieu of a throttle is indicative of a compression ignition engine.

(10) "Diesel Fuel" means any fuel that is commonly or commercially known, sold, or represented by the supplier as diesel fuel, including any mixture of primarily liquid hydrocarbons (HC) - organic compounds consisting exclusively of the elements carbon and hydrogen - that is sold or represented by the supplier as suitable for use in an internal combustion, compression-ignition engine.

(11) "Diesel-Fueled" means a CI engine fueled by diesel fuel, CARB diesel fuel, or jet fuel, in whole or part.

(12) "Diesel Oxidation Catalyst (DOC)" means a catalyst promoting oxidation processes in diesel exhaust, and usually designed to reduce emissions of the organic fraction of diesel particulates, gas-phase HC, and CO.

(13) "Diesel Particulate Filter (DPF)" means an emission control technology that reduces PM emissions by trapping the particles in a flow filter substrate and periodically removes the collected particles by either physical action or by oxidizing (burning off) the particles in a process called regeneration.

(14) "Diesel Particulate Matter (Diesel PM)" means the particles found in the exhaust of diesel-fueled CI engines. Diesel PM may agglomerate and adsorb other species to form structures of complex physical and chemical properties.

(15) "Dozer" means an off-road tractor, either tracked or wheeled, equipped with a blade.

(16) "Emission Control Strategy" means any device, system, or strategy employed with a diesel engine that is intended to reduce emissions, including, but not limited to, diesel oxidation catalysts, selective catalytic reduction systems, fuel additives, diesel particulate filters, alternative diesel fuels, water emulsified fuels, and any combination of the above.

(17) "Excavator" means an off-road vehicle consisting of a backhoe and cab mounted on a pivot atop an undercarriage with tracks or wheels.

(18) "Executive Officer" means the Executive Officer of the California Air Resources Board or his/her designee.

(19) "Fleet" means the total number of mobile cargo handling equipment vehicles owned, rented, or leased by an owner or operator at a specific terminal or intermodal yard location.

(20) "Forklift" means an off-road industrial truck used to hoist and transport materials by means of steel fork(s) under the load.

(21) "Fuel Additive" means any substance designed to be added to fuel or fuel systems or other engine-related engine systems such that it is present in-cylinder during combustion and has any of the following effects: decreased emissions, improved fuel economy, increased performance of the engine; or assists diesel emission control strategies in decreasing emissions, or improving fuel economy or increasing performance of the engine.

(22) "Heavy-duty Pilot Ignition Engine" means an engine designed to operate using an alternative fuel, except that diesel fuel is used for pilot ignition at an average ratio of no more than one part diesel fuel to ten parts total fuel on any energy equivalent basis. An engine that can operate or idle solely on diesel fuel at any time does not meet this definition.

(23) "Hydrocarbon (HC)" means the sum of all hydrocarbon air pollutants.

(24) "In-Use" means a CI engine that is not a "new" CI engine.

(25) "Intermodal Rail Yard" means any rail 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.

(26) "Lease" means a contract by which one conveys cargo handling equipment for a specified term and for a specified rent.

(27) "Level" means one of three categories of Air Resources Board-verified diesel emission control strategies as set forth in title 13, CCR, section 2701 et seq: Level 1 means the strategy reduces engine diesel particulate matter emissions by between 25 and 49 percent, Level 2 means the strategy reduces engine diesel particulate matter emissions by between 50 and 84 percent, and Level 3 means the strategy reduces engine diesel particulate matter emissions by 85 percent or greater, or reduces engine emissions to less than or equal to 0.01 grams diesel PM per brake horsepower-hour.

(28) "Loader" means 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; can be also referred to as a front-end loader, front loader, skid steer loader, backhoe, rubber-tired loader, or wheeled loader.

(29) "Minimum Use Requirement" means an agreement, as part of state or local incentive funding programs or written agreement between mobile cargo handling equipment owners or operators and the Ports of Long Beach, Los Angeles, or Oakland, to use an emission control device on mobile cargo handling equipment for a specified minimum number of years and/or hours.

(30) "Mobile Crane" means the propulsion engine of a crane other than a rubber-tired gantry crane.

(31) "Model Year" means the CI engine manufacturer's annual production period, which includes January 1st of a calendar year, or if the manufacturer has no annual production period, the calendar year.

(32) "Newly Purchased, Leased, or Rented Cargo Handling Equipment" means mobile cargo handling equipment, or a diesel-fueled CI engine installed in mobile cargo handling equipment, that is newly purchased, rented, or leased by an owner or operator on or after January 1, 2007, and is operated at a port or intermodal rail yard in the state of California after January 1, 2007.

(33) "Nitrogen Oxides (NOx)" means compounds of nitric oxide (NO), nitrogen dioxide (NO_2), and other oxides of nitrogen, which are typically created during combustion processes and are major contributors to smog formation and acid deposition.

(34) "Non-Methane Hydrocarbons (NMHC)" means the sum of all HC air pollutants except methane.

(35) "Non-Yard Truck Mobile Cargo Handling Equipment" means all mobile cargo handling equipment other than yard trucks.

(36) "Off-Road Engine" means an engine used in an off-road vehicle, or piece of equipment, including a certified on-road diesel engine.

(37) "Off-Road Vehicle or Equipment" means any non-stationary device, including registered motor vehicles, powered by an internal combustion engine or motor, used primarily off the highways to propel, move, or transport persons or property.

(38) "Owner or Operator" means any person subject to the requirements of this section, including but not limited to:

(A) an individual, trust, firm, joint stock company, business concern, partnership, limited liability company, association, or corporation including but not limited to, a government corporation; and

(B) any city, county, district, commission, the state or any department, agency, or political subdivision thereof, any interstate body, and the federal government or any department or agency thereof to the extent permitted by law.

(39) "Particulate Matter (PM)" means the particles found in the exhaust of CI engines, which may agglomerate and adsorb other species to form structures of complex physical and chemical properties.

(40) "Portable CI Engine" means a compression ignition (CI) engine designed and capable of being carried or moved from one location to another. Indicators of portability include, but are not limited to, wheels, skids, carrying handles, dolly, trailer, or platform. Portable engines are not self-propelled.

(41) "Port" means facilities used for water-borne commerce.

(42) "Purchased" means the date shown on the front of the cashed check, the date of the financial transaction, or the date on the engine purchasing agreement, whichever is earliest.

(43) "Railcar Mover" means an off-road vehicle fitted with rail couplers and capable of traveling on both roads and rail tracks.

(44) "Reach Stacker" means an off-road truck-like cargo container handler that uses an overhead telescopic boom that can reach across two or more stacks of cargo containers and lift the containers from the top.

(45) "Registered Motor Vehicle" means a yard truck or other cargo handling vehicle that is registered as a motor vehicle under Vehicle Code section 4000, et seq.

(46) "Rent" means payment for the use of mobile cargo handling equipment for a specified term.

(47) "Retirement" or "Retire" means an engine or vehicle that will be taken out of service by an owner or operator and will not be operated at a port or intermodal rail yard in the State of California. The engine may be sold outside of California or scrapped.

(48) "Rubber-tired Gantry Crane or RTG Crane" means an off-road overhead cargo container crane with the lifting mechanism mounted on a cross-beam supported on vertical legs which run on rubber tires.

(49) "Side Handler or Side Pick" means an off-road truck-like cargo container handler that uses an overhead telescopic boom to lift empty or loaded cargo containers by grabbing either two top corners on the longest side of a container, both arms of one side of a container, or both top and bottom sides of a container; also referred to as "side pick."

(50) "Sweeper" means an off-road vehicle with attached brushes underneath that sweep the ground and pick up dirt and debris.

(51) "Terminal" means a facility that operates cargo handling equipment at a port or intermodal rail yard.

(52) "Tier 4 Off-road Emission Standards" means the emission standards promulgated by the United States Environmental Protection Agency in "Control of Emissions of Air Pollution from Nonroad Diesel Engines and Fuel; Final Rule" (Vol. 69, No. 124 Fed.Reg. pp. 38957-39273, June 29, 2004) which harmonize with the final amended emission standards for newly manufactured off-road engines approved by the Air Resources Board on December 12, 2004.

(53) "Top Handler or Top Pick" means an off-road truck-like cargo container handler that uses an overhead telescopic boom to lift empty or loaded cargo containers by grabbing the top of the containers; also referred to as "top pick."

(54) "Verification Procedure, Warranty and In-Use Compliance Requirements for In-Use Strategies to Control Emissions from Diesel Engines (Verification Procedure)" means the Air Resources Board (ARB) regulatory procedure codified in title 13, CCR, sections 2700-2710, which is incorporated herein by reference, that engine manufacturers, sellers, owners, or operators may use to verify the reductions of diesel PM or NOx from in-use diesel engines using a particular emission control strategy.

(55) "Verified Diesel Emission Control Strategy (VDECS)" means an emission control strategy, designed primarily for the reduction of diesel PM emissions, which has been verified pursuant to the "Verification Procedure for In-Use Strategies to Control Emissions from Diesel Engines" in title 13, California Code of Regulations, commencing with section 2700.

(56) "Yard truck" means an off-road mobile utility vehicle used to carry cargo containers with or without chassis; also known as utility tractor rig (UTR), yard tractor, yard goat, yard hostler, yard hustler, or prime mover.

(e) Requirements

(1) Newly Purchased, Leased, or Rented Equipment Performance Standards:

(A) Yard Trucks:

1. Except as provided in subsection (c), on or after January 1, 2007, no owner or operator shall operate any newly purchased, leased, or rented yard trucks unless they are equipped with the following types of engines:

   a. Yard trucks that are registered as motor vehicles shall be equipped with engines that meet the on-road emission standards as specified in title 13, California Code of Regulations, section 1956.8, for the model year in which the yard trucks and engines were newly purchased, leased, or rented.

   b. Yard trucks that are *not* registered as motor vehicles shall be equipped with engines:

      i. that are certified to the on-road emission standards set forth in title 13, CCR, section 1956.8; for the model year in which the yard trucks and engines were newly purchased, leased, or rented; or
      ii. that have been certified to meet the final Tier 4 off-road emission standards for the rated horsepower.

(B) Non-Yard Truck Cargo Handling Equipment:

1. Except as provided in subsection (c), on or after January 1, 2007, no owner or operator shall operate any newly purchased, leased, or rented non-yard truck vehicles or equipment unless they meet the following:

   a. Non-yard truck mobile cargo handling equipment that are registered as motor vehicles shall be equipped with engines that meet the on-road emission standards as specified in title 13, California Code of Regulations, section 1956.8, for the model year in which the non-yard truck mobile cargo handling equipment and engines were newly purchased, leased, or rented.

   b. Non-yard truck mobile cargo handling equipment that are *not* registered as motor vehicles shall be equipped with engines:

      i. that have been certified to meet the on-road emission standards as specified in title 13, California Code of Regulations, section 1956.8 for the model year in which the non-yard truck mobile cargo handling equipment and engines were newly purchased, leased, or rented; or
      ii. that have been certified to meet the Tier 4 off-road emission standards for the model year and rated horsepower of the newly purchased, leased, or rented non-yard truck mobile cargo handling equipment engines; or

   c. if (b) above is not available for the specific application and equipment type, the non-yard truck mobile cargo handling equipment shall be equipped with engines that have been certified to meet the highest available level off-road diesel engine emission standards as specified in title 13, California Code of Regulations, section 2423 for the rated horsepower and model year in which the equipment were newly purchased, leased, or rented, provided the owner or operator must install the highest level VDECS available within one year after the purchase, lease, or rental of the equipment, or within 6 months of when a VDECS becomes available, if that occurs after one year after the purchase, lease, or rental.

(2) In-Use Performance Standards for Yard Trucks

(A) In accordance with the schedule set forth below in paragraph (e)(2)(B), no owner or operator shall operate an in-use yard truck at a port or intermodal rail yard unless the engine meets the performance standards set forth below:

1. is certified to 2007 or later on-road emission standards for the model year of the year purchased as specified in title 13, California Code of Regulations, section 1956.8; or

2. is certified to final Tier 4 off-road emission standards for the rated horsepower; or
3. is equipped with a VDECS that results in emissions less than or equal to the diesel PM and NOx emission standards for a certified final Tier 4 off-road diesel engine of the same horsepower rating.

(B) Compliance Schedules for In-Use Yard Trucks

1. All owners or operators of three or fewer yard trucks shall comply with subsection (e)(2) according to the schedule in Table 1:

Table 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

2. All owners or operators of four or more yard trucks shall comply with subsection (e)(2) according to the schedule in Table 2:

Table 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

a. for each compliance deadline, the percentage of yard trucks (25 percent, 50 percent, or 100 percent) that must meet the requirements of subsection (e)(2) 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; and

b. if the number of yard trucks is not a whole number, conventional rounding practices apply (i.e., if less 0.5, round down; if 0.5 or greater, round up).

(3) In-Use Performance Standards for Non-Yard Truck Mobile Cargo Handling Equipment

(A) In accordance with the schedule set forth in subsection (e)(3)(C), no owner or operator shall operate non-yard truck mobile cargo handling equipment unless they meet all of the following:

1. Use one of the Compliance Options for each vehicle or equipment in the active fleet as specified in paragraph (e)(3)(B) per the compliance schedule listed in Table 3 in subsection (e)(3)(C); and

2. Adherence to any special circumstances that may apply when a diesel emission control strategy is used as a Compliance Option as specified in subsection (g); and

3. Maintenance of all records as specified in subsection (i); and

4. Continuous Compliance. An owner or operator is required to keep all mobile cargo handling equipment operating in California in compliance with the requirements of this regulation at all times.

(B) Compliance Option. Each owner or operator shall use one of the following Compliance Options on each engine or vehicle in his fleet as required by the implementation schedule listed in Table 3 in subsection (e)(3)(C):

1. Basic Container Handling Equipment:

a. An engine or power system, including a diesel, alternative fuel, or heavy-duty pilot ignition engine, certified to either the 2007 or later model year on-road emission standards for the year manufactured as specified in title 13, CCR, section 1956.8, or the Tier 4 off-road emission standards for the rated horsepower and model year of the year manufactured; or

b. An engine or power system certified to the on-road emission standards for the year manufactured as specified in title 13, CCR, section 1956.8, or certified to the Tier 2 or Tier 3 off-road diesel engine standard for the rated horsepower and model year of the year manufactured, and used in conjunction with the highest level VDECS that is verified for a specific engine family and model year. If the highest level VDECS used is Level 1, the engine or power system must meet the certified Tier 4 off-road emission standards, or be equipped with a Level 3 VDECS by December 31, 2015; or

c. An engine or power system certified to the Tier 1 off-road diesel engine standard, as specified in title 13, CCR, section 2423, or to a higher emission level, and equipped with the highest level VDECS that is verified for the specific engine family and model year. If the highest level VDECS used is Level 1 or Level 2, the engine or power system must meet the certified Tier 4 off-road emission standards or be equipped with a Level 3 VDECS by December 31, 2015.

2. Bulk Cargo Handling Equipment:

a. An engine or power system, including a diesel, alternative fuel, or heavy-duty pilot ignition engine, certified to either the 2007 or later model year on-road emission standards for the year manufactured as specified in title 13, CCR, section 1956.8, or the Tier 4 off-road emission standards for the rated horsepower and model year of the year manufactured; or

b. An engine or power system certified to the on-road emission standards for the year manufactured as specified in title 13, CCR, section 1956.8, or certified to the Tier 2 or Tier 3 off-road diesel engine standard for the rated horsepower and model year of the year manufactured, and used in conjunction with the highest level VDECS that is verified for a specific engine family and model year. If the highest level VDECS used is Level 1, the engine or power system must meet the certified Tier 4 off-road emission standards, or be equipped with a Level 3 VDECS by December 31, 2015; or

c. An engine or power system certified to the Tier 1 off-road diesel engine standard, as specified in title 13, CCR, section 2423, or to a higher emission level, and equipped with the highest level VDECS that is verified for the specific engine family and model year. If the highest level VDECS used is Level 1, the engine or power system must meet the certified Tier 4 off-road emission standards or be equipped with a Level 3 VDECS by December 31, 2015.

3. Rubber-Tired Gantry Cranes:

   a. An engine or power system, including a diesel, alternative fuel, or heavy-duty pilot ignition engine, certified to either the 2007 or later model year on-road emission standards for the year manufactured as specified in title 13, CCR, section 1956.8, or the Tier 4 off-road emission standards for the rated horsepower and model year of the year manufactured; or

   b. An engine or power system certified to the on-road emission standards for the year manufactured as specified in title 13, CCR, section 1956.8, or certified to the Tier 2 or Tier 3 off-road diesel engine standard for the rated horsepower and model year of the year manufactured, and used in conjunction with the highest level VDECS that is verified for a specific engine family and model year; or

   c. An engine or power system certified to the Tier 1 off-road diesel engine standard, as specified in title 13, CCR, section 2423, or to a higher emission level, and equipped with the highest level VDECS that is verified for the specific engine family and model year. If the highest level VDECS used is Level 1 or Level 2, the engine or power system must meet the certified Tier 4 off-road emission standards or be equipped with a Level 3 VDECS by the latter of model year plus 12 years or December 31, 2015.

(C) Compliance Schedule for Non-Yard Truck Mobile Cargo Handling Equipment

1. All owners or operators of non-yard truck mobile cargo handling equipment shall comply with subsection (e)(3) according to the schedule in Table 3:

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

Engine Model Years	Compliance Date[1]				
	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

a. for each compliance deadline, the percentage of non-yard truck equipment (25 percent, 50 percent, or 100 percent) that must meet the requirements of subsection (e)(3) 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; and
b. if the number of non-yard truck equipment is not a whole number, conventional rounding practices apply (i.e., if less 0.5, round down; if 0.5 or greater, round up).

(4) Fuel Requirements

(A) Except as provided for in subsection (c), on or after January 1, 2007, no owner or operator of cargo handling equipment shall fuel the equipment with any fuel unless the fuel is one of the following:

1. CARB Diesel Fuel; or
2. An alternative diesel fuel that meets the requirements of the Verification Procedure; or
3. An alternative fuel; or
4. CARB Diesel Fuel used with fuel additives that meets the requirements of the Verification Procedure; or
5. Any combination of (e)(4)(A)1. through (e)(4)(A)4. above.

(B) Owners or operators choosing to use alternative diesel fuels in mobile cargo handling equipment to meet the requirements of subsections (e)(2) and (e)(3) shall:

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

1. Maintain records in accordance with subsection (i); and
2. Use only fuel that is a VDECS alternative diesel fuel in mobile cargo handling equipment at ports or intermodal rail yards in California; and
3. Permanently affix a label in clear view near the fill spout that identifies the proper fuel that is required to be in compliance; and
4. In the event that the owner or operator decides to revert to using CARB diesel fuel, the operator shall comply with the requirements of subsections (e)(2) and (e)(3) within 10 days of discontinuation of alternative diesel fuel use. Within 10 days of discontinuation, the owner or operator shall notify the Executive Officer in writing of this change in fuel use and shall include an update to any annual report submitted to comply with subsections (e)(2), (e)(3), (i), or (j).

(C) 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 reduction or PM emissions shall only fuel the subject mobile cargo handling equipment with fuel that meets these specifications. In addition, owners or operators that choose a VDECS that requires certain fuel properties to be met in order to prevent damage to the VDECS or an increase in toxic air contaminants, other harmful compounds, or in the nature of the emitted PM, shall only fuel the subject mobile cargo handling equipment with fuel that meets these specifications.

(f) Compliance Extensions

An owner or operator may be granted an extension to a compliance deadline specified in subsection (e) for one of the following reasons. If a compliance extension is granted by the Executive Officer, the owner or operator shall be deemed to be in compliance as specified by the Executive Officer's authorization. Unless specifically stated, compliance extensions may not be combined or used consecutively, and only one compliance extension type may be granted per engine or vehicle.

(1) *Compliance Extension for an Engine Near Retirement*. If an owner or operator has applied a Compliance Option to its fleet pursuant to the schedule set forth in Table 3 of subsection (e), and the next engine subject to the Compliance Options is scheduled to be retired from the active fleet within one year of the applicable compliance deadline, the owner or operator does not need to apply a Compliance Option to that engine for up to one year, provided the owner or operator maintains appropriate records and documentation, as specified in subparagraph (i)(1)(F), regarding the assigned retirement date and the engine is retired on or before the assigned date. If upon inspection, ARB finds the aforementioned conditions to have not been met, the engine would be in noncompliance from the date that compliance would otherwise have been required under the schedule set forth in Table 3 of subsection (e).

(2) *Compliance Extension Based on No Verified Diesel Emission Control Strategy for Non-Yard Truck Mobile Cargo Handling Equipment.* If the Executive Officer has not verified a diesel emission control strategy or one is not commercially available for a particular engine and equipment combination, an annual extension in compliance, up to a maximum of two years, may be granted by the Executive Officer. The Executive Officer shall grant the extension upon determining that the following circumstances have been met:

(A) The owner or operator has applied to the Executive Officer for a compliance extension for an engine six months prior to each compliance deadline specified in subsection (e)(3)(C) and provided sufficient documentation to meet the conditions set forth below. The owner or operator may, six-months prior to the expiration of the extension, apply for an additional one-year extension. In such a case, the owner or operator shall once again be required to show to the Executive Officer's satisfaction that the conditions set forth below have been met:

1. The owner or operator must establish that it has applied a Compliance Option specified in subsection (e)(3) to all applicable engines in its fleet for which a Compliance Option is feasible pursuant to the schedule set forth in Table 3 of subsection (e),
2. Identify each engine for which an extension is requested by engine serial number; engine manufacturer, model year, family, and series; and type of mobile cargo handling equipment, for which a specific diesel emission control strategy would jeopardize the original engine warranty and a statement from the engine manufacturer or authorized dealer stating the original engine warranty would be jeopardized; or
3. Identify each engine and equipment or vehicle combination for which an extension is requested by engine serial number; engine manufacturer, model year, family, and series; and type of mobile cargo handling equipment, for which no diesel emission control strategy is commercially available and a list of manufacturers that have been contacted with their responses to a request to purchase, and
4. Describe the reason(s) for the request for a compliance extension for each engine or engine and equipment or vehicle combination.

(3) *Use of Experimental Diesel Particulate Matter Emission Control Strategies for Non-Yard Truck Mobile Cargo Handling Equipment.* An annual compliance extension may be granted by the Executive Officer for the use of an experimental, or non-verified, diesel PM emission control strategy if a VDECS is not available or if the owner or operator can demonstrate that an existing VDECS is not feasible for their equipment or application. The owner or operator shall keep documentation of this use in records as specified in paragraph (i)(1)(G). Each mobile cargo handling equipment engine will be considered to be in compliance for the duration of the experiment, until the extension expires. The owner or operator must bring the mobile cargo handling equipment into compliance within six months of the end of the annual compliance extension.

The Executive Officer may grant the extension upon determining that the owner or operator has met the conditions specified below:

(A) The engine owner or operator has applied to the Executive Officer for a compliance extension six months prior to each compliance deadline, including annually if the owner or operator wishes to continue with the experimental controls. The application must include emissions data demonstrating the experimental control achieves at least a Level 1 diesel PM emission reduction through:

1. off-road engine certification test data for the cargo handling equipment engine;
2. engine manufacturer test data;
3. emissions test data from a similar engine;
4. emissions test data used in meeting the requirements of the Verification Procedure for the emission control strategy implemented; or
5. emissions testing conducted under the following conditions:
   a. baseline testing may be conducted with the emission control strategy in place, provided the test sample is taken upstream of the emission control strategy;
   b. control strategy testing shall be performed on the cargo handling equipment engine with full implementation of the emission control strategy;
   c. the percent change from baseline shall be calculated as the baseline emissions minus control strategy emissions, with the difference being divided by the baseline emissions and the result expressed as a percentage;
   d. the same test method shall be used for determining both baseline emissions and control strategy emissions; and
   e. diesel PM, NOx, CO, HC, NMHC, and CO_2 testing shall be done in accordance with one of the following methods:
      i. International Organization for Standardization (ISO) 8178 Test procedures: ISO 8178-1: 1996(E) ("ISO 8178 Part 1"); ISO 8178-2: 1996(E) ("ISO 8178 Part 2"); and ISO 8178-4: 1996(E) ("ISO 8178 Part 4"), which are incorporated herein by reference; or
      ii. Title 13, California Code of Regulations, section 2423, "Exhaust Emission Standards and Test Procedures – Off-Road Compression Ignition Engines," which is incorporated herein by reference.

(B) The application for extension must include the following: explanation demonstrating that the highest level VDECS are not feasible for the specific equipment or application (if applicable), identification of each engine (serial number, engine manufacturer, model year, family, and series), description of the emission control system to be demonstrated, emissions data required in (A) above, the contact information for the emission control system supplier, and a letter of intent from the supplier that they intend to apply for verification of the experimental system;

(C) The owner or operator must bring the mobile cargo handling equipment into compliance within six months of the end of the compliance extension period;

(D) If VDECS are available, or become available during the extension period, and are determined to be feasible for the specific engine and equipment type, the owner or operator must demonstrate that the experimental control achieves equivalent to or better than a Level 1 VDECS; and

(E) No experimental diesel particulate matter emission control strategy may be used on mobile cargo handling equipment after December 31, 2015.

(4) *Compliance Extension for Equipment Manufacturer Delays.* An owner or operator who has purchased new equipment in order to comply with subsection (e), including an owner or operator who has been granted a compliance extension per subsections (f)(2), (f)(3), or (f)(5), will be considered to be in compliance if the new equipment has not been received due to manufacturing delays, as long as the following conditions are met:

(A) The equipment was purchased, or the owner or operator and seller had entered into contractual agreement for the purchase, at least six months prior to the required compliance date as specified in subsection (e); and

(B) Proof of purchase, such as a purchase order or signed contract for the sale, including engine specifications for each applicable equipment, must be maintained by the owner or operator and provided to an agent or employee of ARB upon request.

(5) *Compliance Extension for Yard Trucks Having VDECS with Minimum Use Requirements.* If VDECS were installed on a yard truck prior to December 31, 2005, and the minimum use requirements of the VDECS, as established under a public funding program, is later than the compliance date as specified in subsection (e)(2)(B), an exemption from compliance may be extended to three years beyond the installation date of the VDECS if the following conditions are demonstrated by the owner or operator:

(A) The VDECS was installed using funding from a public agency; and

(B) The funding program stipulated minimum use requirements that would expire after the required compliance date as specified in subsection (e)(2)(B).

(g) Diesel Emission Control Strategy Special Circumstances

An owner or operator shall maintain the original level of the elected Compliance Option for each engine once that engine is required to be in compliance, and is not required to upgrade to a higher level of Compliance Option, except under specified special circumstances, as follows:

(1) In the event of a failure or damage of a diesel emission control strategy, the following conditions apply:

(A) Failure or Damage during the Warranty Period. If a diesel emission control strategy fails or is damaged within its warranty period and the diesel emission control strategy manufacturer or authorized dealer determines it cannot be repaired, the owner or operator shall replace the diesel emission control strategy with either the same level diesel emission control strategy or another approved Compliance Option as defined in subsection (e)(3) within 90 days of diesel emission control strategy failure.

(B) Failure or Damage Outside of Warranty Period. If a diesel emission control strategy fails or is damaged outside of its warranty period, and it cannot be repaired, the owner or operator shall apply a Compliance Option within 90 days, as defined in subsection (e)(3).

(h) Alternative Compliance Plan for Non-Yard Truck Cargo Handling Equipment

(A) Requirements

1. The purpose of this subsection is to allow any person ("person" or "applicant") subject to this regulation the option of complying with the requirements of this subsection (h) in lieu of the requirements of subsection (e)(3). Under subsection (h), alternative emission control strategies (AECS) can be implemented as an alternative compliance plan (ACP) in lieu of meeting the requirements of subsection (e)(3), provided they result in no greater emissions, expressed in pounds, of diesel PM and NOx from the non-yard truck cargo handling equipment, over the applicable calendar year, relative to the emissions that would have occurred under subsection (e)(3).

2. An applicant wishing to participate in an ACP may include one or more non-yard truck cargo handling equipment in the ACP, but the applicant shall only include equipment that the person owns or operates under their direct control.

3. An applicant for an ACP shall submit information to the Executive Officer that demonstrates that the AECS under the proposed ACP will result in

no greater emissions, expressed in pounds, of diesel PM and NOx from the non-yard truck cargo handling equipment, over the applicable calendar year, relative to the emissions that would have occurred under subsection (e)(3).

4. AECS may include, but are not limited to:

   a. equipment engine modifications,
   b. exhaust treatment control,
   c. engine repower,
   d. equipment replacement, and
   e. use of alternative fuels or fuel additives.

5. The ACP application demonstrating compliance with this subsection shall contain, at a minimum, the following information:

   a. the company name, address, and contact information;
   b. the equipment subject to the ACP, including equipment and engine make, model, and serial numbers, and other information that uniquely identify the equipment;
   c. documentation, calculations, emissions test data, or other information that establishes the diesel PM and NOx reductions, expressed in pounds, from non-yard truck cargo handling equipment will be equivalent to or greater than the emission reductions that would have been achieved upon compliance with under subsection (e)(3);
   d. the proposed recordkeeping, reporting, monitoring, and testing procedures that the applicant plans to use to demonstrate continued compliance with the ACP.

6. Emission reduction calculations demonstrating equivalence with the requirements of subsection (e)(3) shall only include diesel PM and NOx emissions from non-yard truck cargo handling equipment operating at a California port or intermodal rail yard.

7. Any owner or operator subject to an approved ACP shall maintain operating records in a manner and form as specified by the Executive Officer in the approved ACP. Required records may include, but are not limited to, information on hours of operation, fuel usage, maintenance procedures, and emissions test results. Such records and reports shall be retained for a period of not less than three (3) years and shall be submitted to the Executive Officer in the manner specified in the approved ACP and upon request by the Executive Officer.

8. Emission reductions included in an ACP shall not include reductions that are otherwise required by any State or federal rule, regulation, or statute.

9. No person may operate any non-yard truck cargo handling equipment under an ACP unless the applicant has first been notified in writing by the Executive Officer that the ACP application has been approved. Prior to such approval, applicants shall comply with the provisions of this section, including the requirements in subsection (e)(3).

(B) Application Process

1. Applications for an ACP shall be submitted in writing to the Executive Officer for evaluation.

2. The Executive Officer shall notify the applicant in writing whether their application is approved or denied within 90 days of receipt of the submittal.

3. Additional information may be provided by the applicant after submittal of the original application. However, the Executive Officer shall have 90 days after submittal of the additional information to notify the applicant of approval or denial of the ACP.

4. The applicant shall notify the Executive Officer in writing within 30 days upon learning of any information that would alter the emissions estimates submitted in the ACP application. If the Executive Officer has reason to believe that an approved ACP has been granted to a person that no longer meets the criteria for an ACP, the Executive Officer may modify or revoke the ACP as necessary to assure that the subject non-yard truck cargo handling equipment will meet the emission reduction requirements in this section.

(i) Recordkeeping Requirements

Beginning December 31, 2006, an owner or operator of mobile cargo handling equipment shall maintain the following records or copies of records at port and intermodal rail yard facilities where applicable. The owner or operator shall provide the following records for inspection to an agent or employee of ARB upon request, including copies of these records at the department's expense, for all mobile cargo handling equipment subject to compliance with the regulation:

(1) Records Kept at Terminal. The owner or operator shall keep the following records accessible either in hard copy format or computer records at the terminal where the mobile cargo handling equipment normally resides:

(A) Owner or Operator Contact Information

1. Company name
2. Contact name, phone number, address, e-mail address
3. Address of equipment

(B) Equipment and Engine Information
1. Make of equipment and engine
2. Model of equipment and engine
3. Engine family (if applicable)
4. Engine serial number
5. Year of manufacture of equipment and engine (if unable to determine, approximate age)
6. Rated brake horsepower
7. Control equipment (if applicable)
   a. Type of diesel emission control strategy
   b. Serial number of installed diesel emission control strategy
   c. Manufacturer of installed diesel emission control strategy
   d. Model of installed diesel emission control strategy
   e. Installation date of installed diesel emission control strategy
   f. Level of control (1, 2, or 3); if using a Level 1 or 2, include the reason for the choice
   g. Documentation for Minimum Use Requirement Compliance Extension pursuant to paragraph (f)(5)

(C) Records of maintenance for each installed diesel emission control strategy

(D) Fuel(s) Used
1. CARB Diesel
2. Alternative diesel fuel (specify)
3. Alternative fuel (specify)
4. Combination (dual fuel) (specify)
5. Other (specify)

(E) Operation Information
1. Describe general use of engine
2. Typical load (percent of maximum bhp rating)
3. Typical annual hours of operation
4. If seasonal, months of year operated and typical hours per month operated

(F) For each engine for which an owner or operator is claiming an exemption pursuant to paragraph (f)(1), the retirement date correlated to the information in paragraph (i)(1) above

(G) For each engine for which an owner or operator is claiming an extension pursuant to paragraph (f)(3), the records of the test plan, including start and end dates of the experiment; diesel particulate matter emission control strategy manufacturer name and contact information (representative, address, and phone number); name and type of experimental diesel particulate matter emission control strategy; and targeted data to be generated by experiment, correlated to the information in paragraph (i)(1) above

(H) For each engine for which an owner or operator is claiming an extension pursuant to paragraph (f)(4), the purchase order or signed contract between the owner or operator and seller of the new equipment that has been purchased in order to comply with subsection (e)

(I) A statement of compliance, prepared beginning January 1, 2007, and renewed each January 1 thereafter until January 1, 2016, certifying that the owner's or operator's engines are in compliance as required, including the following:

1. "The mobile cargo handling equipment at terminal (insert terminal name and name of port or intermodal rail yard) are in compliance with title 13, California Code of Regulations, section 2479;" and
2. The owner's or operator's name, business address, business telephone; and
3. The signature of the owner or operator or its agent and date signed.

(2) Records Kept in Mobile Cargo Handling Equipment. For each mobile cargo handling equipment, the owner or operator shall keep the following information affixed to the driver's side door jamb, or another readily accessible location known by the owner or operator of each mobile cargo handling equipment, in the form of a legible and durable label or in an alternative form approved by the Executive Officer or designee that is immediately accessible at the time of inspection by the enforcement agency:

(A) For each installed diesel emission control strategy, label information as specified in title 13, CCR, section 2706(g), and the installation date; or

(B) For each mobile cargo handling equipment that has installed a certified on-road or off-road engine in order to comply with subsection (e), the engine make, model, and installation date; or

(C) Engine model year and planned compliance date; or

(D) Engine model year and retirement date for an engine for which an owner or operator is claiming an extension pursuant to paragraph (f)(1); or

(E) Engine model year and beginning and end date for which an owner or operator is claiming an extension pursuant to paragraph (f)(2): or

(F) Engine model year and beginning and ending date of the test plan for an engine for which an owner or operator is claiming an extension pursuant to paragraph (f)(3); or

(G) Engine model year and date of purchase of replacement engine or equipment for which an owner or operator is claiming an extension pursuant to paragraph (f)(4); or

(H) Engine model year, date of installation of VDECS, and supporting documentation for public funding program, for the engine and equipment for which an owner or operator is claiming an extension pursuant to paragraph (f)(5).

(3) Each owner or operator shall maintain these records for each mobile cargo handling equipment until it is sold outside of the State of California or is no longer used at a port or intermodal rail yard in the State of California. If ownership is transferred, the seller shall convey the records to the buyer.

(j) Reporting Requirements

(1) Compliance Plan. By January 31, 2007, each owner or operator of in-use mobile cargo handling equipment subject to the requirements of subsection (e) shall provide the following information to the Executive Officer:

(A) Information listed in paragraph (i)(1), and

(B) An identification of the planned control strategy (Compliance Plan) for each mobile cargo handling equipment listed in paragraph (i)(1) that, when implemented, will result in compliance with subsection (e). If applicable, the information should include the Executive Order number issued by the Executive Officer for a VDECS that has been approved by the Executive Officer through the Verification Procedure. The Compliance Plan is not binding and can be changed by the owner or operator prior to the required compliance date(s).

(2) Demonstration of Compliance. By no later than the earliest applicable compliance date specified in subsections (e)(2)(B) or (e)(3)(C), the owner or operator of an in-use mobile cargo handling equipment subject to the requirements of subsection (e) shall provide the following information to the Executive Officer:

(A) Information listed in (i)(1), and

(B) An identification of the control strategy implemented for each mobile cargo handling equipment in accordance with the requirements of subsection (e) for purposes of demonstrating compliance.

(3) Annual Reporting. Each terminal owner or operator shall submit an annual report to the Executive Officer by January 31, 2007, and by each January 31 annually, through 2016 as described below:

(A) Company name;

(B) Contact name, phone number, address, e-mail address;

(C) Address of equipment, including name of port or intermodal rail yard where equipment is operated; and

(D) A signed affidavit stating the completeness and accuracy of the annual report.

(4) Reporting for Off-Road Equipment that Does Not Handle Cargo at any Time. Each terminal owner or operator to whom subsection (c)(3) applies, shall submit a report to the Executive Officer by January 31, 2007, as described below:

(A) Owner or Operator Contact Information
1. Company name
2. Contact name, phone number, address, e-mail address
3. Address of equipment

(B) Equipment and Engine Information
1. Make of equipment and engine
2. Model of equipment and engine
3. Engine family (if applicable)
4. Engine serial number
5. Year of manufacture of equipment and engine (if unable to determine, approximate age)
6. Rated brake horsepower
7. Control equipment (if applicable)
   a. Type of diesel emission control strategy
   b. Serial number of installed diesel emission control strategy
   c. Manufacturer of installed diesel emission control strategy
   d. Model of installed diesel emission control strategy
   e. Installation date of installed diesel emission control strategy
   f. Level of control (1, 2, or 3)

(C) Fuel(s) Used
1. CARB Diesel
2. Alternative diesel fuel (specify)
3. Alternative fuel (specify)
4. Combination (dual fuel) (specify)
5. Other (specify)

(D) Operation Information
1. Describe general use of engine
2. Typical load (percent of maximum bhp rating)
3. Typical annual hours of operation

4. If seasonal, months of year operated and typical hours per month operated

(k) Right of Entry

An agent or employee of the Air Resources Board has the right of entry to port and intermodal rail yard cargo handling facilities for the purpose of inspecting on-road and off-road cargo handling equipment and their records to determine compliance to these regulations.

(l) Prohibitions

No person who is engaged in this State in the business of selling to an ultimate purchaser, or renting or leasing new or used mobile cargo handling equipment, including, but not limited to, manufacturers, distributors, and dealers, shall sell, offer for sell, import, deliver, purchase, receive, or otherwise acquire a new or used mobile cargo handling equipment for the purpose of selling, renting, or leasing, that does not meet the performance requirements of this regulation.

(m) Severability

If any subsection, paragraph, subparagraph, sentence, clause, phrase, or portion of this regulation is, for any reason, held invalid, unconstitutional, or unenforceable by any court of competent jurisdiction, such portion shall be deemed as a separate, distinct, and independent provision, and such holding shall not affect the validity of the remaining portions of the regulation.

(n) Submittal of Documents

(A) All documents required under this regulation to be submitted to the Executive Officer shall be submitted as follows:

California Air Resources Board
Stationary Source Division, Cargo Handling Equipment
P.O. Box 2815
Sacramento, California 95812-2815

(B) An alternative method, including electronic submittals, may be approved by the Executive Officer.

NOTE: Authority cited: sections 39600, 39601, 39618, 39658, 39659, 39666, 39667, 39674, 39675, 42400 et seq., 42402 et seq., 42410, 43013, 43018, California Health and Safety Code. Reference: sections 39618, 39650, 39658, 39659, 39666, 39667, 39674, 39675, 42400 et seq., 42402 et seq., 42410, 40717.9, 43013, and 43018.

TITLES 13 AND 17. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER THE ADOPTION OF PROPOSED REGULATIONS TO REDUCE EMISSIONS FROM AUXILIARY DIESEL ENGINES AND DIESEL-ELECTRIC ENGINES OPERATED ON OCEAN-GOING VESSELS WITHIN CALIFORNIA WATERS AND 24 NAUTICAL MILES OF THE CALIFORNIA BASELINE

The Air Resources Board (ARB or Board) will conduct a public hearing at the time and place noted below to consider adoption of regulations to reduce emissions of diesel particulate matter (PM), nitrogen oxides (NOx), and sulfur oxides (SOx) from the use of auxiliary diesel engines and diesel-electric engines operated on ocean-going vessels *located within all California inland waters; all California estuarine waters; and within* 24 nautical miles, except as otherwise specified in this proposal, of the California baseline, including but not limited to, the Territorial Sea, the Contiguous Zone, and any California port, roadstead or terminal facility.

DATE: December 8, 2005

TIME: 9:00 a.m.

PLACE: California Environmental Protection Agency
Air Resources Board
Byron Sher Auditorium, Second Floor
1001 I Street
Sacramento, California 95814

This item will be considered at a two-day meeting of the ARB, which will commence at 9:00 a.m., December 8, 2005, and may continue at 8:30 a.m., December 9, 2005. This item may not be considered until Friday, December 9, 2005. Please consult the agenda for the meeting, which will be available at least 10 days before December 8, 2005, to determine the day on which this item will be considered.

If you have a disability-related accommodation need, please go to http://www.arb.ca.gov/html/ada/ada.htm for assistance or contact the ADA Coordinator at (916) 323-4916. If you are a person who needs assistance in a language other than English, please contact the Bilingual Coordinator at (916) 324-5049. TTY/TDD/Speech-to-Speech users may dial 7-1-1 for the California Relay Service.

INFORMATIVE DIGEST OF PROPOSED ACTION AND POLICY STATEMENT OVERVIEW

Sections Affected: Proposed adoption of section 2299.1, title 13, California Code of Regulations (CCR) and section 93118, title 17, CCR. The following documents would be incorporated in the regulations by reference: (1) International Standard ISO 8217, "Specifications of Marine Fuels Requirements for Marine Residual Fuels," (as revised in

1996); (2) International Standard ISO 8754, "Determination of Sulfur Content -- Energy-dispersive X-ray Fluorescence Method," (as adopted in 1992); and (3) the following National Oceanic and Atmospheric Administration (NOAA) Nautical Charts, as authored by the NOAA Office of Coast Survey: (A) Chart 18600, Trinidad Head to Cape Blanco (January 2002), (B) Chart 18620, Point Arena to Trinidad Head (June 2002), (C) Chart 18640, San Francisco to Point Arena (July 2000), (D) Chart 18680, Point Sur to San Francisco (March 2001), (E) Chart 18700, Point Conception to Point Sur (July 2003), (F) Chart 18720, Point Dume to Purisima Point (January 2005), and (G) Chart 18740, San Diego to Santa Rosa Island (August 2003).

Background:

Health and Safety Code (H&SC) sections 43013 and 43018 direct ARB to adopt standards and regulations that the Board has found to be necessary, cost-effective, and technologically feasible for all mobile source categories, including off-road diesel engines and equipment such as marine vessels, through the setting of emission control requirements. Specifically, H&SC 43013 directs ARB to adopt such standards and regulations on marine vessels to the extent permitted by federal law.

The California Toxic Air Contaminant Identification and Control Program, established under California law by Assembly Bill 1807 (Stats. 1983, Ch. 1047) and set forth in H&SC sections 39650-39675, requires ARB to identify and control air toxicants in California. In 1998, the Board identified diesel particulate matter as a toxic air contaminant (TAC) with no Board-specified threshold exposure level.

Following the identification of a substance as a TAC, H&SC section 39665 requires ARB, with 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. Health and Safety Code section 39665(b) requires that this "needs assessment" address, among other things, the technological feasibility of proposed airborne toxic control measures (ATCMs) and the availability, suitability, and relative efficacy of substitute products or processes of a less hazardous nature.

A needs assessment for diesel PM was conducted between 1998 and 2000, which resulted in ARB's development of the Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles (Diesel RRP). The Diesel RRP presented information that identified the available options for reducing diesel PM and recommended control measures to achieve further reductions. The scope of the Diesel RRP was broad, addressing all categories of engines, both mobile and stationary.

Once ARB has evaluated the need and appropriate degree of regulation for a TAC, H&SC section 39666(c) requires ARB to adopt regulations to reduce emissions of the TAC from nonvehicular sources to the lowest level achievable through the application of best available control technology (BACT) or a more effective control method, in consideration of cost, risk, environmental impacts, and other specified factors. In

developing the proposed control measure, State law also requires an assessment of the appropriateness of substitute products or processes.

The purpose of this proposed regulatory action is to reduce emissions of diesel PM, NOx, and SOx. Diesel PM emission reductions are needed to reduce the potential cancer risk and other adverse impacts from PM exposure to people who live in the vicinity of California's major ports and shipping lanes. Reductions in diesel PM, NOx (which forms "secondary" nitrate PM in the atmosphere), and SOx (which forms "secondary" sulfate PM in the atmosphere) will also contribute to regional PM reductions that will assist in California's progress toward achieving State and federal air quality standards. Reductions in NOx, an ingredient in the formation of ozone pollution, will help reduce regional ozone levels.

The proposed regulations will provide about 2.7 tons per day (TPD) of diesel PM emission reductions in 2007 (about 3.7 TPD in 2010), about 1.9 TPD of NOx emission reductions in 2007 (about 2.3 in 2010), and about 22 TPD of SOx emission reductions (about 32 TPD in 2010) throughout California, especially in coastal urban areas. Many of these coastal areas are non-attainment for the State and federal ambient air quality standards for PM_{10}, $PM_{2.5}$, and ozone.

Description of the Proposed Regulatory Action:

Under the approach proposed by staff, the Board would approve adoption of a regulation, pursuant to its authority under H&SC sections 43013 and 43018, which would apply to the emissions from auxiliary diesel engines on ocean-going vessels operating within any of regulated California waters (as defined in the proposal). The Board would also approve adoption of identical provisions as an ATCM, pursuant to its authority under H&SC sections 39666, which would complement the regulation and provide maximum notice to the regulated community of the regulatory requirements on ocean-going vessels.

Applicability

The proposal applies to any person who owns or operates an ocean-going vessel within any of the regulated California waters, which includes all California inland waters, all California estuarine waters, and all waters within a zone 24 nautical miles seaward of the California coastline, except for specified areas along the Southern California coastline. In general, ocean-going vessels include large cargo vessels and passenger cruise ships. The control measure applies to foreign-flagged vessels, which are vessels registered under the flag of a country other than the United States, as well as U.S.-flagged vessels.

The proposed regulations include language explicitly stating and clarifying that the proposal does not change or supersede any existing United States Coast Guard (U.S.CG) regulations, and vessel owners and operators are responsible for ensuring

that they meet all applicable U.S.CG regulations, as well as the proposed regulation and ATCM.

Exemptions

The proposed regulations include four exemptions. First, the proposal does not apply to vessels while in "innocent passage," defined as travel within the 24 nautical mile boundary off California's coastline without stopping or anchoring, except in limited situations such as when the vessel is in distress or must stop to comply with U.S.CG regulations. A second exemption is included for slow-speed two-stroke diesel engines. The design of these engines differs significantly from the four-stroke, medium speed engines used in virtually all auxiliary engine applications. The third exemption is for military vessels. Military vessels primarily use specialized military specification distillate fuels that must be used on a consistent basis for military equipment globally. Finally, there is an exemption for auxiliary engines while they are operating on liquefied natural gas or compressed natural gas because of their expected inherently low emissions of diesel PM and NOx.

Emission Limits

Under the staff's proposal, the emissions of diesel PM, NOx, and SOx from a regulated auxiliary diesel engine would generally be limited to the emission rates that would have resulted had the engine been fueled with the distillate fuels identified in the proposal. Starting on January 1, 2007, vessel operators must ensure that their auxiliary engines operating in the regulated California waters meet the first set of emission limits. One way to meet this requirement is to use marine diesel oil (MDO) with a maximum 0.5 percent sulfur by weight or use marine gas oil (MGO). Starting on January 1, 2010, vessel operators would need to ensure that their auxiliary engines operating in regulated California waters meet the second set of emission limits; one way to do this would be to use marine gas oil with 0.1 percent sulfur by weight.

The latter emission standard is intended to be consistent with a similar regulation adopted by the European Union. While staff believes engines can meet the emission limits associated with the 0.1 percent sulfur marine gas oil, we understand that changes in the fuels markets and ship technologies may affect the availability or use of this fuel. Therefore, the proposal includes a provision directing the Executive Officer to reevaluate the feasibility and availability of the 0.1 percent sulfur marine gas oil in 2008. Based on the results of this reevaluation, modifications to this requirement may be proposed to the Board as needed.

The proposal provides built-in flexibility by specifying a performance standard (i.e., emission limits) instead of a prescriptive standard (i.e., specifying which fuels can only be used). Furthermore, the proposal includes additional provisions that should help to maximize the degree of flexibility available to vessel owners and operators. As described below, persons who operate the regulated vessels would have to either comply with these emissions limits, or apply for and obtain permission from ARB to

operate under one or more alternative emission control strategies (see "Alternative Compliance Plan" below). In addition, vessel operators would be allowed under specified circumstances to pay a noncompliance mitigation fee for a limited duration in lieu of meeting the emission limits. These flexibility provisions would provide vessel owners and operators with a wide choice of options to choose from to reduce their emissions.

Recordkeeping

Starting on January 1, 2007, any person who owns or operates an ocean-going vessel within the regulated California waters will be required to maintain specified records in English for a minimum of three years. Staff has designed these requirements to minimize any impacts on vessel crews by relying on existing recordkeeping procedures to the extent possible.

Reporting, Monitoring, and Right of Entry Provisions

The information required to be recorded, as specified in the proposal, would have to be supplied in writing to the Executive Officer, but only upon request. Some of the recordkeeping required by the proposal may already be recorded to comply with other regulations or standardized practices. In these cases, the information may be provided to ARB in a format consistent with these regulations or practices, as long as the required information is provided. Ship owners or operators must also supply additional information as requested that may be necessary to determine compliance with the proposed regulations.

To monitor compliance with the requirements of the proposal, vessel owners or operators would have to provide access to the vessel to ARB employees or officers or the local air districts. This right of entry applies to vessels within the regulated California waters. It includes access to records necessary to establish compliance with the requirements of the proposal, as well as access to fuel tanks or pipes for the purpose of collecting fuel samples for testing and analysis.

Alternative Compliance Plan

The alternative compliance plan (ACP) provision allows ship owners and operators the flexibility to implement alternative emission control strategies in lieu of complying with the emission limits. Under the ACP, vessel owners or operators would be required to achieve and demonstrate equivalent or greater emission reductions over a calendar year than that which would have been achieved with direct compliance with the emission limits. Alternative emission control strategies may include any feasible and enforceable strategies not otherwise required by law, regulation or statute. These can include the use of shore-side electrical power, engine modifications, exhaust treatment devices (e.g., diesel oxidation catalysts), and the use of alternative fuels or fuel additives. The application process is detailed, and special provisions for ships using shore-side power are included in the proposal.

Noncompliance Fee

The proposed regulation allows a vessel owner or operator, under restricted and specified circumstances, to pay a fee in lieu of complying with the emission limits. A vessel owner or operator using this mechanism would have to notify the Executive Officer of the vessel's noncompliance condition prior to the vessel entering regulated California waters. Also, the situations under which the fee provision could be used are limited to a finite set of specific circumstances, all of which must be documented (i.e., a "needs" demonstration). Further, the fee increases substantially with each port visit after January 1, 2007, which serves as an effective deterrent to continued use of the fee and an incentive to make whatever changes may be needed in order to meet the emission limits.

To use this option, the ship owner or operator would need to submit the required notification and mitigation fee, along with evidence demonstrating that the person meets the required conditions for participation in the program. The mitigation fees collected under this program would be used at the ports that are visited; emission reductions from marine and port related sources would be funded with these mitigation fees to benefit nearby affected communities. The fees would be disbursed pursuant to contracts entered into between the participating ports and ARB. If there are no such agreements at the ports visited by the affected vessels, the fees would be deposited into the California Air Pollution Control Fund.

Test Methods and other Incorporated Documents

The proposal references International Standard ISO 8217, as revised in 1996 by the International Organization for Standardization (ISO). This standard includes the properties necessary for a fuel to qualify as DMX or DMA grade fuel (marine gas oil), or DMB grade fuel (marine diesel oil), and specifies the test methods for determining compliance with each of these properties. The proposal also references the test method (ISO 8754, as adopted in 1992) to be used for determining the sulfur level of these fuels, if the use of marine gas oil or marine diesel oil is the method chosen to comply with the emission limits. The proposal allows the use of alternative test methods, such as equivalent methods adopted by ASTM International, which are demonstrated to be equally accurate and approved as such by ARB's Executive Officer.

Sunset Provision

The "sunset" provision directs the Executive Officer to propose for the Board's consideration the termination of the proposed regulations under specified conditions. This would occur if the Executive Officer determines that the International Maritime Organization or the U.S. EPA adopts regulations that will achieve equivalent or greater emission reductions from ocean-going vessels in California than the proposal would achieve. This provision recognizes that, while California is authorized to regulate the

emissions from ocean-going vessels, it would be preferable to regulate such emissions on a national or international basis.

Technology Reevaluation and Review of Baseline and Test Methods

This proposed regulation describes the reevaluation that will be conducted on the 2010 emission limits, which are derived from the use of 0.1 percent sulfur marine gas oil. The ARB staff will conduct this reevaluation no later than July 1, 2008. If ARB determines, based on the reevaluation, that modifications to the regulations are necessary, the Executive Officer will propose changes to the Board prior to January 1, 2009 (a year prior to the implementation date of the January 1, 2010 emissions limits).

This provision also directs the Executive Officer to review the baseline determinations and conduct a public hearing to consider appropriate updates to the baseline. The definition for "Regulated California Waters" is based partly on the definition of "baseline," which generally follows the California coastline but is subject to change due to erosion and accretion. The baseline is published on official charts authored by the National Oceanic and Atmospheric Administration (NOAA); it is ARB staff's understanding that NOAA is in the process of updating these charts. When NOAA finalizes its updating efforts, the Executive Officer can determine at that time whether revisions to the proposed regulations are necessary.

Similar to the baseline review, this provision also directs the Executive Officer to periodically review the test methods cited in the proposal and hold a public hearing to consider recommended changes to the Board as needed.

For the Executive Officer to conduct the hearings on the baseline and test methods specified, the Board will need to delegate such authority to the Executive Officer. The ARB staff intends to seek such express delegation as part of the Board resolution to this proposal.

Severability

This proposed regulation states that if any part of the regulation is held to be invalid, the remainder of the regulation shall continue to be effective.

COMPARABLE FEDERAL REGULATIONS

There are no federal regulations that are comparable to the proposed regulations. The United States Environmental Protection Agency (U.S.EPA) adopted regulations – title 40, Code of Federal Regulations (C.F.R.), parts 89 and 94 – that govern the emissions from so-called "Category 2" (between 5 and 30 liters per cylinder displacement) and "Category 3" (at or above 30 liters per cylinder displacement) compression-ignition engines used on ocean-going vessels. The staff's proposal governs mainly Category 2-type engines, with some regulated engines falling into Category 3 classification (i.e., diesel-electric engines). The federal regulations are

generally consistent with analogous restrictions in Annex VI of the 1973 International Convention for the Prevention of Pollution from Ships (as amended in 1978, also known as the MARPOL 73/78 Protocol).

While the U.S. EPA regulations also apply to ocean-going vessels, they differ significantly from the staff's proposal in several ways. First, the federal regulations apply only to new engines to be installed on vessels, and only to engines installed on U.S. flagged vessels. By contrast, the staff's proposal applies to in-use auxiliary engines on all vessels that visit California ports, including both U.S. and foreign-flagged vessels. Further, the U.S. EPA regulation in 40 C.F.R., part 94, does not apply to the diesel PM emissions from the regulated Category 3 engines, whereas the staff's proposal places a major emphasis on the control of toxic diesel PM emissions, as well as NOx and SOx, on regulated all auxiliary diesel engines, including Category 3 engines (i.e., diesel-electric engines). Because of these differences, the federal regulations are not comparable to the staff's proposal.

AVAILABILITY OF DOCUMENTS AND AGENCY CONTACT PERSONS

The Board staff has prepared a Staff Report: Initial Statement of Reasons (ISOR) for the proposed regulatory action, which includes a summary of the potential environmental and economic impacts of the proposal, if any. The ISOR is entitled, "Staff Report: Initial Statement of Reasons for the Proposed Regulations to Reduce Emissions from Auxiliary Diesel Engines and Diesel-Electric Engines operated on Ocean-going Vessels Within California Waters and 24 Nautical Miles of the California Baseline."

Copies of the ISOR and the full text of the proposed regulatory language may be obtained from the Public Information Office, Air Resources Board, 1001 I Street, Visitors and Environmental Services Center, 1st Floor, Sacramento, CA 95814, (916) 322-2990 at least 45 days prior to the scheduled hearing which will begin on December 8, 2005.

Upon its completion, the Final Statement of Reasons (FSOR) will be available and copies may be requested from the agency contact persons in this notice, or may be accessed on the website listed below.

Inquiries concerning the substance of the proposed regulations may be directed to the designated agency contact persons, Peggy Taricco, Manager of the Technical Analysis Section, at (916) 327-7213 or by email at ptaricco@arb.ca.gov, or Paul Milkey, Staff Air Pollution Specialist, at (916) 327-2957 or by email at pmilkey@arb.ca.gov.

Further, the agency representative and designated back-up contact persons to whom nonsubstantive inquiries concerning the proposed administrative action may be directed are Artavia Edwards, Manager, Board Administration & Regulatory Coordination Unit, (916) 322-6070, and Alexa Malik, Regulations Coordinator, (916) 322-4011. The Board has compiled a record for this rulemaking action, which includes all the information upon

which the proposal is based. This material is available for inspection upon request to the contact persons.

This notice, the ISOR and all subsequent regulatory documents, including the FSOR, when completed, are available on the ARB Internet site for this rulemaking at http://www.arb.ca.gov/regact/marine2005/marine2005.htm.

COSTS TO PUBLIC AGENCIES AND TO BUSINESSES AND PERSONS AFFECTED

The determinations of the Board's Executive Officer concerning the costs or savings necessarily incurred by public agencies and private persons and businesses in reasonable compliance with the proposed regulations are presented below.

Pursuant to Government Code sections 11346.5(a)(5) and 11346.5(a)(6), the Executive Officer has determined that the proposed regulatory action will not create costs or savings to any state agency or in federal funding to the state, costs or mandate to any local agency or school district whether or not reimbursable by the state pursuant to Part 7 (commencing with section 17500), Division 4, Title 2 of the Government Code, except as discussed below, or other nondiscretionary savings to state or local agencies.

The Executive Officer has determined that while vessel operators would likely meet the proposal's emission limits by using more costly distillate marine fuel, these costs are a small fraction of the overall operating costs. We therefore expect no significant impacts on affected businesses. On average, we estimated the added annual fuel cost for a typical business operating non-diesel electric vessels to be about $20,000 and about $2,000,000 for a typical business operating diesel-electric vessels. For the entire ocean-going shipping fleet that visits California, we estimated an added annual fuel cost of about $34 million in 2007 and $38 million in 2010, when the emission limits based on the use of 0.1 percent sulfur marine gas oil becomes effective. As compared to typical cargo vessels, the proposed regulations will have a larger impact on diesel electric vessels (primarily cruise lines and some tankers).

The Executive Officer has determined that, because the added costs of the proposed regulations are such a small percentage of the overall operating costs, no significant impact on ship operators, businesses that import or export goods, California port competitiveness, or on individuals purchasing such goods is expected, even if all these costs were passed on to the consumer.

The Executive Officer has determined that the total statewide cost of the proposed control measure over a five-year period is estimated to be about $170 million dollars. This estimated cost was derived from the present value of capital costs combined with recurring costs over a five-year period. The total annual cost is estimated to be about $38 million for years 2007-2009 and about $42 million for 2010 and later (this latter figure assumes the reevaluation called for in the proposal finds that 0.1% sulfur marine gas oil will be available in sufficient quantities at that time).

The Executive Officer has further determined that less than ten percent of vessels may need some modifications such as adding a new fuel tank and piping. These retrofit costs will vary widely with the type of modifications, but we estimated the average cost to be on the order of $100,000 per non-diesel electric vessel and $100,000 to $500,000 per diesel-electric vessel, with a total retrofit cost to the industry of about 11 to 18 million dollars.

The Executive Officer has made an initial determination that the proposed regulatory action will not have a significant statewide adverse economic impact directly affecting businesses, including the ability of California businesses to compete with businesses in other states, or on representative private persons. A number of businesses are integrally linked to the goods that travel through California ports. However, we do not believe that the added costs of the proposed regulations are high enough for ship operators to consider alternative ports outside California.

In accordance with Government Code section 11346.3, the Executive Officer has determined that the proposed regulatory action will not affect the creation or elimination of jobs within the State of California, the creation of new businesses or elimination of existing businesses within the State of California, or the expansion of businesses currently doing business within the State of California.

The Executive Officer has also determined that, pursuant to title 1, CCR, section 4, the proposed regulatory action will have no impact on small businesses because we do not believe that the ship operators subject to this proposal would qualify as small businesses due to the large capital and operating costs associated with vessel operation.

The Executive Officer has also determined that there is a possibility the proposed regulatory action will result in a positive impact on business creation due to additional sales of marine fuels in California beginning in 2010, when we anticipate most vessel operators would use 0.1 percent sulfur marine gas oil to meet the specified emission limits. This is because California is expected to have 0.1 percent sulfur fuel available, whereas the extent of availability of this fuel in other ports worldwide is somewhat uncertain.

In accordance with Government Code sections 11346.3(c) and 11346.5(a) (11), the Executive Officer has found that the reporting requirements of the regulations that apply to businesses are necessary for the health, safety, and welfare of the people of the State of California.

In accordance with H&SC sections 43013(a) and (b), the Executive Officer has determined that the standards and other requirements in the proposed regulations are necessary, cost-effective, and technologically feasible for auxiliary diesel engines and diesel-electric engines operated on ocean-going vessels within the regulated California waters.

Before taking final action on the proposed regulatory action, the Board must determine that no reasonable alternative considered by the agency or that has otherwise been identified and brought to the attention of the agency would be more effective in carrying out the purpose for which the action is proposed or would be as effective and less burdensome to affected private persons than the proposed action.

A detailed assessment of the economic impacts of the proposed regulatory action can be found in the ISOR.

SUBMITTAL OF COMMENTS

The public may present comments relating to this matter orally or in writing at the hearing, and in writing or by e-mail before the hearing. To be considered by the Board, written submissions must be received **no later than 12:00 noon, December 7, 2005,** and addressed to the following:

Postal mail is to be sent to:

Clerk of the Board
Air Resources Board
1001 I Street, 23rd Floor
Sacramento, California 95814

Electronic mail is to be sent to: marine2005@listserv.arb.ca.gov, and received at the ARB **no later than 12:00 noon, December 7, 2005.**

Facsimile submissions are to be transmitted to the Clerk of the Board at (916) 322-3928 and received at the ARB **no later than 12:00 noon, December 7, 2005.**

The Board requests but does not require 30 copies of any written submission. The Board also requests that written, facsimile, and e-mail statements be filed at least 10 days prior to the hearing so that ARB staff and Board Members have time to fully consider each comment. The ARB encourages members of the public to bring to the attention of staff in advance of the hearing any suggestions for modification of the proposed regulatory action.

Additionally, the Board requests but does not require that persons who submit written comments to the Board reference the title of the proposal in their comments to facilitate review.

STATUTORY AUTHORITY AND REFERENCES

This regulatory action is proposed under the authority granted to ARB in sections 39600, 39601, 39650, 39658, 39659, 39666, 41510, 41511, 43013, and 43018, Health and Safety Code, and *Western Oil and Gas Ass'n v. Orange County Air Pollution Control District*, 14 Cal.3rd 411, 121 Cal.Rptr. 249 (1975). This regulatory action is

proposed to implement, interpret, or make specific sections 39000, 39001, 39002, 39003, 39500, 39515, 39516, 39650, 39658, 39659, 39666, 41510, 41511, 43013, 43016, and 43018, Health and Safety Code, and *Western Oil and Gas Ass'n v. Orange County Air Pollution Control District*, 14 Cal.3rd 411, 121 Cal.Rptr. 249 (1975).

HEARING PROCEDURES

The public hearing will be conducted in accordance with the California Administrative Procedure Act, Title 2, Division 3, Part 1, Chapter 3.5 (commencing with section 11340) of the Government Code.

Following the public hearing, the ARB may adopt the regulatory language as originally proposed or with non-substantial or grammatical modifications. The Board may also adopt the proposed regulatory language with other modifications if the text as modified is sufficiently related to the originally proposed text that the public was adequately placed on notice that the regulatory language as modified could result from the proposed regulatory action. In the event that such modifications are made, the full regulatory text, with the modifications clearly indicated, will be made available to the public for written comment at least 15 days before it is adopted.

The public may request a copy of the modified regulatory text from the ARB's Public Information Office, Air Resources Board, 1001 I Street, Visitors and Environmental Services Center, 1st Floor, Sacramento, California 95814, (916) 322-2990.

CALIFORNIA AIR RESOURCES BOARD

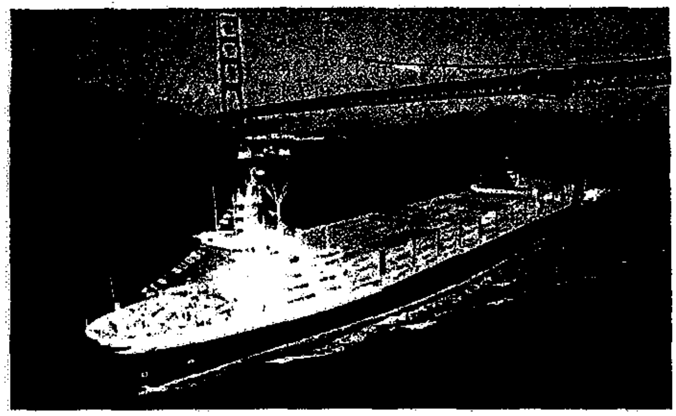
Catherine Witherspoon
Executive Officer

Date: October 11, 2005

California Environmental Protection Agency

AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING



PROPOSED REGULATION FOR AUXILIARY DIESEL ENGINES AND DIESEL-ELECTRIC ENGINES OPERATED ON OCEAN-GOING VESSELS WITHIN CALIFORNIA WATERS AND 24 NAUTICAL MILES OF THE CALIFORNIA BASELINE

Stationary Source Division
Emissions Assessment Branch
October 2005

State of California
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

Public Hearing to Consider

PROPOSED REGULATION FOR AUXILIARY DIESEL ENGINES AND DIESEL-ELECTRIC ENGINES OPERATED ON OCEAN-GOING VESSLES WITHIN CALIFORNIA WATERS AND 24 NAUTICAL MILES OF THE CALIFORNIA BASELINE

To be considered by the Air Resources Board on December 8-9, 2005, at:

California Environmental Protection Agency
Headquarters Building
1001 "I" Street
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Sacramento, California

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State of California
AIR RESOURCES BOARD

PROPOSED REGULATION FOR AUXILIARY DIESEL ENGINES AND DIESEL-ELECTRIC ENGINES OPERATED ON OCEAN-GOING VESSELS WITHIN CALIFORNIA WATERS AND 24 NAUTICAL MILES OF THE CALIFORNIA BASELINE

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Staff Report: Initial Statement of Reasons for Proposed Rulemaking Proposed Regulation for Auxiliary Diesel Engines and Diesel-Electric Engines Operated on Ocean-going Vessels within California Waters and 24 Nautical Miles of the California Baseline

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EXECUTIVE SUMMARY

Air pollution from maritime port activities is a significant and growing concern in California. Diesel-powered vehicles and engines at the ports emit soot, or diesel particulate matter (PM), and other air pollutants than can increase health risks to nearby residents. Port operations are also a significant source of oxides of nitrogen (NOx) which can contribute to the formation of regional smog, or ozone, and fine particulate matter.

Living in any area impacted by air pollution is harmful, particularly for children, the elderly, and those with compromised health. The communities closest to port operations face even greater impacts and have a greater localized risk due to exposures to high levels of diesel PM. This pollutant poses a lung cancer hazard for humans, and causes non-cancer respiratory and cardiovascular effects that increase the risk of premature death. In addition, in many cases, the populations nearby ports are economically disadvantaged and less able to obtain quality health care to address air pollution-related illnesses.

Unless substantial additional control measures are implemented, port-related emissions are expected to significantly increase as trade grows over the next 15 to 20 years. While the movement of goods through California ports is a vital component of the State's overall economy and provides a key link to international trade, it is essential that aggressive steps be taken to counter the projected emissions increases and ensure that the port-related emissions are reduced to health protective levels.

As one of several steps being taken to reduce emissions from port activities, the Air Resources Board (ARB) staff is proposing a regulation to reduce emissions from ocean-going vessel auxiliary engines. Implementation of this regulation will be an important and necessary step in the effort to improve the public health in communities near ports. A recent ARB study has shown that diesel PM emissions from hotelling (auxiliary engine emissions while vessels are moored) are the largest contributor of toxic pollutants to neighboring communities. The proposed regulation would reduce the emissions of diesel PM, NOx, sulfur oxides (SOx), and "secondarily" formed PM (PM formed in the atmosphere from NOx and SOx). The proposed regulation will reduce emissions from ocean-going vessel auxiliary engines through the use of cleaner marine distillate fuels, or equally effective alternative controls. This would result in immediate, substantial reductions in emissions upon implementation in 2007. Specifically, for the nearly 80 percent of vessels currently using heavy fuel oil in their auxiliary engines, compliance with the proposed regulation will result in an estimated 75 percent reduction in diesel PM, 80 percent reduction in SOx, and 6 percent reduction in NOx.

This proposed regulation is one of several measures currently under consideration that will continue progress in meeting the air quality goals defined in the Diesel Risk Reduction Plan and the State Implementation Plan and that will help offset the projected emissions increases in port-related emissions. Other regulations being proposed include measures to reduce emissions from cargo handling equipment, commercial harbor craft, and off-road diesel engines. ARB staff is also pursuing additional air pollution control strategies for ocean-going vessels in the coming years, including addressing the main engines on ocean-going vessels, and exploring emission reduction options for vessels that make frequent port visits.

Presented below is an overview which briefly discusses the information presented in this document. For simplicity, the discussion is presented in question-and-answer format. It should be noted that this summary provides only brief discussions of the topics. The reader is directed to subsequent chapters in the main body of the report for more detailed information.

1. What is ARB proposing?

The proposed regulation requires that auxiliary engines on vessels operating within 24 nautical miles (nm) of the California coastline significantly reduce their diesel PM, NOx, and SOx emissions. Emission reductions can be achieved by using cleaner-burning marine distillate fuels, or implementing equally effective alternative emission control strategies under an "Alternative Compliance Plan (ACP)." For vessels complying with the fuel requirement, vessel operators will need to switch from the use of heavy fuel oil to marine distillate fuel while they are in port and while they are operating within 24 nm of the California coastline, unless they already use complying distillate fuels or choose to use distillate fuels on a permanent basis. If operators choose to comply with the proposed regulation under an ACP, they must demonstrate that the alternative emission control strategies will result in no greater emissions relative to the emissions that would have occurred by complying with the fuel requirements. The proposed regulation will apply to both U.S.-flagged and foreign-flagged vessels.

2. Does ARB have the authority to regulate the emissions from ocean-going vessels as specified in the proposal?

Yes, under State and federal law, ARB can regulate both criteria pollutants and toxic diesel PM emissions from marine vessels. Health and Safety Code (H&SC) sections 43013 and 43018 authorize ARB to regulate marine vessels to the extent such regulation is not preempted by federal law. Also, H&SC § 39666 requires ARB to regulate emissions of toxic air contaminants (TAC) from nonvehicular sources, which include ocean-going vessels. The proposed regulation reduces or limits emissions of diesel PM, which is both a TAC and criteria pollutant, and NOx and SOx, which are both criteria pollutants.

The proposed regulation is neither preempted under federal law, nor does it violate the Commerce Clause. Federal authorization under section 209(e) of the Clean Air Act (CAA) is required for regulating new nonroad engines and for requiring retrofits on existing engines. Ocean-going vessel engines, by definition, fall within the category of nonroad engines. However, no federal authorization is required for implementing in-use operational requirements on existing marine vessels and their engines. The proposed regulation is an in-use operational requirement because it does not apply to the manufacturing process for an engine (i.e., new engine certifications), but only to the emissions of engines installed on ocean-going vessels that operate in California waters.

Further, the proposed regulation does not conflict with the Ports and Waterways Safety Act (PWSA) and U.S. Coast Guard regulations. As an even-handed regulation with substantial benefits, the proposed regulation does not violate the Commerce Clause. And federal and state cases support our authority to regulate both U.S. and foreign-flag vessels within California waters. Therefore, federal law neither preempts the proposed regulation, nor does the regulation violate the requirements of the Commerce Clause.

3. Why is ARB proposing statewide implementation of this regulation rather than having the districts adopt regulations?

We are proposing statewide, uniform implementation of this regulation, rather than encouraging district-by-district adoption of different regulations, for practical reasons as well as ensuring that California speaks with "one voice" with regard to regulating foreign-flag vessels. Under H&SC § 43013 and 43018, ARB and the districts share concurrent jurisdiction over marine vessels, which are considered to be nonvehicular sources. In addition, H&SC § 39666(d) requires the districts to implement and enforce an ARB airborne toxic control measure (ATCM) or adopt and enforce an equally effective or more stringent ATCM. Thus, the districts are authorized to regulate the auxiliary diesel engines on vessels, and each district can do so provided its regulations are equally effective or more stringent.

The districts' authority notwithstanding, we believe it is prudent for the districts to coordinate their efforts with those of ARB and have ARB to take the lead role in implementing the ATCM. We believe this for several reasons. First, it is impractical for many districts to enforce an ATCM against ocean-going vessels, many of which make multiple visits to ports throughout California. Second, ARB has gained technical expertise over several years of developing this regulation, which would require a significant expenditure of district resources to replicate. Third, the districts are permitted but not required to adopt and enforce an equally effective or more stringent ATCM. By coordinating their efforts with ARB and having ARB take the primary lead in implementing the ATCM statewide, the districts will have met their statutory obligations under H&SC § 39666(d).

Equally important to the practical concerns are the international foreign commerce concerns. Under the dormant Foreign Commerce Clause, regulations that interfere with a nation's ability to "speak with one voice when regulating commercial relations with foreign governments," may be held invalid. Having a patchwork of district regulations different from ARB's proposal, may frustrate the efficient execution of the nation's foreign policy to speak with one voice. Thus, it would be in California's best interests to coordinate statewide efforts so that foreign-flag and U.S.-flag vessels visiting California ports only need to understand and meet one set of statewide regulations.

4. What is an ocean-going vessel?

Ocean-going vessels are generally very large vessels designed for deep water navigation. Ocean-going vessels include large cargo vessels such as container vessels, tankers, bulk carriers, and car carriers, as well as passenger cruise vessels. These vessels transport containerized cargo; bulk items such as vehicles, cement, and coke; liquids such as oil and petrochemicals; and passengers.

Ocean-going vessels travel internationally and may be registered by the U.S. Coast Guard (U.S.-flagged), or under the flag of another country (foreign-flagged). The majority of vessels that visit California ports are foreign-flagged vessels.

5. What is an auxiliary engine?

Auxiliary engines are diesel engines on ocean-going vessels that provide power for uses other than propulsion (except as noted below for diesel-electric vessels). Auxiliary engines are usually coupled to generators used to produce electrical power. On cargo vessels, most auxiliary engines are used to provide ship-board electricity for lighting, navigation equipment, refrigeration of cargo, and other equipment. Typically, a cargo vessel will have a single, very large main engine used for propulsion, and several smaller auxiliary "generator-set" engines.

Passenger cruise vessels, and some tankers, use a different engine configuration which is referred to as "diesel-electric." These vessels use large diesel generator sets to provide electrical power for both propulsion and ship-board electricity. For the purposes of the proposed regulation, these large diesel generator sets are included in the definition of "auxiliary engines."

6. What fuels do ocean-going vessel operators use in auxiliary engines?

Most vessel operators use either heavy fuel oil (HFO or residual fuel) or marine distillate fuels in their auxiliary engines. HFO is a very viscous fuel that must be heated to allow it to flow through piping and be combusted in auxiliary engines. HFO is often referred to as residual fuel or bunker fuel. This fuel has high levels of sulfur, ash, and nitrogen containing compounds, and results in much higher emissions than the use of marine distillate fuels. Marine distillate fuels include marine gas oil (MGO) and marine diesel oil (MDO). These distillate fuels are similar to the diesel fuel used by landside sources. According to an ARB survey of vessels visiting California ports, about 75 percent of auxiliary engines use HFO and about 25 percent use marine distillate fuels.

7. What emissions result from the auxiliary engines used on ocean-going vessels?

Estimates of the statewide 2004 emissions of diesel PM, NOx, hydrocarbons (HC), and SOx, from ocean-going vessel auxiliary engines are presented in Table ES-1 below.

These emissions estimates include emissions that occur within 100 nm or less off California's coast, emissions that occur in California inland waters such as emissions from vessels transiting to the ports of Stockton and Sacramento, and emissions that occur while vessels are in-port. The "boundary" of 100 nm was selected because it can be distinguished with relative ease and it is inclusive of the major areas of activity of the sources of interest.

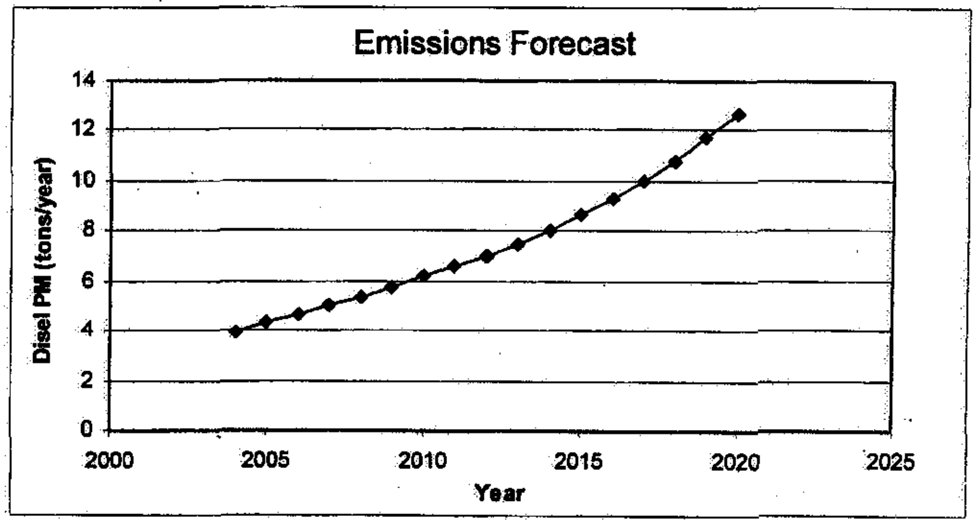
Table ES-1: 2004 Emissions from Ocean-going Vessel Auxiliary Engines in California

Vessel Types	Number of Vessels	Numbers of Vessel Visits	2004 Pollutant Emissions, Tons/Day				
			NOx	HC	CO	PM	SOx
Auto	225	750	1.11	0.03	0.08	0.10	0.71
Bulk	475	946	4.02	0.11	0.30	0.35	2.55
Container	594	4744	18.11	0.50	1.37	1.57	11.48
General	196	721	1.75	0.05	0.13	0.15	1.11
Passenger	44	687	14.44	0.39	1.09	1.39	10.24
Reefer	19	52	0.60	0.02	0.05	0.05	0.38
RoRo	13	34	0.40	0.01	0.03	0.03	0.25
Tanker	372	1941	3.16	0.09	0.24	0.27	2.00
Totals	1938	9875	43.6	1.20	3.29	3.91	28.7

As shown in Table ES-1, there are approximately 1,900 ocean-going vessels that visited California's ports in 2004, and these vessels made nearly 10,000 port calls. Of those 1,900 vessels that visited California's ports, 30 percent were container vessels, and these vessels represented more than 45 percent of the vessel visits to California's ports.

The emissions from ocean-going vessels are projected to grow significantly over time as trade continues to increase. The projected diesel PM emission estimates up to 2020 are presented in Figure ES-1.

Figure ES-1: Ocean-going Vessel Auxiliary Engine Diesel PM Emissions Estimates Projected to Year 2020



8. What are the exposures and potential heath risks from ocean-going vessel auxiliary engine emissions?

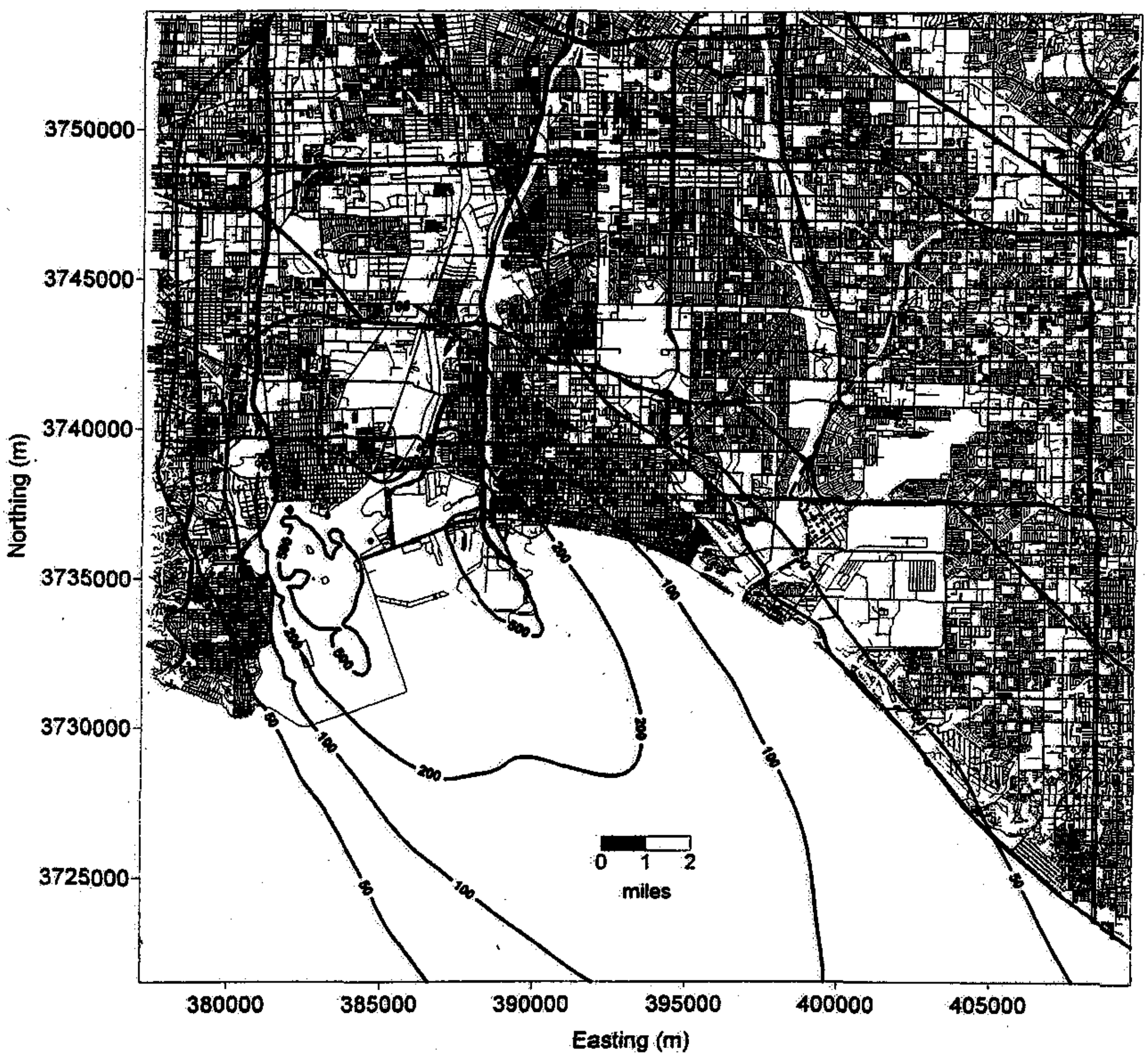
The majority of California's ports are in urban areas and, in most cases, are located near where people live, work, and go to school. This results in substantial exposures to diesel PM emissions from the operation of vessel auxiliary engines California. Exposures to these emissions can result in increased cancer risk and non-cancer health impacts, such as premature death, irritation to the eyes and lungs, allergic reactions in the lungs, and asthma exacerbation.

Because analytical tools to distinguish between ambient diesel PM emissions from vessel auxiliary engines and that from other sources of diesel PM do not exist, we cannot measure the actual exposures to emissions from auxiliary engines. However, modeling tools can be used to estimate potential exposures. To investigate the potential risks from exposures to the emissions from auxiliary engines, ARB staff used dispersion modeling to estimate the ambient concentration of diesel PM that results from the operation of ocean-going vessel auxiliary engines that visit the Port of Los Angeles (POLA) and the Port of Long Beach (POLB). The study area was a 20-mile by 20-mile grid centered on POLA and POLB.

The activities of vessel auxiliary engines resulted in significant cancer risk and other PM related health impacts on the nearby residential areas. Figure ES-2 shows the estimated cancer risk isopleths for diesel PM emissions from vessel auxiliary engines (during transiting, maneuvering, and hotelling) at the Ports of Los Angeles and Long Beach superimposed on a map that covers the ports and the nearby communities.

ARB estimated the area in which the cancer risks are predicted to exceed 100 in a million to be about 13,500 acres with an exposed population of about 225,000. For the cancer risk level over 200 in a million, the impacted area is estimated to be about 2,260 acres, with an exposed population of about 48,000 people. Overall, about 99.5 percent of the study area (excluding port property and the surrounding ocean area) has an estimated cancer risk level of over 10 in a million due to auxiliary engine emissions. We estimate that about 2 million people live in the study area. ARB staff believes that the results from this analysis provide quantitative results for exposures around the Ports of Los Angeles and Long Beach and indicate that elevated risks also occur at other ports in California.

Figure ES-2: Estimated Diesel PM Cancer Risk from Vessel Auxiliary Engine Activity at POLA and POLB (Wilmington Met Data, Urban Dispersion Coefficients, 80th Percentile Breathing Rate, Emission = 405 TPY, Modeling Receptor Domain = 20 mi x 20 mi, Resolution = 200 m x 200 m)



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

- 31 premature deaths (for ages 30 and older), 16 to 48 deaths as 95% confidence interval (CI);
- 830 asthma attacks, 202 to 1,457 as 95% CI;
- 7,258 days of work loss (for ages 18-65), 6,143 to 8,370 as 95% CI;
- 38,526 minor restricted activity days (for ages 18-65), 31,403 to 45,642 as 95% CI.

9. What does the proposed regulation require?

Under the proposed regulation, vessel operators are required to reduce diesel PM, NOx and SOx emissions to levels equivalent to the emissions levels that would occur if cleaner-burning distillate fuels were used. To meet this requirement, we expect that most vessel operators will elect to use the distillate fuels specified in the proposal. However, some may decide to implement an alternative emission control strategy that would achieve equivalent or greater emission reductions. Specifically, under the proposal, starting on January 1, 2007, vessel operators can comply by using one of the following distillate fuels when operating their auxiliary engines within 24 nm of the California Coastline: (1) marine gas oil (MGO); or (2) marine diesel oil (MDO) with less than or equal to 0.5 percent by weight sulfur. A 0.5 percent sulfur limit is specified for MDO because it tends to have a higher sulfur level than MGO. MGO is expected to average at or below 0.5 percent sulfur in California based on the results of a survey sent to vessel operators in 2005.

Starting on January 1, 2010, marine gas oil meeting a 0.1 percent sulfur limit is specified under the proposed regulation. This lower sulfur fuel will result in additional emission reductions of PM and SOx, compared to the January 1, 2007 requirement. This standard is consistent with a recently adopted European Union regulation. However, a feasibility analysis is required under the proposed regulation prior to implementation of this fuel requirement to investigate the supply, cost, and technical feasibility of using this fuel. Based on the results of this evaluation, modifications to this requirement could be proposed to the Board.

While ARB has the authority to regulate ocean-going vessel emissions, we recognize that uniform national or international regulation of vessel emissions would be preferable to most vessel operators. As such, we have included a provision in the staff's proposal that requires the Executive Officer to propose terminating or modifying the requirements of this proposal to the Board if the United States Environmental Protection Agency

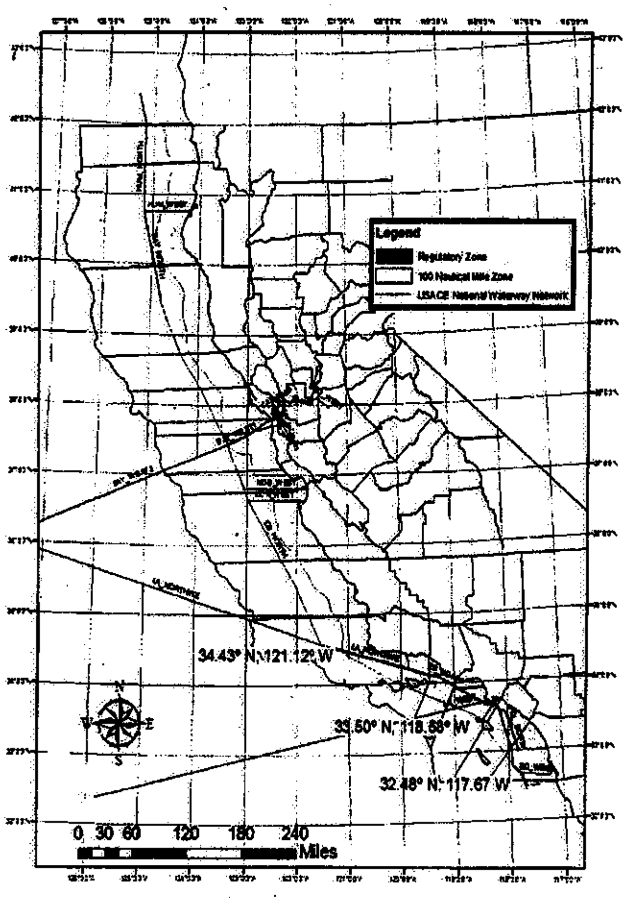
(U.S. EPA) or the International Maritime Organization adopts regulations that will achieve equivalent or greater emission reductions from vessels.

The proposed regulation does not address emissions from main engines (except for diesel-electric vessels), boilers, gas or steam turbine engines, or auxiliary engines on military vessels, which are exempted from the requirements of the proposed regulation. ARB staff plan to address main engines and other sources not regulated in this proposed rulemaking in the next couple of years.

10. How far offshore are ocean-going vessels required to comply with the proposed regulation?

Under the proposed regulation, vessel emissions would be regulated up to 24 nm off the California coastline. ARB has the authority to require emission reductions out to the California Coastal Water (CCW) boundary. This is the region within which emissions are likely to be transported onshore, and it extends beyond the 24 nm boundary. However, the 24 nm boundary which is shown as the gray area in Figure ES-3 was proposed because it significantly lowers the cost of the regulation while still providing the vast majority of the potential on-shore benefits in terms of reduced exposure to diesel PM. Specifically, about 75 percent of the auxiliary engine diesel PM emissions within 100 nm of the California coastline is emitted within the 24 nm boundary. The 24 nm boundary is also easily defined for vessel operators. The boundary is aligned in Central and Northern California with the outer boundary of the Contiguous Zone, an internationally recognized boundary which extends 24 nm offshore and is noted on most nautical charts. In Southern California, the boundary consists of straight line segments approximately 24 nm offshore of the coastline. This approximation is used because the outer edge of the Contiguous Zone extends around the Channel Islands, bringing the boundary well beyond 24 nm, and in some cases beyond the California Coastal Waters boundary.

Figure ES-3: Offshore 24 Nautical Mile Boundary for Proposed Regulation



11. Are the fuels specified in the proposed regulation available?

Yes. It is important that these fuels be available at ports worldwide because vessel operators seeking to comply with the proposed regulation through the use of these fuels will need to use them upon entering the 24 nm boundary off California's coastline. The fuels specified for January 1, 2007, are MGO, and MDO at or below 0.5 percent sulfur. MGO is widely available at ports worldwide since it is already used by harbor craft and many auxiliary engines on ocean-going vessels. We are not proposing a sulfur limit for MGO at this time because some ports only have higher sulfur MGO available. Because the proposed regulation has an initial compliance date of January 1, 2007, ARB staff had concerns that there would not be sufficient time or incentive for fuel refiners and suppliers worldwide to make fuel meeting a specified sulfur limit available at all bunkering ports. However, we expect the sulfur content of the MGO used by vessels visiting California ports to average at or below 0.5 percent sulfur, based on the results of an ARB survey and data on historical trends in sulfur content for these fuels. To provide additional flexibility to vessel operators, we are also allowing the use of MDO. This fuel tends to have a higher sulfur content than MGO, so we are limiting this fuel to 0.5 percent sulfur. Vessel owners can choose between using MDO that meets the sulfur limits or MGO.

Begining January 1, 2010, MGO meeting a 0.1 percent sulfur limit is specified under the proposed regulation. While this fuel is not currently available at all ports worldwide, we believe it will become much more widely available by 2010, when a European Union directive requires the use of MGO meeting a 0.1 percent sulfur limit. In addition, to ensure this requirement of the proposed regulation can be implemented, ARB staff is proposing that an evaluation be conducted prior to 2010 to investigate the availability of 0.1 percent sulfur MGO at bunkering ports worldwide.

12. Will ocean-going vessels need to make modifications to the use the specified fuels?

According to a survey conducted by ARB staff, we expect that about 10 percent of the ocean-going vessels visiting California ports will require some type of modification to use the fuels specified in the proposed regulation. The modifications needed are vessel-specific, and may include:

- expanding fuel storage capacity for distillate fuel;
- adding piping, instrumentation, valves, and vents;
- adding fuel processing equipment (settling tanks, filters, etc.); and/or
- modifying fuel pumps and fuel injectors.

The proposed regulation has provisions to provide additional time (up to five years to make vessel modifications) and flexibility to operators of these vessels (see item 14 below).

13. Is the proposal technically feasible?

Yes. Based upon ARB staff's analysis and discussions with numerous stakeholders, including the engine manufacturers, staff believes that the requirements of the proposed regulation are technically feasible. Under the proposal, vessel operators may comply by using cleaner-burning marine distillate fuels in their auxiliary engines instead of heavy fuel oils, or implementing alternative emission control strategies. For vessel operators that comply through the use of cleaner-burning fuels, they will need to ensure that they are using marine distillate fuels prior to entering the 24 nm boundary. ARB staff found that vessel operators already switch to marine distillate fuels prior to certain scheduled maintenance operations, and many also routinely switch to these fuels for air quality reasons in California. Discussions with the manufacturers also indicated that these engines can operate on marine distillate fuels provided certain precautions are followed, such as performing fuel switches according to recommended procedures. Beginning January 1, 2010, the proposal specifies a lower 0.1 percent sulfur marine distillate fuel. This standard will be subject to a feasibility evaluation prior to implementation to fully investigate the availability of this fuel and if any technical issues exist.

14. What key provisions are included in the proposed regulation to provide flexibility?

The proposed regulation includes two provisions providing compliance flexibility. These provisions are summarized below.

<u>Alternative Control Plan</u>

The alternative compliance plan (ACP) was included in the proposed regulation to provide vessel owner/operators with the flexibility to implement alternative emission control strategies that result in no greater emissions compared to the use of the fuels specified in the proposal. Alternative emission control strategies may include the use of shore-side electrical power, engine modifications, exhaust treatment devices such as diesel oxidation catalysts, and the use of alternative fuels or fuel additives. ACP plans may apply to a single vessel, or a fleet of vessels under the direct control of the applicant for an ACP.

There is also a specific provision that applies to vessels that shut off their diesel auxiliary engines and connect to shore-side power. Under this provision, emissions from auxiliary engines will be considered to meet the emission reduction requirements of the proposed regulation: (1) during travel from a previous port to a California port where shore-side power is used; (2) while docked and utilizing shore power; and (3) during travel to a subsequent port. This provision is designed to encourage the expanded use of shoreside power, which achieves greater emission reductions closest to nearby communities.

Noncompliance Fee Provision

This provision provides vessel operators with the flexibility to pay a fee in lieu of compliance in certain limited circumstances. The funds collected under this provision would be used to substantially reduce emissions from: (1) port sources; (2) sources within 2 miles of port boundaries; or (3) oceangoing vessels within "Regulated California Waters." Under this program, the fee is designed to ensure that participants will not be provided an economic advantage compared to vessel operators complying with the regulation. The fee schedule is graduated such that subsequent visits would result in increasing fees.

This option could only be used in the following circumstances:

- vessel is unexpectedly redirected to a California port;
- vessel was not able to acquire a sufficient quantity of compliant fuel at the last fueling port;
- fuel was found to be out of compliance after leaving the last bunkering port;
- modifications are required and the vessel operator is not able to complete the modifications in time to meet the January 1, 2007 requirements; and
- modifications are required and the vessel will visit a California port a maximum of two times per calendar year, and a four times over the life of the vessel after January 1, 2007.

15. How does the regulation affect diesel-electric vessels?

Diesel-electric vessels use large diesel generator sets to provide power for both propulsion and ship-board electricity. Passenger cruise vessels, and a few tankers, use this engine configuration. For the purposes of the proposed regulation, these large diesel generator sets are considered "auxiliary engines," and are covered by the proposed regulation. We are proposing to regulate these engines the same as other auxiliary engines because they are mechanically similar to the smaller auxiliary engines used on other vessels. Specifically, they are four-stroke, medium speed engines used in generator set applications. As such, these engines can meet the requirements of the proposed regulation. In fact, some diesel-electric cruise vessels currently use the distillate fuels specified in the proposed regulation near California ports.

16. How will ARB staff verify compliance with the proposed regulation?

Enforcement of the proposed regulation will be achieved through random inspections of records, and fuel sampling/testing. ARB staff will coordinate vessel inspections with inspections conducted by other State agencies such as the California State Lands Commission to the extent feasible. During vessel inspections, records will be reviewed to determine when vessels traveled within "Regulated California Waters" and the fuels used during this time. Records on the quantity of fuel purchased, the fuel type, and the sulfur content of the fuel will be reviewed to determine compliance. Fuel samples will be analyzed to ensure that they meet the ISO specifications for the fuel type and do not exceed the sulfur content limits under ISO or the proposed regulation.

As a long term goal, ARB staff wants to transition from compliance data being recorded in logs maintained on the vessel, to automated electronic data devices that can store and transmit data needed to assess compliance. ARB staff plans to work with vessel owners and equipment suppliers to develop and field test data recording and submittal systems that can provide compliance data on a real-time basis.

17. What businesses and public agencies will be affected by the proposed regulation?

The proposed regulation would impact foreign and domestic businesses that own or operate large ocean-going vessels. This would include ocean shipping companies and passenger cruise vessel operators.

We do not expect significant impacts on "downstream" companies such as importers or exporters of goods, since the added costs imposed by the proposal are not expected to result in significant adverse impacts to vessel owners or operators. Similarly, we do not expect adverse impacts on California ports because we do not believe the added cost of the proposed regulation is great enough to induce vessel operators to divert cargos to ports outside California.

We do not predict any significant impact on public agencies. With the exception of military vessels, which are exempted from the requirements of the proposed regulation, public agencies in California generally do not operate ocean going vessels as defined in the proposal.

18. What are the health and environmental impacts of the proposed regulation?

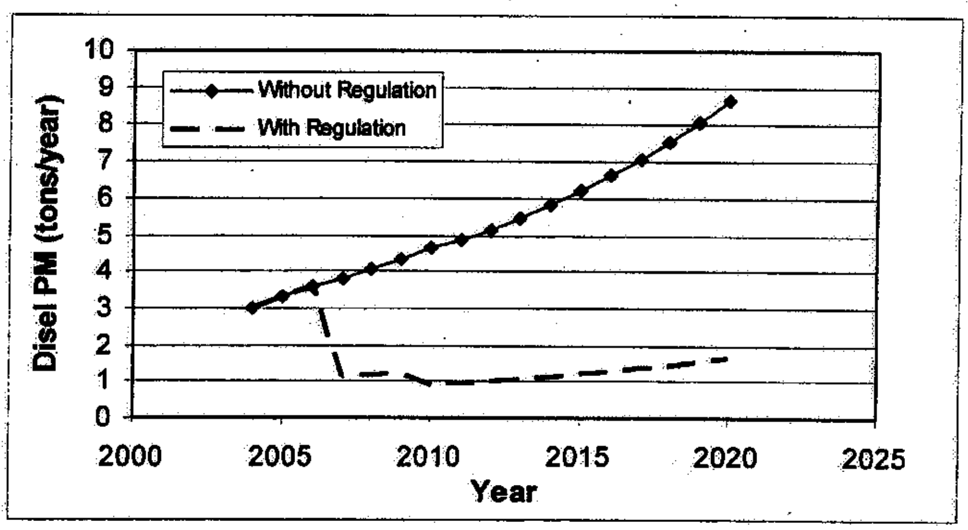
Upon implementation in 2007, the proposed regulation will result in immediate and significant reductions in emissions of diesel PM, NOx, SOx, and "secondarily" formed particulate matter. Specifically, considering only the directly emitted emissions (not secondarily formed PM), the proposed regulation will result in estimated statewide emission reductions of 2.7 TPD of diesel PM, 1.9 TPD of NOx, and 22 TPD of SOx in 2007. For perspective, the proposal would result in an estimated 75 percent reduction in diesel PM, 80 percent reduction in SOx, and a 6 percent reduction NOx from an engine that previously used typical heavy fuel oil. Beginning in 2010, the 0.1 percent sulfur limit will result in an additional 10 percent reduction in diesel PM. The estimated reductions for diesel PM, NOx and SOx, as shown in Table ES-2, reflect the use of the cleaner marine distillate fuels specified in the proposed regulation, although alternative control technologies could also be used to achieve equivalent reductions. The estimates do not reflect participation in the "noncompliance fee provision" in the proposal that allow shippers to pay a fee in lieu of compliance because we cannot predict the rate of participation. However, we would expect that the use of noncompliance fees would be very limited, and whatever fees that are generated would be used to achieve emission reduction around the ports.

Table ES-2: Estimated Emission Reductions from Implementation of the Proposed Regulation

Year	Auxiliary Engine Emission Reductions (Tons per Day)		
	PM	NOx	SOx
2007	2.7	1.9	22
2010	3.7	2.3	32
2015	5.0	3.2	43
2020	7.0	4.4	61

The emission reductions shown for 2007 reflect the initial implementation of the fuel specifications in the proposal, assuming that the average sulfur content of the fuel will be 0.5 percent. The 2010 and later reductions reflect the use of 0.1 percent sulfur marine gas oil, which is scheduled to be implemented in 2010 subject to the results of a feasibility evaluation required under the proposed regulation. Figure ES-4 provides a graphical depiction of the change in diesel PM emissions expected with implementation of the regulation.

Figure ES-4: Estimated Diesel PM Emissions in 24 nm Zone With and Without the Implementation of the Proposed Regulation



Significant air quality benefits are expected from the proposed regulation. The reductions in diesel PM, NOx and SOx will help improve regional ambient air quality levels of PM and ozone. We also 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 non-cancer health effects from air pollution in California. Staff estimates that the implementation of this regulation will avoid between 2007 and 2020 years approximately:

- 520 premature deaths (260 to 810, 95% CI))
- 14,000 asthma attacks (3,400 to 24,000, 95% CI)
- 120,000 work loss days (103,000 to 140,000, 95% CI)
- 650,000 minor restricted activity days (530,000 to 770,000, 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 in California. For example, based on an analysis of the predicted 2008 and 2015 ambient diesel PM levels near the POLA and POLB, we estimate that in 2008 there will be a 70 percent reduction in the population-weighted average risk relative to the predicted risk levels in 2008 from ocean-going vessel auxiliary engine diesel PM emissions and a 78 percent reduction in 2015.

ARB staff has concluded that no significant adverse environmental impacts will occur from implementation of the proposed regulation. There will be no increase in emissions at any of the locations due to this proposed regulation. The locations experiencing the greatest emission reductions will be those areas nearest to the ports.

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

The proposed regulation would directly impact businesses that operate large ocean-going vessels. These businesses would be required to reduce their emissions through the use of marine distillate fuels, or other equally effective emission control strategies. To estimate the costs of the proposed regulation, we assume compliance will occur through the use of marine distillate fuels. We also estimate that about ten percent of vessels will need to make some modifications to be able to use the specified fuels. For example, some vessels would add an additional fuel tank dedicated for the use of marine distillate fuels.

We estimate the total added fuel cost of the proposed regulation to be about $34 million annually, and about $38 million in 2010 when the lower sulfur fuel standard is scheduled to be implemented. We also estimate total capital costs of about $11 to $18 million for vessel modifications.

The total annual cost and cost-effectiveness of the proposed regulation is estimated in table ES-3 below by assigning all of the cost of the proposed regulation to each pollutant individually. Using this approach, the diesel PM cost-effectiveness would be about $26-27 per pound of diesel PM reduced. This estimate does not account for the fact that the proposed regulation would also reduce emissions of NOx and SOx. If half of the compliance costs are attributed to diesel PM reductions, and half to NOx and SOx reductions, the diesel PM cost-effectiveness would be about $13-14 per pound. Using either approach, these results compare favorably with the cost-effectiveness of other diesel PM regulations adopted by the Board.

Table ES-3: Cost-Effectiveness of the Proposed Regulation*

Year	Total Annual Cost (dollars)	Emission Reductions (tons per year)			Cost-Effectiveness $/Ton and ($/pound)		
		NOx	PM	SOx	NOx	PM	SOx
2007 - 2009	38 million	575	730	5,800	66,000 ($33)	52,000 ($26)	6,600 ($3.20)
2010 - 2011	42 million	575	800	7,200	73,000 ($37)	53,000 ($27)	5,800 ($2.90)

*The proposed regulation becomes effective on January 1, 2007. A lower sulfur 0.1 percent marine gas oil is scheduled for implementation on January 1, 2010, subject to review. The emission reductions and costs shown are based on the 2004 emissions inventory to be consistent with other 2004 data used. The emission reductions in 2007 and 2010 will be greater than the emission reduction figures shown.

The cost to individual businesses will vary widely based on factors such as the following:

- number of vessels visiting California ports;
- number of California port visits per vessel;
- power generated by the auxiliary engines;
- whether the vessel is a "diesel-electric" vessel; and
- number of vessels requiring retrofits.

For example, a business that owns a single small cargo vessel that makes a single annual visit to a California port visit may incur an added cost of a couple thousand dollars. On the other hand, a large vessel operator with several vessels making frequent California port visits may incur added fuel costs approaching a million dollars annually.

Table ES-4 below provides a summary of the added costs to a typical company. The added costs are higher for operators of diesel-electric vessels because their engines use more fuel than the auxiliary engines on other vessels, and because they are primarily large cruise vessel companies that make more frequent visits to California ports.

Table ES-4: Estimated Added Fuel Cost to Typical Vessel Operators*

Type of Company	Capital Cost*	Average Added Annual Fuel Cost
Cargo Vessel	$100,000 per vessel	$20,000 per company
Passenger Cruise Vessel/Diesel-electric	$100,000 to $500,000 per vessel	$2,000,000 per company

* Most companies will not need to modify their vessels. Average added annual fuel costs are rounded.

We estimate that 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 for typical businesses was less than one percent. Generally, a decline of more than ten percent in ROE suggests a significant impact on profitability. In addition, the added costs of the proposed regulation are a small fraction of the overall operating costs of these large vessels.

Another way to analyze the costs of the proposed regulation is to assume all of the added costs are passed on to the customer. Using this type of analysis, we do not expect significant impacts on the customers of oceangoing vessel operators. For example, we estimate that the added costs of the proposed regulation would add about a dollar per container for importers or exporters shipping containerized goods overseas. We estimate that this represents less than one percent of the shipping cost. For passenger cruise ships, we estimate the added cost of the proposed regulation for a typical Los Angeles to Mexico cruise would be about $8 per passenger, representing about a 2 percent fare increase.

Since the proposal would not significantly alter the profitability of most businesses, we do not expect a noticeable change in employment, business creation, elimination, or expansion, and business competitiveness in California. We also found no significant adverse economic impacts on any local or State agencies.

20. How does the proposed regulation compare to other air quality regulations affecting ocean-going vessel auxiliary engines?

The U.S. EPA and the International Maritime Organization (IMO) have adopted regulations designed to reduce the emissions from these engines. However, these existing regulations will achieve relatively modest diesel PM reductions compared to the proposed regulation. The U.S. EPA and IMO regulations are summarized below in Table ES-5.

Table ES-5: Summary of U.S. EPA and IMO Regulations

Regulation	Description of Regulation	Comparison to the ARB Staff Proposal
IMO Annex VI New Engine Standards	Establishes NOx exhaust standards for new marine engines. Engine manufacturers have complied since 2000.	•Standards do not reduce PM and achieve modest NOx benefits
U.S. EPA 1999 Category 1&2 Engine Rule	Establishes NOx+HC, PM, and CO exhaust standards for new marine engines. Implementation starts in 2007 for most vessel auxiliary engines.	• Standards only apply to U.S.-flagged vessels. • Foreign trade exemption is provided that exempts most vessel auxiliary engines • Benefits phase in slowly with vessel turnover
U.S. EPA 2003 Category 3 Engine Rule	Establishes NOx exhaust standards for new marine propulsion engines equivalent to IMO standards. Would apply large "auxiliary" engines on diesel-electric vessels	• Standards only apply to U.S. flagged vessels • Eliminates the foreign trade exemption for category 1 & 2 vessels (see above)
Annex VI IMO marine fuel sulfur limit	Establishes a fuel sulfur cap of 4.5 percent.	Very little fuel is available with a sulfur content this high.
EPA Nonroad diesel Rule	Establishes sulfur limits for diesel fuel used in marine applications	Exempts heavy fuel oil, and marine diesel oil.

In addition to the regulations summarized above (which apply to engines operated in the United States), the European Union countries have developed measures that will reduce emissions from oceangoing vessels. In November, 2002, the European Commission adopted a European Union Strategy to reduce atmospheric emissions from seagoing ships. A step toward implementing this strategy is *Directive 2005/33/EC of the European Parliament and Council Modifying Directive 1999/32 as Regards the Sulfur Content of Marine Fuels* (Directive 2005/33/EC). Directive 2005/33/EC enters into force on August 11, 2005, and includes the following provisions:

- A 1.5 percent sulfur limit for marine fuels used by all seagoing vessels in the Baltic Sea starting May 19, 2006, and in the North Sea and English Channel starting in Autumn 2007;
- A 1.5 percent sulfur limit for marine fuels used by passenger vessels on regular services between EU ports, starting May 19, 2006; and
- A 0.1 percent sulfur limit on fuel used by inland vessels and by seagoing ships at berth in EU ports, staring January 1, 2010.

The provision regarding the use 0.1 percent sulfur fuel by seagoing ships at berth is very similar to the staff's proposal. Like the staff's proposal, the EU control measure specifies a 0.1 percent sulfur limit in 2010. However, the staff's proposal extends out 24 nm, while the EU proposal only applies at berth.

21. How was this proposal developed?

Staff began the development of the proposal with the creation of the Maritime Air Quality Technical Working Group (MWG) in late 2001. During MWG meetings, staff discussed different approaches to reduce marine vessel emissions at the conceptual stage. In late 2004, staff began a series of public workshops focused on the proposed regulation for auxiliary engines. Extensive efforts were made to ensure that the public and affected parties were aware of and had the opportunity to participate in the development of this proposal. For example, meetings to discuss the proposal were held at times and locations that encouraged public participation, including meetings at California ports and evening sessions. Attendees included representatives from environmental organizations, community groups, port administration, vessel operators, engine manufacturers, fuel producers, the U.S. Coast Guard, local and federal air quality agencies, and other parties interested in marine emissions. These stakeholders participated both by providing data and reviewing draft regulations, and by participating in open forum workshops, in which staff directly addressed their concerns. During these meetings, ARB staff discussed a number of regulatory strategies at the concept stage, including the current proposal. Nearly 400 individuals and/or companies were notified for each workshop through a series of mailings. Notices were posted to ARB's marine and public workshops web sites and e-mailed to subscribers of the marine electronic list server.

As a way of inviting public participation and enhancing the information flow between ARB and interested parties, staff created a commercial marine Internet website (http://www.arb.ca.gov/msprog/offroad/marinevess/marinevess.htm) in 2001. Since that time, staff has consistently made available on the website all related documents, including meeting presentations and draft versions of the proposed regulatory language. The website has also provided workshop and meeting notices and materials, other marine related information, and has served as a portal to other websites with related information.

Recognizing that other states also have concerns about marine emissions, and that uniformity of requirements should be promoted, ARB set up a States Marine Emission Reduction Group. ARB staff schedules periodic meetings with this group, which includes regulatory agencies in other states and Canada.

22. How does the proposed regulation relate to the State Implementation Plan for Ozone and PM?

On October 23, 2003, ARB adopted the *Proposed 2003 State and Federal Strategy for the California State Implementation Plan* (State and Federal Strategy). The State and Federal Strategy identifies the Board's regulatory agenda to reduce ozone and PM by establishing targets to develop and adopt new measures for each year from 2003 to 2006. In addition to meeting federal requirements, the Statewide Strategy ensures continued progress towards California's own health-based standards. The State and

Federal Strategy includes a commitment to reduce emissions from the existing fleet of ocean-going vessels. The proposed regulation will help to fulfill this commitment.

23. 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 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 proposal will reduce diesel PM, NOx and SOx emissions from ocean-going vessels for all communities near California ports and shipping lanes, particularly for communities near the ports of Los Angeles, Long Beach and Oakland.

24. What future activities are planned?

In addition to activities associated with monitoring and compliance with the proposed regulation, staff recognizes the need to conduct a number of other activities. These activities include:

- outreach to the vessel operators that only visit California ports occasionally to ensure that they are aware of the requirements of the proposal;
- develop procedures to implement the Noncompliance Fee Provision, and ensure funds are used effectively to reduce port and marine emissions; and
- continue to encourage the U.S. EPA and the IMO to take a more active role in reducing emissions from ocean-going vessels.

In addition, staff recognizes the need to achieve additional emission reductions from ocean-going vessels. Reducing emissions from the main propulsion engines on ocean-going vessels will be the next priority. While the emissions from these engines are mostly emitted outside the ports, they contribute far more emissions than those affected by the current proposal. Another area for investigation is the potential for emission reductions from vessels that make frequent calls at California ports. One such option for these vessels may be the use of shore-side power. ARB staff is developing a study of the feasibility of implementing shore-side power hookups that will investigate the technical and economic issues. These and other potential emission reduction strategies will be evaluated as part of an effort to develop a port and intermodal goods movement Comprehensive Emission Reduction Plan that will define the strategies needed to reduce public health impacts from ports and related activities. This effort, which is part of the Governor's Phase II Goods Movement Action Plan, is currently underway and it is expected to be completed by the end of 2005.

25. What is staff's recommendation?

We recommend that the Board approve the proposed regulation presented in this report (Appendix A). The proposal will reduce emissions of diesel PM, NOx, and SOx, resulting in significant health benefits to the public. In particular, communities near California's major ports and shipping lanes benefit from reduced exposure to the potential cancer risk from diesel PM. Staff believes that the proposal is technologically and economically feasible and necessary to carry out the Board's responsibilities under State law.

REFERENCES

(Directive 2005/33/EC) European Union Official Journal, Directive 2005/33/EC of the European Parliament and of the Council of 6 July 2005 amending Directive 1999/32/EC

I. INTRODUCTION

In this chapter, the Air Resources Board (ARB or Board) staff provides an overview of the Staff Report, discusses the purpose of the proposed regulation ("proposal"), and discusses the regulatory authority ARB has to adopt the proposed regulation. We also discuss the process used to include all interested stakeholders in the development of the proposal, including providing opportunities for meaningful public participation.

A. Overview

This report presents the proposed regulation to reduce emissions of diesel particulate matter (PM), nitrogen oxides (NOx), and sulfur oxides (SOx) from diesel auxiliary engines used on ocean-going vessels within 24 nautical miles of the California Coastline. A detailed summary of the requirements of the proposal are included in Chapter V. The report also shares the information that ARB staff used in developing the proposal. This information includes:

- the health effects associated with exposure to diesel PM, NOx, and SOx emissions (Chapter II);
- a description of the affected industry and the existing regulations designed to reduce emissions from auxiliary engines used on ocean-going vessels (Chapter III);
- the diesel PM, NOx, and SOx emission inventory and health risks posed by auxiliary engines used on ocean-going vessels (Chapter IV);
- a summary of the provisions in the proposal, and a discussion of the regulatory alternatives to the proposal that were considered (Chapter V);
- a discussion of the technical feasibility of using the fuels specified in the proposal, and other control technology options (Chapter VI);
- the environmental impacts of implementing the proposal (Chapter VII); and
- the estimated costs to industry and the fiscal impacts of these costs (Chapter VIII).

In developing the proposal, there were a number of technical and policy issues that had to be addressed. These included the impacts of the proposal on diesel-electric vessels, vessels requiring modifications to use distillate fuel, and the scope of the Alternative Compliance Plan provision. These and other key issues are discussed in Chapter IX, Additional Considerations.

The text of the proposal and other supporting information are found in the Appendices.

B. Purpose

The purpose of this proposal is to reduce emissions of diesel PM, NOx, SOx, and "secondarily" formed PM (PM formed in the atmosphere from NOx and SOx emissions). Diesel PM emission reductions are needed to reduce the potential cancer risk, premature mortality and other adverse impacts from PM exposures to people who live in the vicinity of California's major ports and shipping lanes. Reductions in diesel PM and SOx (which forms "secondary" sulfate PM in the atmosphere) will also contribute to regional PM reductions that will assist in California's progress toward achieving State and federal air quality standards. Reductions in NOx, an ingredient in the formation of ozone pollution, will help reduce regional ozone levels and secondary nitrate PM. The health impacts of these pollutants are described in Chapter II.

C. Regulatory Authority

Under State and federal law, ARB can regulate both criteria pollutant and toxic diesel PM emissions from marine vessels. Health and Safety Code (H&SC) sections 43013 and 43018 authorize ARB to regulate marine vessels to the extent such regulation is not preempted by federal law. Also, H&SC § 39666 requires ARB to regulate emissions of toxic air contaminants (TAC) from nonvehicular sources, which include ocean-going vessels. The proposed regulation reduces or limits diesel PM, which is both a TAC and criteria pollutant, and NOx and SOx, which are both criteria pollutants.

The proposed regulation is neither preempted under federal law, nor does it violate the Commerce Clause. Federal authorization under section 209(e) of the Clean Air Act (CAA) is required for regulating new nonroad engines and for requiring retrofits on existing engines. Ocean-going vessel engines, by definition, fall within the category of nonroad engines. However, no federal authorization is required for implementing in-use operational requirements on existing marine vessels and their engines.

Further, the proposed regulation does not conflict with the Ports and Waterways Safety Act (PWSA) and U.S. Coast Guard regulations. As a non-discriminatory regulation with substantial benefits, the proposed regulation does not violate the Commerce Clause. And federal and state cases support our authority to regulate both U.S. and foreign-flag vessels within California Coastal Waters. Therefore, federal law does not preempt the proposed regulation, nor does the regulation violate the requirements of the Commerce Clause.

The ARB's legal authority to promulgate the proposed regulation is discussed in more detail in Appendix B.

D. Public Outreach and Environmental Justice

Environmental Justice

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 ARB's programs, consistent with the directive of California State law. 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 (Policies) are intended to promote the fair treatment of all Californians and cover the full spectrum of 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, ARB staff searched for 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 meetings at California ports, and evening sessions. Attendees included representatives from environmental organizations, community groups, port administration, vessel operators, engine manufacturers, fuel producers, the U.S. Coast Guard, local and federal air quality agencies, and other parties interested in marine emissions. 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-1 below provides meeting dates that were made to apprise the public about the development of the proposed regulation.

Table I-1: Workshop/Outreach Meeting Locations and Times

Date	Meeting	Location	Time
December 6, 2001	Maritime Working Group	Port of Long Beach	10:30 a.m.
April 9, 2002	Maritime Working Group	Port of Long Beach	9:30 a.m.
May 23, 2002	Maritime Working Group/Incentives Subgroup	Phillip Burton Federal Building, San Francisco	10:00 a.m.
July 26, 2002	Maritime Working Group	Port of Oakland	9:00 a.m.
December 3, 2003	Maritime Working Group	Port of Los Angeles	10:30 a.m.
April 8, 2004	Maritime Working Group	Cal/EPA Building, Sacramento	10:00 a.m.
Sept. 9-10, 2004	Conference on Air Quality, Int'l Trade and Transportation	Marina Hotel, San Pedro	10:00 a.m.
October 27, 2004	No Net Increase Air Quality Task Force	Sheraton LA Harbor Hotel, San Pedro	1:00 p.m.
November 10, 2004	Public Workshop	Cal/EPA Building, Sacramento	1:30 p.m.
January 19, 2005	Port Community Advisory Committee	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	1:00 p.m.
August 15, 2005	Workgroup Meeting	Teleconference	9:00 a.m.
August 24, 2005	Public Workshop	Port of Long Beach	1:00 p.m.
August 24, 2005	Community Workshop	Long Beach Senior Center	6:00 p.m.
October 4, 2005	Workgroup Meeting	Teleconference	1:30 p.m.
October 7, 2005	Bunkerworld Forum: Marine Fuel Sustainability	Hyatt Regency, San Francisco	11:00 a.m.

The proposal is consistent with the environmental justice policy to reduce health risks in all communities, including those with low-income and minority populations, regardless of location. The proposal will achieve the most significant reductions in emissions in the communities adjacent to the ports of Los Angeles, Long Beach, and Oakland, where the greatest shipping activity occurs. The proposal will also provide air quality benefits to other coastal regions, particularly near shipping lanes and the other ports.

Outreach Efforts

Since the identification of diesel PM as a toxic air contaminant (TAC) in 1998, the public has been more aware of the health risks posed by the emissions of this TAC. At many of 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 marine vessels.

To create a forum for the discussion of marine and port air quality issues, ARB formed the Maritime Air Quality Technical Working Group (Maritime Working Group or "MWG") in late 2001. The MWG provided an opportunity for ARB staff to include the public in the early stages of developing strategies to reduce emissions from marine sources, including the emissions from the existing fleet of ocean-going vessels. From late 2001 to early 2004, ARB held five such meetings. During these meetings, ARB staff discussed a number of regulatory strategies at the concept stage, including the current proposal. Five public workshops or workgroup meetings have also been held since late 2004 to discuss draft language for the proposed regulation. During this process, staff has modified the proposal based on the comments received.

Nearly 400 individuals and/or companies were notified for each workshop through a series of mailings. Notices were posted to ARB's marine and public workshops web sites and e-mailed to subscribers of the marine electronic list server.

Recognizing that other states also have concerns about marine emissions, and that uniformity of requirements should be promoted, ARB set up a States Marine Emission Reduction Group. The ARB staff schedules periodic meetings with this group, which includes regulatory agencies in other states and Canada, including the following: Environment Canada, the Northeast States for Coordinated Air Use Management, the New York State Department of Environmental Conservation, the Puget Sound Clean Air Agency, the Alaska Department of Environmental Conservation, Northeast States Clean Air Foundation, Texas Commission on Environmental Quality, Washington State Department of Ecology, and the Oregon Department of Environmental Equality. During these meetings, status reports are given on the progress of marine air quality projects, including the proposed regulation.

In addition to the public meetings presented in Table I-1, ARB staff and management participated in numerous meetings with industry, government agencies, and environmental groups over the past three years. During these meetings, staff presented information on ARB's plans to regulate emissions from marine vessels, and incorporated the feedback from stakeholders. Some of the groups participating were the Pacific Merchant Shipping Association, International Council of Cruise Lines, Western States Petroleum Association, Ports of Los Angeles, Long Beach, Oakland, and San Francisco, the U.S. Maritime Administration, U.S. Environmental Protection Agency, U.S. Coast Guard, U.S. Navy, California Maritime Academy, California State Lands Commission, South Coast Air Quality Management District, Santa Barbara County Air Quality Management District, Coalition for Clean Air, Environmental Defense, Natural Resources Defense Council, Union of Concerned Scientists, Citizens for a Better Environment, Wilmington Coalition for a Safe Environment, and San Pedro Homeowners Association.

As a way of inviting public participation and enhancing the information flow between ARB and interested parties, staff created a commercial marine Internet web site (http://www.arb.ca.gov/msprog/offroad/marinevess/marinevess.htm) in 2001. 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 workshop, meeting notices and materials, and other marine related information, along with serving 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, environmental, State agencies, military officials and representatives, and other federal agencies.

II. NEED FOR CONTROL OF DIESEL PARTICULATE MATTER

In 1998, the Air Resources Board identified diesel PM as a toxic air contaminant (TAC). Diesel PM is by far the most important TAC and contributes over 70 percent of the estimated risk from air toxic contaminants today. In September 2000, 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. In addition, the Office of Environmental Health Hazard Assessment (OEHHA) identified diesel PM in 2001 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 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.

A. 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 (SO_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 polycyclic aromatic hydrocarbons (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 SO_2, 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 the entire 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.

B. Health Impacts of Exposure to Diesel PM, Ambient Particulate Matter, Ozone, and Sulfur Dioxide

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 NOx and SOx. NOx is a precursor to the formation of ozone, and both NOx and SOx also contribute to secondarily formed PM 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 $\mu g/m^3$) 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 $\mu g/m^3$ of direct $PM_{2.5}$ or 0.81 $\mu g/m^3$ 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. Diesel exhaust also includes compounds resulting from incomplete combustion, such as CO, ROG, carbonyls, alkenes, aromatic hydrocarbons, PAHs, PAH derivatives, and SOx. 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 population 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.

Sulfur Dioxide and Sulfates

Sulfur dioxide (SO_2) is a gaseous compound of sulfur and oxygen. SO_2 is formed when sulfur-containing fuel is burned by mobile sources, such as locomotives, vessels, and off-road diesel equipment. SO_2 is also emitted from several industrial processes, such as petroleum refining and metal processing.

SO_2 causes a wide variety of health and environmental impacts because of the way it reacts with other substances in the air. Particularly sensitive groups include people with asthma who are active outdoors and children, the elderly, and people with heart or lung disease. Effects from SO_2 exposures at levels near the one-hour standard include bronchoconstriction accompanied by symptoms, which may include wheezing, shortness of breath and chest tightness, especially during exercise or physical activity. Children, the elderly, and people with asthma, cardiovascular disease or chronic lung disease (such as bronchitis or emphysema) are most susceptible to these symptoms. Continued exposure at elevated levels of SO_2 results in increased incidence of pulmonary symptoms and disease, decreased pulmonary function, and increased risk of mortality.

Sulfates (SO_4^{2-}) are the fully oxidized ionic form of sulfur. Sulfates occur in combination with metal and / or hydrogen ions. In California, emissions of sulfur compounds occur primarily from the combustion of petroleum-derived fuels (e.g., gasoline and diesel fuel) that contain sulfur. This sulfur is oxidized to sulfur dioxide (SO_2) during the combustion process and subsequently converted to sulfate compounds in the atmosphere. The conversion of SO_2 to sulfates takes place comparatively rapidly and completely in urban areas of California due to regional meteorological features. When these are breathed, they gather in the lungs and are associated with increased respiratory symptoms and disease, difficulty in breathing, and premature death. (ARB 1991a,b; ARB 1994a,b; EPA, 2000a)

C. Applicability of the Cancer Potency Factor for Diesel PM to Engines Using Marine Gas Oil, Marine Diesel Oil, or Marine Heavy Fuel Oil

ARB staff, in consultation with OEHHA, has concluded that particulate matter emissions from ocean-going vessel diesel (compression ignition) engines operating on marine gas oil (MGO), marine diesel oil (MDO), or marine heavy fuel oil (HFO) constitute "diesel particulate matter" emissions. As such, the cancer potency factor and chronic reference exposure level for exhaust emissions from diesel-fueled engines, approved by the Scientific Review Panel and adopted by the ARB in 1998, are applicable to exhaust emissions from ocean-going vessel diesel engines using MGO, MDO, or HFO. The basis for staff's conclusion is presented below.

<u>Marine Gas Oil and Marine Diesel Oil</u>

For the following reasons, ARB staff believes the health values developed for diesel PM are appropriate for emissions from diesel engines using MGO and MDO:

- MGO and MDO are distillate fuels with most fuel properties nearly identical to diesel fuel.

Marine gas oil is generally the heavier middle fraction product from the atmospheric distillation of crude oil. Conventional diesel is the lighter middle fraction product from the atmospheric distillation of crude oil. The key fuel properties for marine distillate fuel (MGO and MDO) are very similar to conventional diesel fuel that is used for on-road and off-road diesel engines. The density, heating value, and hydrogen and carbon content for MGO, MDO and conventional diesel fuel are essentially the same. The viscosity of MGO and conventional diesel are very close to the same; while the viscosity of MDO is somewhat higher the MGO or conventional diesel fuel.

The main difference among these fuels is the sulfur content. Since diesel used in on-road and off-road applications are required to meet ARB and U.S. EPA sulfur content limits, conventional diesel fuel generally has lower sulfur content than MGO or MDO. As discussed earlier, the current average sulfur content for MGO used by vessels visiting California ports is about 0.5 percent (5000 ppm). Diesel fuel meeting ARB specification averages about 0.014 percent (140 ppm) and is scheduled to be reduced to 0.0015 percent (15 ppm) in 2006. Generally, MGO will be sold as MDO if it has come in contact with HFO.

- The fuel specifications for MGO and MDO are very similar to the diesel fuel specification that existed prior to 1993.

MGO and MDO fuel specifications are very similar to pre-1993 diesel fuel. Pre-1993 diesel fuels, compared to post-1993 diesel fuel in California, generally had higher aromatic content (33 vs. 20-25 vol. percent), higher sulfur (<5000 vs. 100-150 ppm Wt.), lower cetane number (>40 vs. 50-55), higher PAHs (8 vs. 2-5 Wt. percent) and higher nitrogen (300-600 vs. 40-500 ppm Wt.) (ARB, 1998). This is important in that one of the key health studies linking increases cancer risk with exposure to diesel exhaust emissions was based on railroad workers exposed to diesel exhaust emissions in the 1950s through 1970s.

Heavy Fuel Oil

The health values developed for diesel PM are also appropriate for emissions from diesel engines using HFO since the basic fuel properties of HFO are similar to diesel fuel, and since emission characteristics from diesel engines using HFO are similar to diesel engines using diesel fuel.

- HFO is a blended petroleum product containing the same classes of hydrocarbons as diesel fuel

Heavy fuel oil, like diesel fuel, is comprised of a complex mixture of aliphatic, naphthenic, and aromatic hydrocarbons. With both types of fuel, the final product will contain varying amounts of these classes of hydrocarbons based on the crude oil used and the refinery process. Heavy fuel oil simply contains a higher proportion of heavier (higher molecular weight - typically having a carbon number from C_{20} to C_{50}) versions of the same hydrocarbon types, and higher levels of sulfur, metals, and other contaminants.

- Heavy fuel oil contains some diesel fuel

Marine fuels may be separated into two basic types of fuels: distillate and residual (EPA, 1999). Distillate fuel (e.g., diesel fuel and marine gas oil) is composed of the fractions of crude oil that are separated in a refinery by a boiling process, while the remaining fraction that did not boil is referred to as residual. To produce fuels that can be conveniently handled and stored in industrial and marine installations, and to meet marketing specifications limits, the high viscosity residual components are normally blended with MGO or similar lower viscosity fractions. (CONCAWE, 1998) For example, the most common grades of marine heavy fuel oil (IFO-380 and IFO-180) are composed of a mixture of residual compounds and distillate components (EPA, 1999; FAMM, 2001). Specifically, typical heavy fuel oil has been estimated to contain as much as 12 percent distillate (EPA, 1999).

- The emission characteristics of a marine diesel engine using HFO are similar to those of a diesel engine using diesel fuel

The diesel engines covered by the proposed regulation are larger versions of typical land-based diesel engines. They operate on a compression-ignition "diesel" cycle similar to land-based diesel engines. Marine diesel engines are designed to burn HFO, MGO, or MDO. The combustion process is nearly identical for any of these fuels. The liquid petroleum based fuel is injected into the engine where it is compressed to the point of auto-ignition. The peak combustion temperatures are similar for all of the fuels. While the relative magnitude of the combustion products may vary with fuel; the relative percentage of organic material, elemental carbon, and ash are similar among the various fuels. The percent of sulfates and sulfate bound water is higher as the sulfur content of the fuel increases. As a result of the nearly identical combustion process, we would expect that the major combustion products of an engine burning HFO will be similar in chemical nature to an engine using diesel fuel.

- The general classes of PM exhaust components from a marine diesel engine using HFO are similar to a diesel engine using diesel fuel

The PM components emitted from vessel auxiliary engines using heavy fuel oil are the same as those emitted from a typical diesel engine: elemental carbon, ash, soluble organic compounds, and a sulfate fraction (Man B&W, 2004). However, the overall levels of PM will be significantly higher, and a greater proportion of the PM will be from sulfate. Specifically, as discussed in Chapter IV, we estimate that a typical vessel auxiliary engine running on 2.5 percent sulfur heavy fuel oil will emit about 1.5 g of PM per kW-hr. This compares to an emission factor of about 0.3 g/kw-hr for the same engine running on marine gas oil with a sulfur content of about 0.25 percent. Much of this difference is due to the sulfur content of the fuel, since sulfate PM is estimated to be directly related to fuel sulfur. The higher ash content and density of heavy fuel oil is also expected to play a role in the higher emissions from engines using heavy fuel oil (EPA 2002).

- The particle size distribution of the exhaust emissions from a marine diesel engine using HFO is similar to the particle size distribution from a diesel engine using diesel fuel

Preliminary results from testing performed in 2005 by the University of California, Riverside, CE-CERT, in association with Maersk and CARB, indicate that over 85 percent of the particulate matter emissions from a marine diesel engines burning HFO are less than 2.5 microns in size. These results are similar to results for diesel engines using diesel fuel where 95 percent of the particulate were found to be less than 2.5 microns in size. (ARB, 1998) These very small particles are more likely to be inhaled deep into the lung and, as a result, may pose more of a health issue than larger particles.

D. Health and Environmental Benefits from the Proposed Regulation

Reducing diesel PM emissions from vessel auxiliary engines will have both public health and environmental benefits. The proposed regulation will reduce localized health risks associated with the operation of vessel auxiliary engines that are near receptors 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 VIII.

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} and $PM_{2.5}$ 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 II-1).

Table II-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 this proposal will result in lower ambient particulate matter levels and significant reductions of exposure to primary diesel and secondary PM resulting from NOx and SOx emissions from auxiliary engines. 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, a precursor 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 are non-attainment for the State and federal 8-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. Reducing NOx emissions will also reduce secondarily formed PM (nitrates).

Table II-2: State and National Ozone Standards

	California Standard	National Standard
1 hour	0.09 ppm (180 $\mu g/m^3$)	
8 hour	0.07 ppm (137 $\mu g/m^3$)	0.08 ppm (157 $\mu g/m^3$)

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 stationary diesel-fueled engines will help improve visibility in these Class I areas.

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III. INDUSTRY CHARACTERIZATION

Ocean-going vessels (or "vessels") that operate within 24 nautical miles of the California coastline ("regulated waters") would be subject to the requirements of the proposed regulation. The requirements of the proposal would apply to both foreign-flagged and domestic vessels. However, exemptions are provided for military vessels and vessels passing through regulated waters without stopping at a California port ("innocent passage").

For the purposes of the proposed regulation, an ocean-going vessel is defined as a commercial or military vessel that meets any one of the following criteria:

- a U.S.-registered vessel that is used in foreign trade, and has the appropriate U.S. Coast Guard endorsement;
- a foreign-registered vessel;
- a vessel greater than 400 feet in overall length;
- a vessel greater than or equal to 10,000 gross tons; or
- a vessel propelled by a marine compression ignition engine with a per cylinder displacement of greater than or equal to 30 liters.

Vessels meeting none of these criteria are classified as harbor craft (including pleasure craft), and are subject to more stringent fuel requirements than those specified in this proposal.[1]

In this chapter, we identify the types of vessels that are defined as ocean-going vessels, and also describe the types of engines and fuels currently being used by these vessels. Additional information on this industry can also be found in the U.S. EPA's Final Regulatory Support Document: Control of Emissions from New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder. (U.S. EPA, 2003).

This section also identifies and summarizes the requirements of existing air pollution regulations that affect ocean-going vessels.

A. Vessel Descriptions

Examples of the types of oceangoing vessels subject to the proposed regulation include container vessels, passenger cruise vessels, general cargo, reefers, RORO vessels, tanker vessels, and bulk carriers. Brief descriptions of these vessel types are provided below.

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[1] Specifically, only diesel fuel meeting CARB vehicular diesel fuel standards will be sold to harbor craft in California in 2007 (2006 in the South Coast Air Quality Management District).

Container Vessels

Container vessels are cargo vessels that carry standardized truck-sized containers. These containers have capacities measured in TEUs (Twenty-foot Equivalent Units). One TEU refers to a container with external dimensions of 8'x8'x20'. Capacity is sometimes also measured by FEU's, forty-foot equivalents, 8'x8'x40', since the majority of containers used today are 40 feet in length. Many vessels also have a number of container slots that will accept refrigerated containers.

Container vessel capacity is often described in terms of the number of TEU's the vessel can hold. Due to economies of scale, container vessel capacity has increased over the years. Currently, some large vessels are able to transport between 5,000 and 8,000 TEUs. This compares to older vessels built prior to 1970, which typically held less than 1,000 TEUs.

Most container vessels, like most ocean-going vessels, are propelled by large slow-speed two-stroke direct drive diesel engines (see figure 2). In addition, most container vessels have installed a number of smaller medium speed four-stroke auxiliary engines. The auxiliary engines, which are subject to the proposed regulation, provide electrical power for lighting, navigation equipment, and other ship-board uses.

Passenger Cruise Vessels

Passenger cruise vessels are passenger vessels used for pleasure voyages. These vessels typically stop at ports, where they coordinate activities for their passengers. Passenger cruise vessels also provide a number of entertainment options for their passengers while on the vessel. These vessels typically include swimming pools, exercise and recreation facilities, movie theaters, dance halls, casinos, and restaurants. As with other types of vessels, the size and capacity of these vessels has increased steadily over the years.

Table III-1: Typical Size of Passenger Cruise Vessels Over the Years

Year Built	Tonnage	Number of Passengers
1970	18,420	377 passengers
1980	37,600	707 passengers
1990	74,140	975 passengers
2000	137,300	1557 passengers

(Solentwaters, 2005)

Cruise ship propulsion is typically provided by several diesel engines coupled to generators. These generators produce electrical power that drives electric motors coupled to the vessel's propellers. This arrangement provides the option to run the vessel at a slower speed, while operating fewer engines at their peak efficiency, as opposed to a single engine at low, relatively inefficient loads. The same engines that are used for propulsion are also used to generate auxiliary power onboard the vessel for lights, refrigeration, etc.

Some vessels have the electric motor outside the ships hull in an azipod. This method eliminates the need for a rudder as the pod can be rotated to provide thrust in any direction. Some vessels also have a combination of a fixed propeller and azipods.

Reefer Vessels

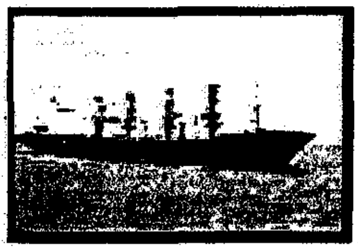
A Reefer vessel is a type of vessel typically used to transport perishable commodities which require temperature-controlled transportation, mostly fruits, meat, fish, vegetables, dairy products, and other foods. Reefer vessels are effectively large refrigerators, heavily insulated with glass fiber or similarly efficient insulation. They are vessels that tend to be divided into many more spaces than conventional dry cargo vessel, so that different commodities can be separated and carried, if required, at different temperatures. Below deck, a reefer vessel resembles a large modern warehouse, and cargo is usually carried and handled in palletized form, moved about on conveyors or by electric fork lift trucks.

RORO Vessels

A RORO vessel carries wheeled cargo such as automobiles, trailers or railway carriages. RORO is an acronym for "roll on/roll off". RORO vessels have built-in ramps, which allow the cargo to be "rolled on" and "rolled off" the vessel when in port. While smaller ferries that operate across rivers and other short distances often have these facilities, the term RORO is generally reserved for ocean-going vessels.

Typically new automobiles that are transported by vessel around the world are moved on ROROs. These large new-car carriers are commonly called Pure Car Carriers (PCCs) or Pure Car Truck Carriers (PCTCs). The largest PCC currently in service can carry over 7000 cars.

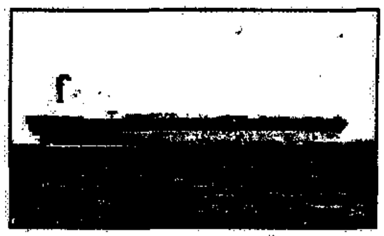
Bulk Carriers



Bulk carriers are vessels used to transport bulk items such as mineral ore, fertilizer, wood chips, or grain. They have large box-like hatches on their deck, designed to slide outboard for loading.

The bulk carriers primarily carry dry cargoes, which are shipped in large quantities and do not need to be carried in packaged form. The principal bulk cargoes are coal, iron ore, bauxite, phosphate, nitrate and grains such as wheat. The advantage of carrying such cargoes in bulk is that packaging costs can be greatly reduced and loading and unloading operations can be speeded up.

Tanker Vessel



Tanker vessels are vessels designed to transport liquids in bulk. Tankers can range in size from several hundred tons, designed for coastal service, to several hundred thousand tons, for transoceanic voyages. A wide range of products are carried by tankers, including:

- hydrocarbon products such as crude oil, LPG, and LNG
- chemicals, such as ammonia, chlorine, and styrene monomer; or
- fresh water

Different products require different handling and transport, thus special types of tankers have been built, such as "chemical tankers," "oil tankers," and "LNG carriers."

B. Vessels That Visit California Ports

California is a key player in international shipping. All of the vessel types described previously visit California ports delivering and receiving products used in California, the United States, and the rest of the world. As shown in Table III-2 below, container vessels accounted for nearly half of the California port visits in 2004, followed by tankers at 19 percent of port visits. The remaining categories of vessels each account for less than ten percent of vessel visits.

Table III-2: 2004 California Port Calls by Vessel Type

Vessel Type	Number of Calls	Percentage of Total Calls
Container Vessels	4,545	48%
Tankers	1,811	19%
Bulk Carriers	885	9%
Auto Carriers (RORO)	713	8%
General Cargo/Reefers	685	7%
Passenger Cruise Vessel	652	7%
Barge	106	1%
Other	44	<1%
Total	9,441	100%

(California State Lands Commission, 2004)

Table III-3 ranks California's ports by the number of vessel visits. As shown in the table, over 50 percent of port calls occurred at the Ports of Los Angeles and Long Beach (which are adjacent to each other). The Port of Oakland accounted for about 19 percent of the port calls, and the remaining ports individually received 5 percent or less of the vessel calls.

Table III-3: 2004 Port Ranking by Vessel Visits

Port	Number of Calls	Percentage of Total Calls
Los Angeles/Long Beach	5,083	54%
Oakland	1,797	19%
Richmond	491	5%
Carquinez	463	5%
San Diego	447	5%
Hueneme	318	3%
San Francisco	300	3%
El Segundo	205	2%
Stockton	133	2%
All Other	203	2%
Total	9,441	100%

(California State Lands Commission, 2004)

C. Auxiliary Engines and Fuels

The following sections describe the types of engines currently being used by ocean-going vessels. The information presented below was reported by vessel owners and operators in response to ARB's *Oceangoing Ship Survey* or "Survey" (January 2005). The Survey requested information only for oceangoing vessels that visited California ports in 2004. Data was provided on approximately 327 vessels and over 1,400 engines. For more detailed Oceangoing Ship Survey data, see Appendix C.

Most of the ocean-going vessels subject to the proposed regulation have both main propulsion (main engines) and auxiliary diesel engines. The main engine for most vessels is a diesel-mechanical propulsion system, where the diesel engine is directly coupled to the propeller through a transmission. The exception is passenger cruise vessels and a few tankers, where the main engines are coupled to electric generators which provide electric power to electric motors which are directly coupled to the propellers. These are referred to as diesel-electric systems.

In most cases, the auxiliary engines provide power for uses other than propulsion. Most auxiliary engines are part of a diesel-electric system that is used to provide power for a variety of on-board systems including lighting systems, onboard cargo handling equipment, heating and air conditioning systems, and emergency power. Many passenger cruise vessels that have diesel-electric propulsion systems use the main engines to power electric motors that perform the same functions as auxiliary engines. Because of the relatively high electrical energy draw aboard a passenger cruise vessel, some also have gas turbine-electric systems aboard. Below we provide summaries of selected data collected from the Survey with an emphasis on auxiliary engine information.

<u>Auxiliary Engines</u>

All vessel owners responding to the Survey reported at least one auxiliary engine. Table III-4 summarizes the quantity of auxiliary engines the Survey reported. The majority of the auxiliary engines are diesel compression ignition engines and all of the auxiliary engines reported are four-stroke engines. A four-stroke engine completes one power cycle for every two revolutions of the crankshaft. Therefore, there is one power stroke for every two revolutions of the crankshaft. The four-strokes include: intake, compression, power, and exhaust. The tables listed below provide more information on auxiliary engines on oceangoing vessels.

Table III-4: Number of Auxiliary Engines

Vessel Type	Minimum Number of Auxiliary Engines	Maximum Number of Auxiliary Engines	Average Number of Auxiliary Engines
Passenger/Cruise	3	6	4.7
Reefer	4	4	4
Auto Carrier	2	4	2.9
Container	2	6	3.6
Tanker	1	6	2.7
Other	2	4	2.9

Tables III-5 and III-6 provide information on the type of fuel used to power the auxiliary engines and the average sulfur content of that fuel. According to the Survey, 25 percent of the auxiliary engines already use distillate fuel. The sulfur content of the distillate ranges from 0.03 – 1.5 percent with an average sulfur content of 0.5 percent.

Table III-5: Auxiliary Engine Fuels

Fuel Used in Auxiliary Engine	Number of Engines Reporting in Survey	Percent of Total Engines
Heavy Fuel Oil	877	75%
Distillate Fuel	294	25%

Table III-6: Average Sulfur Content of Fuel Used in Ocean-going Auxiliary Engines

Fuel	Minimum Sulfur Content (%)	Maximum Sulfur Content (%)	Average Sulfur Content (%)
Heavy Fuel Oil	0.15%	4.0%	2.5%
Distillate	0.03%	1.5%	0.5%*

* 0.5 for compression-ignition engines only (excludes turbines which use low sulfur fuel).

The manufacturers of the auxiliary engines were numerous, but five manufacturers accounted for almost 90 percent of the engines reported. These manufacturers are shown below in Table III-7.

Table III-7: Ocean-going Vessel Auxiliary Engine Manufacturers

Engine Maker	Number of Engines	Percent of Total Engines
Man B&W	324	29%
Daihatsu	251	22%
Wartsila/Sulzer	249	22%
Yanmar	118	10%
MAK	44	4%
Other	151	13%

Figure III-1 shows the distribution in age of the auxiliary engines. It is interesting to note that a large percentage of the auxiliary engines are less than 10 years old. Typically, the auxiliary engines last the life of the vessel, so the age distribution of these engines is similar to the age distribution of vessels visiting California ports.

Figure III-1: Ocean-going Vessel Auxiliary Engine Age Distribution

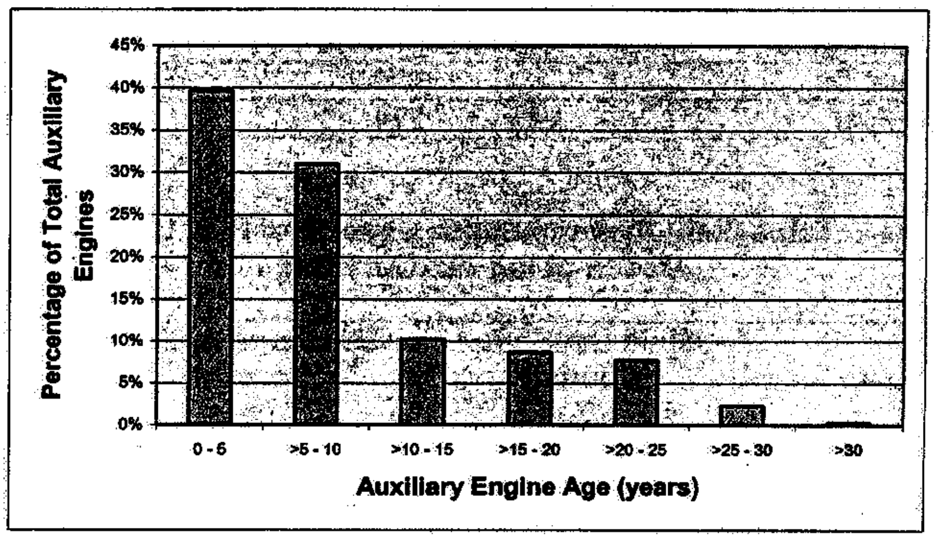


Table III-10 provides information on the average power generated by the auxiliary engines when vessels are hotelling (dockside), maneuvering at ports, and transiting at sea. The diesel generator set engines on passenger cruise vessels are defined as "auxiliary engines" for the purposes of the proposed regulation. The power generated by these engines is much higher than for other vessels because these engines produce electrical power for both propulsion and ship-board electricity.

Table III-8: Average Power Generated

Type of Vessel	Power Generated While Hotelling (kw)	Power Generated While Maneuvering (kw)	Power Generated While At Sea (kw)
Passenger/Cruise	7,500	13,800	34,000
Container	1,600	3,300	3,800
Other	1,450	1,700	4,200
Auto Carrier	600	1,300	580
Tanker	500	660	480
Reefer	1,200	1,200	2,000
Average All Vessels	2,000	3,420	6,600

Main Engines

According to the Survey, as reported in Table III-9, main engines are dominated by diesel engines, with only a small fraction being either gas or steam turbine. The diesel piston engines used on vessels are reciprocating internal combustion engines that operate on the same basic principles as land-based diesel engines. The main engine type results are shown below.

Table III-9: Main Engine Types

Engine Type	Number of Engines	Percent of Total Main Engines
Diesel Compression-Ignition	289	96%
Steam Turbine	9	3%
Gas Turbine	2	1%

Additional information was gathered regarding whether the diesel engines were either two or four-stroke. As shown in Table III-10 below, 95 percent of the main engines on oceangoing vessels were reported to be two-stroke engines. Reciprocating internal combustion engines may operate in a two or four-stroke cycle, where a stroke is one complete movement of the piston from one end of the cylinder to the other. Two stoke engines have higher horsepower to weight ratio than four-stroke engines, but two-stroke engines tend to have higher NOx emissions. According to the survey, main engines use primarily heavy fuel oil.

Table III-10: Diesel Main Engine Types

Diesel Engine Type	Number of Engines	Percent of Total Diesel Engines
2-stroke	271	95%
4-stroke	15	5%

D. Vessel Fuels and Fuel Systems

As explained in Section B, most oceangoing vessels are propelled by a single large slow-speed two-stroke direct drive diesel engine, with smaller medium speed four-stroke auxiliary engines providing electrical power for lighting, navigation equipment, and other ship-board uses. For these vessels, the large main engine almost always operates on heavy fuel oil (HFO), while the smaller auxiliary engines may run on either HFO or marine distillate fuels such as marine gas oil or marine diesel oil. Vessels that use HFO in both their main and auxiliary engines are referred to as mono-fueled (or uni-fueled) vessels, while vessels that use distillate fuels in their auxiliary engines are referred to as dual-fueled.

Diesel-electric vessels such as passenger cruise vessels use very large four-stroke medium speed engines coupled to generators to provide electrical power for both propulsion and ship-board electrical power. These vessels generally use HFO, although some have reported using marine distillate fuels close to shore to reduce their emissions.

Fuel Types

The two basic types of marine fuels are distillate and residual. Distillate fuel is composed of the lighter fractions of crude oil that are separated in a refinery by a boiling process, while the remaining fraction that did not boil is referred to as residual.

Distillate Marine Fuels

The two most common types of marine distillate fuels are marine gas oil (MGO) and marine diesel oil (MDO). MGO is also referred to as DMA using official fuel specification terminology, where the "D" denotes a distillate fuel, the "M" indicates a marine fuel, and the "A" is the grade of fuel. MDO is similar to MGO, but may have a somewhat higher viscosity and sulfur content. This fuel is also referred to as DMB using official terminology, with the same nomenclature as for DMA fuel. MDO is generally MGO that contains a limited amount of residual fuel from storage in tanks or piping that previously held residual fuel. Other types of distillate marine fuels include DMX and DMC fuels. DMX fuel is special grade of fuel generally used only in emergency backup generators, while DMC is a distillate fuel like DMB, except that it is intentionally manufactured from heavier boiling fractions from a distillation process, or is blended from DMA and residual fuels. (U.S. EPA, 1999).

Residual Fuels

Marine residual fuel (also called "heavy fuel oil") is generally a mixture of residual and distillate fuels referred to as intermediate fuel oil (IFO). While there are numerous grades of marine residual fuels, the most common types are IFO-180 and IFO-380. Using this informal terminology, the numbers used in naming these fuels refers to the viscosity limits at the common fuel handling temperature of 50°C. Similar to the distillate fuels, there is also a parallel official terminology. For example, IFO-380 fuel is referred to as either RMG-35 or RMH-35. Using this terminology the "R" denotes a residual fuel, the "M" denotes a marine fuel, and the "35" is the maximum viscosity at 100°C. (U.S. EPA, 1999)

Listed below in Table III-11 are the common marine fuels discussed above, and the range in their allowable properties.

Table III-11: Selected ASTM Specifications for Marine Fuels

	Distillate Fuels		HFO/Residual Fuels	
Specification	**MGO (DMA)**	**MDO (DMB)**	**IFO 180 (RME/F-25)**	**IFO 380 RMG/H-35**
Min. Flash Pt. (°C)	60	60	60	60
Kinematic Viscosity (cSt@40°C)	1.5-6	11 max	25 *	35*
Max % Sulfur (wt.)	1.5	2.0	5.0**	5.0**
Max. % Ash (wt.)	0.01	0.01	0.10-0.15	0.15-0.2
% Distillate	100	99+	12	2

* Viscosity in centistokes at 100°C, ** IMO Annex VI limits sulfur to 4.5%.

<u>Fuel Handling</u>

Ocean-going vessels have complex fuel handling and processing systems that vary with the individual vessel. Most have multiple fuel storage tanks that can hold various grades of fuel, both distillate and HFO. Marine fuels undergo several processes before they are combusted in the engine. Typically, fuel from the storage tank is: (1) pumped to a settling tank; (2) pumped to a centrifuge for removal of water and sludge; (3) pumped to service (day) tank; and (4) pumped to the engine for consumption. Depending on the vessel, there are different ways these processes are handled, some with complete segregation of fuel processes for different grades of fuel, and some utilizing the same fuel processing components for different grades of fuel (Marintek, 2003). In addition, the complete fuel handling system will include additional filtration, venting, drainage, and other components.

The fuel processing steps mentioned above apply to both HFO and distillate fuels. However, heavy fuel oil must also be heated to 100 to 200 degrees

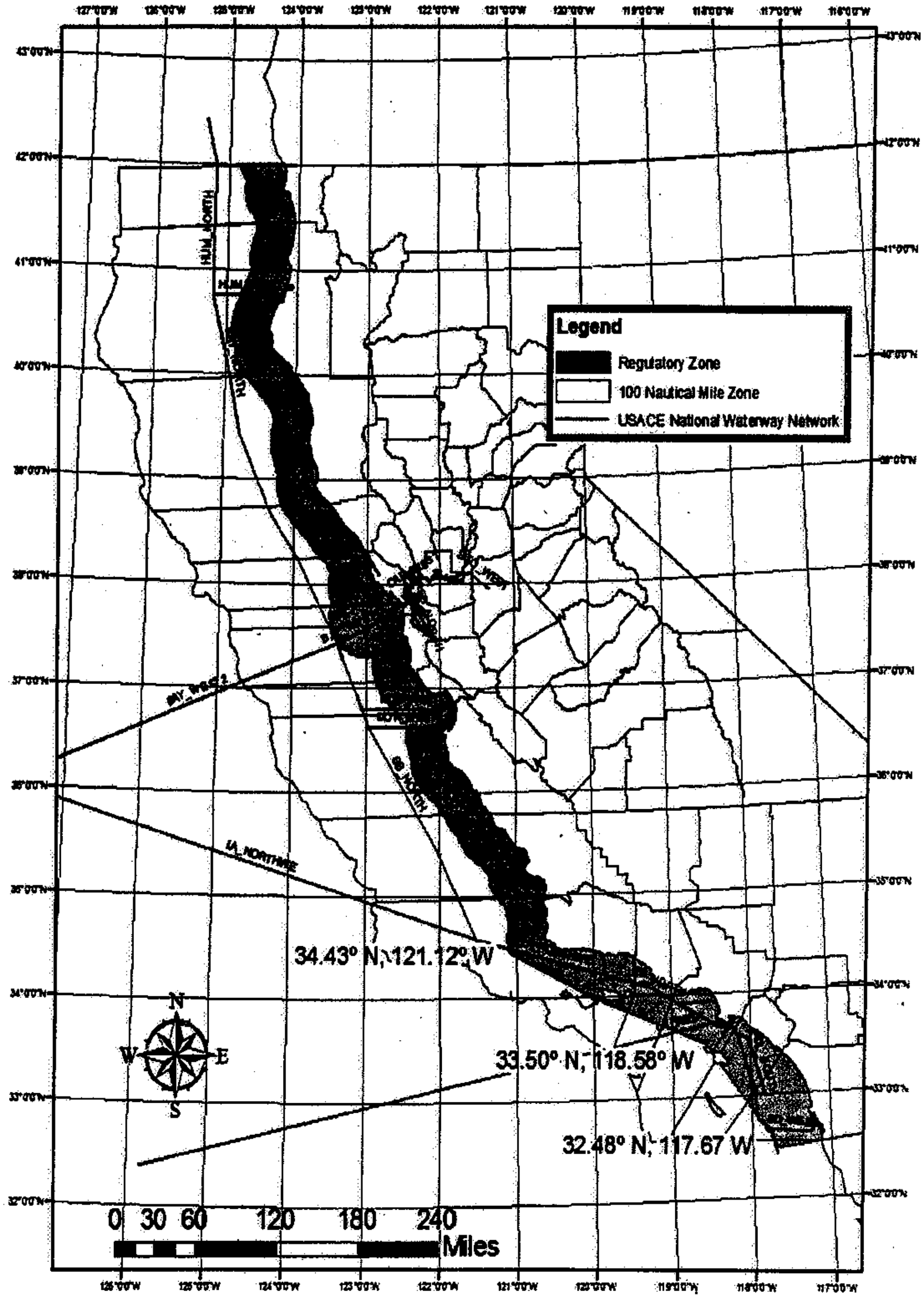
Celsius to reduce its viscosity to a point where it can be pumped and combusted in the engine. Because HFO is so viscous, vessel operators switch to distillate marine fuels prior to vessel dry-dock maintenance operations so that this fuel does not solidify in pipes and components when the engine is stopped.

E. The Shipping Lanes and Ocean-going Vessel Activity Off the Coast of California

The coastline of California stretches more than 800 miles, from Mexico in the south to Oregon in the north. In 2004, California's ports were visited by more than 1,900 ocean-going vessels. These vessels made approximately 10,000 visits to one or more of California's deep-water ports.

Ships typically travel in designated shipping lanes in high traffic areas near California's ports. For example, there are designated shipping lanes that oceangoing vessels use within the Santa Barbara Channel and approximately 25 nautical miles south of the Ports of Los Angeles and Long Beach. (Marine Exchange of Southern California). Similarly, there are designated shipping lanes within the San Francisco Bay and surrounding areas north to approximately Point Reyes, west to the Farallon Islands, and south to Half Moon Bay. (Marine Exchange of San Francisco). Outside of the port areas, vessels are generally free to choose their routes, although certain vessel-specific requirements may apply. For these low traffic areas, approximations must be made of the most likely routes. To approximate the routes used by oceangoing vessels off California's coastline, including both designated shipping lanes and other areas, ARB staff used the "United States Army Corps of Engineers (USACE) Shipping Lanes," as shown in Figure III-2.

Figure III-2: USACE Shipping Lanes Off the Coast of California and the 24 nm Contiguous Zone



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IV. EMISSIONS, POTENTIAL EXPOSURES, AND RISK

This chapter presents the most recent emissions inventory for diesel-fueled ocean-going vessel auxiliary engines operating offshore of California as well as at California's ports. A discussion on the potential cancer and non-cancer health risks that may occur due to the operation of auxiliary engines is also provided.

A. Estimated Emissions from Ocean-going Vessel Auxiliary Engines

To develop an emissions estimate of the emissions from diesel-fueled ocean-going vessel auxiliary engines operating offshore of California as well as at California's ports, ARB staff developed a methodology that integrated information from three main sources of information:

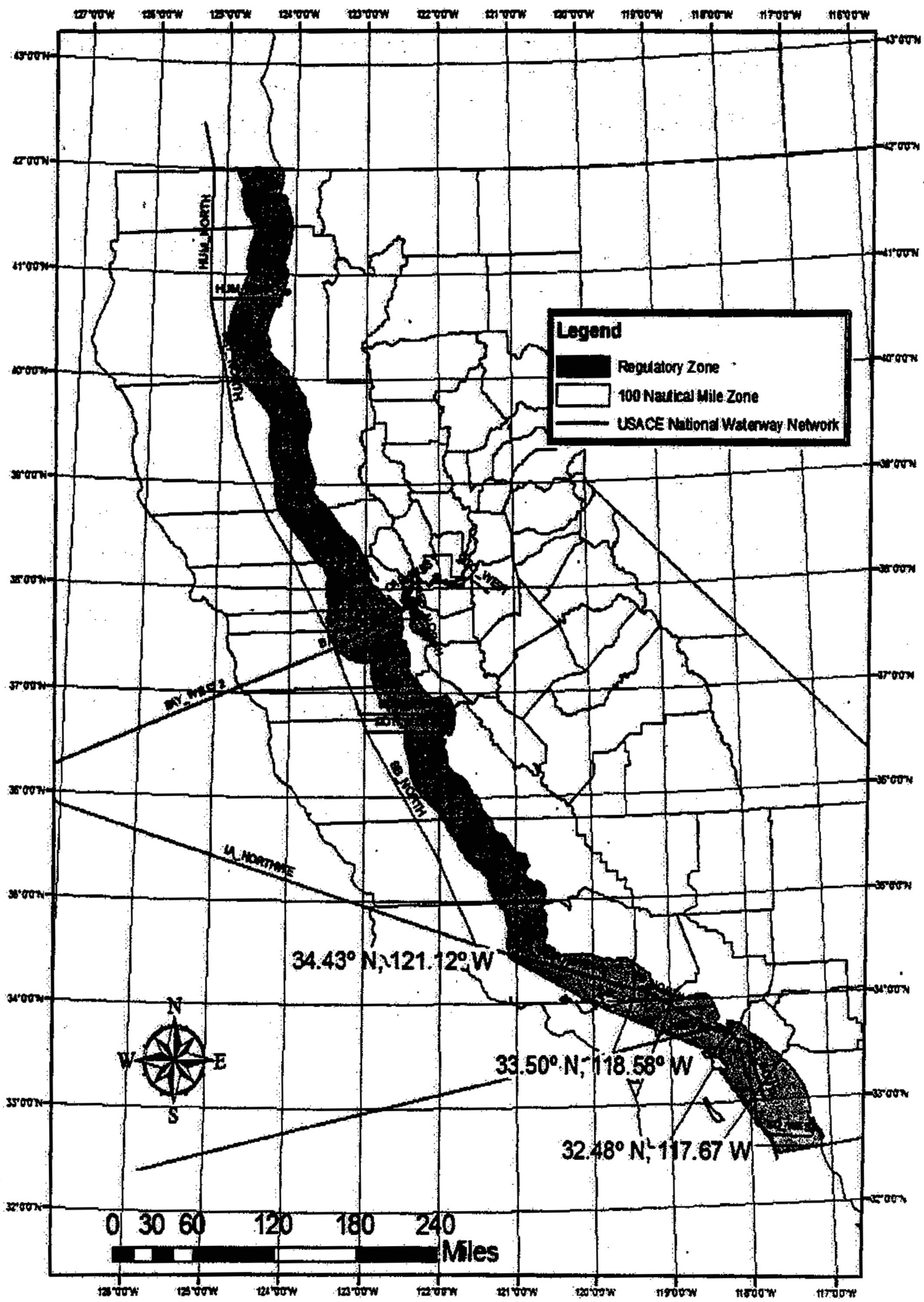
- ARB's 2005 Ocean-going Vessel Survey;
- 2004 California State Lands Commission ocean-going vessel visit data; and
- the ocean-going vessel element of the 2001 Port of Los Angeles emission inventory.

Baseline emission estimates for the year 2004 were developed and emission projections to 2010 and 2020 were also developed using estimates of expected growth. Details of the methodology are found in Appendix D. Based on the information available to date, we believe the methodology has resulted in a reasonable estimate of the emissions from ocean-going vessel auxiliary engines. However, there are continuing efforts by ARB and the major California ports to update and improve the ocean-going vessel emission inventories. As new information becomes available from these efforts, the ocean-going vessel auxiliary engine emission inventory will be updated.

Current 2004 Emission Estimates for Diesel-fueled Ocean-going Auxiliary Engines

ARB staff estimate that the statewide operation of diesel-fueled ocean-going vessel auxiliary engines operating 100 nm or less off of California's coast, in California's ports, and inland waters results in approximately 4 tons per day or approximately 1,430 tons per year of diesel PM emissions. These emission estimates are associated with the use of an ocean-going vessel's auxiliary engines to assist the propulsion engines during the maneuvering of the vessel or to power the vessels electrical systems while at dockside (hotelling). The estimates also include emissions from ocean-going vessels powered by diesel-electric engines. The emission estimation "boundary" of 100 nm was selected because it can be distinguished with relative ease and it is inclusive of the major areas of activity of the sources of interest. Figure IV-1 provides a graphical representation of the 100 nm emission inventory boundary. On the figure, the outer black line, which mirrors the California coastline, represents the inventory boundary while the shaded gray area is the region in which the proposed regulation would be applicable.

Figure IV-1: Ocean-going Vessel Emission Inventory Boundary



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 ocean-going vessel diesel-fueled auxiliary engines to be between 13.1 and 21.8 tons per day.[1] This estimate only reflects the potential conversion of the ocean-going vessel auxiliary engine NOx emissions associated with maneuvering and hotelling activities. The ARB staff is unable at this time to adequately evaluate the potential for the formation of secondary PM_{10} nitrate at sea due to a lack of documentation concerning the impacts of higher humidity at sea, less available ammonia at sea, and the overall deposition of PM in transport along the coast of California. Because of this we believe these values are an underestimate of the quantities of secondary PM_{10} nitrate formed from ocean-going vessel diesel-fueled auxiliary engines.

Estimates of statewide 2004 diesel PM, NOx, SOx, carbon monoxide, and hydrocarbons from ocean-going vessel auxiliary engines are presented in Table IV-1.

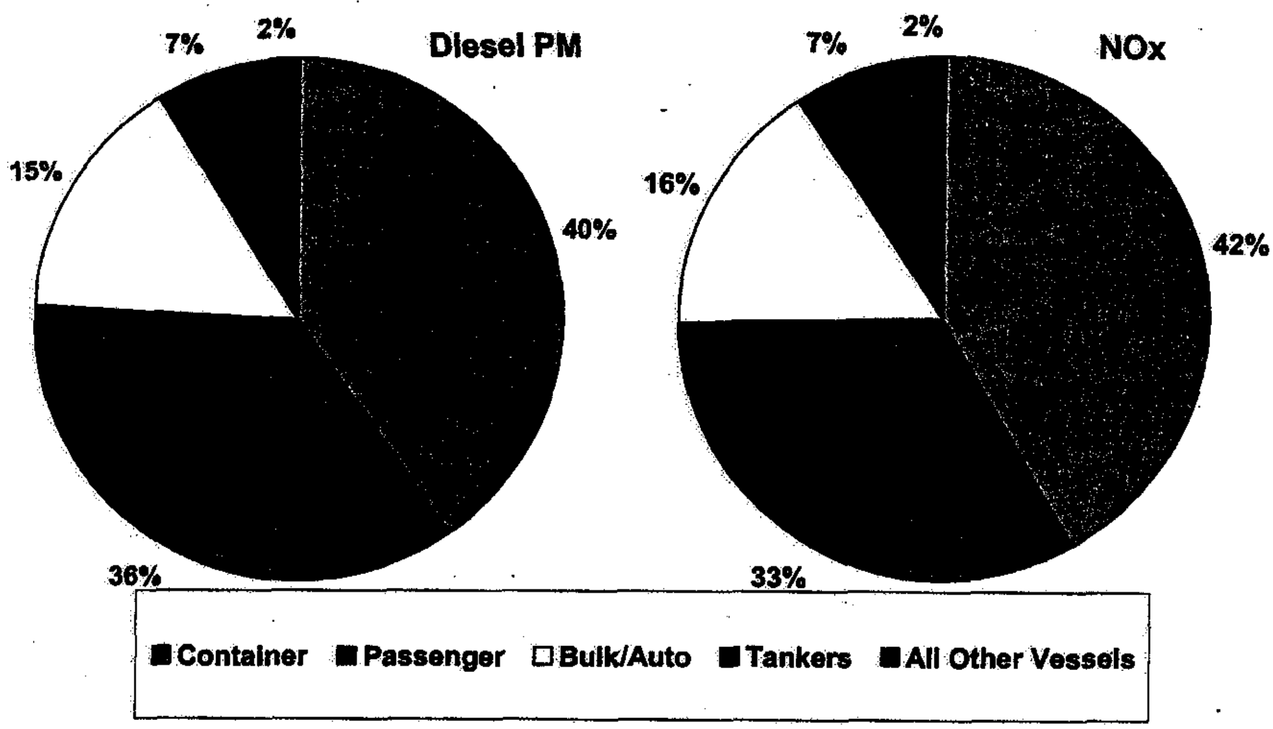
Table IV-1: Estimated Statewide 2004 Ocean-going Vessel Auxiliary Engine Emissions

Vessel Types	Numbers of Vessels	Numbers of Vessel Visits	2004 Pollutant Emissions, Tons/Day				
			NOx	HC	CO	PM	SOx
Auto	225	750	1.11	0.03	0.08	0.10	0.71
Bulk	475	946	4.02	0.11	0.30	0.35	2.55
Container	594	4744	18.11	0.50	1.37	1.57	11.48
General	196	721	1.75	0.05	0.13	0.15	1.11
Passenger	44	687	14.44	0.39	1.09	1.39	10.24
Reefer	19	52	0.60	0.02	0.05	0.05	0.38
RoRo	13	34	0.40	0.01	0.03	0.03	0.25
Tanker	372	1941	3.16	0.09	0.24	0.27	2.00
Totals	1938	9875	43.6	1.20	3.29	3.91	28.7

As shown in Table IV-1, there are approximately 1,900 ocean-going vessels that visited California's ports in 2004. Of those 1,900 vessels that visited California's ports, 30 percent were container vessels. Those container vessels represented more than 45 percent of the vessel visits to California's ports. As shown in Figure IV-2, container vessels represent approximately 50 percent of all the pollutants emitted by ocean-going vessel auxiliary engines; followed by passenger vessels, tankers, and bulk cargo and auto carriers.

[1] 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 E.

Figure IV-2: 2004 NOx and Diesel PM Emission Distributions for Ocean-going Vessel Auxiliary Engines



The ARB staff also estimated district-specific emissions associated with ocean-going vessel auxiliary engines. The allocation of these estimates is based on the length(s) of United States Army Corps of Engineers shipping lanes associated with a specific district. Table IV-2 presents a district-by-district estimate of emissions from ocean-going vessel auxiliary engines.

Table IV- 2: Estimated 2004 Ocean-going Vessel Auxiliary Engine Emissions By District (tpd)[2]

District	NOx	HC	CO	PM	SOx
Bay Area	7.37	0.21	0.55	0.66	4.81
Mendocino	0.85	0.02	0.06	0.08	0.58
Monterey Bay	1.40	0.04	0.10	0.13	0.95
North Coast	1.47	0.04	0.11	0.13	1.00
Northern Sonoma	0.39	0.01	0.03	0.04	0.27
San Diego	5.50	0.16	0.42	0.53	3.83
San Joaquin Valley	0.39	0.01	0.03	0.03	0.23
San Luis Obispo	0.78	0.02	0.06	0.07	0.53
Santa Barbara	2.96	0.08	0.22	0.27	1.96
South Coast	21.32	0.59	1.62	1.89	13.78
Ventura	0.98	0.03	0.07	0.09	0.64
Yolo-Solano	0.18	<0.01	0.01	0.01	0.11
Total	43.59	1.21	3.28	3.93	28.69

Note: The following districts had no ocean-going auxiliary engine emissions allocated to them; Amador, Antelope Valley, Butte, Calaveras, Colusa, El Dorado, Feather River, Glenn, Great Basin Unified, Imperial, Kern, Lake, Lassen, Mariposa, Modoc, Mojave Desert, Northern Sierra, Placer, Sacramento, Shasta, Siskiyou, Tehama, and Tuolumne.

Table IV-3 provides estimates of emissions from ocean-going auxiliary engines operating in the proposed regulated waters, which includes all of California's inland waters, estuarine waters, and all waters within 24 nautical miles (nm) of the California coastline. The 24 nm proposed regulatory waters has been designated by ARB staff as the area where the proposed regulation would be enforced. This area is shown in Figure IV-1 as the dark grey area adjoining the California coastline.

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

Table IV-3: Estimated 2004 Ocean-going Vessel Auxiliary Engine Emissions Occurring Within the Proposed Regulatory Waters

Vessel Types	2004 Pollutant Emissions, Tons/Day				
	NOx	PM	HC	CO	SOx
Auto	0.90	0.08	0.02	0.07	0.57
Bulk	3.76	0.33	0.10	0.28	2.38
Container	15.71	1.37	0.43	1.19	9.95
General	1.62	0.14	0.04	0.12	1.03
Passenger	8.31	0.80	0.23	0.62	5.89
Reefer	0.59	0.05	0.02	0.04	0.37
RoRo	0.34	0.03	0.01	0.03	0.21
Tanker	2.24	0.19	0.06	0.17	1.42
Totals	33.47	2.99	0.91	2.52	21.82

Projected 2010 and 2020 Emission Estimates for Ocean-going Vessel Auxiliary Engines

The projected emission estimates for the years 2010 and 2020 are presented in Table IV-4. As discussed in the methodology included in Appendix D, the vessel type-specific ocean-going vessel growth estimates were developed based upon historical data of the installed power of the propulsion engines of ocean-going vessels from 1997 to 2003. The vessel type-specific growth rates developed were the midpoint between the best fit compounded growth rate for the seven data points and the best fit linear (arithmetic) growth rate for the same data.

The port specific growth rates were applied to in-port emissions: hotelling and maneuvering and in-transit emissions within 3 nm of the coast of the California mainland. In-transit emissions that occur in the outer continental shelf (beyond the 3 nm limit) cannot be tied directly to a single port; as a result, vessel type-specific growth factors are used. The vessel type specific growth factors are also used where port specific factors are not available, such as passenger vessels calling on Monterey. Details on the growth assumptions are provided in Appendix D.

Expected emission reductions and the impact on the ocean-going vessel auxiliary engine emission estimates are discussed in Chapter VII, Environmental Impacts.

Table IV-4: Ocean-going Vessel Auxiliary Engine Projected Year 2010 and 2020 Emission Estimates

Vessel Types	2010 Emission, Tons per Day					2020 Emission, Tons per Day				
	NOx	HC	CO	PM	Sox	NOx	HC	CO	PM	SOx
Auto	1.35	0.04	0.10	0.12	0.86	2.63	0.07	0.20	0.23	1.67
Bulk	5.40	0.15	0.41	0.47	3.42	8.34	0.23	0.63	0.73	5.28
Container	23.22	0.64	1.76	2.02	14.72	33.71	0.93	2.55	2.93	21.37
General	2.36	0.07	0.18	0.21	1.50	4.42	0.12	0.33	0.38	2.80
Passenger	14.99	0.41	1.13	1.44	10.63	40.26	1.10	3.03	3.88	28.55
Reefer	0.86	0.02	0.07	0.08	0.55	1.27	0.03	0.10	0.11	0.81
RoRo	0.49	0.01	0.04	0.05	0.31	0.71	0.02	0.05	0.06	0.45
Tanker	2.99	0.08	0.23	0.26	1.89	4.09	0.11	0.31	0.36	2.59
Totals	51.66	1.42	3.92	4.65	33.88	95.43	2.61	7.20	8.68	63.52

B. Transport of Offshore Ocean-going Vessel Emissions to Onshore

The transport of air pollution over long distances and between air basins has been well established. The emissions from ocean-going vessels can travel great distances and numerous studies have shown local, regional, and global impacts on air quality (Endresen, 2003; Jonson, 2000; Corbett and Fishbeck, 1997; Streets, 2000; Saxe and Larsen, 2004). Tracer studies, air quality modeling, and meteorological data analysis are typical approaches used to determine the extent to which emissions released offshore can impact onshore areas. Several studies support ARB staffs conclusion that emissions from ocean-going vessels released offshore the California Coast can impact onshore air quality. These studies are briefly described below and provided in additional detail in Appendix F.

A tracer study involves the release of a known amount of a non-toxic, inert gas such as sulfur hexafluoride and perfluorocarbon, from either a moving or fixed point offshore and the subsequent sampling of the atmosphere for concentrations of that gas at sites onshore. In California, there have been three tracer studies conducted to investigate the effect of offshore vessel emissions on onshore air quality (Chen, 2005; ARB, 1982; ARB, 1983; ARB, 1984). The tracer gases were released from 8 to over 20 miles offshore. All three studies resulted in tracer gases being detected at onshore sampling stations spanning over wide distances. From these studies we can infer that pollutants emitted from offshore vessels can be transported to onshore areas and be available to participate in onshore atmospheric processes, influencing onshore air quality.

The onshore impacts of offshore emissions have also been investigated using air quality modeling. A modeling study conducted by the Department of Defense has concluded that the emissions released within 60 nautical miles offshore in the southern California coastal region could transport to the coast (ARB, 2000). Another modeling study conducted by the U. S. Navy using 10 years of hourly surface wind data to estimate the probability that offshore emissions would impact land from specified distances has shown that for California, the probabilities of offshore emissions being transported to the coast within 96 hours were greater than 80 percent from 50 nautical miles offshore (Eddington, 1997).

The U.S. EPA has set a 175 nautical mile boundary off from the United States coasts for development of vessel NOx emission inventory (Eddington, 2003; EPA, 2003). The 175-mile area is based on the estimate of the distance a NOx molecule could travel in one day (assuming a 10 mile per hour wind traveling toward a coast, NOx molecules emitted 12 miles from the coast could reach the coast in just over one hour. NOx molecules emitted 175 nautical miles (200 miles) could reach the coast in less than a day). ARB has also conducted studies on the onshore impact of offshore emissions. ARB's studies have demonstrated that pollutants released off California's coast can be transported to inland areas due to the meteorological conditions off the coast (Chen, 2005; ARB, 1982; ARB, 1983; ARB, 1984).

There has been very little actual in-transit measurement of the pollutant emissions from ships to better understand various aspects of vessel plume chemistry and reconcile differences between measurements and model predictions. However, a recent study conducted by Chen et al (Chen, 2005), in which measurements of chemical species in vessel plumes were taken from aircraft transecting a vessel plume, indicates that the NOx half-life within a vessel's plume may be much shorter than predicted by photochemical models. The study demonstrated a NOx lifetime of about 1.8 hours inside the vessel plume at noontime as compared to about 6.5 hours in the background marine boundary layer of the experiment. Additional studies investigating vessel plume chemistry will help us better understand vessel plume chemistry and improve the photochemical models used to investigate the impacts of vessels on air quality.

The analysis of meteorological data can also be used to demonstrate that emissions released offshore can reach onshore airsheds. In 1983, the ARB established the California Coastal Waters (CCW) boundary, based on coastal meteorology, within which pollutants released offshore would be transported onshore. The development of the boundary was based on over 500,000 island, ship-board, and coastal observations from a variety of records, including those from the U.S. Weather Bureau, U.S. Coast Guard, Navy, Air Force, Marine Corps, and Army Air Force (ARB, 1982). The CCW boundary ranges from about 25 miles off the coast at the narrowest to just over 100 miles at the widest.

C. Potential Exposures and Health Risks from Ocean-going Vessel Auxiliary Engine Diesel PM Emissions

This section examines the exposures and potential health risks associated with particulate matter (PM) emissions from auxiliary engines on ocean-going vessels. A brief qualitative discussion is provided on the potential exposures of Californians to the diesel PM emissions from ocean-going vessel auxiliary engine operations. 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 ocean-going vessel auxiliary engines associated with operations at the Ports of Los Angeles and Long Beach. The 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 in California, providing a qualitative estimate for those areas.

Exposures to Diesel PM

As discussed previously, ocean-going vessels visit California ports and travel in waters along the coastline of California and within certain inland waterways. The diesel PM emissions from auxiliary engines contribute to ambient levels of diesel PM emissions. Based on the most recent emissions inventory, there are about 10,000 visits to California ports by ocean-going vessels that have auxiliary engines. The majority of ports 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 vessel auxiliary engines. Because analytical tools to distinguish between ambient diesel PM emissions from vessel auxiliary engines and that from other sources of diesel PM do not exist, we cannot measure the actual exposures to emissions from diesel-fueled vessel auxiliary engines. However, modeling tools can be used to estimate potential exposures.

To investigate the potential risks from exposures to the emissions from auxiliary engines, ARB staff used dispersion modeling to estimate the ambient concentration of diesel PM emissions that result from the operation of ocean-going vessel auxiliary engines that visit 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 G.

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 examine the potential health risks for ocean-going vessel auxiliary engines, ARB staff conducted a risk assessment for operations at the Ports of Los Angeles and Long Beach. We evaluated the impacts from the 2002 estimated emissions for all sources of emissions at the two ports including ocean-going vessel auxiliary engines. Meteorological data from Wilmington was used for the 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-meter 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, 2002a; OEHHA, 2002b). 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 $(mg/kg\text{-}d)^{-1}$).

<u>Cancer Risk Characterization</u>

Emissions from vessel auxiliary engines resulted in significant health risk impacts on the nearby residential areas. Figure IV-3 shows the risk isopleths for diesel PM emissions from vessel auxiliary engines (transiting and hotelling) 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 IV-3, the area in which the risks are predicted to exceed 100 in a million has been estimated to be about 13,500 acres with a population of 225,100. For the risk level of over 200 in a million, the impacted areas have been estimated to be about 2,260 acres and about 48,000 people living around the ports who are exposed to the risk level. Overall, about 99.5 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 and about 99.6 percent of 2 million people who are living in the domain are exposed to the risk level (see Table IV-5).

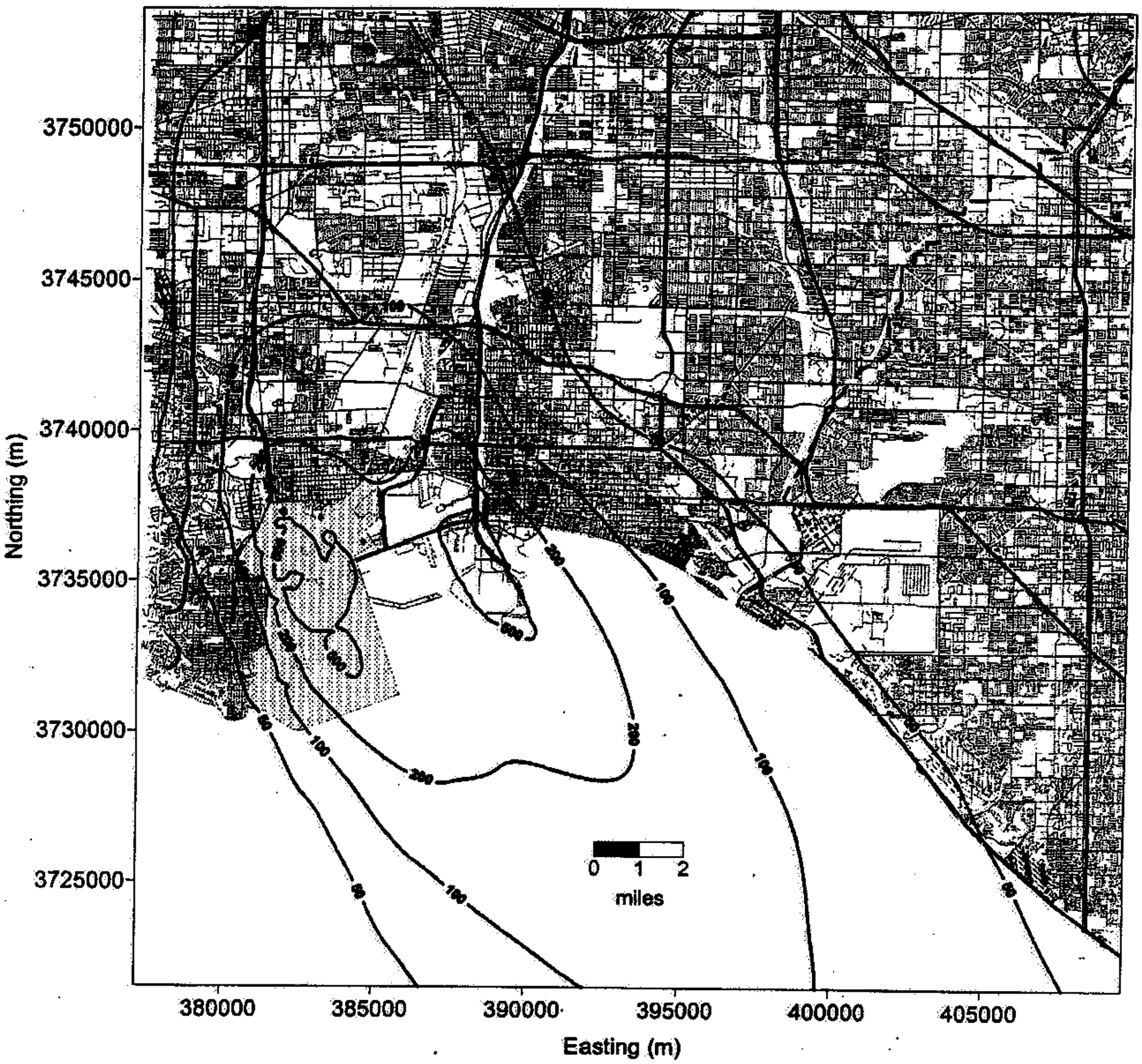
Using the U.S. Census Bureau's year 2000 census data, we estimated the population within the isopleth boundaries. The acres impacted and population affected for the risk ranges of 10-100, 100-200, 200-500, and over 500 are presented in Table IV-5. As shown in Table IV-5, nearly 2 million people living in the area around the ports have a predicted cancer risk of greater than 10 in a million due to emissions from auxiliary engines. 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 area are exposed to risks greater than 10 in a million.

Table IV-5: Summary of Area Impacted and Population Affected by Risk Levels

Risk Level	Acres Impacted	Population Affected
Risk > 500	0	0
Risk > 200	2,263	47,941
Risk > 100	13,492	225,162
Risk > 10	162,565	1,969,397

Note: The effective modeling domain is the land area outside of port property, and is about 255 square miles or 163,435 acres. The total population within the domain is about 2 million.

Figure IV-3: Estimated Diesel PM Cancer Risk from Ocean-going Vessel Auxiliary Engine Activity at POLA and POLB



Parameters: Wilmington Met Data
Urban Dispersion Coefficients
80^{th} Percentile Breathing Rate
Emission = 405 TPY
Modeling Receptor Domain = 20 mi x 20 mi
Resolution = 200 m x 200 m

Non-Cancer Health Risks

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 due to emissions from auxiliary engines would be as follows:

- 31 premature deaths (for ages 30 and older), 16 to 48 deaths as 95% confidence interval (CI);
- 830 asthma attacks, 202 to 1, 457 as 95% CI;
- 7,258 days of work loss (for ages 18-65), 6,143 to 8,370 as 95% CI;
- 38,526 minor restricted activity days (for ages 18-65), 31,403 to 45,642 as 95% CI.

As stated previously, to estimate these statewide potential non-cancer health impacts from auxiliary engine emissions, ARB staff estimated the non-cancer health impacts from ocean-going vessel auxiliary engine emissions 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.

Non-Cancer Health Effects Methodology

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 auxiliary engine emissions 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 (ARB, 2002) and in Lloyd and Cackette (Lloyd and Cackette, 2001). Staff estimated that the ports of Los Angeles and Long Beach account for approximately 48% of total statewide emissions related to auxiliary engine activities. Hence, the statewide impact of the auxiliary engine emissions was estimated by dividing the estimated impacts in the modeling domain around the ports of Los Angeles and Long Beach by 0.48.

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 al, 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 (ARB, 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, we 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.

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V. SUMMARY OF THE PROPOSED REGULATION

In this chapter, we provide a plain English discussion of the key requirements of the proposed regulation for auxiliary diesel engines operated on ocean-going vessels (or "vessels"). This chapter begins with a general overview of the regulation and the approach taken in developing the requirements in the proposal. The remainder of the chapter follows the structure of the proposed regulation and provides an explanation of each major requirement of the proposal. This chapter is intended to satisfy the requirements of Government Code section 11346.2, which requires that a non-controlling "plain English" summary of the regulation be made available to the public.

A. Overview of the Proposed Regulation

The proposed regulation requires that auxiliary engines operating within 24 nautical miles (nm) of the California coastline significantly reduce their diesel particulate matter (PM), nitrogen oxide (NOx), and sulfur oxide (SOx) emissions. Emission reductions can be achieved by using cleaner burning distillate marine fuels, or implementing alternative emission control strategies under an "Alternative Compliance Plan (ACP)." For vessels electing to comply with the fuel requirement, vessel operators will need to switch from the use of heavy fuel oil to marine distillate fuel within 24 nm of the California coastline, unless they already use complying distillate fuels or choose to use distillate fuels on a permanent basis. If operators choose to comply with the proposed regulation under an ACP, they must demonstrate that the alternative emission control strategies will achieve equivalent or greater emission reductions compared to the fuel requirements.

Our approach in developing the fuel and ACP requirements in the proposal was to apply the best available emission control strategy that could be applied to the variety of vessels visiting California ports. Factors considered when establishing these requirements included the potential for near-source risk reduction in port communities, the cost and technical feasibility of using the fuels specified in the proposal, and sufficient availability of the specified fuels at ports worldwide.

B. Purpose

The purpose of this proposed regulation is to reduce emissions of diesel PM, NOx, SOx, and "secondarily" formed PM (PM formed in the atmosphere from NOx and SOx). If adopted, the proposed regulation will achieve immediate, significant emission reductions upon implementation in 2007. Specifically, the proposed regulation will have the following benefits:

- diesel PM emission reductions will reduce the potential cancer risk, premature mortality and other adverse health impacts from PM exposure to people who live in the vicinity of California's major ports and shipping lanes;

- diesel PM emission reductions will reduce regional exposure to PM, and help continue progress toward State and federal ambient air quality standards for PM_{10} and $PM_{2.5}$;
- NOx emission reductions will reduce the formation of regional ozone and secondary nitrate PM; and
- reductions in SOx emissions will reduce the formation of secondary sulfate PM.

C. Applicability

This subsection explains who must comply with the proposed regulation. Except for the exemptions described below, the proposal applies to any person who owns or operates an ocean-going vessel within 24 nm of the California coastline. The definition of ocean-going vessel is key to this section. In general, ocean-going vessels include large cargo vessels and passenger cruise vessels (see section on "Definitions" below). The regulation applies to both U.S.-flagged vessels and foreign-flagged vessels. Foreign-flagged vessels are vessels registered under the flag of a country other than the United States.

The proposed regulation includes language clarifying that the proposal does not change any applicable U.S. Coast Guard regulations and that vessel owners and operators are responsible for ensuring that they meet all applicable U.S. Coast Guard regulations.

D. Exemptions

The proposed regulation includes three exemptions. First, the proposal does not apply to vessels while in "innocent passage." As defined in subsection (d) of the proposal, "innocent passage" generally means travel within the 24 nm boundary off California's coastline without stopping or anchoring, except in limited situations such as when the vessel is in distress or must stop to comply with U.S. Coast Guard regulations.

An exemption is included for two-stroke slow-speed diesel engines as defined in subsection (d) of the proposal. The design of these engines differs significantly from the four-stroke, medium speed engines used in virtually all auxiliary engine applications. While distillate fuels can be used in two-stroke slow-speed engines in some situations, the additional technical challenges associated with using distillate fuels in these engines make it impractical to subject these engines to the same performance standards as four-stroke medium speed engines.

An exemption is also included for military vessels. Military vessels primarily use military specification distillate fuels that must be used on a consistent basis for military equipment globally.

E. Definitions

The proposed regulation provides definitions for a number of terms that are not self-explanatory, or have specific meaning within the context of the proposed regulation. In this subchapter, we discuss some of the key definitions.

Auxiliary Engine

Auxiliary engines are defined as engines designed primarily to provide power for uses other than for direct, mechanical propulsion. Auxiliary engines include diesel generator set engines on diesel-electric vessels, which are used as a source of electricity for any use. Generally, auxiliary diesel engines on cargo vessels are connected to generators and are used to produce electrical power primarily for ship-board uses such as lighting and navigation equipment. These engines are generally four-stroke, medium speed engines. In contrast, the main propulsion engines on cargo vessels are generally very large two-stroke slow-speed engines of a significantly different design than auxiliary engines. Passenger cruise vessels are generally diesel-electric vessels, where several large diesel generator sets provide power for both propulsion and on-board electrical needs. These large generator sets are included in the proposed regulation as "auxiliary engines" because they are similar in design to the smaller auxiliary engines on cargo vessels. Specifically, they are four-stroke, medium-speed generator set engines.

Baseline

The California "baseline" is the boundary line that divides the land and internal waters from the ocean. This boundary line is determined by the United States Baseline Committee and shown on the official United States nautical charts published by the National Oceanic and Atmospheric Administration (NOAA). Because the waterline rises and falls with the tide, the baseline is defined with respect to the tides. For this regulation, we have defined the baseline as the mean lower low water line along the California coast, as shown on the applicable NOAA Nautical Charts authored by the NOAA Office of Coast Survey. The NOAA routinely updates its nautical charts to update hazards to navigation and other information considered essential for safe navigation and any changes made to the baseline by the U.S. Baseline Committee. It is our understanding that NOAA will be updating the charts for the California coast in the near future. The California baseline is used in the definitions of "Territorial Sea" (which extends to 12 nautical miles from the California Baseline) and "Contiguous Zone" (which extends to 24 miles from the California baseline).

Marine Gas Oil

Marine Gas Oil (MGO) is a marine grade distillate fuel very similar to on-road diesel fuel except that it has a higher flash point requirement and often a much higher sulfur content. The International Organization for Standardization (ISO) sets standards for marine fuels under International Standard ISO 8217, including fuels designated DMX and DMA, which correspond to marine gas oil. For example, the maximum sulfur content for grade DMA fuel is 1.5 percent by weight, and the minimum flash point is 60 degrees Celsius. If a fuel meets all of the standards for DMA or DMX fuels in the applicable ISO standard, then it qualifies in the proposed regulation as "marine gas oil." In practice, on-road diesel fuel in California often meets the specifications for DMA fuel and is sold for marine use. In most cases, DMX grade fuel is primarily used only for emergency generators, so marine gas oil is generally DMA grade fuel.

Marine Diesel Oil

Marine Diesel Oil (MDO) is a marine grade distillate fuel very similar to marine gas oil except that it generally contains a small amount of marine residual fuel (heavy fuel oil) due to storage or transportation in tanks or piping that previously held marine residual fuels. The International Organization for Standardization (ISO) sets somewhat less stringent standards for MDO fuel, which corresponds to DMB grade fuel in ISO terminology. The sulfur content limit for DMB grade fuel is 2 percent, compared to 1.5 percent for DMA grade fuel (marine gas oil).

Ocean-going Vessel

An ocean-going vessel is defined as a vessel meeting any of the following criteria:

- a vessel with a "registry" (foreign trade) endorsement on its U.S. Coast Guard certificate of documentation, or a vessel that is registered under the flag of a country other than the United States;
- a vessel greater than or equal to 400 feet in length overall (LOA) as defined in the Code of Federal Regulations (50 CFR § 679.2, as adopted June 19, 1996);
- a vessel greater than or equal to 10,000 gross tons (GT ITC) per the convention measurement (international system) as defined in 46 CFR 69.51-.61, as adopted September 12, 1989; or
- a vessel propelled by a marine compression ignition engine with a per-cylinder displacement of greater than or equal to 30 liters.

The criteria in the definition of ocean-going vessel are designed to include vessels that travel internationally, such as container vessels, auto carriers, tankers, and passenger cruise vessels. The definition is also designed to exclude harbor craft such as tug boats, fishing boats and ferries, which will be subject to more stringent fuel requirements in 2007. Specifically, diesel fuel sold to harbor craft in California will be required to meet California on-road "vehicular" standards.

Territorial Sea and Contiguous Zone

Both the Territorial Sea and the Contiguous Zone represent internationally recognized over-water boundaries. The Territorial Sea extends 12 nm offshore of the California coastline (or "baseline"), while the Contiguous Zone extends from the Territorial Sea to 24 nm offshore of the California coastline. Together, these zones represent the region subject to the proposed regulation approximately north of Point Concepción. South of this point, a boundary approximately 24 nm off the shoreline is defined by straight line segments. We selected this linear boundary south of Point Concepción because the Territorial Sea and Contiguous zone around the Channel Islands would bring the effective zone of the proposed regulation beyond the intended boundary of approximately 24 nm offshore of the California mainland coastline.

F. Cleaner Fuel Option

This section explains the types of fuels that may be used by operators of ocean-going vessels to comply with the requirements of the proposed regulation. Under the proposed regulation, starting on January 1, 2007, vessel operators can comply with the proposal by using one of the following fuels when operating their auxiliary engines within 24 nm of the California coastline: (1) marine gas oil; or (2) marine diesel oil with less than or equal to 0.5 percent by weight sulfur. A 0.5 percent sulfur limit is specified for marine diesel oil because it tends to have a higher sulfur level than marine gas oil. Marine gas oil used by vessels that visit California ports is expected to average at or below 0.5 percent sulfur based on the results of a survey sent to vessel operators in 2005. Specifically, the average sulfur content of distillate marine fuels used by vessel auxiliary engines was reported to be 0.5 percent, and we do not anticipate that this will increase in the future.

Starting on January 1, 2010, marine gas oil meeting a 0.1 percent sulfur limit is specified under the proposed regulation. This lower sulfur fuel will result in additional emission reductions of PM and SOx, compared to the January 1, 2010 requirement. This standard is also consistent with a recently adopted European Union regulation. However, a feasibility analysis is required under the proposed regulation prior to implementation of this fuel requirement to investigate the supply, cost, and technical feasibility of using this fuel. Based on the results of this evaluation, modifications to this requirement may be proposed to the Board.

Under the proposed regulation, vessel emissions would be regulated up to 24 nm off the California coastline. The ARB has the authority to require emission reductions out to the California Coastal Water (CCW) boundary. This is the region within which emissions are likely to be transported onshore, and it extends beyond the 24 nm boundary. However, the 24 nm boundary was proposed because it significantly lowers the cost of the regulation while still providing the vast majority of the potential on-shore benefits in terms of reduced exposure to diesel PM. Specifically, about 75 percent of the auxiliary engine diesel PM emissions within 100 nm of the California coastline is emitted within the 24 nm boundary. The 24 nm boundary is also easily defined for vessel operators. The boundary is aligned in Central and Northern California with the outer boundary of the Contiguous Zone, an internationally recognized boundary which extends 24 nm offshore and is noted on most nautical charts. In Southern California, the boundary consists of straight line segments approximately 24 nm offshore of the coastline. This approximation is used because the Contiguous zone extends around the Channel Islands, bringing the boundary well beyond 24 nm, and in some cases beyond the California Coastal Waters boundary

G. Recordkeeping and Reporting Requirements

Recordkeeping

Recordkeeping, in addition to ship-board inspections and fuel testing, is necessary for ARB enforcement staff to verify that a vessel operator is complying with the requirements of the proposed regulation. This section explains the recordkeeping requirements.

Beginning with the implementation of the fuel requirement on January 1, 2007, any person who owns or operates an ocean-going vessel within 24 nm of the California coastline will be required to maintain certain records (in English) for a minimum of three years. These requirements do not apply to vessels that travel along California's coastline in "innocent passage," meaning traveling without stopping or anchoring, except in limited situations. The records that must be maintained are as follows:

- the date, time, and position (longitude and latitude) of the vessel for each entry into and departure from the region covered by the proposed regulation;
- the date, time, and position (longitude and latitude) of the vessel at the initiation and completion of any fuel switching procedures used to comply with the fuel requirements in the proposed regulation. Completion of fuel switching procedures means the moment at which auxiliary engines have completely switched from one fuel to another fuel;
- the date, time, and position (longitude and latitude) of the vessel at the initiation and completion of any fuel switching procedures within the region covered by the proposed regulation;
- the type of each fuel used (e.g. marine gas oil) in each auxiliary engine operated within the region covered by the proposed regulation; and
- the types and amounts of fuels purchased for use on the vessel, and the actual percent by weight sulfur content of such fuels as reported by the fuel supplier or a fuel testing firm.

Reporting and Monitoring Provisions

These provisions explain when the records described above will be provided (reported) to ARB. The provisions also explain that access to vessels shall be provided to allow enforcement staff to verify compliance with the proposed regulation. For example, enforcement staff may need to access the vessel to inspect records instead of requesting that they be mailed, or they may need to obtain a sample of fuel used by the vessels auxiliary engines.

Under these provisions, the recordkeeping information specified in the proposed regulation must be supplied in writing to the Executive Officer upon request. Some of the recordkeeping required by the proposed regulation may already be recorded to comply with other regulations or standardized practices. In these cases, the information may be provided to ARB in a format consistent with these regulations or practices, as long as the required information is provided.

Vessel owners or operations may be requested to provide additional information needed to determine compliance with the proposed regulation. For example, information about the auxiliary engines, fuel tanks, and fuel delivery system may be needed on a case-by-case basis.

To monitor compliance with the requirements of the proposed regulation, these provisions require that vessel owners or operators provide access to the vessel to employees or officers of the Air Resources Board. This is to include access to records necessary to establish compliance with the requirements of the proposal and access to fuel tanks or pipes for the purpose of collecting fuel samples for testing and analysis.

H. Noncompliance Fee Option

The proposal contains this provision to address the limited situations where a vessel operator may not be able to comply with the proposed regulation for reasons beyond their reasonable control, or it may be impractical to comply. Instead of providing exemptions for these situations, staff is proposing a provision that would allow a vessel owner or operator, under special circumstances, to pay a fee in lieu of complying with the proposed regulation. The funds collected under this provision would be used for marine or port emission reduction projects, with the goal of achieving equivalent or greater emission reductions near affected communities. Under this program, the vessel owners or operators would need to notify the Executive Officer that they will not meet the requirements of the regulation prior to entering the 24 nautical mile boundary (California Regulatory Waters). The fees under this program are designed to ensure that participants will not receive an economic advantage over vessel operators that directly comply with the proposed regulation. The fee schedule is graduated such that subsequent visits would result in increasing fee amounts.

This option could only be used in the following circumstances:

- the vessel owner is unexpectedly redirected to a California port and the vessel does not have a sufficient quantity of fuel complying with the requirements of the proposed regulation;
- due to reasons beyond the vessel operator's control, the vessel was not able to acquire a sufficient quantity of fuel complying with the requirements of the proposed regulation;
- due to reasons beyond the vessel operator's control, fuel necessary to comply with the requirements of the proposed regulation was found to be contaminated or otherwise out of compliance after the vessel left the last bunkering port prior to a California port call;

- modifications to a vessel are required to comply with the proposed regulation and the vessel operator is not able to complete the modifications in time to meet the January 1, 2007 requirements in the proposal. The vessel operator must submit a Compliance Retrofit Report that identifies the modifications necessary and the date by which modifications will be completed; and
- modifications to a vessel are required to comply with the proposed regulation and the vessel will visit a California port a maximum of two times per calendar year, and four times over the life of the vessel after January 1, 2007 (the effective date of the requirements in the proposal).

The non-compliance fees funds would be deposited into the port's Noncompliance Fee Settlement and Air Quality Mitigation Fund prior to leaving the port. The fee increases with each port visited while complying with this provision. The port visits are cumulative over the life of the vessel. For example, if a diesel-electric vessel visits a California port and uses the noncompliance fee option for the first time, the vessels owner would pay a fee of $32,500. If that same vessel visits another California port sometime later and again uses the noncompliance fee option, the vessel owner would pay a fee of $65,000; since this was the second port visited under this provision. The basis of the fees is discussed in Appendix H, Basis for the Noncompliance Fees. The fee schedule is shown in Table V-1, Noncompliance Fee Schedule, Per Vessel.

Table V-1: Noncompliance Fee Schedule, Per Vessel

Noncompliance Fee Schedule		
Visit	**Fee (per vessel)**	
	Diesel-Electric Vessels	Other Vessels
1st Port Visited	$32,500	$13,000
2nd Port Visited	$65,000	$26,000
3rd Port Visited	$97,500	$39,000
4th Port Visited	$130,000	$52,000
5th or more Port Visited	$162,500	$65,000

I. Alternative Compliance Plan

The alternative compliance plan (ACP) is included in the proposed regulation to provide vessel owner/operators with the flexibility to implement alternative emission control strategies that achieve equivalent or greater emission reductions than the distillate fuel compliance option. Alternative emission control strategies may include the use of shore-side electrical power, engine modifications, exhaust treatment devices such as diesel oxidation catalysts, the use of alternative fuels or fuel additives, and operational controls such as limits on idling time.

Application Process

To comply with the proposed regulation under the ACP, a vessel owner or operator must submit an application to ARB. The application must demonstrate that the alternative emission control strategy employed will achieve equivalent or greater emission reductions in PM, NOx, and SOx from auxiliary engines, relative to the emission reductions that would have occurred by using the distillate fuel compliance option. The proposed regulation specifies basic information that must be included in the application, such as emissions test data, and other information that demonstrates the emissions level to be achieved with the proposed alternative emission control strategy. ARB staff will develop a guidance document to assist applicants in making a demonstration of equivalent emission reductions.

The scope of the ACP is limited to auxiliary engines. In other words, emission reductions from main engines or other sources may not be included in the ACP. In addition, compliance with the ACP can be demonstrated on an individual vessel basis, or across a fleet of vessels with the same owner or lessor.

After an application for an ACP is submitted, ARB has 90 days to accept or deny the application. If ARB staff finds that additional information is necessary, the applicant will be provided an opportunity to submit the necessary information. It should be noted that submittal of an ACP application does not mean that the applicant is complying with the regulation. The applicant must comply with the fuel requirements and other provisions of the regulation until an ACP application is granted. For this reason, applicants may want to submit applications at least 90 days prior to the implementation date of the fuel requirement on January 1, 2007.

ARB may revoke or modify an ACP if it believes that an ACP has been granted to an owner or operator that is not complying with the provision or no longer meets the criteria of an ACP. In addition, ACP applications may be inadequate if the 0.1 percent sulfur MGO requirement effective on January 1, 2010, is implemented. As such, applicants may want to consider pursuing alternative emission control strategies that will also comply with this more stringent emission level.

Additional provision for applicants using shore-side power

There is an additional provision in the ACP that applies to vessels that connect to shore-side power, subject to certain conditions. Specifically, the vessel must connect to power supplied by a utility company (or another source with equivalent or lower emissions per unit of delivered energy) and shut down all auxiliary engines subject to the proposed regulation. The vessel must also connect to shore power within one hour after the vessel is secured at the port terminal, and continuously use this power until no more than one hour prior to when the vessel leaves the terminal.

If these conditions are met, the vessel would not be subject to the fuel-based emission limitation during travel from a previous port to a California port where shore-side power is to be used, while docked prior to utilizing shore-side power, and during travel to a subsequent port. For example, a vessel operator could run their auxiliary engines on heavy fuel oil while traveling to a California port where shore-side power is to be used. After docking at this port, the vessel would have one hour to shut off all its auxiliary engines and begin using shore-side electrical power. When preparing to depart, the vessel could disconnect from shore-side power and run their auxiliary engines on heavy fuel oil for up to one hour prior to departing. While departing port, the vessel operator could continue to run the auxiliary engines on heavy fuel oil.

If two California ports are visited in succession, and a vessel utilizes shore-side power only at the second port, the vessel would be considered to meet the emission reduction requirements of the ACP: (1) while traveling from the first port to the second port; (2) while dockside at the second port; and (3) while departing the second port. While traveling to the first port, and during mooring at the first port, the vessel must comply with the requirements of the regulation through the use of distillate fuels or other emission control strategies (See Figure V-1). For example, while traveling to the first port, a vessel operator may switch from heavy fuel oil to distillate fuels in the auxiliary engines prior to entering the 24 nautical mile boundary off California's coastline. The distillate fuel would continue to be used while at dockside. However, as soon as the vessel operator left the first port, the operator could switch to heavy fuel oil, which could be used thereafter except when the auxiliary engines are shut down while the vessel is connected to shore-side power at the second port.

If two California ports are visited in succession and a vessel utilizes shore-side power at the first port visited, the vessel would meet the requirements of the ACP during travel to this first port, during the time the vessel is dockside at the first port, and while traveling from the first to second port. While dockside at the second port, and during the departure from the second port, the vessel must comply with the requirements of the regulation through the use of distillate fuels or other emission control strategies (See Figure V-2 below). For example, while traveling to the first port, a vessel operator may use heavy fuel oil. The heavy fuel oil could continue to be used while at dockside for up to one hour, after which the auxiliary engines must be shut off while shore-side power is connected. While preparing to depart, the vessel could disconnect from shore-side power and begin operating the auxiliary engines on heavy fuel oil. Heavy fuel could also be used in transit to the second port. However, at some point prior to docking at the second port, the vessel operator would need to switch to distillate fuel or implement an alternative emission control strategy, which would be used at dockside and while the vessel departs the second port.

The additional provisions for applicants using shore-side power are included in the proposed regulation to encourage the use of shore-side power in recognition of its ability to greatly reduce diesel PM emissions released close to portside communities. In addition, the use of shore-side power results in significant reductions in carbon dioxide (a global warming gas).

Applicants do not have to utilize this provision of the ACP in all cases when their emission control strategies utilize shore-side power. They may choose to comply with the proposal using shore-side power under the general ACP provisions. For example, if they cannot connect within one hour of mooring at the terminal, they can utilize the general provisions of the ACP. However, the special provisions for shore-side power provide some advantages. First, the application process would be simplified because less information would be needed to demonstrate compliance. In addition, there may be instances where the emissions from a vessel would be greater overall while utilizing this provision compared to compliance with the fuel requirements in the proposed regulation. However, we believe the benefits of reducing the risk resulting from near-shore PM emission reductions will generally offset any potential increases in overall emissions.

Figure V-1

Vessel Uses Auxiliary Engine Power at First Port Call and Shore-side Power at Second Port Call

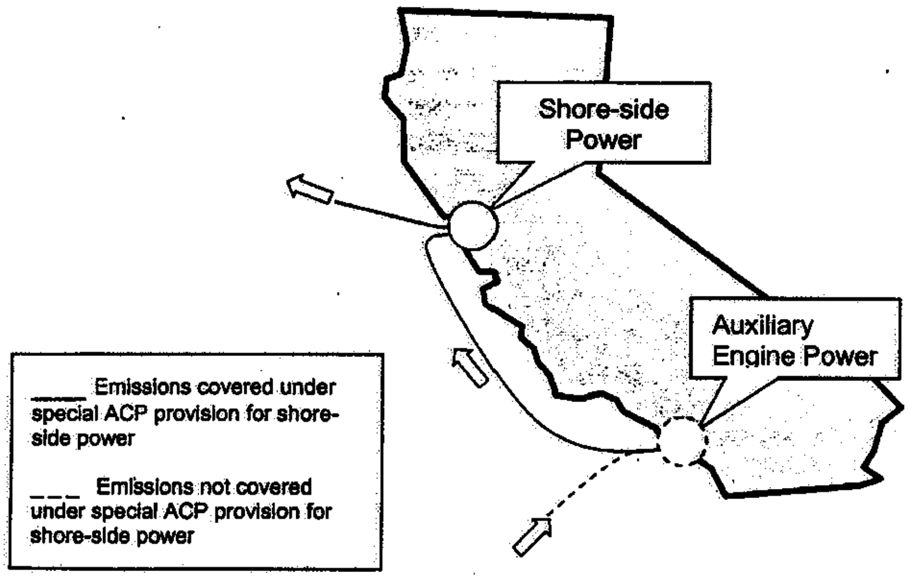
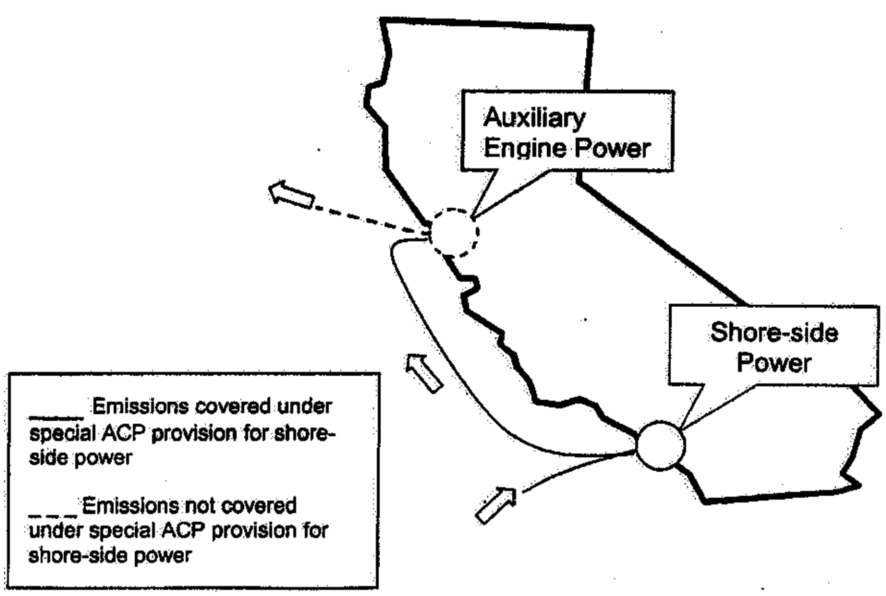


Figure V-2

Vessel Uses Shore-side Power at First Port Call and Auxiliary Engine Power at Second Port Call



J. Test Methods

The proposed regulation includes test methods to determine whether fuels meet the requirements of the proposed regulation. Specifically, the proposed regulation references International Standard 8217 as adopted by the International Organization for Standardization in 1996. ISO 8217 includes the properties necessary for a fuel to qualify as DMX or DMA grade fuel (marine gas oil), or DMB grade fuel (marine diesel oil), and specifies the test methods to be used to determine compliance with each of these properties. The proposal also includes the test method to be used to determine the sulfur level of these fuels.

The proposed regulation allows the use of alternative test methods demonstrated to be equally accurate, as approved by the Executive Officer of ARB. For example, ASTM equivalent methods are available for many or all of the ISO test methods specified in ISO 8217.

K. Sunset and Technology Review Provisions

Sunset Provision

If the Executive Officer of the ARB determines that the IMO or the U.S. EPA adopts regulations that will achieve equivalent or greater emission reductions from ocean-going vessels in California, compared to the emission reductions achieved by the proposed regulation, then the Executive officer will propose to the Board for its consideration terminating or modifying the requirements of the proposed regulation. This provision recognizes that it would be preferable to adopt regulations for ocean-going vessels on a national or international basis.

Feasibility Review

This section describes the feasibility evaluation that will be conducted relative to the January 1, 2010, fuel requirement to use 0.1 percent sulfur marine gas oil. Under these provisions, an evaluation of the feasibility of this fuel requirement will be conducted by ARB staff no later than July 1, 2008. The evaluation will consider, at a minimum, the following:

- the current availability of 0.1 percent sulfur MGO at bunkering ports worldwide;
- the ability of petroleum refiners and marine fuel marketers to supply this fuel by 2010;
- technical considerations such as whether fuel at this lower sulfur level will be compatible with all marine engines; and
- the cost of this fuel.

If, based on the evaluation, modifications to the regulation are necessary, staff will propose changes to the Board prior to January 1, 2009, (a year prior to the implementation date of the 0.1 percent sulfur fuel standard).

L. Severability

This provision states that if a particular section of the proposed regulation is held to be invalid, the remainder of the proposal shall continue to be effective.

M. Regulatory Alternatives

The Government Code section 11346.2 requires ARB to consider and evaluate reasonable alternatives to the proposed regulation and provide the reasons for rejecting those alternatives. ARB staff evaluated five 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 make progress toward ARB's goals of: (1) reducing diesel PM by 85 percent in 2020, as described in the Diesel Risk Reduction Plan; and (2) achieving State and federal air quality standards for PM and ozone. The proposed regulation provides vessel operators with the flexibility to pursue alternative emission control strategies if they choose not comply with the fuel requirements in the proposal.

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

<u>Alternative 1: Do Nothing</u>

As discussed in Chapter VII, the proposed regulation will result in significant reductions in diesel PM, NOx, and SOx emissions. The diesel PM reductions are an important element of the Diesel Risk Reduction Plan, and along with other regulations to be adopted by ARB, will contribute to reducing cancer and noncancer health risks to the public associated with inhalation exposure to emissions of diesel PM.

The emission reductions from the proposal are also necessary to make progress toward compliance with State and federal air quality standards for ozone and PM in nonattainment areas throughout the State. As discussed in Chapter IV, NOx and SOx emissions form "secondary" nitrate and sulfate PM, respectfully, in the atmosphere, while NOx emissions contribute to the formation of ozone.

In addition, ARB is required by H&SC Section 39658 to establish regulations for toxic air contaminants (TACs) such as diesel PM. Further, H&SC Sections 39666 and 39667 require the ARB to adopt measures to reduce emissions of TACs from nonvehicular and vehicular sources. In consideration of ARB's statutory requirements and the recognized potential for adverse health impacts to the public resulting from exposure to diesel PM and ozone, this alternative is not a reasonable option.

Alternative 2: Rely on U.S. Environmental Protection Agency (EPA) and International Maritime Organization (IMO) Regulations

As discussed in subsection K above, the proposed regulation includes a "sunset" provision which requires the Executive Officer of ARB to consider terminating the requirements of the proposed regulation if it is determined that the U.S. EPA or IMO adopts regulations that will achieve equivalent or greater emission reductions from vessel auxiliary engines compared to the emission reductions achieved by the proposed regulation. This provision recognizes that it would be preferable to adopt regulations for ocean-going vessels on a national or international basis. However, existing IMO and U.S. EPA regulations will not achieve the needed emission reductions from the proposal in the near term (prior to 2010), and it appears unlikely that the U.S. EPA or IMO will adopt equally effective regulations in the next foreseeable future. The following is a brief summary of the status of IMO and U.S. EPA activities supporting our position that we cannot wait for IMO or U.S. EPA to act.

IMO Annex VI NOx Standards

These standards apply to marine diesel engines greater than 130 kilowatts, which would include the auxiliary engines covered by the ARB staff proposal. However, these standards only apply to NOx emissions, and therefore would not achieve the significant PM benefits of the proposed regulation.

U.S. EPA 1999 Category 1&2 Engine Rule

The standards in this rule apply to new "category 1 & 2" engines (engines with a displacement less than 30 liters per cylinder), which would apply to most auxiliary engines covered by the ARB staff proposal (except the engines on diesel-electric vessels such as cruise vessels). This rule specifies standards for NOx plus hydrocarbons, PM, and carbon monoxide. However, this rule only applies to new engines in U.S.-flagged vessels, which make up a very small proportion (less than 10 percent) of the vessels that visit California ports. In addition, there is a foreign-trade exemption for U.S.-flagged vessels.

U.S. EPA 2003 Category 3 Engine Rule

The U.S. EPA recently adopted standards for new "category 3" engines (the large engines used for propulsion of ocean-going vessels). These NOx standards would apply to the large generator set engines used on diesel-electric vessels such as cruise vessels. However, the standards are identical to the IMO NOx standards and would only achieve modest NOx emission reductions and no diesel PM reductions. In addition, they only apply to new engines on U.S.-flagged vessels, which represent a very small proportion of the vessels visiting California ports. In this rulemaking, U.S. EPA also addresses "category 1" and "category 2" engines, with a displacement at or above 2.5 liters per cylinders but less than 30 liters per cylinder (typical of auxiliary engines used on ocean-going vessels). On U.S.-flagged vessels, these engines would be required to meet NOx standards equivalent to the IMO standards. In addition, beginning in 2007, these engines would be subject to the U.S. EPA's standards for category 1 and 2 engines adopted in 1999. In this rulemaking, U.S. EPA also eliminated the foreign trade exemption included in U.S. EPA's 1999 rule. However, all these requirements would only apply to U.S. flagged vessels, which represent a small proportion of the vessels that visit California ports.

EPA Nonroad Diesel Rule

Among other requirements, this rule would limit the sulfur content of diesel fuels for non-road applications. For marine use, the rule would limit the sulfur content in diesel fuel to 0.05 percent (500 ppm) in 2007, and 0.0015 percent (15 ppm) in 2012 (EPA, 2004). However, this rule does not apply to marine diesel oil or heavy fuel oil. Since most ocean-going vessel auxiliary engines use heavy fuel oil, this would have little impact in reducing emissions from this source.

Potential Tier II EPA Category 3 New Engine Standards

The U.S. EPA reportedly intends to adopt more stringent technology-forcing Tier 2 standards for category 3 engines in April, 2007. (EPA, 2003). However, these standards may again only apply to U.S.-flagged vessels, and may not address PM emissions. In addition, we estimate that such standards would become effective for new engines in the 2010 timeframe and the emission reductions achieved by such a measure would phase in gradually as new vessels enter into service. As such, the measure would not be expected to achieve significant reductions until well after 2010.

Sulfur Emission Control Area (SECA)

The U.S. EPA, in association with ARB and other air quality agencies, is currently investigating the creation of SECA's under a process provided by the IMO. Specifically, the IMO's Annex VI ("Regulations for the Prevention of Air Pollution from Ships") of the MARPOL Convention provides a mechanism to require the use of marine fuel with a sulfur content limit of 1.5 percent in designated areas. The formation of a SECA may provide significant and necessary PM and SOx emission reductions to California if a West Coast SECA is established. However, the benefits of such a program would not be comparable to the ARB staff proposal. The percent PM and SOx emission reductions achieved from the use of 1.5 percent sulfur heavy fuel oil are far less than the reductions that would be achieved by the use of the distillate fuels specified in the proposed regulation. Specifically, the U.S. EPA estimates an 18 percent PM reduction and a 44 percent SOx reduction from the use of 1.5 percent heavy fuel oil (EPA, 2002). We estimate the use of the distillate fuel will result in a 75 percent PM reduction, an 80 percent SOx reduction, and a 6 percent NOx reduction. It should be noted that the use of 1.5 percent heavy fuel oil may result in larger emission reductions overall because it would apply to the main and auxiliary engines of vessels, whereas the ARB staff proposal would only apply to auxiliary engines. However, the ARB staff proposal would achieve far greater emission reductions at dockside where diesel PM reductions are most critical. In addition, ARB staff plans to develop strategies to reduce the emissions from main engines on marine vessels in the next year or two.

A comparison between the ARB staff proposal and the potential regulations discussed in Alternative 2 are summarized in Table V-2. As shown, none of the potential regulations are expected to achieve the same benefits as the measure proposed by ARB staff.

Table V-2: Comparison between Potential IMO/U.S. EPA Proposals and the ARB Staff Proposal

Regulation	Comparison to the ARB Staff Proposal
IMO Annex VI NOx Standards	•Standards do not reduce PM
U.S. EPA 1999 Category 1&2 Engine Rule	• Standards only apply to U.S. flagged vessels • Benefits phase in slowly starting in 2007 for most engines • Foreign-trade exemption for U.S. flagged vessels
U.S. EPA 2003 Category 3 Engine Rule	• Standards only apply to U.S. flagged vessels • Standards same as IMO and do not reduce PM for category 3 engines • Rulemaking eliminates foreign trade exemption for certain category 1 & 2 engines on U.S.-flagged vessels
U.S. EPA Nonroad Diesel Rule	• Specifies sulfur limits for diesel fuel used in marine applications, but exempts marine diesel oil & heavy fuel oil
Potential Tier II EPA Category 3 New Engine Standards (2007 adoption expected)	• Standards may only apply to U.S.-flagged vessels • Standards may not reduce PM • Standards not expected to be effective until circa 2010 • Benefits phase in slowly beginning in 2010 with vessel turnover
Potential IMO SECA off California Coast	• Significantly less reductions in diesel PM and SOx at dockside • Standards expected to be effective later than the ARB staff proposal if implemented •No NOx benefit

<u>Alternative 3: Use Marine Distillate Fuels Only at Dockside</u>

Under this alternative, ocean-going vessels visiting California ports would only be required to use marine distillate fuels at dockside. The emission reductions under this proposed alternative would be reduced by a minimum of 40 percent compared to the proposed regulation because the emissions from auxiliary engines on vessels at sea within the 24 nm boundary during transit would no longer be controlled. Fewer health benefits would result from this approach, and the loss in emission reductions would be greater if auxiliary engines are allowed to transition from one fuel to another at dockside, since such transitions can take an hour or more.

The recurring fuel costs associated with the proposed regulation would be lower under this alternative. There could also be a reduction in the cost impacts associated with modifying vessels to use distillate fuel, particularly with the diesel-electric vessels. For example, we anticipate that some vessels may not need an additional tank for storing distillate fuel if the fuel will only be used at dockside. However, given the variability involved, we cannot quantify the reduction in retrofit costs under this alternative. Nevertheless, looking at the overall industry costs, the retrofit costs are relatively small compared to the recurring added fuel costs. Therefore, the overall cost-effectiveness, in terms of dollars per pound of emissions reduced, of the alternative is expected to be similar to the proposed regulation. In summary, this alternative has similar cost-effectiveness to the ARB staff proposal, due to both reduced cost and reduced emission reductions. However, given the feasibility, cost-effectiveness, and health benefits of requiring reductions both at dockside and within the specified 24 nautical mile zone, Alternative 3 was judged inferior to the proposed regulation.

Alternative 4: Special Provisions for Diesel-Electric Vessels

Under this alternative, diesel electric-vessels would have three compliance options: (1) use distillate fuels only at dockside as in Alternative 3 above; (2) use 1.5 percent sulfur heavy fuel oil within the 24 nm boundary and at dockside; or (3) retrofit vessels to use shoreside electrical power and connect at California terminals where the facilities are available.

Under the first option, the same situation applies as in Alternative 3, except that the option only applies to diesel electric-vessels (primarily cruise vessels). This option would achieve significantly less emission reductions and the cost would be reduced proportionately. The cost-effectiveness is expected to be similar to the staff's proposal.

For the option to use 1.5 percent sulfur heavy fuel oil, the estimated PM emission reductions are expected to be significantly less (about 18 percent versus 75 percent for staff's proposal relative to an engine burning standard high suflur heavy fuel oil). SOx emissions would be reduced by about 44 percent versus 80 percent for staff's proposal, and there would be no NOx reductions. On the other hand, the cost of the 1.5 percent sulfur heavy fuel is currently much less than marine gas oil. As a result, the cost of this option would be considerably less than the cost associated with staff's proposal. Overall, we expect that the PM cost efffectiveness of this option would be in the same range as the proposed regulation.

The third option, utilizing cold ironing where available is difficult to analyze because vessels retrofitted for cold ironing would only plug into shoreside power if it is available. To date, only a few California port terminals have shoreside power facilities installed. Additional facilities are anticipated at the Ports of Los Angeles, Long Beach and Oakland. However, it will be several years before new additional shoreside power facilities are operational. As a result, we cannot quantify the emissions reductions for this option at this time.

Overall, the emission reductions from any of these options under this alternative would be significantly less than the ARB staff proposal, although the cost-effectiveness would be similar. As with Alternative 3, we judged this option to inferior.

Alternative 5: Exemption of Power used for Propulsion in Diesel-Electric Vessels

Diesel-electric vessels have large diesel engines coupled to generators that supply electrical power for both propulsion and shipboard electrical uses. Under this alternative, only the power generated for shipboard electrical uses would be subject to the proposed regulation. The power generated for propulsion would not be subject to regulation.

Industry sources have suggested this alternative because the engines used for propulsion in other vessel types are not controlled under the staff proposal. Specifically, most other (non-diesel-electric) vessels have separate main engines mechanically connected to a propeller used for propulsion, and auxiliary engines used for shipboard power. The main engines would not be subject to control, while the auxiliary engines would be covered. For diesel-electric vessels, which have generator set engines that supply electrical power for both propulsion and shipboard electricity, all of the power and emissions generated by these engines would be subject to control. As such, the costs are higher for operators of these vessels.

However, we feel it is appropriate to control all of the emissions from the engines on diesel-electric vessels, whether generated for shipboard electrical power or propulsion, because it is technically feasible and cost-effective to do so. The engines used in diesel-electric vesssels are very similar to the auxiliary engines used in other vessels, except that they are larger. Specifically, they are four-stroke, medium speed engines used in generator set applications. The main engines in other vessels are generally two-stroke slow-speed engines. These engines have a significantly different design that is less amenable to the use of distillate fuels.

Alernative 5 would achieve less emission reductions than the staff proposal because the amount of power (and thus emissions) generated by diesel-electric vessels for propulsion is significant, and would not be controlled under this altemtive. The cost to ship operators would also be reduced proportionally because they would not need to use the more expensive distillate fuels (or other emission control strategies) for the power generated for propulsion. However, the overall, the cost-effectiveness is expected to be similar to the staff's proposal.

Another consideration is the difficulty in separating out the power generated for propulsion and shipboard electricity. For example, a typical diesel-electric cruise ship will have varying shipboard electrical power needs based on factors such as the effect of temperature on space heating or cooling for passenger cabins. Propulsion power needs will also vary based on the speed of the vessel and ocean currents. Even if the power used only for shipboard electrical uses could be clearly distinguished, it may be difficult for ship operators to limit the emissions only from the amount of power for shipboard use separately from the power used for propulsion. Extensive recordkeeping would be necessary to ensure compliance under this alternative.

In summary, this alternative has similar cost-effectiveness to the ARB staff proposal, due to both reduced cost and reduced emission reductions. This alternative would also require burdensome recordkeeping. Given the cost-effectiveness, technical feasibility, and health benefits of controlling emissions from all power generated by these engines, Alternative 5 was judged inferior to the proposed regulation.

REFERENCES

(EPA, 2002) United States Environmental Protection Agency, *Control of Emissions of Air Pollution from New Marine Compression-Ignition Engines at or Above 30 Liters/Cylinder*, Notice of Proposed Rulemaking, April 30, 2002, Table VI.F-1.

(EPA, 2003) United States Environmental Protection Agency Regulatory Announcement, *Emission Standards Adopted for New Marine Diesel Engines*, EPA420-F-03-001, January 2003.

(EPA, 2004) United States Environmental Protection Agency Fact Sheet, *Clean Air Nonroad Diesel Rule*, EPA420-F-04-032, May 2004.

VI. TECHNOLOGICAL FEASIBILITY OF THE PROPOSED REGULATION

In this chapter, we discuss the technological feasibility of the proposed regulation. In particular, we focus on the availability of the fuel that we expect most vessel operators will use to comply with the emission limits, and the ability of ocean-going vessels to use that fuel. In addition, we discuss possible alternative emission reduction strategies that vessel operators may use.

It should be noted at the outset that the proposed regulation does not require the use of any specific fuels. Rather, the proposed regulation requires vessel operators in regulated California waters to limit the emissions from their auxiliary engines to the levels of specified pollutants (diesel PM, NOx, SOx) equivalent to or lower than the levels that would have resulted had those engines used (1) marine gas oil (MGO), or (2) marine diesel oil (MDO) with a sulfur content of 0.5 percent or less. In 2010, the proposed regulation further reduces these limits to the level of emissions from an engine operating on MGO with 0.1 percent sulfur to maximize the regulation's emissions benefits.

Vessel operators can meet these limits in one of several ways. First, they can use MGO, or MDO with 0.5 percent sulfur or less, starting January 1, 2007. For the second tier (2010) limits, they can use MGO with 0.1 percent sulfur or less. As we stated above, vessel operators are not required to use these fuels, but there is an automatic presumption created that the operator has met the emission limits if he uses these fuels in the regulated engines.

Another way vessel operators can meet the emission limits is through the use of an approved Alternative Compliance Plan (ACP). The ACP provides a high degree of flexibility by allowing vessel operators to implement alternative emission control strategies, provided such measures achieve equivalent or greater reductions relative to the emission reductions that would have occurred by using the marine distillate fuels described above. Thus, if a vessel operator determines that there are overriding concerns justifying the use of other emission control strategies (e.g., safety during fuel switching, costs), the operator can seek, prior to entering California waters, ARB approval of an ACP, under which the operator would achieve equivalent or greater reductions using measures that the operator chooses. In this way, the vessel operator maintains full control in determining which emission reduction strategy is best suited for each particular vessel, with due consideration for safety, costs, and other factors important to the operator.

A. Availability of Marine Distillate Fuels

The term "marine distillate" refers to specific grades of marine distillate fuels. The proposed regulation allows the use of MGO that meets the specifications for DMX or DMA[1] grades as defined in Table I of the International Standard ISO

[1] "D" means distillate, "M" means marine, and "A" is the grade of the fuel.

8217 (as revised in 1996). The proposed regulation also allows the use of MDO (limited to 0.5 percent sulfur), which is fuel that meets all the specifications for DMB grades as defined in Table I of the International Standard ISO 8217 (as revised in 1996). DMA is the most prominent marine distillate, and is available in the largest quantities. DMX, which is similar in specification to CARB diesel, is used in smaller amounts and is required for use in emergency back-up engines on vessels. DMB is basically DMA containing a limited amount of residual fuel (heavy fuel oil), typically due to storage or transfer of DMA in tanks or piping that previously held residual fuel.

In this section, we present information on the international fuel specifications for marine distillates, data on the current fuel sulfur levels found in fuels supplied to ocean-going vessels, and information on where vessels that come to California ports normally fuel. In addition, we discuss our findings with respect to the volume of fuels needed to comply with the proposed regulation and the impact the proposed regulation could have on the availability of marine distillate fuel worldwide. We also provide our preliminary findings on the availability of lower 0.1% sulfur distillate fuels we expect most vessels will use to comply with the proposed 2010 emissions limits.

Fuel Sulfur Specifications for Marine Distillates

The majority of marine distillates produced and sold worldwide conform to fuel quality standards categorized under ISO 8217. These standards place limits on the fuels' chemical and physical properties, including sulfur content. Table VI-1, Fuel Specifications, lists the sulfur content and flashpoint of land and marine based fuels that can be used to fuel compression-ignition ("diesel") engines. The sulfur content of a fuel is important because the lower the sulfur content of the fuel, the lower the PM and SOx emissions. Flashpoint is important for safety reasons; the minimum flashpoint for marine fuels is 60 degrees Celsius. (ISO 8217, 1996).

In general, land-based fuels are required to meet more stringent State and federal sulfur specifications than marine distillates. As shown in Table VI-1, the lowest sulfur content specifications are for land-based distillates – with the exception of U.S. EPA off-road diesel. However, this exception will not be long-lived since the U.S. EPA off-road diesel specifications will in 2010 be harmonized with the on-road diesel specifications effective in 2007. The marine fuels also differ from land-based distillates in the minimum flashpoint specification. The lowest sulfur content specifications for fuels that meet the flashpoint specification for marine applications are found in the specifications for marine distillates. In contrast the highest sulfur content specifications are found in residual marine fuels (heavy fuel oil).

Table VI-1: Fuel Specifications

Primary Use	Fuel Type	Fuel Grades	Fuel Specifications	Maximum Sulfur (%)	Maximum Sulfur (ppm)	Minimum Flashpoint (Centigrade)
Land	Distillate	CARB Diesel (2006)Ultra Low Sulfur Diesel (ULSD)	No. 2-D	0.0015	15	52
Land	Distillate	CARB Diesel (current)	No. 2-D	0.05	500	52
Land	Distillate	U.S. EPA Diesel	No. 2-D	0.05	500	52
Land	Distillate	Off-Road U.S. EPA Diesel	No. 2-D	0.5	5,000	52
Marine	*Distillate*	*Marine Gas Oil (MGO)*	*DMA*	*1.5*	*1,500*	*60*
Marine	*Distillate*	*Marine Diesel Oil (MDO)*	*DMB*	*2.0*	*2,000*	*60*
Marine	Residual	Intermediate Fuel Oil (IFO) 180	RME/F-25	5.0[1]	50,000	60
Marine	Residual	Intermediate Fuel Oil (IFO) 380	RMG/H-35	5.0[1]	50,000	60
Marine	Residual	Bunker fuel	RML-55	5.0[1]	50,000	60

1. The International Maritime Organization (IMO) MARPOL 73/78 Annex VI, Regulations for the Prevention of Air Pollution from Ships, entered into force in May 2005, lowers the sulfur cap on residual fuel from 5.0% to 4.5% in 2007.

Fuel Sulfur Properties of Currently Available Marine Distillates

The fuel specifications discussed above essentially establish limits that cannot be exceeded for sulfur content and flashpoint. As shown, marine distillates meet the most stringent sulfur specification for marine fuels. In order to assess the impact on emissions from the use of marine distillates, staff evaluated the actual fuel sulfur properties of marine distillate fuel currently available. The two sources of fuel property information staff reviewed were the ARB Oceangoing Ship Survey and the Det Norske Veritas Petroleum Services fuel sample data. (DNV, 2005). The results are summarized in Table VI-2 and discussed below.

Table VI-2: Current Sulfur Properties of Marine Fuel

Fuel Specification	Average Fuel Sulfur Content (wt. %)	
	ARB Survey (CA Vessels)	DNV (Worldwide)
DMA	0.5% (survey asked for marine distillate sulfur content)	0.38%
DMB		0.65%
Residual	2.5%	-

The ARB Oceangoing Ship Survey (ARB Survey) was sent out in January 2005 to 158 vessel operators and agents. The survey requested information about ocean-going vessels that visited California ports in 2004. To date, we have received information on 327 vessels that visit California ports. This represents about 17 percent of the total number of vessels that visited California in 2004 (ARB Survey, 2004).

From the survey responses, staff estimates that the average sulfur content of marine distillate fuels used in auxiliary engines is about 0.5 percent. (Note: Separate sulfur content estimates for DMA and DMB were not requested in the survey). The average sulfur content of residual fuel was reported to be about 2.5 percent. Both are well below the maximum specifications listed in Table VI-1, which are 1.5 to 2.0 percent for marine distillates and 5.0 percent for residual fuel.

DNV performs a service to the marine industry by sampling and testing marine fuels from many suppliers in ports throughout the world and claims to be responsible for testing 70 percent of the marine fuel tested worldwide. DNV collected samples of marine distillates from ocean-going vessels in 2003. (DNV, 2003) The average sulfur content of samples of DMA taken worldwide was 0.38 percent sulfur by weight – well below the 1.5 percent standard. For DMB, the average sulfur content from the samples was 0.65 percent sulfur by weight – well below the 2.0 percent standard. Among the different areas of the world, averages are calculated from the samples taken at each port. The minimum and maximum average sulfur content samples of DMA taken from any one area of the world were 0.05 percent (Mexico) to 0.97 percent sulfur (Saudi Arabia). The minimum and maximum average sulfur content samples of DMB taken from any one location in the world were 0.05 percent (Mexico) to 1.30 percent sulfur (Germany).

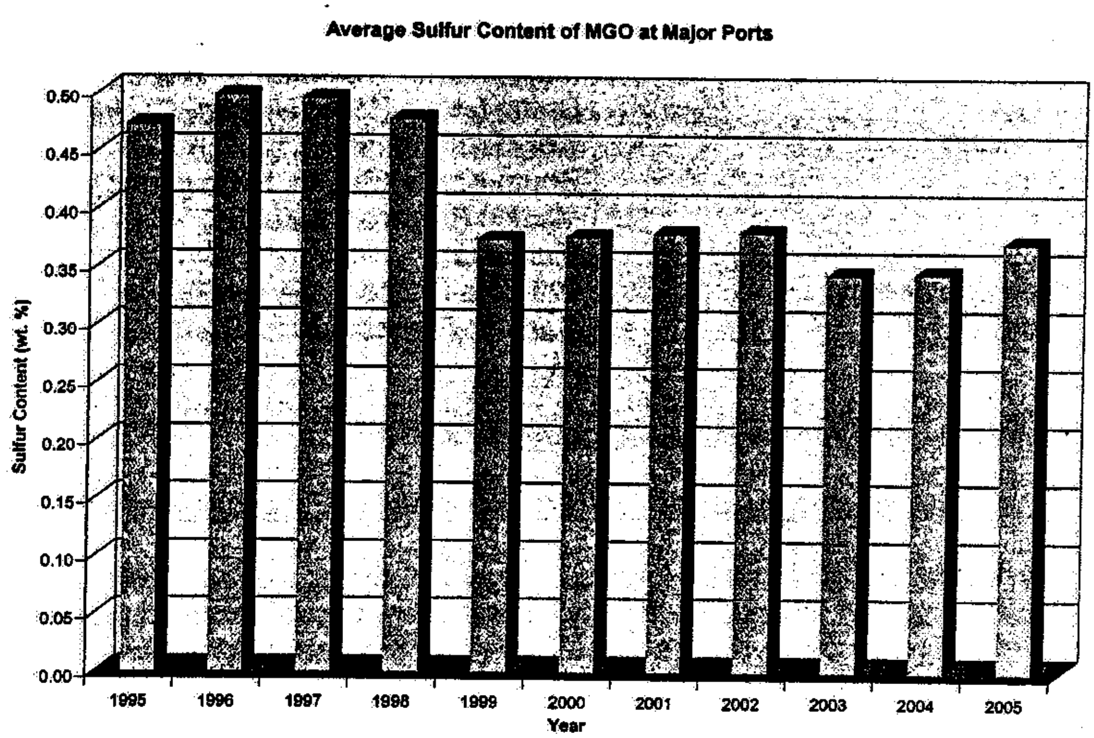
Table VI-3 lists the average marine distillate sulfur contents for those areas of the world where ocean-going vessels that operate in the Pacific Rim have historically refueled. As shown in Table 3, the sulfur content of marine distillates varies widely. Figure VI-1 shows the historical average sulfur content of all samples taken in these areas of the world over the last ten years. As shown, the average sulfur content has ranged from a high of about 0.50 percent to a low of about 0.35 percent. Although historical trends are no guarantee of future sulfur levels, staff believes current and future regulatory efforts to lower sulfur levels in all types diesel fuels will result in the average sulfur levels continuing to decline over the coming years; specifically, regulatory efforts to reduce emissions from diesel engines in California, the United States, Japan, and Europe.

Table VI-3: Marine Distillate Average Sulfur Content (weight % Sulfur)

Area of World	MGO	MDO
	DMA	DMB
Netherlands	0.30	1.02
Malaysia	0.40	0.36
Mexico	0.05	0.05
Panama	0.42	0.42
Canada	0.21	0.24
Singapore	0.53	0.53
Japan	0.12	0.77
Hong Kong	0.39	0.42
Korea	0.81	0.87
China	0.29	0.32
United States	0.23	0.68
Average	0.34	0.52

(Source: DNVPS, 2003)

Figure VI-1: Sulfur Content of MGO at Pacific Rim Refueling Ports from 1995 to 2005



(Source: DNV, 2005)

Availability of Marine Distillate Fuel

Marine distillate fuel is currently available in most areas throughout the world. (Beicip-Franlab, 2003). Vessels typically obtain marine distillate via fuel barges, where the fuel is loaded on the barge either directly from a refinery terminal or from a storage tank at that is dedicated to marine distillate fuels. Based on discussions with vessel operators, a key factor in determining where to refuel is finding a fueling location within a vessel's current route, where it is available at the lowest cost.

Table VI- 4 provides a listing of ports where ocean-going vessels that operate in California waters have historically refueled either before or after operating in California waters.

Table VI-4: Common Refueling Ports for Vessels that Visit California

Vessels that Visit California Ports May Refuel at the Following U.S. or International Ports	
U.S. Port Locations	International Locations
Los Angeles (POLB, POLA) Santa Barbara (Hueneme) Puget Sound Oakland San Diego San Francisco Savannah Honolulu Norfolk New York/New Jersey Charleston	Netherlands (Rotterdam) Singapore Japan (Shimzu, Tokyo, Osaka, Nagoya, Moji, Hakata, Yokohama, Kobe) China (Hong Kong, Ningbo, Chiwan, Quigdao, Xiamen) South Korea (Busan, Kwangyand) Mexico (Lazaro Cardenas) Malaysia Panama (Balboa, Manzanillo) Canada (Vancouver, B.C.)

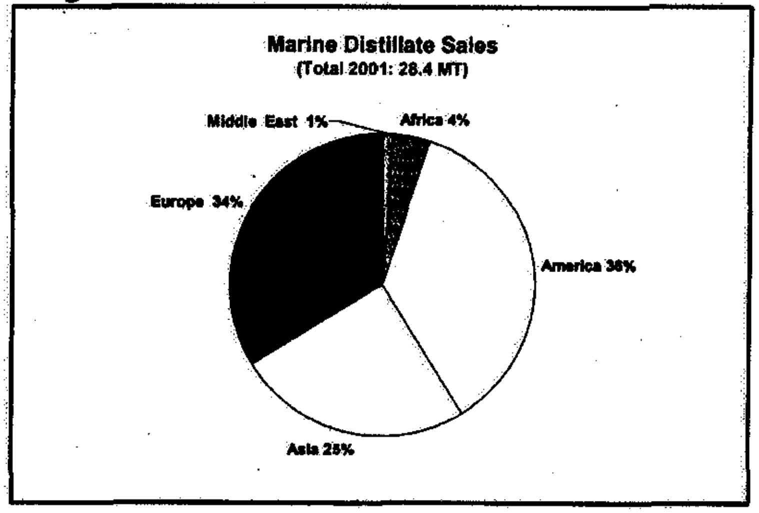
(ARB Bunker Survey, 2005; Correspondence, 2005; Starcrest Report, 2005)

Impact on Volume of Marine Distillate Required by Proposed Regulation

Currently, ocean-going vessels use either heavy fuel oils or marine distillates in their auxiliary engines. Based on the ARB Survey responses, about 75 percent of the oceangoing vessels use heavy fuel oil in their auxiliary engines and 25 percent use marine distillate. As stated earlier, we expect most vessel operators will use marine distillates while within 24 nm of the California coastline to comply with the proposed regulation's emission limits.

Assuming all vessels elected to comply with the proposed regulation by using marine distillate, staff estimates that approximately 46 million gallons (150,000 metric tons) of low-sulfur marine distillate would be needed in 2007 and 61 million gallons (200,000 metric tons) would be needed in 2010. This equates to less than 1 percent of the current total sales, 28.4 million metric tones (MT), for marine distillate worldwide. The distribution of marine distillate sales throughout the world is shown in figure VI-2. Marine distillate sales are highest in areas where Pacific Rim vessels have historically refueled -- Asia, Europe, and America. (Beicip-Franlab, 2003; Marine Distillate Volume Calculation, 2005).

Figure VI-2: Worldwide Marine Distillate Sales



Based on the reasons discussed above, staff believes that the relatively small additional demand for marine distillate likely to be created by this rule will be met by existing refineries without significant modifications to existing infrastructure. However, operators who choose to replace all residual fuel used in their auxiliary engines with marine distillate may experience some scheduling conflicts and logistics issues when loading large amounts from local suppliers (e.g. 1,400 MT or more). We cannot predict the extent to which these delays may occur, if at all, but the primary limiting factor in these situations is the capacity of barges dedicated to carrying marine distillate fuels. (Barge Capacity, 2005)

Some commenters have suggested during the informal phase of this rulemaking that the proposal's emission limits based on the use of MGO be based instead on MGO that is capped at 0.5 percent sulfur. We do not agree with this suggestion. At this time, we believe that establishing an emissions limit based on a 0.5 percent sulfur cap for MGO is likely to result in a supply issue at some port locations. This would be especially true for ports in areas of the world that import marine distillate from refineries that use crude oil with a high sulfur content.

For example, South Korea imports all of their crude oil, and most of it comes from the Persian Gulf region. Persian Gulf crude oil is typically "sour" crude, meaning that it has a relatively high sulfur content that typically ranges from 0.8 to 2.3 percent. This high sulfur content is reflected in the DMA sample data summarized in Table VI-3, which lists Korea as having the highest average sulfur content of those countries listed at 0.81 percent. (Starcrest, 2005; Blumberg, 2003).

Availability of Low-Sulfur Marine Distillate Fuel

As noted previously, the proposed regulation limits emissions, starting in 2010, to levels based on the use of 0.1 percent sulfur marine distillate. It is important to note that this requirement is consistent with the recently adopted European Union Directive 2005/33/EC, which establishes a 0.1 percent sulfur standard for marine fuels used by seagoing vessels at berth in European Union ports starting January 1, 2010. (EU, 2005).

In an earlier version of the staff's proposal, we explored the feasibility of an emissions limit based on 0.2 percent sulfur marine distillate beginning in 2006. We evaluated the availability of low-sulfur marine distillates and determined that low-sulfur marine distillate with a sulfur content of 0.2 percent or less cannot be reliably supplied in most port locations and there are many unanswered questions regarding the ability of the worldwide fuel market to make adjustments that would enable them to reliably supply the fuel in the near-term. These findings are presented in Appendix I.

Based on the findings discussed in Appendix I, staff concluded it was not feasible to implement a requirement to use 0.1 or 0.2 percent marine distillate fuel in the near term (i.e., before 2010) without having additional information about world-wide fuel supplies and refining capacities. As such, staff revised the proposal to its current version, which retains the majority of the emissions benefits and ensures that fuel will be available to comply with the proposed regulation in the near-term.

While the proposal retains an emissions limit based on the use of 0.1 percent low-sulfur fuel in 2010, many of the same concerns associated with the availability of less than 0.2 percent sulfur by weight marine distillate also apply to 0.1 percent sulfur marine distillate. To address these concerns, the proposed regulation contains a feasibility review provision to ensure the fuel supply issues are thoroughly evaluated prior to implementation.

Under the review provision, the Executive Officer would evaluate by 2008 the feasibility of the 0.1 percent sulfur limit. This evaluation would take into consideration the availability of the low-sulfur fuel at bunkering ports worldwide; the ability of petroleum refiners and marine fuel suppliers to deliver the fuel by the January 1, 2010 implementation date; the fuel lubricity and compatibility with heavy fuel oil during fuel transitions; and the costs of the fuel compared to marine gas oil with a sulfur content of greater than 0.1 percent. If the Executive Officer determines that modifications are necessary, the Executive Officer would propose changes to the Board prior to January 1, 2009.

By harmonizing with the 2010 EU requirements for low sulfur marine distillates, the staff's proposal promotes international consistency and increases the availability of cleaner marine distillates at ports that refuel Pacific Rim vessels.

B. Feasibility of Using Distillate Marine Fuels in Ocean-going Vessel Auxiliary Engines

Currently, most ocean-going vessels use either heavy fuel oils or marine distillate fuels in their auxiliary engines. According to ARB's 2005 Ship Survey ("Survey"), approximately 75 percent of the engines subject to the proposed rule currently use heavy fuel oil, while the other 25 percent use distillate fuels such as marine gas oil or marine diesel oil. For the 75 percent of the engines that currently use residual fuel, the proposed regulation would likely result in ship operators switching to distillate fuel prior to entering within 24 nm of the California coastline, assuming the operator selected this compliance option.

Because heavy fuel oil is virtually a solid at room temperature, it is heated to reduce its viscosity to the point where it can be pumped and injected into marine engines. Once liquefied, heavy fuel oil behaves much like ordinary diesel in the engine. By contrast, marine distillate fuels are liquids at room temperature, with properties already similar to typical on-road diesel fuel.

When an engine switches from one fuel to another, a transition period is generally needed to minimize rapid temperature changes; reduce fuel gassing; and ensure smooth, steady-state operation of the engine, as discussed in more detail below. To accomplish this transition period, vessel operators typically use a mixing tank. The operator steadily increases the ratio of distillate fuel to heavy fuel oil in the mixing tank, which eventually results in only distillate fuel being fed into the engine.

Considering the available information as discussed below, we believe that vessel operators can safely make this fuel switch and continue to operate their auxiliary engines with distillate fuels while operating off California's coastline. We also note these engines are certified by the manufacturer to International Maritime Organization nitrogen oxide emission standards through engine testing while the engine is operating on a distillate fuel, since heavy fuel oil properties are too variable. (IMO Annex VI) In addition, the European Union adopted a rule that will require the use of 0.1 percent sulfur fuel at dockside in 2010, which will also require these engines to switch to distillate fuel since heavy fuel oil is not available at this low sulfur level. (EU). Finally, we note that the ACP provisions in the proposed regulation allow a vessel operator to achieve equivalent emission reductions by other means if the operator chooses not to use distillate fuel.

Existing Practice

Marine vessels currently perform the same type of fuel switches that are likely to occur under this regulation. Vessel operators perform many of these fuel switches prior to dry-dock maintenance operations to prevent heavy fuel oil from solidifying in fuel lines and engine components after engine shut down.

More importantly, there are also some vessels that routinely switch from heavy fuel oil to distillate fuels during California port visits. Specifically, NYK Line, a major container ship operator, reported that they are using low (0.2 percent) sulfur marine diesel oil in their auxiliary engines on 9 to 12 vessels while hotelling at the Port of Los Angeles. (NYK Line, 2004; NYK Line, 2005) These vessels use auxiliary engines made by three different engine manufacturers, and NYK Line reported no operational problems with their use of low-sulfur MDO.

Another example involves four steel coil carrier vessels operated by USS-POSCO Industries. In these vessels, the operators switch from heavy fuel oil to ultra-low (less than 0.05 percent) sulfur diesel two to three hours prior to entering the Bay Area Air Quality Management District boundary on their regular routes between South Korea and Pittsburg, California. (McMahon) These fuel switches have been performed since the early 1990's to facilitate the use of on-board selective catalytic reduction emission control systems used to reduce emissions of nitrogen oxides.

Further, some passenger liners regularly switch fuels for air quality reasons. For example, Carnival Cruise Lines, a major passenger cruise line, reported that it is company policy to switch to distillate MDO fuel when their vessels are within 3 miles of the California shore. (Carnival, 2005a; Carnival 2005b) Another cruise line, Crystal Cruises, also reported that it switches to MDO near California ports to reduce smoke, and that cruise line has not had any operational problems with this practice. (Crystal Cruises, 2005) Further, Marine Transport Lines, which operates under contract with the United States Maritime Administration, also reported that it switches to distillate fuel in its vessels prior to entering the Bay Area. (MTL, 2005)

Finally, we should note that switching to distillate fuels upon entry to port was a standard practice for most diesel powered vessels in the past, when it was difficult for main engines to operate reliably on heavy fuel oil during maneuvering and low load operation. The use of less expensive heavy fuel oil in auxiliary engines, and main engines during maneuvering, is a relatively recent development made possible by improvements in fuel heating technology. (BMT, 2000)

Vessel Fuel Infrastructure Needs

Most vessels are equipped to run their auxiliary engines on either distillate fuel or heavy fuel oil. Less than 10 percent of the vessels that participated in the ARB Ship Survey reported the need for vessel modifications to use marine gas oil in their auxiliary engines. Specifically, 32 out of 358 vessels were reported to need modifications. These changes may or may not require that the vessel be dry-docked. Dry-dock maintenance typically occurs every five years, and many other maintenance operations are performed while the vessel is at dockside.

For vessel operators that reported the need to modify their vessels, the following types of changes were reportedly required:

- segregate an existing fuel tank for MGO;
- convert an existing heavy fuel oil tank to use MGO;
- add a fuel cooler;
- modify fuel pumps and injectors; and/or
- add a mixing tank and separate fuel treatment system.

Although most vessels have multiple fuel tanks, they may not have adequate capacity in their distillate fuel tanks to operate in the waters covered by the proposed regulation. This is particularly true for diesel-electric vessels, and "mono-fueled" vessels (i.e., vessels that normally operate both their main and auxiliary engines on heavy fuel oil). In these cases, vessel owners may need to add a new tank, convert an existing heavy fuel oil tank to use MGO, or segregate an existing tank by installing a barrier inside the tank.

If a new or segregated tank is required, ancillary equipment such as pumps, piping, vents, filing pipes, gauges, and manhole access would be required, as well as tank testing. (Entec, 2002) In addition, fuel processing systems include settling tanks, filters, and centrifuges. While some vessel operators may be able to use their existing processing systems, other operators have reported that they will need to add to these systems, along with increased fuel capacity or other modifications.

As noted previously, mixing tanks are used to assist in a gradual transition from one fuel to another. (Wartsila, 2005a) As discussed below, sudden changes in fuel temperature or viscosity may cause damage to fuel pumps and injectors. One Survey participant reported that a mixing tank would be necessary. Fuel coolers may also assist in controlling fuel temperatures and viscosity during fuel transitions. One Survey participant reported the need for a fuel cooler.

Some Survey participants also reported the need to modify engine components such fuel pumps, injectors, and nozzles. However, engine manufacturers have stated that, with certain caveats, the engines they designed for heavy fuel can also operate on MGO. (Wärtsilä, 2004; Caterpillar, 2005; MAN B&W, 2005; Pielstick, 2004; Yanmar, 2005)

Fuel Switching Procedures and Safety

As discussed above, marine engines can operate continuously during transitions between heavy fuel oil and distillate fuels. Procedures for conducting these transitions are well known since vessel operators perform these transitions prior to dry-dock maintenance. Engine manufacturers and marine equipment suppliers publish guidance for vessel operators that explain the recommended procedures. (MAN B&W, 2001; Aalborg) These procedures are designed to ensure a transition period from one fuel to another that controls temperature changes and ensures minimum fuel viscosity levels are maintained.

Engine manufacturers have commented that problems can occur if the transition is conducted too quickly, including fuel pump or injector scuffing, seizure, or cavitation, and fuel gassing. However, based on the fact that many vessels routinely transition from heavy fuel oil to distillate fuel, and virtually all vessels do this prior to dry-dock maintenance, we believe that vessel operators are well equipped to safely handle these transitions. We also note that equipment is available to vessel owners to automatically handle these fuel transitions.

As noted previously, we believe the safety of fuel transitions is amply demonstrated by the many vessels that routinely perform them. There are no problems reported for the vast majority of these fuel switches. However, there is a slight risk that temporary engine failure may occur if the vessel operator does not correctly follow procedures, possibly resulting in some loss of electrical power to the vessel. In these cases, a vessels' emergency backup generators, which run solely on marine distillate fuel, would become operational.

For diesel-electric vessels, which generally have several large diesel generator sets that provide power for both propulsion and onboard electrical power, a temporary failure in one or more engines could compromise vessel maneuverability to some degree. However, we do not believe fuel switching on diesel-electric vessels raises a significant problem for a number of reasons. . First, the proposed regulation permits, but does not require, vessel operators to switch to the lower-sulfur distillate fuels. As we discussed previously, vessel operators can choose to comply with the regulation's emission limits with one of several options, only one of which is switching to the low sulfur fuels. Those vessel operators who believe fuel switching may cause problems that raise safety concerns have other options with which to comply. Second, as mentioned above under "existing practice," many diesel-electric cruise vessels currently switch to cleaner distillate fuels near California ports on a routine basis. Third, because there are generally several engines on diesel-electric vessels, it is likely that some engines would remain operational, providing the necessary power to the ship's systems. Fourth, the U.S. Coast Guard and shipping associations have recommended in some cases that fuel transitions in propulsion engines be performed away from confined areas. (PSSOA, 1999) The proposed regulation is entirely consistent with these recommendations because the 24 nautical mile boundary in the regulation would generally result in fuel transitions being performed in open water, for those operators that choose to switch fuels. Arguably, switching fuels at or prior to entering the 24 nm, should provide a greater margin for safety than conducting the switch much closer to the ports, which is the practice for some vessels.

Technical and Safety Considerations

ARB staff contacted the major manufacturers of auxiliary engines used on ocean-going vessels to determine whether these engines could operate on marine distillate fuel (marine gas oil or marine diesel oil). Based on our requests for information, engine manufacturers uniformly reported that their auxiliary engines designed for use with heavy fuel oil can also use distillate fuels. (Wartsila, 2004; Caterpillar, 2005; MAN B&W, 2005; Yanmar, 2005; Pielstick, 2004) However, they noted that certain technical and safety considerations need to be observed with the use of distillate fuels and during the transition from one fuel to another.

Given this, we believe that vessel operators already can and do safely use distillate fuels when they follow the engine manufacturers' recommendations. In some cases, modifications may need to be made to the fuel supply and processing equipment on the vessel. Each of these technical considerations is discussed below.

Fuel Compatibility: Engine manufacturers have commented that there is always a risk of fuel incompatibility when blending two fuels, particularly between heavy fuel oil and distillate fuels (especially very low sulfur distillate fuels which tend to be low in aromatic hydrocarbons). The main concern is that aromatic hydrocarbons in heavy fuel oil keep asphaltene compounds in solution, and the introduction of lower sulfur (often low aromatic) fuels may cause some asphaltene compounds to precipitate out of solution and clog fuel filters.

Much of the available information on this subject is focused on continuous blending of low sulfur distillate fuels with high sulfur heavy fuel oils to produce 1.5 percent sulfur fuel for Sulfur Emission Control Areas in Europe. In these situations, there may be a greater potential for filter plugging to occur than during the temporary mixing of fuels that occurs during the switchover from one fuel to another. Nevertheless, manufacturers have stated that incompatibility problems are a concern during fuel transitions as well. However, as noted above, many vessels routinely transition from heavy fuel oil to existing marine distillate fuel without incident, and virtually all vessels do this prior to dry-dock maintenance.

We also note that some manufacturers have stated that the potential for incompatibility problems is more of a concern with the very low sulfur on-road fuels which tend to have the lowest aromatic levels. (CIMAC, 2004; MAN B&W, 2005) The proposed regulation limits emissions based on the use of regular MGO, or MDO at or below 0.5 percent sulfur, starting January 1, 2007. As such, the distillate fuels used under the proposed regulation would be essentially the same fuels vessel operators now use when performing fuel transitions.

The proposed regulation also specifies a 0.1 percent sulfur level for 2010, consistent with a European Union Directive for vessels at dockside. (EU) However, as specified in the proposed regulation, ARB staff will conduct a feasibility study prior to 2010 to investigate fuel compatibility as well as other issues, prior to implementing this fuel.

Compatibility of Lubricants with Low Sulfur Fuels: Marine engine lubricants are matched to the expected sulfur content of fuel. Specifically, sulfur in fuel results in acidic compounds in the engine that are neutralized by alkaline calcium compounds in the engine lubricant. Higher "base number (BN)" lubricants are able to neutralize higher sulfur fuels. When a relatively high BN lubricant is used with a low sulfur fuel, calcium deposits can form in the combustion chamber.

These problems are primarily associated with slow speed two-stroke engines, rather than the four-stroke engines covered by this proposed regulation. (DNV, 2005) One manufacturer stated that the effect of using low sulfur fuel with a relatively high BN lubricant is a long-term issue for four-stroke engines, whereas the impact is more immediate for two-stroke engines. (Wartsila, 2005b)

For four-stroke engines that temporarily use lower sulfur fuels with a relatively high BN lubricant, problems are generally not expected unless low sulfur fuel is used for extended periods of time. One engine manufacturer recommends that their four-stroke engines can continue to use the same high BN lubricant when a heavy fuel oil engine alternates between heavy fuel oil and distillate fuel. (*Ibid*) Another manufacturer reported that their heavy fuel oil engines are expected to be able to operate for up to 300 hours on marine gas oil with high BN lubricants. (Yanmar, 5/1/05) We do not expect vessels to spend close to 300 hours of operation while traveling within 24 nautical miles (nm) of the California coastline. This is because a vessel would only need 40 hours to travel at 20 knots along the entire 800 nm California coastline.

Lubricity: Several sources reported that lower sulfur fuels have lower lubricity, which could potentially cause fuel pump damage. (DNV, 2005, App I; CIMAC, 10/04; MAN B&W, 5/05) Some of these sources noted that low sulfur automotive diesel fuels have a minimum lubricity requirement, unlike marine fuels. However, the concern appears to be related to the use of very low sulfur levels associated with landside diesel fuels, which have a lower sulfur content than what the proposed regulation specifies. For example, one source states that sulfur levels below 0.05 percent, in conjunction with a viscosity below 2 centistokes, could lead to fuel pump problems. (DNV, 2005, App. I) Another source reported that lubricity is not considered a problem for their four-stroke engine fuel injectors as long as the sulfur content is above 0.01 percent. This source mentioned that insufficient information was available to determine if fuel below this level would be problematic, but noted that lubricity additives could be added by the fuel manufacturer or marketer. (Wartsila, 2005b) As noted previously, ship operators can comply with the proposed regulation through the use of marine gas oil with no sulfur limit, or though the use of marine diesel oil with a relatively high sulfur limit of 0.5 percent in 2007. For 2010, there is a lower 0.1 percent sulfur limit. However, this limit will be subject to a feasibility review that will consider this and other technical concerns prior to implementation.

Low Viscosity: One manufacturer noted that the low viscosity of distillate marine fuels could potentially be a concern with some of their engines. One of the potential impacts of low fuel viscosity is greater internal leakage in fuel pumps and injectors, resulting in lower fuel pressures, and less fuel delivered. (DNV, 2005) According to one manufacturer, the minimum viscosity of fuel supplied to their engines is in the range of 1.8 to 3 centistokes, and noted that minimum viscosity for marine gas oil (DMA) is 1.5 centistokes. However, this manufacturer also noted that for their four-stroke engines low fuel viscosity is generally not a severe problem. The manufacturer suggested that that a minimum viscosity could be specified when ordering distillate fuels, or modifications could be made to address this issue. (Wartsila, 2005b) One possible modification would be a fuel cooler since lowering the fuel temperature will increase its viscosity.

Fuel Energy Content Differences: Marine distillate fuels have less energy than heavy fuel oils on a volume basis. Some manufacturers have commented that this will reduce the output of a four-stroke engine by approximately 6-15 percent depending on the engine model. (Wartsila, 2005b; Yanmar, 2005; Pielstick, 2004) Depending on the engine, governor adjustments or a change in the fuel "rack" position may address this issue.

Pipe Leakage: Use of less viscous marine distillate fuels, and temperature changes that occur during transitions between heated heavy fuel oil and non-heated distillate fuel have been reported to increase the likelihood of fuel leaks. However, such leaks would also be expected to occur during fuel transitions performed prior to dry-dock operations. Such leaks can be prevented through maintenance, such as replacement of deteriorated gasket materials or o-rings, and tightening connections.

C. Potential Options for Alternative Control Plans

Below, we provide descriptions of diesel PM and NOx emission reduction control strategies that potentially could be used as compliance options under an alternative control plan. These technologies are currently available or projected to be available in the near future. In many cases, similar technologies have been used on stationary diesel engines, which are operated similarly to vessel auxiliary engines. Each technology may not be by itself an alternative emission control strategy, but used in combination with other technologies may equal or exceed the required emission levels of 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)

Cold Ironing or Alternative Marine Power

This option would allow vessels to use dockside electrical power (cold ironing) during hotelling, instead of operating ship-board auxiliary diesel engines to provide electric power. Although there are technical challenges associated with providing cold ironing for vessels, this process is currently being used by several West Coast ports. For example, the Princess Cruise vessels that dock in Juneau, Alaska and Seattle, Washington use shore-side power for hotelling. USS-POSCO industries has four vessels that have been cold ironing at a Pittsburg, California terminal since the early 1990s. The Port of Los Angeles retrofitted the China Shipping terminal to include shoreline power infrastructure. Two China Shipping vessels began connecting to shore power in June 2004, with the goal of 70 percent of the vessels visiting the terminal using shore power. Also at the Port of Los Angeles, shore-side infrastructure is currently being constructed to allow an NYK Atlas container vessel already built with cold ironing capabilities to use shore-side power. The Port of Long Beach will also provide cold ironing capabilities for two British Petroleum tankers that regularly visit the port. Finally, the U.S. Navy has been cold ironing in port at bases all over the world for several decades.

Selective Catalytic Reduction (SCR)

Selective catalytic reduction (SCR) is an exhaust after-treatment method for controlling NOx emissions up to 90 percent or more. The SCR process basically works by using ammonia (NH_3) as a reagent, injecting it into the exhaust gas of the engine, in the presence of a catalyst. The ammonia and NOx emissions react in the presence of the catalyst to form nitrogen (N_2) and water. Atmospheric nitrogen is usually in its diatomic form of N_2 and the water is non-polluting. The ammonia is injected into the process with air or steam.

SCR systems have been installed on new marine engines for many years. For example the four USS-POSCO vessels mentioned above are equipped with SCR on their main engines. However, retrofitting SCR systems on existing vessels is challenging. Some SCR retrofit challenges are urea and ammonia storage and safety requirements. Also, SCR systems require a large amount of space near the engine.

Diesel Oxidation Catalysts

Diesel oxidation catalysts (DOCs) have been used on many land-based engines. DOCs are generally referred to as "catalytic converters." DOCs are devices attached to the engine exhaust system similar to a muffler. They have chemical catalysts dispersed on a substrate within their interior which assist in the oxidation of carbonaceous pollutants – some of the soot emissions and a significant portion of the soluble organic fraction of diesel PM. These carbon-containing pollutants are oxidized to CO_2 and water. The catalysts that are used are known as the platinum group metals. 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)

Flow Through Filters

Flow through filter (FTF) technology is a relatively new technology for reducing diesel PM emissions. Unlike diesel particulate filters (DPF), in which only gases 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. Also, limiting the sulfur fuel content to <350 ppm or less will limit clogging and reduce backpressure problems.

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 emergency circumstances. The FTF, therefore, is a candidate for use in applications that are unsuitable for DPFs.

Advanced Control Technology Inc. Technology

Advanced Control Technology Inc. (ACTI) has developed an emission reduction technology that they claim has the potential to remove 95 percent of NOx emissions and 90 percent of PM emissions. The system would reduce emissions from marine engine auxiliary engines while at port by placing a flexible hood over the exhaust stack. The flexible hood would be placed over the exhaust stack by a robotic arm, diverting the exhaust into a two stage "wet scrubbing" process where the pollutants would be removed. The system would be placed on a mobile barge. (ENN, 2005) Currently, ACTI is installing this technology at the J.R. Davis Roseville, California rail yard. Testing will follow with the goal of U.S. EPA certification. (ARB, 2005)

Slide Valve Technology

Replacing stock fuel injectors with slide valve fuel injector technology can result in a PM reduction of up to 50 percent, depending on the engine load. Standard fuel injectors leave a residual volume of fuel that remains in the injector after the fuel is injected into the cylinder. The remaining fuel drips into the cylinder during the non-combustion portion of the stroke, causing soot and PM. The new slide valve technology reduces the residual fuel volume to a minimum, thereby reducing soot and PM emissions. Most engine companies are installing slide valve technology on their new engines as standard equipment and also offering slide valves during normal injector maintenance replacement. (Man B&W)

Common Rail

Fuel pressure is distributed evenly to the injectors by an accumulator or rail. The high pressure is supplied by a pump. The rail pressure, at the start and the end of the injection is controlled electronically. The common rail system offers the following advantages: high fuel pressure at all engine speeds, ability to offer pilot injection and post injection at all engine speeds, and most conventional injection systems can be replaced with a common rail system without major engine modifications. (DieselNet, 2002a)

Water Injection

Adding water to the combustion chamber absorbs heat when the water vaporizes, lowering the peak combustion temperatures and reducing NOx emissions. Water can be introduced in a variety of ways: direct water injection, fumigation into the intake air, or with the fuel in an emulsion. Unmodified engines can use emulsified fuel, if the injection systems can handle the extra volume. Other systems require major redesign to include separate water supply tanks, injection lines, fuel pumps, injectors, etc. Generally, a 1 percent increase of water equates to a 1 percent decrease in NOx emissions. However, hydrocarbon and carbon monoxide emissions may increase using water injection strategies. (DieselNet, 2003)

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VII. ENVIRONMENTAL IMPACTS

This chapter describes the potential environmental impacts of the proposed regulation. The proposed regulation is intended to protect the health of California's citizens by reducing the exposure to the emissions from ocean-going vessel auxiliary engines. An additional consideration is the impact that implementation of the proposed regulation may have on the environment. Based upon available information, ARB staff has determined that no significant adverse environmental impacts should occur as the result of the proposed regulation. This chapter describes the potential impacts that the proposed regulation may have on air quality, water quality, and hazardous waste disposal.

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 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 (H&SC) sections 39666 and to fulfill the goals of the Diesel Risk Reduction Plan. Alternatives to the proposed regulation have been discussed earlier in Chapter V of this report. ARB staff has concluded that there are no alternative means of compliance with the requirements of H&SC sections 39666 that would achieve similar diesel PM emission reductions at a lower cost.

B. Effects on Air Quality

The proposed regulation will provide diesel PM, NOx, and SOx emissions reductions throughout California, especially in coastal urban areas many of which are non-attainment for the State and federal ambient air quality standards for PM_{10}, $PM_{2.5}$ a and ozone.

Emission Reduction Estimates

For 2007 through 2009, the emission reductions resulting from the proposed regulation were estimated based on the proportion of auxiliary engines using heavy fuel oil, and the differences in the emissions between auxiliary engines using 2.5 percent heavy fuel oil and 0.5 percent marine gas oil. The sulfur levels for heavy fuel oil and marine gas oil represent the average sulfur contents for these fuels based on vessels visiting California ports based on the ARB's 2005 Ship Survey. (ARB, 2005). Auxiliary engines using distillate fuels would generally be unaffected by the proposed regulation until 2010.

For 2010 and later, when the emission limit based on the anticipated use of 0.1 percent sulfur marine gas oil is implemented, we estimated the emission reductions based on: (1) the proportion of auxiliary engines using heavy fuel oil, and the differences in the emissions between auxiliary engines using 2.5 percent heavy fuel oil and 0.1 percent marine gas oil; and (2) the proportion of auxiliary engines using distillate fuel, and the differences in the emissions between auxiliary engines using 0.5 percent marine gas oil and 0.1 percent marine gas oil.

The estimated reductions in PM emissions that would occur when switching from heavy fuel oil to distillate fuels result, in large part, from the lower sulfur content of distillate fuel, which reduces the formation of sulfate PM. In addition, the lower ash content and lower density of distillate fuel also contributes to lower PM emissions (EPA, 2002). The lower sulfur content of distillate fuel also directly contributes to lower SOx emissions. For example, lowering the sulfur content from 2.5 percent to 0.5 percent represents an 80 percent reduction in the sulfur content of these fuels, and results in an 80 percent reduction in SOx emissions. The lower nitrogen content of distillate fuels also results in a reduction in NOx emissions (EPA, 2002).

The emission factors used to estimate the emissions and emission reductions from auxiliary engines are discussed in detail in Appendix D. These emission factors are shown in Table VII-1 below. The estimated percent emission reductions from auxiliary engines that switch fuels are shown in Table VII-2 below. While these percent emission reductions represent our best estimates, we recognize that emissions test results for PM vary widely depending on the source of information.

Table VII-1: Estimated Emission Factors (g/kw-hr)

Pollutant	HFO @ 2.5% sulfur	MGO @ 0.5% sulfur	MGO @ 0.1% sulfur
NOx	14.7	13.9	13.9
SOx	11.1	2.1	0.4
PM	1.5	0.38	0.25

Table VII-2: Estimated Emission Reductions for Auxiliary Engines Switching from Heavy Fuel Oil to the Specified Distillate Fuels

Pollutant	Percent Reduction: HFO to MGO @ 0.5% Sulfur	Percent Reduction: HFO to MGO @ 0.1% Sulfur
NOx	6%	6%
SOx	80%	96%
PM	75%	83%

Table VII-3 below shows the auxiliary engine emissions within the 24 nautical mile boundary, which are subject to the proposed regulation. The emissions are grown uncontrolled from 2004 to 2020 based on the growth assumptions discussed in Appendix D.

Table VII-3: Projected Emissions from Auxiliary Engines within 24 Nautical Miles of California's Coastline

Year	Auxiliary Engine Emissions (Tons per Day)		
	PM	NOx	SOx
2004	3.0	34	22
2007	3.8	43	28
2010	4.6	52	34
2015	6.2	69	45
2020	8.7	95	64

The ARB staff estimates that implementation of the proposed regulation will result in immediate and substantial reductions in diesel PM, NOx, and SOx emissions, as shown in Table VII-4 below. Upon implementation in 2007, this represents about a 70 percent reduction in PM emissions from the baseline emissions subject to the regulation (emissions within the 24 nautical mile boundary). In addition, the proposed regulation will result in reductions in carbon dioxide (CO_2), a global warming gas. Specifically, the use of use of distillate marine fuels will result in about a 5 percent reduction in CO_2

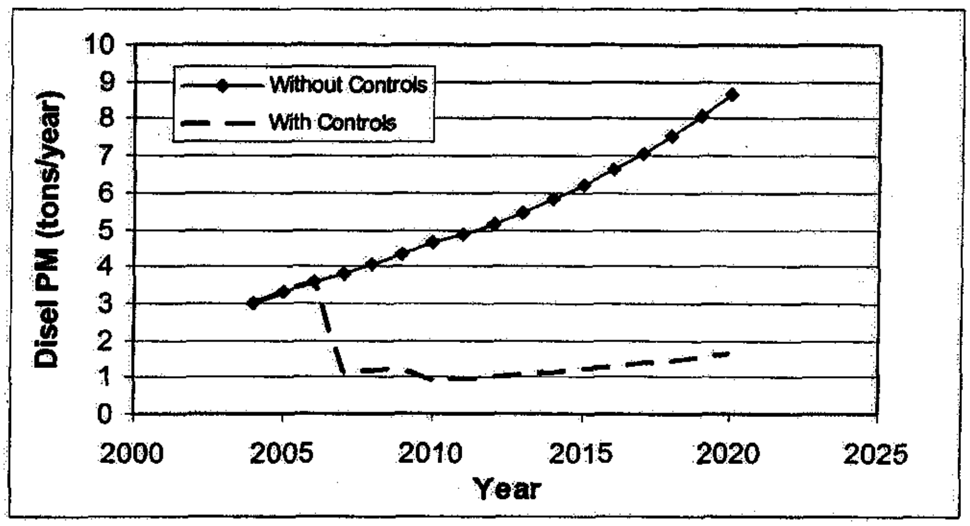
emissions compared with heavy fuel oil, and use of shore-side power would result in much greater percent reductions compared to the use of diesel auxiliary engines.

Table VII-4: Emission Reductions from Implementation of the Proposed Regulation

Year	Auxiliary Engine Emission Reductions (Tons per Day)		
	PM	NOx	SOx
2007	2.7	1.9	22
2010	3.7	2.3	32
2015	5.0	3.2	43
2020	7.0	4.4	61

Figure VII-1 illustrates how the diesel PM emissions from ship auxiliary engines within the 24 nautical mile boundary will grow with and without the proposed regulation. As shown, the growth in emissions would eventually negate the emissions reductions associated with the implementation of the proposed regulation.

Figure VII-1: Estimated Diesel PM Emissions in 24 nm Zone With and Without the Implementation of the Proposed Regulation



C. Estimating the Health Benefits Associated with the Reductions of Diesel PM Emissions

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.

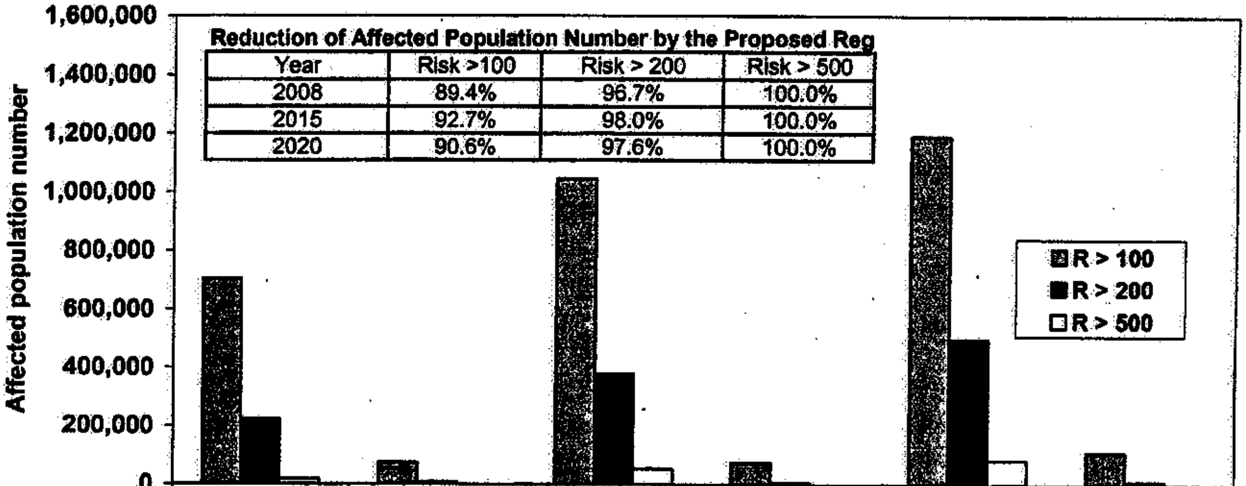
Reduction in Potential Cancer Risks

The reductions in diesel PM emissions that will result from implementation of the proposed regulation will reduce the publics exposures to diesel PM emissions and the potential cancer risks associated with those exposures. The ARB staff used the air dispersion model and modél 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. The 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 in California, providing a qualitative estimate for those areas.

To investigate the reductions in potential risks that will result as emissions from ocean-going vessel auxiliary engines decline, ARB staff used dispersion modeling and the projected 2008 and 2015 controlled and uncontrolled 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 2008 and 2015. The potential cancer risks from exposures to the projected controlled and uncontrolled 2008 and 2015 emissions were then estimated to determine how the potential risks will change. As shown in Figures VII-2 and VII-3, 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.[1] Based on our analysis, which is summarized in Appendix K, we estimate that, in 2008, there will be a 70 percent reduction in the population-weighted average risk relative to uncontrolled risk levels in from ocean-going vessel auxiliary engine emissions and approximately a 78 percent reduction in 2015.

[1] Because the isopleths for risk levels at 10 in a million were outside the modeling domain, we are not able to quantify the expected regulatory impact on this risk level. However, we believe that the risk levels greater than 10 in a million are also significantly reduced.

Figure VII-2: Comparison of Affected Population Numbers With and Without the Proposed Ship Auxiliary Engine Fuel Regulation for the Years 2008 and 2015

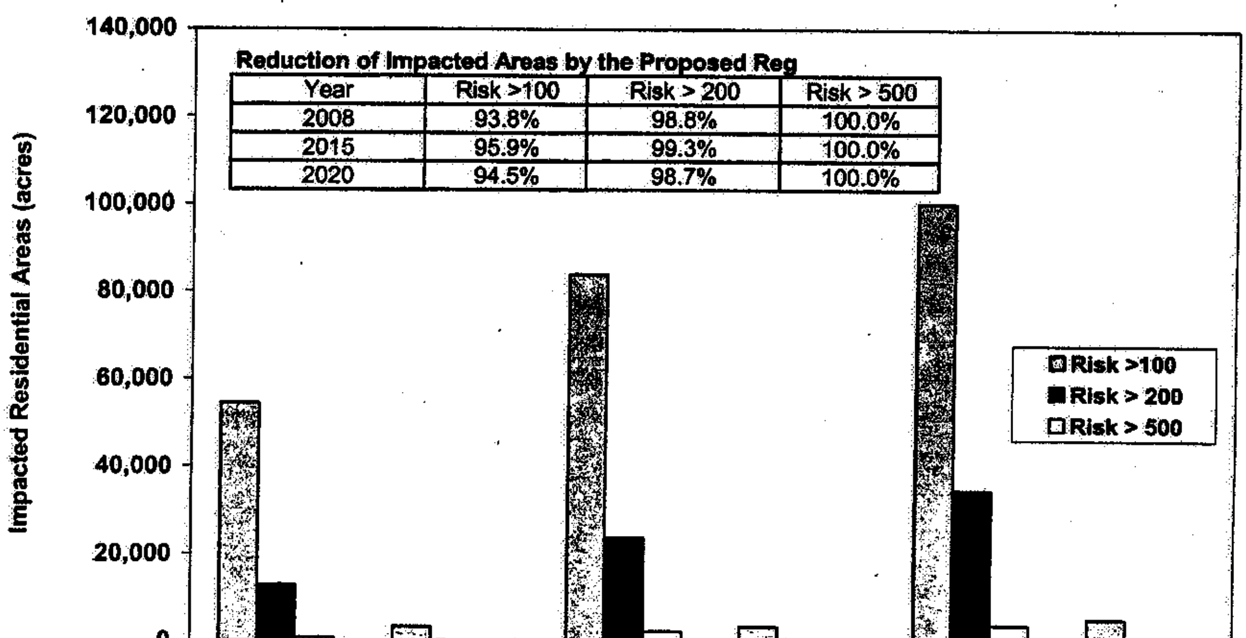


Reduction of Affected Population Number by the Proposed Reg

Year	Risk >100	Risk > 200	Risk > 500
2008	89.4%	96.7%	100.0%
2015	92.7%	98.0%	100.0%
2020	90.6%	97.6%	100.0%

	2008 without Reg	2008 with Reg	2015 without Reg	2015 with Reg	2020 without Reg	2020 with Reg
R > 100	704,995	74,630	1,045,555	75,870	1,191,262	112,440
R > 200	223,561	7,464	379,237	7,570	499,675	12,100
R > 500	18,885	0	52,277	0	84,760	0

Figure VII-3: Comparison of Impacted Residential Areas With and Without the Proposed Ship Auxiliary Engine Fuel Regulation for the Years 2008 and 2015



Reduction of Impacted Areas by the Proposed Reg

Year	Risk >100	Risk > 200	Risk > 500
2008	93.8%	98.8%	100.0%
2015	95.9%	99.3%	100.0%
2020	94.5%	98.7%	100.0%

	2008 without Reg	2008 with Reg	2015 without Reg	2015 with Reg	2020 without Reg	2020 with Reg
Risk >100	54,333	3,361	83,838	3,440	100,255	5,535
Risk > 200	12,909	158	23,732	168	34,852	455
Risk > 500	811	0	2,273	0	3,973	0

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 IV 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:

- 520 premature deaths (260 to 810, 95% CI)
- 14,000 asthma attacks (3,400 to 24,000, 95% CI)
- 120,000 work loss days (103,000 to 140,000, 95% CI)
- 650,000 minor restricted activity days (530,000 to 770,000, 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 $3 billion at seven percent discount rate, and $4 billion 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. These are point estimates. The uncertainty in the mortality estimates is on the order of 50 percent, so the valuation estimates are likewise uncertain, by plus-or-minus about 2 billion dollars.

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 14,000 cases. The total valuation is about $0.4 million using a seven percent discount rate, and $0.6 million using a three percent discount rate.

For the 120,000 avoided work loss days, their valuation is about $14 million using a seven percent discount rate, and $18 million using a three percent discount rate. For the 650,000 avoided MRAD, their valuation is about $24 million using a seven percent discount rate, and $31 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

The proposed regulation has two possible compliance routes, the fuels option, and the alternative compliance plan (ACP). Both options have potential environmental impacts.

The fuels option is expected to be the most common compliance method. A vessel complying with the regulation through this option may need to increase its storage capacity for distillate fuel by adding a tank or segregating an existing tank. Adding a fuel tank could potentially displace some cargo space, increasing the amount of fuel burned and emissions per a given amount of cargo transported. However, ARB staff does not expect a significant impact from the potential loss of cargo space. Most vessels already have multiple fuel tanks and are thereby able to accept multiple fuels. Specifically, according to the Survey, only about 10 percent of vessels would require modifications to use distillate fuels to comply with the proposed regulations (such as increasing their storage capacity for distillate fuels). Since some vessels reported the need for modifications not related to fuel storage, less than 10 percent of vessels would need to increase their storage capacity for cleaner burning fuels. For the minority of vessels that need to increase their fuel storage capacity, many may be able to segregate an existing tank as an alternative to adding a new tank. Finally, others will be able to add a new tank without impacting cargo capacity.

The use of a different fuel for California may also require increased fuel deliveries to the ship. This could potentially increase the possibility of fuel spills. However, refueling personnel can lower the possibility of fuel spills with training, and by following standard refueling operating procedures.

The ACP provides for a range of technologies that could be used to comply with the proposed regulation. Listed below are some potential technologies that could be used to comply with the proposed regulation. The ACP provisions are described in more detail in Chapter V.

Selective Catalytic Reduction (SCR)

The heart of the SRC system is the catalyst. The reaction converting NOx to nitrogen and water occurs on the surface of the catalyst. NOx compounds must come into contact with the catalyst in order to be converted. Modern catalysts are usually made in the form of honeycomb structures.

Many catalysts materials contain heavy metal oxides which are hazardous to human health. Vanadium pentoxide, for example, is on the U.S. EPA's Extremely Hazardous Substances. In California, spent catalyst from SCR is considered to be hazardous waste and the volume of waste from SCR is large. The disposal of catalyst is expensive, but some catalyst manufacturers provide for disposal and/or recycling of the catalyst. In Japan, for example, titanium from titanium dioxide spent catalyst is used from paint pigment. An advantage of precious metal catalysts is that they do not produce as much hazardous waste, and they have a salvage value at the end of their useful life, but the initial cost is higher.

Ammonia is necessary for the chemical reactions in SCR to work. Unfortunately, ammonia is also a hazardous substance. Ammonia is on the U.S. EPA's list of extremely hazardous substances under Title III, Section 302 of the Superfund Amendments and Reauthorization Act of 1986 (SARA). Ammonia is immediately dangerous to life and health (IDLH) at only 500 ppm. It has a time weighted average (TWA) exposure limit (the maximum allowable exposure limit in a 10 hour day in a 40 hour week) of 25 ppm. Ammonia has a pungent, suffocating odor. Exposure to ammonia causes eye, nose, and throat irritation and it will burn the skin.

Ammonia is released from an SRC system because excess ammonia is required for efficient conversion of NOx to nitrogen. Excess ammonia is required because of imperfect distribution of the chemical. In theory, if the ammonia could be perfectly distributed so that the reactants could come into contact, no ammonia would be released, but in the real world this is not possible. This is also analogous to the necessity for excess air required for combustion. Excess air is required since all the oxygen molecules can't find all the fuel molecules to react with during the short period of time of combustion due to imperfect mixing of fuel and air. The molar ratio of nitrogen oxide (NO) to ammonia in the SCR reaction is 1.0 (i.e. 1 ft^3 of ammonia is required to convert 1 ft^3 of NOx), and the molar ration of ammonia to nitrogen dioxide (NO_2) is two. Over 80% of the NOx compounds in the exhaust are nitrogen oxide, so the SCR system is usually run with a ratio of ammonia to NOx around 1.0. Further increase of the ratio will reduce NOx emissions, but emissions of ammonia will increase.

In an SCR unit, it is critical that the ammonia is injected and thoroughly distributed throughout the flue gas stream. This is done with the ammonia injected grid located upstream of the catalyst. Ammonia is drawn out of a storage tank and evaporated with the electrical heated or steam heated vaporizer. The vapor is then mixed with a carrier gas which is usually compressed air or steam. The carrier gas provides the momentum to deliver the gas into the exhaust stream.

The storage of ammonia is usually considered to be a greater potential hazard than the ammonia slip from the stack. Emitted levels of ammonia slip are far below the odor and health hazard thresholds of the chemical. Since ammonia is water soluble, it doesn't remain very long in the atmosphere.

Ammonia from SCR is stored in a tank and a relatively large amount of storage is required. Accidental release from storage could pose problems to communities surrounding the ship. Aqueous and anhydrous ammonia are the two types of ammonia used for ammonia injection. The aqueous form is favored in that the stored ammonia concentration can be limited and the volatilization rate is reduced, so it is safer. The aqueous form is used in more heavily populated areas.

Urea is a chemical that comes in the form of powder that can also be used in place of ammonia for SCR. The urea is dissolved with water and then injected into the exhaust stream. The urea breaks down to form nitrogen and hydrogen compounds that will react with nitrogen oxide. The temperature range for efficient NOx reduction with urea is higher than the exhaust temperature of most engines, so urea injection is limited to systems where there is supplemental firing applied to the exhaust stream.

Shoreside Port Electrification ("Cold Ironing")

Supplying shore power to a vessel while at port is an option to reduce hotelling emissions. While shore power is supplied to the ship, the auxiliary engines are turned off. This option does not completely eliminate emissions because most vessels continue to operate boilers. However the emissions from boilers is a small fraction of the hotelling emissions from most vessels, so overall emissions are reduced dramatically. Table VII-5 below compares the emissions per unit of energy for a marine auxiliary engine operating on residual fuel (heavy fuel oil) and distillate fuel (marine diesel oil), and for a power plant.

Table VII-5: Auxiliary Engine and Powerplant Emission Comparison

Pollutant	Residual (g/kw-hr)	MDO (g/kw-hr)	Powerplant (g/kw-hr)
NOx	14.7	13.9	0.0908
PM	1.5	0.3	0.012
SOx	12.3	1.1	0.006

Source: ARB, 2004

As stated previously, shoreside power eliminates the emissions from vessel auxiliary engines, but the power is produced by powerplants. Powerplants get their power from a variety of sources each with a variety of air emissions. Natural gas plays a dominant role in California's fuel-fired generating system and is the preferred fuel for powerplants because of its cleaner combustion characteristics compared to other fuels. Natural gas has negligible sulfur, which limits sulfur compound emissions; negligible ash, which limits particulate matter emissions; and NOx emission rates that are generally lower than from other fuel types. Natural gas provides 91 percent of the fuel – fired electrical generation in California. (ARB, 2004)

Diesel Oxidation Catalyst (DOC)

Two potential adverse environmental impacts from the use of DOCs 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. Second, a DOC 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://www.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 DOC. 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 H&SC, 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.

The 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 DTSC.[2]

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

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

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 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 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.

E. Reasonably Foreseeable Mitigation Measures

The 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 V 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 and other air pollutants emitted from oceangoing auxiliary diesel-fueled engines.

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VIII. ECONOMIC IMPACTS

In this chapter, we present the estimated costs and economic impacts associated with the implementation of the proposed regulation. The estimated capital and recurring costs are presented, as well as an analysis of the cost-effectiveness. The economic impacts associated with the costs of the proposed regulation are presented for private companies, as well as governmental agencies.

Legal Requirements

In this chapter, we will also address certain legal requirements that must be satisfied in analyzing the economic impacts of the proposal.

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.

In addition, the ARB is required under section 43013(b) of the Health and Safety Code (H&SC) to adopt standards and regulations, consistent with H&SC section 43013(a), for marine vessels to the extent permitted by federal law. Health and Safety Code section 43013(a) authorizes ARB to adopt and implement "motor vehicle emission standards, in-use performance standards, and motor vehicle fuel specifications...which the State board has found to be necessary, cost-effective, and technologically feasible..."

A literal reading of H&SC section 43013(a) would lead one to conclude that the criteria "necessary, cost-effective, and technologically feasible" do not apply to a marine vessel regulation because marine vessels are non-vehicular by definition. See H&SC section 39039. However, because the Legislature placed the authorization to regulate marine vessels in H&SC section 43013(b), we will infer a legislative intent to require ARB to determine that its proposed regulations on marine vessels are "necessary, cost-effective, and technologically feasible."

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.

Finally, H&SC 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 in any single year. The estimated cost of the proposed regulation does exceed ten million dollars in a single year, although much of the cost will be borne by businesses based outside of California. Nevertheless, we have conducted an economic impact 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.

A. Summary of the Economic Impacts

Under the proposed regulation, ocean-going vessel (or "vessel") operators can comply through the use of distillate marine fuel or equally effective emission control strategies. This requirement would apply when ships are within 24 nautical miles (nm) of the California coastline.

To estimate the costs of compliance with the proposed regulation, the use of distillate marine fuel will be assumed because the costs can be predicted more accurately compared with the wide range in potential costs from the multitude of potential alternative control strategies. In addition, it is unlikely that alternative control strategies would be pursued unless they are less expensive than the use of distillate marine fuels.

To estimate the costs for 2007 through 2009, we assume that vessel operators will use marine gas oil (MGO) to comply with the proposed regulation. For 2010 and later, we assume that vessel operators will use of 0.1 percent sulfur MGO. However, it should be noted that the 2010 emission limit will be subject to a feasibility evaluation that will consider the supply of this fuel in 2010, as well as technical issues. Therefore, it is possible that this standard could be modified. In addition, throughout the analysis, the costs to passenger cruise vessels (diesel-electric vessels) and cargo vessels (generally direct drive motor-ships) will be analyzed separately due to the differences in these vessel types.

Since the majority of vessels currently use heavy fuel oil in their auxiliary engines, most vessel operators will need to switch to more expensive marine distillate fuel in California upon entering the 24 nm boundary. This fuel is roughly twice as expensive by weight as heavy fuel oil. The added cost to businesses due to the higher cost of using distillate fuel will vary widely based on the amount of heavy fuel oil they use in California. For example, a business that owns a single small cargo vessel that makes a single annual visit to a California port may incur an added cost of a couple thousand dollars, while an operator of a large fleet of vessels that make frequent California port visits may incur costs exceeding a million dollars annually. On average, we estimate the added annual fuel cost for a typical cargo vessel operator at about $20,000 per company ($17,000 for years 2007 to 2009, and $19,000 for 2010 and later). For passenger cruise vessel operators, we estimate the added annual fuel cost at about $2 million per company ($1.7 million for years 2007 to 2009, and $1.9 million for 2010 and later). For the entire oceangoing shipping fleet that visits California, we estimate an added annual fuel cost of about $34 million (2007-2009), and $38 million (2010 and later). These estimates are based on current fuel consumption and do not account for growth.

In addition, we estimate that about five percent of non-diesel-electric (cargo) vessels, and about forty percent of diesel-electric (passenger cruise) vessels will need some modifications such as adding a new fuel tank and piping. These costs will vary widely with the type of modifications, but we estimate the average cost to be on the order of $100,000 per vessel for cargo vessels, and $100,000 to $500,000 for diesel-electric vessels. We estimate the total retrofit cost to the industry at about $11 million to $18 million dollars.

We do not expect significant economic impacts to the industry based on the added costs of the proposed regulation. The added costs of the regulation are relatively minor compared to the overall operating expenses of these vessels. In addition, based on an analysis of the change in "return on owners equity" (ROE) for typical businesses, the added costs of the proposed regulation would result in less than a one percent change in ROE. 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. We also do not expect significant economic impacts on governmental agencies on the local, state, or federal level. Military vessels are exempt from the proposed regulation.

We also do not expect significant impacts on the customers served by ocean-going vessel operators, even assuming that all of the added costs are passed on to customers. For example, we estimate that the added cost of the proposed regulation would add about a dollar per container for importers or exporters shipping containerized goods overseas. We estimate that this represents less than one percent of the shipping cost. For passenger cruise ships, we estimate the added cost of the proposed regulation for a typical Los Angeles to Mexico cruise would be about $8 per passenger, representing about a 2 percent fare increase.

The overall cost-effectiveness of the proposed regulation, considering only reductions in diesel PM, is estimated to be about $52,000 per ton of diesel PM reduced ($26 per pound of diesel PM) from 2007 to 2009, and about $53,000 per ton of diesel PM reduced ($27 per pound of diesel PM) in 2010 and later, when the 0.1 percent sulfur marine gas oil limit is scheduled to be implemented. This is similar to the cost-effectiveness of other regulations adopted by the Board to reduce diesel PM. However, the proposed regulation would also reduce emissions of nitrogen oxides (NOx) and sulfur oxides (SOx). Attributing half the cost of the proposed regulation to diesel PM, and half to NOx plus SOx, the cost-effectiveness for 2007 to 2009 would be about $26,000/ton ($13/pound) of diesel PM reduced, and about $3,000/ton ($1.50/pound) of NOx+SOx reduced. For 2010 and later, the cost-effectiveness would be about $27,000/ton ($14/pound) of diesel PM reduced, and about $2,700/ton ($1.40/pound) of NOx+SOx reduced.

The health benefits of implementing the proposed regulation are substantial. The estimated statewide benefit of reduced premature mortality is about $3 billion at a seven percent discount rate, and $4 billion at a three percent discount rate.

B. Capital Costs

In order to use marine distillate fuels in their auxiliary engines, some vessel owners will need to add additional tanks and piping, or make other modifications to their vessels. This will result in capital costs to the vessel owner. To estimate the number of vessels requiring modifications, we conducted the ARB 2005 Ship Survey ("Survey"). The Survey requested that respondents identify whether their vessels will require modifications to use distillate fuel and the nature of the changes if needed. (ARB, 2005). Eleven companies reported 32 vessels that would require modifications out of 358 total vessels reported in the Survey (i.e., less than 10 percent would require retrofits). More specifically, 8 cargo vessel operators reported 15 vessels requiring modifications, and 3 cruise vessel operators reported 17 vessels requiring modifications. The types of retrofits reported by vessel operators included the addition of fuel tanks, segregation of existing fuel tanks for distillate fuels, addition of a mixing tank and fuel treatment equipment, and fuel pump and fuel injector modifications.

<u>Estimated Average Retrofit Cost per Vessel</u>

The average cost to modify a vessel to use distillate fuel is difficult to estimate because the cost will vary widely based on the particular vessel and the type of modifications. One common modification would be the addition of a tank for distillate fuel, or the partitioning of an existing tank. To estimate the potential cost to add a tank, ARB staff reviewed the available literature, contacted marine engineering firms, and requested information from respondents to the Survey. Our findings and recommendations are summarized below.

The U.S. EPA estimated the cost to add a fuel tank and associated piping to allow a vessel to use cleaner fuel (either distillate or 1.5% sulfur heavy fuel oil) at $50,000. (U.S. EPA, 2002). Relatively little information was provided in the U.S. EPA report detailing how the estimate was derived, so marine engineering firms were contacted to estimate the cost of installing an additional tank that would allow a typical cargo vessel to comply with the proposal. They responded that the $50,000 estimate in the U.S. EPA report was reasonable assuming the vessel is in dry-dock for other maintenance (Herbert Engineering, 2005; Sweeney, 2005).

Others have reported higher costs. For example, a report prepared for the European Union estimated the cost to install a tank, as well as pumps, gauges, and ancillary equipment at 25,000 € (~$30,000) for a 30 meter vessel, and 80,000 € (~$96,000) for a 100 meter vessel. (Entec, 2002). However, the vessels mentioned in the report are smaller than those subject to the proposed control, and it is unclear whether or not the fuel tanks would provide capacity only for auxiliary engine use. ARB staff also contacted respondents to the Survey that indicated that some of their vessels would require retrofits. Only one company responded with an estimate of $350,000 to $500,000 for a passenger cruise vessel. However, as discussed later in this chapter, cruise vessels and other diesel-electric vessels may have higher retrofit costs than other types of vessels. For this reason, a separate business impacts analysis was performed for these vessels, which account for less than three percent of the vessels that visit California annually. Considering the information available and the uncertainty in estimating the retrofit costs, ARB staff proposes to double the U.S. EPA estimate for cargo vessels and use $100,000 per vessel retrofit (except for diesel-electric vessels) to avoid underestimating the cost. For diesel-electric vessels (cruise vessels and some tankers), ARB staff proposes a range from $100,000 to $500,000.

Total Capital Cost of the Proposed Regulation

The capital cost was estimated based on the estimated number of vessels requiring modifications and the cost per vessel. These costs were analyzed separately for non-diesel-electric (cargo) vessels, and diesel-electric (cruise vessels) as shown in Table VIII-1 below.

For cargo vessels, 15 of the 317 cargo vessels reported in the Survey (about 5 percent) were reported to require modifications. According to the California State Lands Commission (CSLC), 1,945 unique vessels (excluding barges) visited California in 2004 (CSLC, 2005). Excluding the 44 cruise vessels from the data, there are about 1,900 cargo vessels. Applying the 5 percent modification rate to the CSLC data (less barges and cruise vessels), we estimate that about 95 cargo vessels would require modifications. Assuming the cost of these retrofits averages $100,000 per vessel, we estimate the total capital cost for cargo vessels would be about $9.5 million.

For cruise vessels, the Survey can be used to directly estimate the number of vessels to be modified because the Survey coverage was nearly complete. Forty-one vessels were reported out of 44 reported by the CSLC data, and 17 of these were indicated to require modifications. Using the 17 vessels and a range in cost from $100,000 (the average for other vessel types) to $500,000 (the highest estimate received as discussed above), the estimated total capital cost to the cruise vessel industry is $1.7 to $8.5 million.

TableVIII-1: Capital Cost Summary

Industry Sector	Estimated Retrofit Cost ($/Vessel)	Estimated Number of Retrofitted Vessels	Total Industry Capital Cost ($/year)
Cargo Vessels	$100,000	95	$9.5 million
Passenger Cruise Vessels	$100,000 to $500,000	17	$1.7 to $8.5 million
Total	N/A	197	$11 to $18 million

There are a number of reasons why the actual capital costs may be different than our estimate. First, the number of vessels requiring retrofits (and the associated total capital costs) may be lower or higher than the above estimate. This is because we modified the proposed regulation after the Survey was conducted to remove the sulfur limit cap on marine gas oil (MGO) for the initial fuel requirement, whereas MGO with a sulfur cap of 0.2% sulfur was the proposed requirement at the time of the Survey. As such, some vessels may not need to add tankage and associated piping to comply with the proposal because they may already carry complying marine distillate fuels.

The current proposal still includes a provision requiring the use of 0.1% sulfur marine gas oil in 2010 subject to a feasibility review. However, this proposal is designed to align with the European Union's Directive which requires the use of 0.1% sulfur MGO for vessels at dockside and in inland waterways. (EU, 2005). It is likely many vessels may already be planning vessel retrofits to meet the EU requirement.

Moreover, the inclusion of a noncompliance fee option to the proposal will also reduce the number of vessels that will need to perform retrofits. Under this option, which was not included in the proposal at the time of the Ship Survey, an infrequent visitor that would otherwise need to perform vessel modifications to use distillate fuel could pay a fee in lieu of compliance with the proposal's fuel requirements.

Another factor that may affect the actual capital costs is the number of new visitors to California ports. As stated above, we based the total capital cost on the estimated total number of vessels that may require modifications to visit California ports in 2004. However, in subsequent years, there will be some new vessels visiting California ports. These could be vessels that did not visit California ports previously, or new vessels that have been added to the worldwide fleet. Some of these vessels may be required to perform modifications to use distillate fuel under the proposed regulation.

The actual number of these new vessels is difficult to estimate due to a variety of variables, including growth in the various shipping sectors, vessel turnover, and route changes initiated by individual businesses due to normal fluctuations in demand. The number of new vessels also could change as vessel owners try to minimize the number of vessels that would require modifications. Nevertheless, to determine an upper end cost estimate, we compared vessel visits over a two-year period. Based on our analysis of State Lands Commission data for 2003 and 2004, we estimate that roughly 50 percent of the vessels in 2004 did not visit in 2003. (CSLC, 2005). Assuming capital costs are proportional to the number vessels, we estimate the capital costs at about half the initial year total capital cost of $11 to $18 million, or $5.5 to $9 million annually, increasing the total present value cost of the regulation from $165 to $171 million, to $184 to $200 million (over a five year lifetime). Under this scenario, the 2007-2009 cost-effectiveness for PM would increase from about $52,000 per ton PM reduced, to $58,000 - $63,000 per ton PM reduced (see Appendix J-Part II).

C. Recurring Costs

The recurring costs associated with the purchase of distillate fuel were determined and accounted for in the cost analysis. We calculated the recurring costs based on the current estimated fuel consumption and the price differential between existing fuels and the cleaner fuels required by the proposal for the years 2007-2011. For years 2007-2009, we calculated the cost based on the consumption of heavy fuel oil in auxiliary engines and the differential in price between the most widely used type of heavy fuel oil (HFO-380) and standard marine gas oil (MGO). For 2010 and 2011, we based the cost on the sum of: (1) the estimated current consumption of heavy fuel oil and the differential in price between HFO-380 and MGO with a 0.1 percent sulfur cap; and (2) the estimated current consumption of standard MGO and the differential in price between standard MGO, and MGO with a 0.1% sulfur cap. Growth in the industry was not projected for this analysis, nor did we attempt to factor in expected price increases due to inflation, given the highly volatile and unpredictable nature of petroleum prices. However, we believe that growth and inflation are likely to have similar effects on both fuels, such that the differential will remain relatively constant. Our assumptions for fuel consumption rates and the price differential between MGO and HFO-380 are described below.

<u>Fuel Consumption Estimates</u>

As shown in detail in Appendix B, we estimated fuel consumption within the 24 nautical mile boundary based on: (1) the estimated NOx emissions from auxiliary engines operating within this zone; (2) the energy specific NOx emission factor for medium speed four-stroke auxiliary engines using heavy fuel oil (Entec, 2002), which allowed emissions to be converted to associated energy in kilowatt-hours; and (3) the brake specific fuel consumption for these engines (*Ibid*), which allowed energy to be converted to estimated fuel consumption. Based on this information, we estimate that about 172,000 metric tons of fuel is currently consumed by auxiliary engines statewide within the 24 nm boundary.

Based on the Survey, we estimate about 92 percent of the fuel used by diesel-electric engines, and 72 percent of the fuel used by auxiliary engines on all other vessels was heavy fuel oil. Overall, about 78 percent of the fuel (by weight) used by all auxiliary engines was heavy fuel oil, and the remaining 22 percent was distillate fuel. Applying this breakdown to the total fuel consumption of 172,000 metric tons, we estimate that about 134,000 metric tons of heavy fuel oil and 38,000 metric tons of distillate fuel are used by the vessels traveling within 24 nm of California's coastline.

<u>Price Premium for Cleaner Fuels</u>

To determine the estimated price differential between heavy fuel oil and distillate fuels complying with the proposed regulation, we estimated an average cost differential using current prices for HFO-380, the most common grade of heavy fuel oil, and marine gas oil. (Bunkerworld, 2005). As shown in Table VIII-2 below, prices were averaged over the time period from March, 2005 through September, 2005 using three major bunkering ports: Singapore, Rotterdam, and Fujairah. Fuel prices tend to be volatile and may change significantly in the future. However, we believe that the price differential between HFO and MGO will be fairly constant.

Table VIII-2: Marine Fuel Prices ($/tonne)*

Fuel	Fujairah	Singapore	Rotterdam	Average
MGO	512	504	523	513
HFO-380	261	264	243	256
Difference	251	240	280	**257**

* Bunkerworld, 2005. Prices averaged from March to September, 2005. A "tonne" equals a metric ton, or 2200 pounds.

To determine the cost differential between standard marine gas oil and 0.1 percent marine gas oil, we used a report prepared for the European Union. The report estimated the price premium for 0.1 percent sulfur marine gas oil compared to standard marine gas oil with no sulfur limit at 14-21 €/metric ton, or about $21/metric ton using the median cost from the range and a conversion of 0.83 Euro per dollar. (Beicip-Franlab, 2002). Table VIII-3 summarizes the estimated price differential for the cleaner fuels specified in the proposed regulation.

Table VIII-3: Fuel Price Differential Due to Proposed Regulation

Year	Fuel Change	Price Premium* ($/tonne)
2007-2009	HFO-380 to Standard MGO	257
2010 and later	HFO-380 to 0.1% S MGO	278
2010 and later	Standard MGO to 0.1% S MGO	21

*Reflects data from Table VIII-2 above and "Advice on the Costs to Fuel Producers and Price Premium Likely to Result from a Reduction in the Level of Sulphur in Marine Fuels Marketed in the EU," Beicip-Franlab, April 2002. A "tonne" equals a metric ton, or 2200 pounds.

<u>Total Recurring Costs</u>

The total annual recurring costs for years 2007-2009, and 2010 and later, for each industry sector and for the total marine industry are shown below in Tables VIII-4 and VIII-5. These estimates are based on the estimated fuel consumption by sector and price differentials shown in Table VIII-3 above.

Table VIII-4: Total Industry Annual Fuel Costs for Years 2007-2009

Marine Industry Sector	Estimated HFO Consumed (tonne)*	Price Differential ($ per tonne)	Total Sector Cost (millions)
Auto Carrier	3,500	$257	$0.90
Bulk	14,000	$257	$3.60
Container	58,000	$257	$14.9
General	6,000	$257	$1.50
Passenger	40,000	$257	$10.3
Reefer	2,200	$257	$0.60
RORO	1,300	$257	$0.30
Tanker	9,000	$257	$2.3
Total	134,000	$257	~$34

* Estimated annual fuel consumption based on methodology used above for total industry fuel consumption.

The total annual recurring fuel cost estimates for 2010 and later reflect the use of somewhat higher cost 0.1 percent sulfur marine gas oil, as shown in Table VIII-5 below. Specifically, the current estimated fuel consumption of heavy fuel oil is multiplied by the higher incremental cost ($278) between heavy fuel oil and 0.1 percent sulfur marine gas oil. The current estimated fuel consumption of marine distillate fuels is multiplied by the higher incremental cost ($21) between standard marine gas oil and 0.1 percent marine gas oil. These costs were added to obtain the total recurring fuel cost by industry sector.

We do not expect significant additional recurring costs to the industry due to recordkeeping and reporting requirements, crew time, or other factors, which are discussed in section E of this Chapter.

Table VIII-5: Total Industry Annual Fuel Costs for 2010 and Later

Marine Industry Sector	Estimated HFO Consumed (tonne)*	Estimated MGO Consumed (tonne)*	Price Differential (HFO to 0.1% S MGO)	Price Differential (Std. MGO to 0.1% S MGO)	Total Sector Cost (millions)
Auto Carrier	3,500	1,100	$278	$21	$1.0
Bulk	14,000	5,300	$278	$21	$4.0
Container	58,000	22,600	$278	$21	$16.6
General	6,000	2,300	$278	$21	$1.7
Passenger	40,000	2,600	$278	$21	$11.2
Reefer	2,200	850	$278	$21	$0.63
RORO	1,300	500	$278	$21	$0.37
Tanker	9,000	3,200	$278	$21	$2.6
Total	134,000	~38,000	$278	$21	~$38

* Estimated fuel consumption based on methodology used above for total industry fuel consumption.

D. Total Industry Cost and Total Annual Cost

Total Industry Cost

We estimate the total statewide cost of the proposed regulation over a 5 year period to be about $165-171 million dollars. This estimated cost was derived from the present value of the capital costs shown in Table VIII-1 combined with the present value of the recurring costs shown in Tables VIII-4 and VIII-5, over a 5 year period (see Appendix B).

Total Annual Cost

The total annual cost, including the total capital costs from Table VIII-1, and the recurring costs from Tables VIII-4 and VIII-5, is estimated to be about $38 million for years 2007-2009, and about $42 million for 2010 and 2011 (See Appendix B). The majority of the estimated total annual cost is contributed by the recurring fuel costs.

E. Potential Additional Costs or Savings

There may be some other costs and potential cost savings that could be incurred under the proposed regulation, but data were not available to enable quantification of these possible impacts. Nevertheless, the net impact of these costs and savings is not expected to be significant. These are briefly described below.

Distillate fuel may result in lower or higher maintenance costs

Marine distillate fuel has a lower sulfur and ash content than heavy fuel oil and may result in a permanent, ongoing reduction in engine maintenance in some engines due to a reduction in deposit formation (Croner, 2002). On the other hand, the use of lower viscosity distillate fuel may make leaks at weak pipe joints more likely than the use of heavier fuels, requiring additional maintenance. Because these effects, to the extent they may occur, are very engine and vessel-specific, we cannot quantify the overall potential savings or added costs from changes in maintenance costs.

Crew time/training

The fuel switching operations necessary under the proposed regulation may be automated or performed manually, depending on the specific vessel. Depending on the fuel system, training of the vessel crew may be required. Vessel crew time would also be required to perform the fuel transition upon entering and leaving the 24 nautical mile boundary. Because of the uncertainty in the extent additional crew time and training may be needed, we are not able to estimate these costs. However, to the extent crew training is required, we expect such crew training to be minimal because vessels must already switch to marine gas oil prior to dry dock maintenance, and fuel transitions may be handled with the existing crews.

Dry-dock costs

The proposed regulation provides up to a one year extension for a small minority of vessels requiring significant modifications to comply with the proposed regulation (i.e., a fraction of the 10 percent of vessels requiring some modification). In addition, a noncompliance fee provision provides an option that allows vessel operators to pay a fee in lieu of compliance for up to five port visits per vessel, if their vessel requires modifications to comply with the proposal. However, even with these provisions, there may still be a small number of vessels that need to make modifications in response to the proposed regulation prior to a regularly scheduled dry-dock date. This would result in lost business opportunities while the vessel is out of service for modifications. We are not able to predict the extent this would occur and therefore cannot accurately quantify these costs.

Fueling costs

Some manufacturers have reported that the proposed regulation may result in more frequent fueling because they may use a smaller tank for the more expensive fuel that can be used to comply with the proposed regulation. However, we cannot predict the extent to which this would occur and the industry has not supplied estimates of these costs.

Loss of Cargo Capacity

For the minority of vessels that will need to add a fuel tank to comply with the proposed regulation, there is a possibility that the addition of the tank will reduce the cargo carrying capacity of the vessel. However, vessel owners can in many cases opt to segregate a volume of an existing tank to avoid this impact. We are unable to estimate the extent of these potential impacts.

Recordkeeping

We do not expect significant added costs to the industry due to the recordkeeping and reporting requirements in the proposed regulation. The proposed regulation would require records be kept of: (1) the date, time, and position of the vessel upon entry to and exit from the 24 nm boundary, and upon initiation and completion of fuel transitions; and (2) fuel purchases, and the types of fuels used within the 24 nm boundary. The recording of fuel purchases and fuel use is already required in accordance with standard practices as well as other regulations and Vessel Classification Society requirements. Recording the date, time, and position of the vessel as required by the proposed regulation would be an added requirement, but we do not expect these activities to require significant time or costs to comply as these can easily be logged either manually or automatically. We expect that existing vessel crews can readily record these data. Finally, the proposed regulation does not require periodic reporting of records. Reporting is only required upon request.

F. Estimated Cost to Businesses

The proposed regulation would primarily impact businesses that operate large ocean-going vessels. These costs are estimated below for typical (average) businesses. However, the cost to individual businesses will vary widely based on factors such as the following:

- number of vessels visiting California ports;
- number of California port visits per vessel;
- power generated, and thus fuel consumed, by the auxiliary engines;
- whether the vessel is a "diesel-electric" vessel; and
- number of vessels requiring retrofits.

For example, a business that owns a single small cargo vessel that makes a single annual visit to a California port visit may incur an added fuel cost of a couple thousand dollars. On the other hand, a large vessel operator with several vessels making frequent California port visits may incur added fuel costs approaching a million dollars annually.

Table VIII-6 below provides a summary of the range of added fuel costs that could be incurred by shipping companies. As shown, most companies make relatively few visits and would incur proportionally lower costs, while a small number of large operators would incur costs up to about $1 million. The average added fuel costs for travel in the 24 nm boundary associated with a California port visit ($3,400/visit) was approximated by dividing the total annual industry recurring cost for years 2007 to 2009, $34 million dollars (see Table VIII-4), by the roughly 10,000 port visits to California ports. In addition, as described below, operators of diesel-electric vessels such as passenger cruise vessels are expected to incur greater costs.

Table VIII-6: Estimated Average Added Fuel Cost to Vessel Operators*

Number of Companies	Number of California Port Visits	Added Fuel Cost @$3,400 per Visit
3	200-300	$680,000-$1 million
6	100-199	$340,000-$677,600
20	50-99	$170,000-$336,600
210	10-49	$34,000-$166,600
221	5-9	$17,000 - $30,600
83	4	$13,600
124	3	$10,200
265	2	$6,800
500	1	$3,400
1432 Total	~10,000 Total	N/A

* Company and port visit information based on the California State Lands Commission data. Added costs assume no diesel-electric vessels, which represent less than 3% of the fleet visiting California.

We do not believe that the vessel operators subject to this proposed vessel would qualify as small businesses due to the large capital and operating costs associated with vessel operation. Typical container vessels are estimated to cost on the order of $50 to $100 million (Mercator, 2005). In addition, Government Code section 11342.610 excludes businesses in transportation and warehousing with annual gross receipts exceeding one and a half million dollars from its definition of "small business." We believe that the annual gross receipts for a profitable vessel owner or operator would far exceed this level in order to be profitable. For example, a single Asia to U.S. West Coast voyage for a typical container vessel costs about $2 to $3 million. (*Ibid*) Therefore, we do not believe there are any small businesses directly affected by the proposed regulation. As such, we have only included costs in this analysis for typical businesses.

The capital and recurring costs to typical businesses are discussed below. Separate analyses are performed for operators of non-diesel-electric vessels (mainly cargo vessels) and diesel-electric vessels (passenger cruise vessels and some tankers), which are expected to incur greater costs. Diesel-electric vessels make up less than three percent of the fleet that visits California.

Capital Costs to Typical Businesses (except diesel-electric vessels)

As discussed previously, capital costs due to the proposed regulation would include vessel modifications, such as adding fuel tanks and piping, or engine modifications. These costs are vessel-specific and are expected to vary widely, with most vessels requiring no retrofits and a few incurring significant costs. According to ARB's Survey, only about 5 percent of non-diesel-electric (cargo) vessels are expected to require modifications. For those companies with vessels that require modifications, the Survey reported a range of one to four vessels requiring modifications per company. Overall, 8 companies reported a total of 15 vessels requiring modifications, or an average of roughly 2 per company. Based on an estimated cost of $100,000 per vessel (section B above), the total cost for a typical company with vessels requiring modifications would be about $200,000, with a range from $100,000 to $400,000.

Recurring Costs to Typical Businesses (Except Diesel Electric Vessels)

The recurring cost for typical businesses is based on the ongoing higher cost of marine distillate fuels that would be required by the proposed regulation. The total cost to a particular company will vary directly with the amount of fuel consumed by the company's vessels operated in California. To determine the average annual ongoing cost for a typical business, we divided the total estimated fuel cost of the regulation for non-diesel-electric vessels by the number of shipping companies that operated ocean-going vessels in California in 2004, as reported by the California State Lands Commission. Specifically, we divided the total recurring cost of $24 million for years 2006-2009 as shown in Table VIII-4 (excludes diesel-electric cruise vessels), and $27 million in 2010 and subsequent years as shown in Table VIII-5, by the approximately 1,400 companies reported by the California State Lands Commission to be responsible for vessel visits to California. (SLC, *supra*) This resulted in an average added fuel cost per company of about $17,000 per year (2006-2009) and $19,000 per year (2010 and later).

Summary of Costs to Typical Businesses (except passenger cruise vessels)

Table VIII-7 below summarizes the costs to a typical business with and without vessels requiring retrofits. As noted previously, only about 5 percent of non-diesel-electric vessels are expected to require modifications, so the cost to most affected businesses would be represented by the recurring higher cost of fuel only. The capital costs are annualized over a five year period, after which only the recurring costs would remain.

Table VIII-7: Summary of Costs to Typical Businesses

Affected Business	Capital Cost	Annualized Capital Cost*	Recurring Cost	Total Annual Cost
Modifications on 2 vessels	$200,000	$46,200	$17,000 - $19,000 (2010)	$63,200 - $65,200 (2010)
No Modifications	0	0	$17,000 - $19,000 (2010)	$17,000 - $19,000 (2010)

*Capital costs annualized over 5 years, 5% interest rate. Recurring cost based on use of marine gas oil meeting ISO sulfur standards (pre 2010).

Costs to Businesses Operating Diesel-Electric Vessels

In this section, we analyze the costs to businesses operating diesel-electric vessels. These businesses are analyzed separately because we expect the proposed regulation to result in greater impacts on diesel-electric vessels, compared to other types of vessels.

The cost impacts of the proposed regulation are greater for diesel-electric vessels because the large diesel generator sets on these vessels are used for both propulsion and ship-board electricity. Therefore, the amount of fuel used by these engines is greater than for auxiliary engines on other types of vessels, and the cost impacts are larger by a commensurate amount.

To determine the impacts on diesel-electric vessels, we focused solely on passenger cruise vessels. Based on the Survey, all passenger cruise vessels serving California were reported to be diesel-electric. With the exception of a couple of tankers that are diesel-electric (but exempt from the proposed regulation because they use slow-speed two-stroke engines), the Survey results did not report any other diesel-electric vessels. However, ARB staff is aware of at least one diesel-electric tanker that recently entered into California that uses an engine that would be subject to the proposed regulation. (Seafarers, 2005)

To put the cost impacts of diesel-electric vessels into perspective, we estimated the average fuel cost associated with a single port visit. To estimate this cost, we divided the total estimated added cost to the cruise vessel industry, $10.3 million (2007-2009), by the 687 port calls to California per the CSLC, yielding about $15,000 per port visit, compared with about $3,400 per port visit for non-diesel-electric vessels as discussed above.

To determine the recurring fuel cost on a typical cruise vessel business, we divided the total estimated added fuel cost of $10.3 million (2007-2009) to $11.2 million (2010 and later) annually by the six companies that reported to the survey. This resulted in an added annual fuel cost of nearly $2 million per company ($1.7 for 2007-2009, and $1.9 million per company for 2010 and later). However, it should be noted that this cost is relatively high compared to businesses operating other types of vessels because cruise vessels make more trips to California ports on average than other types of vessels, and because the passenger cruise industry has undergone mergers in the last few years that have consolidated more vessels under fewer companies.

In addition to higher fuel costs, it appears that these vessels are more likely to require modifications. According to the Survey, 17 of the 41 cruise vessels were reported to require vessel modifications. We also note that the California State Lands Commission reported 44 passenger cruise ships visiting California in 2004. (SLC, *supra*) Therefore, the industry participation in the Survey was nearly complete and the cost of modifying the 17 vessels reported should be a fairly accurate indication of the overall cruise vessel industry cost.

For those cruise vessel operators with vessels that require modifications, the Ship Survey reported a range of 1 to 12 vessels requiring modifications per company. Specifically, 3 companies reported a total of 17 vessels requiring modifications, or an average of roughly 6 vessels per company. Based on an estimated retrofit cost of $100,000 per vessel, the total capital cost for a typical company with 6 vessels requiring modifications would be about $600,000, or about $140,000 annualized over 5 years using a 5 percent discount rate. However, there is a possibility that the average cost of modifications per vessel is higher for cruise vessels than for other types of vessels. This is due to the greater amounts of distillate fuels that would be needed to comply with the proposed regulation, and associated fuel tank capacity, piping, and fuel processing equipment. Only one diesel-electric vessel operator (a cruise vessel operator) provided an estimate of the cost of modifying a vessel to comply with the proposed regulation. This estimate, at $350,000 to $500,000 per cruise vessel, was higher than the other sources of information cited previously. Nevertheless, based on the $500,000 figure as an upper bound, the estimated cost to a typical company with 6 vessels requiring retrofits would be about $3 million, or about $700,000 annualized over five years with a 5 percent discount rate.

Table VIII-8 provides a summary of the estimated costs to the cruise vessel industry. As mentioned previously, about 17 of the 41 cruise vessels reported in the Ship Survey were reported to require retrofits. However, the annual cost of fuel is much higher than the annualized retrofit costs, even when using the upper end retrofit cost estimate of $500,000 per vessel.

Table VIII-8: Summary of Costs* to Typical Cruise Vessel Business

Affected Business	Capital Cost	Annualized Capital Cost*	Recurring Cost	Total Annual Cost
Retrofits on 6 vessels	$600,000 to $3.0 million	$140,000 to $700,000	$1.7-1.9 million	$1.8-2.6 million
No Retrofits	0	0	$1.7-1.9 million	$1.7-1.9 million

*Capital costs annualized over 5 years at a 5% discount rate. Recurring cost based on the use of marine gas oil meeting ISO sulfur standards (pre 2010).

G. Potential Business Impacts

In this section, we analyze the potential impacts of the estimated costs of the proposed regulation on business enterprises. 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 capital and recurring costs associated with the proposed regulation. The analysis also compares the estimated added costs of the proposed regulation to the overall operating costs of these vessels

ARB staff does not have access to financial records for many of these companies. However, it should be noted that many of these businesses are not California-based businesses. Many are foreign owned enterprises, sometimes involving complicated ownership arrangements involving consortiums of investors.

As stated in Section E above, we do not believe that the businesses subject to this proposed regulation would qualify as small businesses due to the large capital and operating costs associated with vessel operation.

<u>Analysis of Return on Owner's Equity (ROE)</u>

In this section, we evaluate the potential economic impact of the proposed regulation on California businesses as follows:

(1) Typical businesses affected by the proposed regulation are identified from port visit data from the California State Lands Commission. The Standard Industrial Classification (SIC) codes associated with these businesses are listed in Table VIII-9 below;

(2) The annual costs of the proposed regulation are estimated for each of these businesses based on the SIC code. For ranges in cost estimates, the high end of the range was used;

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

(4) The adjusted costs are subtracted from net profit data and the results used to calculate the 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 publicly available financial data from 2002 to 2004 for the representative businesses, 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:

(1) All affected businesses are subject to federal and state tax rates of 35 percent and 9.3 percent, respectively; and

(2) Affected businesses neither increase the cost to their customers, nor lower their cost of doing business through cost-cutting measures due to the proposed regulation.

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

The results of the analysis are shown in Table VIII-9 below. Using the ROE to measure profitability, we found that the ROE range for typical businesses from all industry categories would have declined by less than one percent due to the proposed regulation. This represents a small decline in the average profitability of the affected businesses. Overall, most affected businesses will be able to absorb the costs of the proposed regulation with no significant impacts on their profitability.

Table VIII-9: ROE Analysis of Businesses

SIC Code	Description of SIC Code	Percent Change in ROE
4412	Deep Sea Foreign Transportation of Freight	-0.01
4424	Deep Sea Domestic Transportation of Freight	-0.05
4481	Deep Sea Passenger Transportation	-0.60

Comparison of the Costs of the Proposed Regulation with Vessel Operating Costs

This analysis compares the added costs of the proposed regulation with the normal operating costs of large ocean-going vessels. While the costs of the proposed regulation are substantial, they are a small fraction of the overall operating costs for these businesses. For example, based on a typical scenario, a container vessel would pay an extra $5,000 for fuel during visits to two California ports (see Appendix J-Part IV). We do not expect this cost to have a significant impact on vessel operators, or businesses that rely on the goods transported by these businesses, because the added fuel cost represents a minor percentage of the overall transportation cost. To put this in perspective, the total operating cost of a single Asia to U.S. West Coast voyage for a typical container vessel is estimated to be about 2 to 3 million dollars. Therefore, the $5,000 added cost represents less than one percent of the total transportation cost for the voyage, or about a dollar per shipping container for a 5,000 TEU (transport equivalent unit) vessel, out of total costs on the order of $500 per TEU. (Mercator, *supra*)

As compared to typical cargo vessels, the proposed regulation will have a larger impact on diesel electric-vessels (primarily cruise lines and some tankers). Nevertheless, we do not think the added costs will significantly impact these vessel operators. The added cost of the proposal for a typical cruise vessel visit to Mexico from the Los Angeles area would be about $16,000 (see Appendix J-Part III). Because a typical cruise vessel for this voyage carries about 2,000 passengers (Carnival, 2005a), the added cost would be about $8 per passenger. For a relatively low cost 3 or 4 day Mexico cruise, about $350 (Carnival, 2005b), a 2 percent increase in fare would be needed to offset the increased fuel cost.

Because the added costs of the proposed regulation are such as small percentage of the overall operating costs for both cargo and cruise vessels, we do not expect a significant impact on these businesses. There is also a possibility the proposed regulation will result in a positive impact on business creation due to additional sales of marine fuels in California beginning in 2010, when the 0.1 percent sulfur fuel requirement becomes effective (subject to a feasibility review). This is because California is expected to have 0.1 percent sulfur fuel available, whereas it is uncertain whether other ports worldwide will have this fuel available.

H. Potential Impact on Business Competitiveness

The proposed regulation could potentially affect the ability of California ports and California based vessel operators to compete with ports and vessel operators outside California due to the slight increase in operating costs. However, we do not believe that the added costs of the proposed regulation are high enough for vessel operators to consider alternative ports outside California.

There are several reasons for this. First, many vessel operators utilize California ports because there is already a local market for their goods within California, or because California exporters choose to utilize California ports to vessel their goods overseas. Second, other vessel operators find that the overall cost of transporting goods to their final destination beyond California is lowest by using California ports because of the ports' existing and well established infrastructure, including road and rail access. Third, in some cases, vessel operators would have to factor in the added costs of fuel and other costs of traveling greater distances to non-California ports, which may negate the cost savings in not purchasing the lower sulfur fuel. Finally, as stated previously, the added costs resulting from the proposed regulation are a small fraction of the overall operating costs of these vessels, and these costs are not expected to result in a significant adverse impact on the profitability of typical companies.

Most of the affected businesses that operate vessels are large businesses and can either absorb or pass-through the increased costs associated with the proposed regulation with no significant impact on their ability to compete with non-California businesses. Based on these reasons, we do not believe the relatively low costs of this proposed regulation are high enough to significantly affect the competitiveness of those businesses that are integrally linked to the movement of goods through California ports.

I. Potential Impact on Employment, Business Creation, Elimination or Expansion

The proposed regulation is not expected to have a noticeable impact on employment, or business creation, elimination, or expansion. As stated above, the added costs of the proposed regulation are a small percentage of the overall operating costs for both cargo and cruise vessels. In addition, an analysis of the impact of the proposed regulation on the profitability of typical businesses indicated no significant adverse impacts.

There is also a possibility the proposed regulation will result in a positive impact on business creation due to additional sales of marine fuels in California beginning in 2010, when the 0.1 percent sulfur fuel requirement becomes effective (subject to a feasibility review). This is because California is expected to have 0.1 percent sulfur fuel available, whereas it is uncertain whether other ports worldwide will have this fuel available.

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

Local Agencies

We do not expect any significant fiscal impacts on local agencies. We are not aware of any local government agency that operates an ocean-going vessel as defined in the proposed regulation. However, some minor impacts are possible on ports, which in California are established by state government and are operated by entities such as port authorities and departments of municipal governments.

The proposed regulation will increase costs for vessels visiting California ports. As such, some vessel operators could potentially choose to utilize alternative ports outside of California. However, as discussed in detail in section G above, we do not believe that this will occur to any significant degree.

We do not expect significant fiscal impacts on local air pollution control agencies due to the proposed regulation because ARB intends to enforce the provisions of the proposal statewide.

State Agencies

We do not expect any significant fiscal impacts on State agencies. The ARB will need to expend resources to enforce the proposed regulation. However, these enforcement activities can be conducted with existing resources in the short term. Eventually, additional resources will be needed as the implementation of this and other port-related measures occur.

The only other State agency identified by ARB staff that could potentially be impacted is the California Maritime Academy (CMA) in Vallejo. The CMA operates the "Golden Bear" training vessel on an annual overseas voyage. This vessel already uses only distillate marine fuel, so it probably already complies with the proposed regulation. However, when the 0.1 percent sulfur marine gas oil requirement becomes effective in 2010 (subject the required feasibility review), there may be an added cost to operate the vessel.

Federal Agencies

We are not aware of any impacts on federal agencies. Military vessels are exempted from the requirements of the proposed regulation.

K. Cost-Effectiveness

For the purposes of this section, cost-effectiveness is defined as the ratio of the cost of compliance per ton of pollution reduced. Cost-effectiveness figures allow different regulations to be compared to determine the most economic way to reduce a given amount of emissions.

In this section, we calculate the cost-effectiveness in two ways. First, we attribute the total annual cost of the proposed regulation to each pollutant individually. This results in the highest cost-effectiveness values, and may overestimate the overall cost-effectiveness of the proposed regulation. For example, a regulation that resulted in the same costs and diesel PM emission reductions, but no reductions in other pollutants, would have the same cost-effectiveness in terms of diesel PM as the proposed regulation. Therefore, as an alternative, we also calculate the cost-effectiveness by attributing half of the costs of the proposed regulation to diesel PM reductions, and the other half to reductions in nitrogen oxides (NOx) and sulfur oxides (SOx).

We also discuss the cost-effectiveness for diesel-electric vessels, which will generally incur greater costs. Finally, we will analyze the cost-effectiveness of some alternative proposals to the proposed regulation recommended by ARB staff.

Cost-Effectiveness of the Proposed Regulation for All Vessels: Attributes All Costs to Each Pollutant Individually

The estimate of the cost-effectiveness of the proposed regulation for all vessels is shown in Table VIII-10 below, expressed in 2005 dollars. The cost-effectiveness is expressed in terms of dollars per ton of NOx, diesel PM, and SOx removed, with the total annual cost attributed to each pollutant individually.

The cost-effectiveness estimates for 2010 and later assumes that the 0.1 percent sulfur marine gas oil requirement becomes effective in 2010. However, this requirement will be subject to the results of a feasibility analysis as required by the proposed regulation that will analyze the available supply of this fuel, cost, and technical feasibility.

Table VIII-10: Cost-Effectiveness of the Proposed Regulation for All Vessels: Attributes All Costs to Each Pollutant Individually

Year	Total Annual Cost ($ millions)	Emission Reductions* (tons per year)			Cost-Effectiveness $/ton and ($/pound)		
		NOx	PM	SOx	NOx	PM	SOx
2007-2009	38	575	730	5,800	66,000 ($33)	52,000 ($26)	6,600 ($3.20)
2010 - 2011	42	575	800	7,200	73,000 ($37)	53,000 ($27)	5,800 ($2.90)

* The emission reductions and costs shown are based on the 2004 emissions inventory to be consistent with other 2004 data used. The emission reductions in 2007 and 2010 will be greater than the emission reduction figures shown.

The cost-effectiveness of the proposed regulation for diesel PM (as calculated in Table VIII-10) is similar to other regulations recently adopted by the Board (see Table VIII-11 below). For example, the diesel PM cost-effectiveness of the solid waste collection vehicle rule was estimated at $56,000 per ton, 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 $8,000 to $51,000 per ton of diesel PM reduced. (ARB,2003b) Finally, the transport refrigeration unit ATCM was estimated to have a cost-effectiveness of $20,000 to $40,000 per ton of diesel PM reduced. (ARB, 2003c)

Table VIII-11: 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/Ton PM	Dollars/ Pound PM
Ship Auxiliary Engine Proposal	$52,000 - $53,000	$26 – 27
Solid Waste Collection Vehicle Rule	$56,000	$28
Stationary Diesel Engine ATCM	$8,000 - $51,000	$4 - $26
Transport Refrigeration Unit ATCM	$20,000 - $40,000	$10 - $20

Cost-Effectiveness of the Proposed Regulation for All Vessels: Attributes Half the Costs to Diesel PM and Half to NOx plus SOx

In Table VIII-12 below, we calculate the cost-effectiveness by attributing half of the costs of the proposed regulation to diesel PM reductions, and the other half to reductions in nitrogen oxides (NOx) and sulfur oxides (SOx). This may reflect the overall cost-effectiveness more accurately in that it accounts for the multiple benefits of the proposed regulation.

Table VIII-12: Cost-Effectiveness of the Proposed Regulation for All Vessels: Attributes Half of the Costs to Diesel PM and Half to NOx+SOx

Year	Half of Total Annual Cost ($ millions)	Emission Reductions (tons per year)		Cost-Effectiveness $/ton and ($/pound)	
		PM	NOx+SOx	PM	NOx+SOx
2007-2009	19	730	6,300	$26,000 ($13.00)	$3,000 ($1.50)
2010 - 2011	21	800	7,800	$27,000 ($14.00)	$2,700 ($1.40)

Cost-Effectiveness for Diesel-Electric Vessels

As explained in section F, the costs of the proposed regulation are greater for diesel-electric vessels because the large diesel generator sets these vessels use for both propulsion and ship-board electrical uses are covered as "auxiliary engines" under the proposed regulation. However, the emission reductions resulting from the use of distillate fuels will increase proportionally with the cost, so the overall cost-effectiveness of the proposed regulation for these vessels is similar to the other types of vessels. This is shown by comparing the cost-effectiveness results of Table VIII-10, for all vessels, to the results in Table VIII-13 below for diesel-electric vessels only. Similarly, the cost-effectiveness for diesel electric vessels would also be comparable to all vessels using the alternative calculation where half of the proposed regulation costs are attributed to diesel PM and half to NOx plus SOx (as calculated in Table VIII-12).

Table VIII-13: Cost-Effectiveness of Proposal on Diesel-Electric Vessels

Year	Total Annual Cost ($ millions)	Emission Reductions (tons per year)			Cost-Effectiveness $/ton and ($/pound)		
		NOx	PM	SOx	NOx	PM	SOx
2006-2009	10.7 to 12.3	150	215	1,700	$71,000-$82,000 ($36 - $41)	$50,000-$57,000 ($25-$29)	$6,300-$7,200 ($3.20-$3.60)
2010 - 2011	11.6 to 13.2	150	240	2,000	$77,000-$88,000 ($39-$44)	$48,000-$55,000 ($24-$28)	$5,800-$6,600 ($2.90-$3.30)

* Total industry fuel cost of $10.3 million ($11.2 in 2010), and annualized capital cost of 0.4 to 2 million. Annualized capital costs based on a range in retrofit costs per vessel of $100,000-$500,000 for 17 vessels reported in the ARB Ship Survey, a five year life, and 5% discount rate. Emission reductions estimated using the proportion of heavy fuel oil consumption by cruise ships compared to all vessels (~37%) and applying this ratio to total emission reductions from the proposed regulation.

L. Analysis of Alternatives

In this section, we compare the cost-effectiveness of the proposed regulation to two of the four alternative control options discuss in Chapter V. We do not discuss the cost-effectiveness of two additional alternatives discussed in Chapter V because ("Do Nothing" and "Rely on U.S. EPA and IMO Regulations") because there are no added costs associated with them.

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 similar cost-effectiveness to the proposal.

Alternative 1: Use Marine Gas Oil at Dockside Only

Under this alternative, ocean-going vessels visiting California ports would only be required to use marine distillate fuels at dockside. The emission reductions under this proposed alternative would be reduced by a minimum of 40 percent compared to the proposed regulation because the emissions from auxiliary engines on vessels at sea within the 24 nm boundary during transit would no longer be controlled. The actual reduction in emission reductions would be greater if auxiliary engines are allowed to transition from one fuel to another at dockside, since such transitions can take an hour or more. The recurring fuel costs associated with the proposed regulation would be reduced proportionally with the reduction in emissions.

The impact of this alternative on modification costs is difficult to estimate. There will probably be some reduction in retrofit costs, particularly with the diesel-electric vessels that would benefit most from this alternative. For example, such vessels may not need an additional tank for storing higher quantities of distillate fuel if the fuel will only be used at dockside. However, given the variabilities involved, we cannot quantify with certainty the reduction in retrofit costs under this alternative. Nevertheless, looking at the overall industry costs, the retrofit costs are relatively small compared to the recurring added fuel costs. Therefore, the overall cost-effectiveness of the alternative is expected to be similar to the proposed regulation.

Alternative 2: Diesel-Electric Vessels

Under this alternative, diesel electric vessels would have three compliance options: (1) use distillate fuels only at dockside as in Alternative 3 above; (2) use 1.5% sulfur heavy fuel oil within the 24 nautical mile boundary and at dockside; or (3) retrofit vessels to use shoreside electrical power and connect at California terminals where the facilities are available.

Under the first option, the same situation applies as in Alternative 3, except that the option only applies to diesel-electric vessels (primarily cruise vessels). This option would achieve significantly less emission reductions and the cost would be reduced proportionately. The cost-effectiveness is expected to be similar to the staff's proposal.

For the option to use 1.5 percent sulfur heavy fuel oil, the estimated PM emission reductions are expected to be significantly less (about 18 percent versus 75 percent for staff's proposal). SOx emissions would be reduced by about 44 percent versus 80 percent for staff's proposal, and there would be no NOx reductions. On the other hand, the cost of the 1.5 percent sulfur heavy fuel is currently much less than marine gas oil. As a result, the cost of this option would be considerably less than the cost associated with staff's proposal. Overall, we expect that the PM cost-efffectiveness of this option would be in the same range as the proposed regulation.

The third option, utilizing cold ironing where available is difficult to analyze because vessels modified for cold ironing would only plug into shoreside power if it is available.

To date, only a few California port terminals have shoreside power facilities installed. Additional facilities are anticipated at the Ports of Los Angeles, Long Beach and Oakland. However, it will be several years before new additional shoreside power facilities are operational. As a result, we cannot quantify the emissions reductions for this option at this time.

Overall, the emission reductions from any of these options under this alternative would be significantly less than the ARB staff proposal, although the cost-effectiveness would be similar.

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IX. ADDITIONAL CONSIDERATIONS

In this chapter, we discuss additional technical and policy issues that were addressed in developing the proposed regulation for auxiliary engines on ocean-going vessels. These include the impacts on infrequent visitors to California ports, diesel-electric vessels, the over-water boundary covered by the proposal, and the scope of the Alternative Compliance Plan (ACP) provision.

A. Ocean-going Vessels that Require Modifications to Comply

We estimate that a small percentage of vessels will require modifications to comply with the proposed regulation. For example, we estimate that about 5 percent of non-diesel-electric vessels (which make up nearly 98 percent of the vessels visiting California ports) will require retrofits. However, for the minority of vessels that require modifications, the proposed regulation may pose additional challenges. For example, industry representatives have stated that there are a limited number of shipyards available to perform vessel modifications, and it may be difficult to perform the required changes by the January 1, 2007 effective date of the proposed regulation.

In addition, industry representatives have stated that it may be impractical and burdensome to perform vessel modifications on vessels that only occasionally visit California ports. In fact, based on California State Lands Commission data, roughly half of the nearly 2,000 unique vessels that visited California in 2004 only visited once or twice. Although only about 5 percent of these vessels may need modifications, these infrequent visitors that require modifications would still constitute a significant percentage of the overall visits to California ports. Therefore, it is important that these emissions be controlled under the proposed regulation.

To address the above concerns, two options have been included in the Noncompliance Fee Provision as discussed below. Under the Noncompliance Fee Provision, vessel operators can pay a fee in lieu of complying with the emission standard in the proposed regulation. The funds collected would be deposited in an account that would provide resources for port and marine related emission reduction projects. The objective is to reduce equivalent or greater emissions in the same general area more cost-effectively. The fee will be designed to encourage direct compliance with the proposed regulation by ensuring that the use of the provision does not provide an economic advantage relative to the cost of direct compliance with the proposal.

<u>Vessels that Cannot Complete Modifications by January 1, 2007</u>

Under this option, vessel operators may pay a noncompliance fee if they can demonstrate that they cannot complete the necessary modifications prior to the January 1, 2007 effective date of the emission limits in the proposed regulation. To utilize this option, vessel operators must submit a "Compliance Retrofit Report," signed by the Chief Engineer of the vessel which identifies the modifications needed to comply with the proposed regulation, demonstrates that the modifications will be made at the earliest possible date, and provides the date when modifications will be completed.

Infrequent Visitors that Require Modifications

Under this option, a vessel operator could pay the noncompliance fee in lieu of compliance for a vessel requiring modifications up to a maximum of two California port visits per calendar year, and four California port visits over the life of the vessel (starting on January 1, 2007). The vessel operator must demonstrate that vessel modifications are necessary to comply with the proposed regulation and commit to the visitation limits.

B. Vessel Noncompliance for Reasons Beyond the Reasonable Control of the Vessel Owner/Operator

In certain limited situations, vessel owners or operators may not be able to comply with the proposed regulation for reasons beyond their reasonable control. Instead of providing an exemption for these situations, staff is proposing to allow use of the "noncompliance fee" provision. The situations where this provision could be utilized include the following:

- the vessel was redirected to a California port and the vessel does not have sufficient quantity of fuel that meets the requirements of the proposal;
- the vessel operator was not able to acquire a sufficient quantity of complying fuel; or
- the fuel was found to be noncompliant in route to a California port.

To utilize this option, vessel operators must demonstrate through adequate documentation that noncompliance resulted from circumstances beyond their reasonable control.

We believe it is important to retain the fee schedule for vessels that do not comply under these circumstances, as opposed to an exemption or variance, to prevent the creation of a loophole in the proposal. In addition, vessel visits occur too quickly to allow for a detailed review of the information necessary to determine whether a variance or exemption is justified.

C. Diesel-Electric Vessels

Diesel-electric vessels are vessels that use large diesel engines coupled to generators ("gen-sets") to produce electrical power which propels the vessel and provides ship-board electricity. This is in contrast to typical cargo vessels where a large main engine provides propulsion, and separate smaller diesel gen-sets ("auxiliary engines") provide electrical power for ship-board uses. The large gen-sets on diesel-electric vessels are defined as "auxiliary engines" in the proposed regulation and thus are subject to the requirements of the proposed regulation the same as the smaller gen-sets on cargo vessels.

Industry representatives have stated that it is inappropriate to regulate the large gen-sets on diesel-electric vessels as "auxiliary engines" because they are used for propulsion as well as ship-board electricity and the costs of the proposal are disproportionately high for diesel-electric vessels. They have also stated that we may inadvertently drive the industry away from cleaner diesel-electric vessels to higher polluting two-stroke direct drive configurations common in most other types of vessels.

Industry representatives have suggested a number of alternative regulatory approaches to address these diesel-electric vessels including the following: (1) limiting the control of these vessels to the portion of power used for ship-board electrical uses (i.e. exempt the portion of power generated for propulsion); (2) limit the requirements of the proposal to dockside operation; and (3) require the use of 1.5 percent sulfur heavy fuel oil instead of the distillate fuels specified in the proposed rulemaking.

Staff believes it is appropriate to control all of the emissions from the large gen-set engines on diesel-electric vessels because the proposal represents a technically feasible and cost-effective means of controlling their emissions. These large gen-set engines are mechanically similar to the smaller auxiliary engines. Specifically, both engines are four-stroke, medium speed engines, and both are used in generator set applications. We are not addressing the main engines in other types of vessels because they are predominantly two-stroke engines that are mechanically very different, and because the use of marine distillate fuels in these engines introduces additional challenges compared to four-stroke medium speed engines. We plan to address main propulsion engines in future efforts.

We agree that the added cost on the operators of diesel-electric vessels will be significantly higher than for operators of other vessel types. Specifically, because the gen-sets on diesel-electric vessels are used for propulsion as well as ship-board electrical uses, the amount of fuel used in these engines is much greater and the impact of using the distillate fuels specified in the proposal would be proportionately higher. However, as explained in Chapter VIII, Economic Impacts, the impacts on operators of these vessels are not expected to result significant adverse impacts on their profitability, and the control of these vessels is equally cost-effective compared to other vessels because the emission reductions increase commensurately with the cost.

We do not believe that the proposal will lead the industry away from diesel-electric vessels. As mentioned above, we plan to address the emissions from the main engines not covered by the proposed regulation at a later date. In addition, as discussed in Chapter VIII, the added cost resulting from the proposed regulation is generally a small percentage of vessels' overall operating costs. Finally, diesel-electric vessels have advantages that were considered in the design of vessel and its intended function. For example, cruise vessels sometimes operate at less than maximum speed and can run more efficiently by operating some (but not all) of their gen-sets at relatively high loads where they are more fuel-efficient, as opposed to running a single large engine at a less fuel efficient load. In addition, diesel-electric vessels generally have several gen-sets which provide for redundancy in the case of an engine failure.

D. Scope of the Alternative Compliance Plan

The Alternative Compliance Plan (ACP) was included in the proposed regulation to allow vessel owner/operators with the flexibility to implement alternative emission control strategies that achieve equivalent or greater emission reductions than the fuel requirements specified in the proposal. Alternative emission control strategies may include the use of shore-side electrical power, engine modifications, exhaust treatment devices such as diesel oxidation catalysts, the use of alternative fuels or fuel additives, and operational controls such as limits on idling time.

As proposed, the ACP allows a company with a fleet of vessels to average its auxiliary engine emissions over all the vessels in the fleet such that the total emission reduction achieved is equivalent to or greater than the emission reductions that would have occurred if all these vessels complied with the fuel provisions in the proposal. For example, a company with a vessel that frequently visits California ports could achieve greater emission reductions than required on that vessel to offset higher emissions from one or more other vessels. However, the ACP does not allow inter-fleet averaging (i.e. averaging among the fleets of two different companies). The ACP provision also does not allow emission reductions from main engines, or other sources not classified as vessel auxiliary engines. We believe this limitation is necessary to ensure that the complexity of the program will not adversely affect the ability of ARB staff to ensure ongoing compliance under an ACP. In addition, limiting the provision to auxiliary engines will ensure that emission reductions achieved farther offshore are not traded for fewer reductions close to shore, where diesel PM emission reductions are most critical to reducing the potential cancer risk.

E. Enforcement of the Proposed Regulation

Enforcement of this regulation will be achieved through random inspections of records and fuel sampling/testing. Specifically, records will be inspected to determine when vessels were traveling within "Regulated California Waters" and what fuel was used during this time. Records on quantity of fuel purchased, the fuel type, and the sulfur content of the fuel will be reviewed to determine compliance. As appropriate, fuel sampling will be conducted during the vessel inspection. Fuel samples will be analyzed to ensure that they meet the ISO specifications for the fuel type and do not exceed the sulfur content limits under ISO or the regulation.

Given the large number of vessels and relatively lengthy inspection time per vessel, we envision using vessel visit data to prioritize inspection resources. One approach will be to focus on the vessels that are the most frequent visitors to California ports. Inspection priority could also be directed to vessels that are complying using an alternative compliance plan.

As a long term goal, ARB staff would like to transition from compliance data being recorded in logs maintained on the vessel, to automated electronic data devices that can store and transmit data needed to assess compliance. We are aware of technology that potentially would allow continuous monitoring of key parameters such as fuel flow and vessel positions. This information could be recorded in a data logger. Such information could be accessed during an inspection or transmitted to a shore-based receptor.

ARB staff plans to work with vessel owners and equipment suppliers to develop and field test data recording and submittal systems that can provide compliance data on a real-time basis.

Appendix A

Proposed Regulation for Auxiliary Diesel Engines and Diesel-Electric Engines Operated on Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baseline

PROPOSED REGULATION ORDER

EMISSION LIMITS AND REQUIREMENTS FOR AUXILIARY DIESEL ENGINES AND DIESEL-ELECTRIC ENGINES OPERATED ON OCEAN-GOING VESSELS WITHIN CALIFORNIA WATERS AND 24 NAUTICAL MILES OF THE CALIFORNIA BASELINE

Adopt new section 2299.1, title 13, California Code of Regulations (CCR), to read as follows:

13 CCR, section 2299.1. Emission Limits and Requirements for Auxiliary Diesel Engines and Diesel-Electric Engines Operated on Ocean-going Vessels within California Waters and 24 Nautical Miles of the California Baseline.

(a) **Purpose**

The purpose of this section is to reduce emissions of diesel particulate matter (PM), nitrogen oxides, and sulfur oxides from the use of auxiliary diesel engines and diesel-electric engines operated on ocean-going vessels located within any of the waters subject to this regulation ("Regulated California Waters"), which includes all California inland waters; all California estuarine waters; and all waters, except as otherwise specified in this section, within 24 nautical miles, inclusive, of the California baseline, including but not limited to, the Territorial Sea, the Contiguous Zone, and any California port, roadstead or terminal facility.

(b) **Applicability**

(1) Except as provided in subsection (c), this section applies to any person who owns, operates, charters, rents, or leases an ocean-going vessel, including foreign-flagged vessels, within any of the Regulated California Waters, which include all California inland waters; all California estuarine waters; and all waters, except as otherwise specified in this section, within 24 nautical miles, inclusive, of the California baseline, including but not limited to, the Territorial Sea, the Contiguous Zone, and any California port, roadstead, or terminal facility.

(2) Nothing in this section shall be construed to amend, repeal, modify, or change in any way any applicable U.S. Coast Guard requirements. Any person subject to this section shall be responsible for ensuring compliance with both U.S. Coast Guard regulations and the requirements of this section, including but not limited to, obtaining any necessary approvals, exemptions, or orders from the U.S. Coast Guard.

(c) Exemptions

(1) The requirements of this section do not apply to oceangoing vessels while in innocent passage, as defined in subsection (d), through the Territorial Sea or the Contiguous Zone.

(2) The requirements of this section do not apply to slow-speed two-stroke diesel engines as defined in subsection (d).

(3) The requirements of this section do not apply to auxiliary engines onboard oceangoing military vessels.

(4) The requirements of this section do not apply to auxiliary engines while operating on liquefied natural gas or compressed natural gas.

(d) Definitions

For purposes of this section, the following definitions apply:

(1) "ASTM" means ASTM International

(2) "Auxiliary engine" means an engine on an oceangoing vessel designed primarily to provide power for uses other than propulsion, except that all diesel-electric engines shall be considered "auxiliary diesel engines" for purposes of this regulation.

(3) "Baseline" means the mean lower low water line along the California coast, as shown on the following National Oceanic and Atmospheric Administration (NOAA) Nautical Charts as authored by the NOAA Office of Coast Survey, which are incorporated herein by reference:

(A) Chart 18600, Trinidad Head to Cape Blanco (January 2002);
(B) Chart 18620, Point Arena to Trinidad Head (June 2002);
(C) Chart 18640, San Francisco to Point Arena (July 2000);
(D) Chart 18680, Point Sur to San Francisco (March 2001);
(E) Chart 18700, Point Conception to Point Sur (July 2003);
(F) Chart 18720, Point Dume to Purisima Point (January 2005); and
(G) Chart 18740, San Diego to Santa Rosa Island (August 2003).

(4) "Contiguous Zone" means the maritime zone adjacent to the territorial sea and extending to 24 nautical miles from the baseline of California, determined in accordance with international law as specified in Presidential Proclamation No. 7219 of August 2, 1999, 64 F.R. 48701 (September 8, 1999).

(5) "Diesel Engine" means an internal combustion, compression-ignition (CI) engine with operating characteristics significantly similar to the theoretical diesel combustion cycle. The regulation of power by controlling fuel supply in lieu of a throttle is indicative of a compression ignition engine.

(6) "Diesel Particulate Matter" means the particles found in the exhaust of diesel engines, which may agglomerate and adsorb other species to form structures of complex physical and chemical properties.

(7) "Diesel-electric engine" means a diesel engine connected to a generator that is used as a source of electricity for propulsion or other uses.

(8) "Emission Control Strategy" means any device, system, or strategy employed with a diesel engine that is intended to reduce emissions, including, but not limited to, utilization of shore-side electrical power, diesel oxidation catalysts, selective catalytic reduction systems, fuel additives, diesel particulate filters, alternative diesel fuels, water emulsified fuels, lower sulfur fuels, and any combination of the above.

(9) "Estuarine Waters" means an arm of the sea or ocean that extends inland to meet the mouth of a river.

(10) "Executive Officer" means the executive officer of the Air Resources Board, or his or her designee.

(11) "Hydrocarbon (HC)" means the sum of all hydrocarbon air pollutants.

(12) "Inland Waterways" means any navigable river or waterway within the State of California.

(13) "IMO" means the International Maritime Organization.

(14) "Innocent Passage" means the continuous and expeditious navigation through Territorial Sea or the Contiguous Zone for the purpose of traversing such bodies of water without entering internal California waters or calling at a port, roadstead, or terminal facility. "Innocent passage" does not include passage of an oceangoing vessel if that vessel engages in any of the prejudicial activities specified in United Nations Convention on the Law of the Seas (UNCLOS) 1982, Article 19, subpart 2. For the purposes of this definition, "continuous and expeditious navigation" includes stopping and anchoring only to the extent such stopping and anchoring are documented as required by the U.S. Coast Guard; rendered necessary by force majeure or distress; or made for the purpose of rendering assistance to persons, ships, or aircraft in danger or distress. Notwithstanding any Coast Guard mandated stops or stops due to force majeure or the rendering of assistance, a vessel is not in innocent passage if the vessel was otherwise scheduled or intended to enter internal California waters or call at a port, roadstead or terminal facility.

(15) "ISO" means the International Organization for Standardization.

(16) "Marine Diesel Oil" means any fuel that meets all the specifications for DMB grades as defined in Table I of International Standard ISO 8217, as revised in 1996, which is incorporated herein by reference.

(17) "Marine Gas Oil" means any fuel that meets all the specifications for DMX or DMA grades as defined in Table I of International Standard ISO 8217, as revised in 1996, which is incorporated herein by reference.

(18) "Military Vessel" means any ship, boat, watercraft, or other contrivance used for any purpose on water, and owned or operated by the armed services.

(19) "Nitrogen Oxides (NOx)" means compounds of nitric oxide (NO), nitrogen dioxide (NO2), and other oxides of nitrogen, which are typically created during combustion processes and are major contributors to smog formation and acid deposition.

(20) "Non-Methane Hydrocarbons (NMHC)" means the sum of all hydrocarbon air pollutants except methane.

(21) "Oceangoing Vessel" means a commercial, government, or military vessel meeting any one of the following criteria:

(A) a vessel with a "registry" (foreign trade) endorsement on its United States Coast Guard certificate of documentation, or a vessel that is registered under the flag of a country other than the United States;
(B) a vessel greater than or equal to 400 feet in length overall (LOA) as defined in 50 CFR § 679.2, as adopted June 19, 1996;
(C) a vessel greater than or equal to 10,000 gross tons (GT ITC) per the convention measurement (international system) as defined in 46 CFR 69.51-.61, as adopted September 12, 1989; or
(D) a vessel propelled by a marine compression ignition engine with a per-cylinder displacement of greater than or equal to 30 liters.

(22) "Operate" means steering the vessel while underway.

(23) "Own" means having all the incidents of ownership, including the legal title, of a vessel whether or not that person lends, rents, or pledges the vessel; having or being entitled to the possession of a vessel as the purchaser under a conditional sale contract; or being the mortgagor of a vessel.

(24) "Particulate Matter" means any airborne finely divided material, except uncombined water, which exists as a liquid or solid at standard conditions (e.g., dust, smoke, mist, fumes or smog).

(25) "Person" includes all of the following:

(A) any person, firm, association, organization, partnership, business trust, corporation, limited liability company, or company;
(B) any state or local governmental agency or public district, or any officer or employee thereof;
(C) the United States or its agencies, to the extent authorized by federal law.

(26) "Regulated California Waters" means all California inland waters; all California estuarine waters; and any portion of the Territorial Sea, the Contiguous Zone, and any California port, roadstead, or terminal facility located:

(A) within the area between the California baseline and 24 nautical miles seaward, inclusive, starting at the California-Oregon border to 34.43 degrees North, 121.12 degrees West; and
(B) within the area between the California baseline and a line starting at 34.43 degrees North, 121.12 degrees West; thence to 33.50 degrees North, 118.58 degrees West; thence to 32.48 degrees North, 117.67 degrees West; and ending at the California-Mexican border at the Pacific Ocean.

(27) "Roadstead" means any facility, located anywhere within the bodies of water specified in subsection (b), that is used for the loading, unloading, and anchoring of ships.

(28) "Slow Speed Engine" means an engine with a rated speed of 150 revolutions per minute or less.

(29) "Sulfur Oxides" means compounds of sulfur dioxide (SO_2), and other oxides of sulfur, which are typically created during combustion of sulfur containing fuels.

(30) "Territorial Sea" means the maritime zone extending to 12 nautical miles from the California baseline, determined in accordance with international law as specified in Presidential Proclamation No. 5928 of December 27, 1988, 54 F.R. 777 (January 9, 1989).

(31) "Two-stroke Engine" means an internal combustion engine which operates on a two stroke cycle where the cycle of operation completes in one revolution of the crankshaft.

(32) "Vessel" means any tugboat, tanker, freighter, passenger ship, barge, or other boat, ship, or watercraft, except those used primarily for recreation and any of the following:

(A) A seaplane on the water;
(B) A watercraft specifically designed to operate on a permanently fixed course, the movement of which is restricted to a fixed track or arm to which the watercraft is attached or by which the watercraft is controlled.

(e) Requirements

(1) Emission Limits

Except as provided in subsections (c), (f), (g) and (h), no person subject to this section shall operate any auxiliary diesel engine, while the vessel is operating in any of the Regulated California Waters, which emits levels of diesel PM, NOx, or SOx in exceedance of the emission rates of those pollutants that would result had the engine used the following fuels:

(A) Beginning January 1, 2007:

1. marine gas oil, as defined in subsection (d); or

2. marine diesel oil, as defined in subsection (d), with a sulfur content of no more than 0.5 percent by weight;

(B) Beginning January 1, 2010: marine gas oil with a sulfur content of no more than 0.1 percent by weight.

(C) Compliance with the emission rate limits specified in subsection (e)(1) is presumed if the person operates the regulated engine(s) with the fuels as specified in subsection (e)(1)(A) and (e)(1)(B), or as otherwise permitted in subsection (g).

(2) Recordkeeping, Reporting, and Monitoring Requirements

(A) Recordkeeping

Beginning January 1, 2007, any person subject to this section shall retain and maintain records in English that contain the following information for at least three years following the date when the records were made:

1. The date, local time, and position (longitude and latitude) of the vessel for each entry into and departure from the Contiguous Zone, excluding any voyages comprised solely of innocent passage as defined in subsection (d);

2. The date, local time, and position (longitude and latitude) of the vessel at the initiation and completion of any fuel switching procedures used to comply with subsection (e)(1) prior to entry into any of the Regulated California Waters;

3. The date, local time, and position (longitude and latitude) of the vessel at the initiation and completion of any fuel switching procedures within any of the Regulated California Waters;

4. Completion of fuel switching procedures is the moment at which a given engine (or engines) has completely transitioned from operation on one fuel to another fuel;

5. The type of each fuel used (e.g. marine gas oil) in each auxiliary engine operated in any of the Regulated California Waters; and

6. The types, amounts, and the actual percent by weight sulfur content of all fuels purchased for use on the vessel during the calendar year, as reported by the fuel supplier or a fuel testing firm.

(B) Reporting and Monitoring

1. Any person subject to this section shall provide in writing the information specified in subsection (e)(2)(A) to the Executive Officer upon request, either within 24 hours or a mutually agreed time approved by the Executive Officer. To the extent the person already collects the information specified in subsection (e)(2)(A) to comply with other regulatory requirements or standard practices, the person may provide the requested information in a format consistent with those other regulatory requirements or standard practices.

2. Any person subject to this section shall provide to the Executive Officer upon request additional information the Executive Officer determines to be necessary to determine compliance with this section including, but not limited to:

   a. the make, model, rated power, and serial numbers of all auxiliary engines subject to subsection (e)(1);
   b. the capacity and locations of all fuel tanks on the vessel; and
   c. piping diagrams and specifications for mixing tanks or other fuel handling equipment applicable to auxiliary engines.

3. Any person subject to this section shall provide to the Executive Officer access to the vessel for the purpose of determining compliance with the this section, including but not limited to, access to and review of records and information required under subsection (e)(2)(A) or (e)(2)(B)2, and for the purpose of collecting fuel samples for testing and analysis.

(f) [Reserved for future use]

(g) Alternative Compliance Plan (ACP) in Lieu of Meeting Subsection (e)(1)

(1) Requirements

(A) The purpose of this subsection is to allow any person ("person" or "applicant") subject to this regulation the option of complying with the requirements of this subsection (g) in lieu of the requirements of subsection (e)(1). Under this subsection (g), alternative emission control strategies can be implemented in lieu of meeting the requirements of subsection (e)(1), provided they result in no greater emissions, expressed in pounds, of diesel PM, NOx, and SOx, emissions from the auxiliary diesel engines, over the applicable calendar year, relative to the emissions that would have occurred under subsection (e)(1).

(B) An applicant wishing to participate in an ACP may include one or more vessels in the alternative compliance plan, but the applicant shall only include vessels that the person owns or operates under their direct control.

(C) An applicant for an ACP shall submit information to the Executive Officer that demonstrates that the alternative emission control strategies under the proposed ACP will result in no greater emissions, expressed in pounds, of diesel PM, NOx, and SOx emissions from the auxiliary diesel engines, over the applicable calendar year, relative to the emissions that would have occurred under subsection (e)(1).

(D) Alternative emission control strategies may include, but are not limited to:

1. utilization of shore-side electrical power in lieu of onboard generators,
2. auxiliary engine modifications,
3. exhaust treatment control, and
4. use of alternative fuels or fuel additives.

(E) The ACP application demonstrating compliance with this subsection shall contain, at a minimum, the following information:

1. the company name, address, and contact information;
2. the vessel(s) name, country flag, and IMO identification number;
3. the engine/(s) subject to the ACP, make, model, and serial numbers, and other information that uniquely identify the engine on the affected vessel;
4. documentation, calculations, emissions test data,, or other information that establishes the diesel PM, NOx, and SOx, reductions, expressed in pounds, from auxiliary engines will be equivalent to or greater than the emission reductions that would have been achieved upon compliance with under subsection (e)(1);
5. information on the California ports visits expected to be visited by the affected vessel(s) during the period that the ACP will be in effect, the anticipated dates of those visits, and the potential planned oversea routes to and from these ports; and
6. the proposed recordkeeping, reporting, monitoring, and testing procedures that the applicant plans to use to demonstrate continued compliance with the ACP.

(F) Emission reduction calculations demonstrating equivalence with the requirements of subsection (e)(1) shall only include diesel PM, NOx, and SOx emissions from auxiliary engines operating within any of the Regulated California Waters.

(G) Use of Shore-Side Power

1. Except as otherwise provided in this subsection (g)(1)(G), vessels in an ACP that utilize shore-side power in lieu of their auxiliary diesel engines while at dockside shall be considered to meet the emission reduction requirements of the ACP during:

   a. all travel within Regulated California Waters from a previous port to the California port terminal where shore-side power is used;
   b. time spent secured ("docked") at the California port terminal where shore-side power is used; and
   c. all travel within Regulated California Waters from the California port where shore-side power is utilized to the next port visited.

2. For the purposes of this subsection (g)(1)(G), "utilizing shore-side power" means:

   a. connecting to electricity supplied by a utility company, or another source with emissions per unit of delivered energy equivalent to or lower than the January 1, 2007 levels specified in title 17, CCR, sections 94200-94214, "Distributed Generation Certification Program;" and
   b. shutting down all auxiliary engines subject to this control measure no later than one hour after the vessel is secured at the port terminal, and continuously thereafter until no more than one hour prior to when the vessel leaves the terminal.

3. Except as otherwise provided in paragraph 5 below, if a vessel in an ACP visits two California ports in succession, and the vessel utilizes shore-side power at the first port but not at the second port visited, the vessel shall not be considered to meet the emission reduction requirements of the ACP during the time it is docked at the second port and any subsequent travel within Regulated California Waters from this port.

4. Except as otherwise provided in paragraph 5 below, if a vessel in an ACP visits two California ports in succession, and the vessel utilizes shore-side power at the second port but not at the first port visited, the vessel shall not be considered to meet the emission reduction requirements of the ACP during travel within Regulated California Waters to this first port or during the time the vessel is docked at the first port. Travel from the first port to the second port where shore-side power is utilized shall be deemed to meet the emission reduction requirements of the ACP.

5. The provisions in paragraphs 3 and 4 above notwithstanding, if a passenger cruise vessel in an ACP visits a California port, utilizes shore-side power at that port, then leaves that port and moors (i.e.,

drops anchor) at another offshore location away from a port, roadstead or terminal facility (e.g., Catalina Island or off Monterey), the mooring stop shall not be deemed as a second port visit. However, a person subject to this provision shall meet the emission limits in subsection (e)(1) for all auxiliary diesel engines on the passenger cruise vessel (i.e., all diesel-electric engines) during the entire time the vessel is moored.

(H) Any person subject to an approved ACP shall maintain operating records in a manner and form as specified by the Executive Officer in the approved ACP. Required records may include, but are not limited to, information on fuel usage, routes, port calls, maintenance procedures, and emissions test results. Such records and reports shall be retained for a period of not less than three (3) years and shall be submitted to the Executive Officer in the manner specified in the approved ACP and upon request by the Executive Officer.

(I) Emission reductions included in an ACP shall not include reductions that are otherwise required by any State, federal or international rule, regulation, or statute.

(J) No person may operate a vessel under an ACP unless the applicant has first been notified in writing by the Executive Officer that the ACP application has been approved. Prior to such approval, applicants shall comply with the provisions of this section, including the emission limits in subsection (e)(1).

(2) Application Process

(A) Applications for an ACP shall be submitted in writing to the Executive Officer for evaluation.

(B) The Executive Officer shall notify the applicant in writing whether their application is approved or denied within 90 days of receipt of the submittal.

(C) Additional information may be provided by the applicant after submittal of the original application. However, the Executive Officer shall have 90 days after submittal of the additional information to notify the applicant of approval or denial of the ACP.

(D) The applicant shall notify the Executive Officer in writing within 30 days upon learning of any information that would alter the emissions estimates submitted in the ACP application. If the Executive Officer has reason to believe that an approved ACP has been granted to a person that no longer meets the criteria for an ACP, the Executive Officer may modify or revoke the ACP as necessary to assure that the subject vessel(s) will meet the emission reduction requirements in this section.

(h) Noncompliance Fee In Lieu of Meeting Subsection (e)(1)

The Executive Officer may permit a person ("person") to pay noncompliance fees ("fees") in lieu of meeting the requirements of subsection (e)(1). Payment of the fees notwithstanding, all other provisions of this section shall continue to apply. No person shall be permitted to pay the fees unless the person meets the notification requirements in subsection (h)(1) and the requirements in either subsections (h)(2), (h)(3), or (h)(4), as specified below:

(1) Notification Requirements

Before the person's vessel enters Regulated California Waters, the Executive Officer must receive notice that the person will not meet the requirements of subsection (e)(1) while operating within Regulated California Waters, but the person will instead meet the requirements of this subsection (h). If the Executive Officer has not received such notice and the person enters Regulated California Waters, the person will be in violation of this section and will not be permitted to pay the fees in lieu of meeting the requirements of subsection (e)(1).

(2) Noncompliance for Reasons Beyond a Person's Reasonable Control

Any person wishing to pay the fees under this subsection (h)(2) shall meet the following criteria:

(A) ***Demonstration of Need***: The person shall, through adequate documentation, demonstrate to the Executive Officer's satisfaction that the person's noncompliance with the requirements of subsection (e)(1) is beyond the person's reasonable control. For the purposes of this paragraph, "beyond the person's reasonable control" applies only when one or more of the following sets of circumstances (1, 2, 3, or 4) applies:

1. **Unplanned Redirection**. This provision applies only when all of the following criteria are met:

   a. after leaving the last port of call, the person's vessel was redirected from his/her original, officially logged, non-California destination to a California port, roadstead, or terminal facility ("port"); and

   b. the vessel does not contain a quantity of fuel sufficient for the auxiliary engines to meet the requirements of subsection (e)(1).

2. **Inadequate Fuel Supply**. This provision applies only when all of the following criteria are met:

   a. the person made good faith efforts to acquire a quantity of fuel sufficient for the vessel's auxiliary engines to meet the requirements of subsection (e)(1); and

b. the person was unable to acquire fuel sufficient for the engines to meet the requirements of subsection (e)(1).

3. **Inadvertent Purchase of Defective Fuel**. This provision applies only when all of the following criteria are met:

a. based on the fuel supplier's certification of the fuel specifications, the person reasonably believed, and relied on such belief, that the fuel the person purchased on the route from the vessel's home port to California would enable the auxiliary engines to meet the requirements of subsection (e)(1);

b. the person determined that the vessel's auxiliary engines in fact will not meet the requirements of subsection (e)(1) using any of the fuel purchased under paragraph 3.a. above; and

c. the vessel is already on its way to California, and there are no other ports of call on the vessel's route where fuel can be purchased sufficient to meet the requirements of subsection (e)(1).

(B) ***Payment of Fees.*** Upon meeting the requirements of paragraph (A) in this subsection (h)(2), the person shall pay the fees for every port visit during the period of time the person does not meet the requirements of subsection (e)(1), as specified in subsection (h)(5) below.

(C) ***Executive Officer Review.*** For the purposes of verifying the demonstration of need as specified in subsection (h)(2)(A), the Executive Officer may consider and rely on any facts or circumstances the Executive Officer believes are appropriate, including but not limited to: the fuel supplier's ability or failure to provide adequate fuel ordered by the person; any material misrepresentation by the fuel supplier concerning the fuel specifications; the reasonableness of the person's reliance on fuel suppliers with a history of supplying fuel inadequate for meeting the requirements of subsection (e)(1); and force majeure.

(3) Noncompliance for Vessels To Be Taken Out of Service for Modifications

If a person cannot meet the requirements of subsection (e)(1) without vessel modifications, and such modifications cannot be completed prior to the effective date of subsection (e)(1), the Executive Officer may permit the person to pay the fees as specified in this subsection. This provision also applies to vessels that will undergo modifications pursuant to an Executive Officer approved Alternative Compliance Plan. The vessel must be scheduled to complete the necessary modifications (e.g. during a dry dock operation) as soon as possible, but no later than 5 years after the effective date of this section. For this provision to apply, the person shall meet all of the following criteria:

(A) ***Demonstration of Need.*** The person shall provide the Executive Officer a Compliance Retrofit Report, signed by the Chief Engineer of the person's vessel, which:

1. identifies the specific vessel modifications ("modifications") (e.g. installation of additional fuel tanks) the person plans to use for meeting the requirements of subsection (e)(1) or an Alternative Compliance Plan;

2. identifies the specific date by which the modifications will be completed (e.g. while the vessel is in dry dock); and

3. demonstrates to the satisfaction of the Executive Officer that the modifications will be made at the earliest possible date (e.g. the vessel has been scheduled for the earliest available dry dock appointment).

(B) ***Payment of Fees.*** Upon meeting the requirements of paragraph (A) in this subsection (h)(3), the person shall pay the fees for every port visit until the dry dock modifications are completed, as specified in subsection (h)(5) below,.

(C) ***Proof of Modifications Actually Performed.*** Within ten (10) business days after the scheduled or actual completion of the modifications, whichever occurs first, the person shall provide written certification to the Executive Officer that the modifications specified under this subsection (h)(3) have been completed. If the modifications have not been completed, the person shall certify which modifications have been completed, which have not, and the anticipated completion date for the remaining modifications. The notification requirement specified in this paragraph, the notification requirements in subsection (h)(1) above, and the fee provisions in subsection (h)(5) below shall apply until all the modifications have been completed.

(4) Noncompliance Based on Infrequent Visits and Need for Vessel Modifications

If a person cannot meet the requirements of subsection (e)(1) without vessel modifications, and this vessel will make no more than two California port visits per calendar year, and no more than 4 California port visits after January 1, 2007 during the life of the vessel, the Executive Officer may permit the person to pay the fees as specified in this subsection.

(A) ***Demonstration of Need.*** The person shall demonstrate to the satisfaction of the Executive Officer that modifications to the vessel are necessary to meet the requirements of subsection (e)(1), and that the vessel shall meet the visitation limits specified in this subsection (h)(4).

(B) ***Payment of Fees***. Upon meeting the requirements of paragraph (A) in this subsection (h)(4), the person shall pay the fees for every port visit up to a maximum of 4 visits, as specified in subsection (h)(5) below.

(5) Calculation and Payment of Fees

For each California port, roadstead, or terminal facility in Regulated California Waters at which the person's vessel stops or anchors ("port visit"), the person who elects to pay the fees shall pay the applicable fees shown in Table 1. For each port visit, the person shall deposit the fees in the port's Noncompliance Fee Settlement and Air Quality Mitigation Fund prior to leaving the California port:

(A) After January 1, 2007, each instance of a vessel stopping or anchoring at a port shall count as one port visit, and the port visits shall be cumulative.

Table 1: Noncompliance Fee Schedule, Per Vessel		
Visit	Fee	
	Diesel-Electric Vessels	Other Vessels
1st Port Visited	$32,500	$13,000
2nd Port Visited	$65,000	$26,000
3rd Port Visited	$97,500	$39,000
4th Port Visited	$130,000	$52,000
5th or more Port Visited	$162,500	$65,000

(B) The fees shown in Table 1 shall be assessed by the Executive Officer at the time of the port visit. However, if for any reason the person is not notified by the Executive Officer of the assessed fee by the end of the port visit, the person shall nevertheless be responsible for payment of the appropriate fee as specified in this subsection (h) prior to leaving the California port.

(C) The Executive Officer shall enter into enforceable agreements with each port that will receive the fees. The agreements shall require that the fees be used by the ports only to fund projects that will substantially reduce air pollution from on-site sources, sources within 2 miles of port boundaries, or oceangoing vessels operated within the Regulated California Waters, except that the fees shall not be used to fund projects on vessels from which noncompliance fees were paid. Fees intended for ports that do not have such agreements at the time the fees are paid shall be deposited into the California Air Pollution Control Fund.

(i) Test Methods

The following test methods or alternative test methods that are demonstrated to the written satisfaction of the Executive Officer to be equally or more accurate, shall be used to determine compliance with this section:

(1) Test methods used to determine whether fuels meets the requirements of marine gas oil (DMA or DMX) or marine diesel oil (DMB), as specified in subsection (e)(1), shall be the methods specified in International Standard ISO 8217 (as revised in 1996), which is incorporated herein by reference.

(2) The sulfur content of fuels shall be determined per International Standard ISO 8754 (as adopted in 1992), which is incorporated herein by reference.

(j) Sunset, Technology Re-evaluation, and Baseline and Test Method Review

(1) If the Executive Officer determines that the International Maritime Organization or the United States Environmental Protection Agency have adopted regulations that will achieve equivalent or greater emission reductions from oceangoing vessels in California compared to the emission reductions resulting from this regulation, the Executive Officer shall propose to the Board for its consideration the termination of the requirements of this section or other modifications to the section as deemed appropriate by the Executive Officer.

(2) On or before July 1, 2008, the Executive Officer shall re-evaluate the feasibility of the emission limits based on using marine gas oil with no greater than 0.1 percent sulfur by weight in auxiliary diesel engines. The re-evaluation shall consider, but not be limited to:

(A) the availability of 0.1 percent sulfur marine gas oil at bunkering ports worldwide;

(B) the ability of petroleum refiners and marine fuel suppliers to deliver 0.1 percent sulfur fuel by January 1, 2010;

(C) fuel lubricity and compatibility of the 0.1 percent sulfur marine gas oil with heavy fuel oil during fuel transitions; and

(D) the additional cost of 0.1 percent sulfur fuel compared to marine gas oil with other levels of sulfur content.

(3) Pursuant to paragraph (2) of this subsection (j), if the Executive Officer determines that modifications to subsection (e)(1)(B) are necessary, the Executive Officer shall propose appropriate changes to the Board prior to January 1, 2009.

(4) The Executive Officer shall periodically review the California baseline determinations by the National Oceanic and Atmospheric Administration (NOAA) to determine if updates to the baseline maps incorporated by reference in this

section are necessary. If modifications to the baseline maps are determined to be necessary, the Executive Officer shall conduct a public hearing as soon as practicable to amend this section accordingly.

(5) The Executive Officer shall periodically review the test methods incorporated by reference in this section to determine if updates to the referenced methods are necessary. If updates to the test methods are determined to be necessary, the Executive Officer shall conduct a public hearing as soon as practicable to amend this section accordingly.

(k) Severability

Each part of this section shall be deemed severable, and in the event that any part of this section is held to be invalid, the remainder of this section shall continue in full force and effect.

NOTE: Authority cited: Sections 39600, 39601, 41510, 41511, 43013, and 43018, Health and Safety Code; and *Western Oil and Gas Ass'n v. Orange County Air Pollution Control District*, 14 Cal.3rd 411, 121 Cal.Rptr. 249 (1975). Reference: Sections 39000, 39001, 39002, 39003, 39500, 39515, 39516, 41510, 41511, 43013, 43016, and 43018, Health and Safety Code; and *Western Oil and Gas Ass'n v. Orange County Air Pollution Control District*, 14 Cal.3rd 411, 121 Cal.Rptr. 249 (1975).

PROPOSED REGULATION ORDER

AIRBORNE TOXIC CONTROL MEASURE FOR AUXILIARY DIESEL ENGINES AND DIESEL-ELECTRIC ENGINES OPERATED ON OCEAN-GOING VESSELS WITHIN CALIFORNIA WATERS AND 24 NAUTICAL MILES OF THE CALIFORNIA BASELINE

Adopt new section 93118, title 17, California Code of Regulations (CCR), to read as follows:

17 CCR, section 93118. Airborne Toxic Control Measure for Auxiliary Diesel Engines and Diesel-Electric Engines Operated on Ocean-going Vessels within California Waters and 24 Nautical Miles of the California Baseline.

(a) Purpose

The purpose of this section is to reduce emissions of diesel particulate matter (PM), nitrogen oxides, and sulfur oxides from the use of auxiliary diesel engines and diesel-electric engines operated on ocean-going vessels located within any of the waters subject to this regulation ("Regulated California Waters"), which includes all California inland waters; all California estuarine waters; and all waters, except as otherwise specified in this section, within 24 nautical miles, inclusive, of the California baseline, including but not limited to, the Territorial Sea, the Contiguous Zone, and any California port, roadstead or terminal facility.

(b) Applicability

(3) Except as provided in subsection (c), this section applies to any person who owns, operates, charters, rents, or leases an ocean-going vessel, including foreign-flagged vessels, within any of the Regulated California Waters, which include all California inland waters; all California estuarine waters; and all waters, except as otherwise specified in this section, within 24 nautical miles, inclusive, of the California baseline, including but not limited to, the Territorial Sea, the Contiguous Zone, and any California port, roadstead, or terminal facility.

(4) Nothing in this section shall be construed to amend, repeal, modify, or change in any way any applicable U.S. Coast Guard requirements. Any person subject to this section shall be responsible for ensuring compliance with both U.S. Coast Guard regulations and the requirements of this section, including but not limited to, obtaining any necessary approvals, exemptions, or orders from the U.S. Coast Guard.

(c) Exemptions

(5) The requirements of this section do not apply to oceangoing vessels while in innocent passage, as defined in subsection (d), through the Territorial Sea or the Contiguous Zone.

(6) The requirements of this section do not apply to slow-speed two-stroke diesel engines as defined in subsection (d).

(7) The requirements of this section do not apply to auxiliary engines onboard oceangoing military vessels.

(8) The requirements of this section do not apply to auxiliary engines while operating on liquefied natural gas or compressed natural gas.

(d) Definitions

For purposes of this section, the following definitions apply:

(33) "ASTM" means ASTM International

(34) "Auxiliary engine" means an engine on an oceangoing vessel designed primarily to provide power for uses other than propulsion, except that all diesel-electric engines shall be considered "auxiliary diesel engines" for purposes of this regulation.

(35) "Baseline" means the mean lower low water line along the California coast, as shown on the following National Oceanic and Atmospheric Administration (NOAA) Nautical Charts as authored by the NOAA Office of Coast Survey, which are incorporated herein by reference:

(H) Chart 18600, Trinidad Head to Cape Blanco (January 2002);
(I) Chart 18620, Point Arena to Trinidad Head (June 2002);
(J) Chart 18640, San Francisco to Point Arena (July 2000);
(K) Chart 18680, Point Sur to San Francisco (March 2001);
(L) Chart 18700, Point Conception to Point Sur (July 2003);
(M) Chart 18720, Point Dume to Purisima Point (January 2005); and
(N) Chart 18740, San Diego to Santa Rosa Island (August 2003).

(36) "Contiguous Zone" means the maritime zone adjacent to the territorial sea and extending to 24 nautical miles from the baseline of California, determined in accordance with international law as specified in Presidential Proclamation No. 7219 of August 2, 1999, 64 F.R. 48701 (September 8, 1999).

(37) "Diesel Engine" means an internal combustion, compression-ignition (CI) engine with operating characteristics significantly similar to the theoretical diesel combustion cycle. The regulation of power by controlling fuel supply in lieu of a throttle is indicative of a compression ignition engine.

(38) "Diesel Particulate Matter" means the particles found in the exhaust of diesel engines, which may agglomerate and adsorb other species to form structures of complex physical and chemical properties.

(39) "Diesel-electric engine" means a diesel engine connected to a generator that is used as a source of electricity for propulsion or other uses.

(40) "Emission Control Strategy" means any device, system, or strategy employed with a diesel engine that is intended to reduce emissions, including, but not limited to, utilization of shore-side electrical power, diesel oxidation catalysts, selective catalytic reduction systems, fuel additives, diesel particulate filters, alternative diesel fuels, water emulsified fuels, lower sulfur fuels, and any combination of the above.

(41) "Estuarine Waters" means an arm of the sea or ocean that extends inland to meet the mouth of a river.

(42) "Executive Officer" means the executive officer of the Air Resources Board, or his or her designee.

(43) "Hydrocarbon (HC)" means the sum of all hydrocarbon air pollutants.

(44) "Inland Waterways" means any navigable river or waterway within the State of California.

(45) "IMO" means the International Maritime Organization.

(46) "Innocent Passage" means the continuous and expeditious navigation through Territorial Sea or the Contiguous Zone for the purpose of traversing such bodies of water without entering internal California waters or calling at a port, roadstead, or terminal facility. "Innocent passage" does not include passage of an oceangoing vessel if that vessel engages in any of the prejudicial activities specified in United Nations Convention on the Law of the Seas (UNCLOS) 1982, Article 19, subpart 2. For the purposes of this definition, "continuous and expeditious navigation" includes stopping and anchoring only to the extent such stopping and anchoring are documented as required by the U.S. Coast Guard; rendered necessary by force majeure or distress; or made for the purpose of rendering assistance to persons, ships, or aircraft in danger or distress. Notwithstanding any Coast Guard mandated stops or stops due to force majeure or the rendering of assistance, a vessel is not in innocent passage if the vessel was otherwise scheduled or intended to enter internal California waters or call at a port, roadstead or terminal facility.

(47) "ISO" means the International Organization for Standardization.

(48) "Marine Diesel Oil" means any fuel that meets all the specifications for DMB grades as defined in Table I of International Standard ISO 8217, as revised in 1996, which is incorporated herein by reference.

(49) "Marine Gas Oil" means any fuel that meets all the specifications for DMX or DMA grades as defined in Table I of International Standard ISO 8217, as revised in 1996, which is incorporated herein by reference.

(50) "Military Vessel" means any ship, boat, watercraft, or other contrivance used for any purpose on water, and owned or operated by the armed services.

(51) "Nitrogen Oxides (NOx)" means compounds of nitric oxide (NO), nitrogen dioxide (NO2), and other oxides of nitrogen, which are typically created during combustion processes and are major contributors to smog formation and acid deposition.

(52) "Non-Methane Hydrocarbons (NMHC)" means the sum of all hydrocarbon air pollutants except methane.

(53) "Oceangoing Vessel" means a commercial, government, or military vessel meeting any one of the following criteria:

(E) a vessel with a "registry" (foreign trade) endorsement on its United States Coast Guard certificate of documentation, or a vessel that is registered under the flag of a country other than the United States;
(F) a vessel greater than or equal to 400 feet in length overall (LOA) as defined in 50 CFR § 679.2, as adopted June 19, 1996;
(G) a vessel greater than or equal to 10,000 gross tons (GT ITC) per the convention measurement (international system) as defined in 46 CFR 69.51-.61, as adopted September 12, 1989; or
(H) a vessel propelled by a marine compression ignition engine with a per-cylinder displacement of greater than or equal to 30 liters.

(54) "Operate" means steering the vessel while underway.

(55) "Own" means having all the incidents of ownership, including the legal title, of a vessel whether or not that person lends, rents, or pledges the vessel; having or being entitled to the possession of a vessel as the purchaser under a conditional sale contract; or being the mortgagor of a vessel.

(56) "Particulate Matter" means any airborne finely divided material, except uncombined water, which exists as a liquid or solid at standard conditions (e.g., dust, smoke, mist, fumes or smog).

(57) "Person" includes all of the following:

(A) any person, firm, association, organization, partnership, business trust, corporation, limited liability company, or company;
(B) any state or local governmental agency or public district, or any officer or employee thereof;
(C) the United States or its agencies, to the extent authorized by federal law.

(58) "Regulated California Waters" means all California inland waters; all California estuarine waters; and any portion of the Territorial Sea, the Contiguous Zone, and any California port, roadstead, or terminal facility located:

(A) within the area between the California baseline and 24 nautical miles seaward, inclusive, starting at the California-Oregon border to 34.43 degrees North, 121.12 degrees West; and
(B) within the area between the California baseline and a line starting at 34.43 degrees North, 121.12 degrees West; thence to 33.50 degrees North, 118.58 degrees West; thence to 32.48 degrees North, 117.67 degrees West; and ending at the California-Mexican border at the Pacific Ocean.

(59) "Roadstead" means any facility, located anywhere within the bodies of water specified in subsection (b), that is used for the loading, unloading, and anchoring of ships.

(60) "Slow Speed Engine" means an engine with a rated speed of 150 revolutions per minute or less.

(61) "Sulfur Oxides" means compounds of sulfur dioxide (SO_2), and other oxides of sulfur, which are typically created during combustion of sulfur containing fuels.

(62) "Territorial Sea" means the maritime zone extending to 12 nautical miles from the California baseline, determined in accordance with international law as specified in Presidential Proclamation No. 5928 of December 27, 1988, 54 F.R. 777 (January 9, 1989).

(63) "Two-stroke Engine" means an internal combustion engine which operates on a two stroke cycle where the cycle of operation completes in one revolution of the crankshaft.

(64) "Vessel" means any tugboat, tanker, freighter, passenger ship, barge, or other boat, ship, or watercraft, except those used primarily for recreation and any of the following:

(A) A seaplane on the water;
(B) A watercraft specifically designed to operate on a permanently fixed course, the movement of which is restricted to a fixed track or arm to which the watercraft is attached or by which the watercraft is controlled.

(e) Requirements

(3) Emission Limits

Except as provided in subsections (c), (f), (g) and (h), no person subject to this section shall operate any auxiliary diesel engine, while the vessel is operating in any of the Regulated California Waters, which emits levels of diesel PM, NOx, or SOx in exceedance of the emission rates of those pollutants that would result had the engine used the following fuels:

(C) Beginning January 1, 2007:

1. marine gas oil, as defined in subsection (d); or

2. marine diesel oil, as defined in subsection (d), with a sulfur content of no more than 0.5 percent by weight;

(D) Beginning January 1, 2010: marine gas oil with a sulfur content of no more than 0.1 percent by weight.

(C) Compliance with the emission rate limits specified in subsection (e)(1) is presumed if the person operates the regulated engine(s) with the fuels as specified in subsection (e)(1)(A) and (e)(1)(B), or as otherwise permitted in subsection (g).

(4) Recordkeeping, Reporting, and Monitoring Requirements

(A) Recordkeeping

Beginning January 1, 2007, any person subject to this section shall retain and maintain records in English that contain the following information for at least three years following the date when the records were made:

1. The date, local time, and position (longitude and latitude) of the vessel for each entry into and departure from the Contiguous Zone, excluding any voyages comprised solely of innocent passage as defined in subsection (d);

2. The date, local time, and position (longitude and latitude) of the vessel at the initiation and completion of any fuel switching procedures used to comply with subsection (e)(1) prior to entry into any of the Regulated California Waters;

3. The date, local time, and position (longitude and latitude) of the vessel at the initiation and completion of any fuel switching procedures within any of the Regulated California Waters;

4. Completion of fuel switching procedures is the moment at which a given engine (or engines) has completely transitioned from operation on one fuel to another fuel;

5. The type of each fuel used (e.g. marine gas oil) in each auxiliary engine operated in any of the Regulated California Waters; and

6. The types, amounts, and the actual percent by weight sulfur content of all fuels purchased for use on the vessel during the calendar year, as reported by the fuel supplier or a fuel testing firm.

(B) Reporting and Monitoring

3. Any person subject to this section shall provide in writing the information specified in subsection (e)(2)(A) to the Executive Officer upon request, either within 24 hours or a mutually agreed time approved by the Executive Officer. To the extent the person already collects the information specified in subsection (e)(2)(A) to comply with other regulatory requirements or standard practices, the person may provide the requested information in a format consistent with those other regulatory requirements or standard practices.

4. Any person subject to this section shall provide to the Executive Officer upon request additional information the Executive Officer determines to be necessary to determine compliance with this section including, but not limited to:

   a. the make, model, rated power, and serial numbers of all auxiliary engines subject to subsection (e)(1);
   b. the capacity and locations of all fuel tanks on the vessel; and
   c. piping diagrams and specifications for mixing tanks or other fuel handling equipment applicable to auxiliary engines.

3. Any person subject to this section shall provide to the Executive Officer access to the vessel for the purpose of determining compliance with the this section, including but not limited to, access to and review of records and information required under subsection (e)(2)(A) or (e)(2)(B)2, and for the purpose of collecting fuel samples for testing and analysis.

(f) [Reserved for future use]

(g) Alternative Compliance Plan (ACP) In Lieu of Meeting Subsection (e)(1)

(3) Requirements

(K) The purpose of this subsection is to allow any person ("person" or "applicant") subject to this regulation the option of complying with the requirements of this subsection (g) in lieu of the requirements of subsection (e)(1). Under this subsection (g), alternative emission control strategies can be implemented in lieu of meeting the requirements of subsection (e)(1), provided they result in no greater emissions, expressed in pounds, of diesel PM, NOx, and SOx, emissions from the auxiliary diesel engines, over the applicable calendar year, relative to the emissions that would have occurred under subsection (e)(1).

(L) An applicant wishing to participate in an ACP may include one or more vessels in the alternative compliance plan, but the applicant shall only include vessels that the person owns or operates under their direct control.

(M) An applicant for an ACP shall submit information to the Executive Officer that demonstrates that the alternative emission control strategies under the proposed ACP will result in no greater emissions, expressed in pounds, of diesel PM, NOx, and SOx emissions from the auxiliary diesel engines, over the applicable calendar year, relative to the emissions that would have occurred under subsection (e)(1).

(N) Alternative emission control strategies may include, but are not limited to:

5. utilization of shore-side electrical power in lieu of onboard generators,
6. auxiliary engine modifications,
7. exhaust treatment control, and
8. use of alternative fuels or fuel additives.

(O) The ACP application demonstrating compliance with this subsection shall contain, at a minimum, the following information:

7. the company name, address, and contact information;
8. the vessel(s) name, country flag, and IMO identification number;
9. the engine/(s) subject to the ACP, make, model, and serial numbers, and other information that uniquely identify the engine on the affected vessel;
10. documentation, calculations, emissions test data,, or other information that establishes the diesel PM, NOx, and SOx, reductions, expressed in pounds, from auxiliary engines will be equivalent to or greater than the emission reductions that would have been achieved upon compliance with under subsection (e)(1);
11. information on the California ports visits expected to be visited by the affected vessel(s) during the period that the ACP will be in effect, the anticipated dates of those visits, and the potential planned oversea routes to and from these ports; and
12. the proposed recordkeeping, reporting, monitoring, and testing procedures that the applicant plans to use to demonstrate continued compliance with the ACP.

(P) Emission reduction calculations demonstrating equivalence with the requirements of subsection (e)(1) shall only include diesel PM, NOx, and SOx emissions from auxiliary engines operating within any of the Regulated California Waters.

(Q) Use of Shore-Side Power

1. Except as otherwise provided in this subsection (g)(1)(G), vessels in an ACP that utilize shore-side power in lieu of their auxiliary diesel engines while at dockside shall be considered to meet the emission reduction requirements of the ACP during:

    a. all travel within Regulated California Waters from a previous port to the California port terminal where shore-side power is used;
    b. time spent secured ("docked") at the California port terminal where shore-side power is used; and
    c. all travel within Regulated California Waters from the California port where shore-side power is utilized to the next port visited.

2. For the purposes of this subsection (g)(1)(G), "utilizing shore-side power" means:

    a. connecting to electricity supplied by a utility company, or another source with emissions per unit of delivered energy equivalent to or lower than the January 1, 2007 levels specified in title 17, CCR, sections 94200-94214, "Distributed Generation Certification Program;" and
    b. shutting down all auxiliary engines subject to this control measure no later than one hour after the vessel is secured at the port terminal, and continuously thereafter until no more than one hour prior to when the vessel leaves the terminal.

3. Except as otherwise provided in paragraph 5 below, if a vessel in an ACP visits two California ports in succession, and the vessel utilizes shore-side power at the first port but not at the second port visited, the vessel shall not be considered to meet the emission reduction requirements of the ACP during the time it is docked at the second port and any subsequent travel within Regulated California Waters from this port.

4. Except as otherwise provided in paragraph 5 below, if a vessel in an ACP visits two California ports in succession, and the vessel utilizes shore-side power at the second port but not at the first port visited, the vessel shall not be considered to meet the emission reduction requirements of the ACP during travel within Regulated California Waters to this first port or during the time the vessel is docked at the first port. Travel from the first port to the second port where shore-side power is utilized shall be deemed to meet the emission reduction requirements of the ACP.

5. The provisions in paragraphs 3 and 4 above notwithstanding, if a passenger cruise vessel in an ACP visits a California port, utilizes shore-side power at that port, then leaves that port and moors (i.e.,

drops anchor) at another offshore location away from a port, roadstead or terminal facility (e.g., Catalina Island or off Monterey), the mooring stop shall not be deemed as a second port visit. However, a person subject to this provision shall meet the emission limits in subsection (e)(1) for all auxiliary diesel engines on the passenger cruise vessel (i.e., all diesel-electric engines) during the entire time the vessel is moored.

(R) Any person subject to an approved ACP shall maintain operating records in a manner and form as specified by the Executive Officer in the approved ACP. Required records may include, but are not limited to, information on fuel usage, routes, port calls, maintenance procedures, and emissions test results. Such records and reports shall be retained for a period of not less than three (3) years and shall be submitted to the Executive Officer in the manner specified in the approved ACP and upon request by the Executive Officer.

(S) Emission reductions included in an ACP shall not include reductions that are otherwise required by any State, federal or international rule, regulation, or statute.

(T) No person may operate a vessel under an ACP unless the applicant has first been notified in writing by the Executive Officer that the ACP application has been approved. Prior to such approval, applicants shall comply with the provisions of this section, including the emission limits in subsection (e)(1).

(4) Application Process

(E) Applications for an ACP shall be submitted in writing to the Executive Officer for evaluation.

(F) The Executive Officer shall notify the applicant in writing whether their application is approved or denied within 90 days of receipt of the submittal.

(G) Additional information may be provided by the applicant after submittal of the original application. However, the Executive Officer shall have 90 days after submittal of the additional information to notify the applicant of approval or denial of the ACP.

(H) The applicant shall notify the Executive Officer in writing within 30 days upon learning of any information that would alter the emissions estimates submitted in the ACP application. If the Executive Officer has reason to believe that an approved ACP has been granted to a person that no longer meets the criteria for an ACP, the Executive Officer may modify or revoke the ACP as necessary to assure that the subject vessel(s) will meet the emission reduction requirements in this section.

(h) Noncompliance Fee In Lieu of Meeting Subsection (e)(1)

The Executive Officer may permit a person ("person") to pay noncompliance fees ("fees") in lieu of meeting the requirements of subsection (e)(1). Payment of the fees notwithstanding, all other provisions of this section shall continue to apply. No person shall be permitted to pay the fees unless the person meets the notification requirements in subsection (h)(1) and the requirements in either subsections (h)(2), (h)(3), or (h)(4), as specified below:

(1) Notification Requirements

Before the person's vessel enters Regulated California Waters, the Executive Officer must receive notice that the person will not meet the requirements of subsection (e)(1) while operating within Regulated California Waters, but the person will instead meet the requirements of this subsection (h). If the Executive Officer has not received such notice and the person enters Regulated California Waters, the person will be in violation of this section and will not be permitted to pay the fees in lieu of meeting the requirements of subsection (e)(1).

(2) Noncompliance for Reasons Beyond a Person's Reasonable Control

Any person wishing to pay the fees under this subsection (h)(2) shall meet the following criteria:

(A) ***Demonstration of Need***: The person shall, through adequate documentation, demonstrate to the Executive Officer's satisfaction that the person's noncompliance with the requirements of subsection (e)(1) is beyond the person's reasonable control. For the purposes of this paragraph, "beyond the person's reasonable control" applies only when one or more of the following sets of circumstances (1, 2, 3, or 4) applies:

3. **Unplanned Redirection**. This provision applies only when all of the following criteria are met:

   a. after leaving the last port of call, the person's vessel was redirected from his/her original, officially logged, non-California destination to a California port, roadstead, or terminal facility ("port"); and

   b. the vessel does not contain a quantity of fuel sufficient for the auxiliary engines to meet the requirements of subsection (e)(1).

2. **Inadequate Fuel Supply**. This provision applies only when all of the following criteria are met:

   a. the person made good faith efforts to acquire a quantity of fuel sufficient for the vessel's auxiliary engines to meet the requirements of subsection (e)(1); and

b. the person was unable to acquire fuel sufficient for the engines to meet the requirements of subsection (e)(1).

3. **Inadvertent Purchase of Defective Fuel**. This provision applies only when all of the following criteria are met:

a. based on the fuel supplier's certification of the fuel specifications, the person reasonably believed, and relied on such belief, that the fuel the person purchased on the route from the vessel's home port to California would enable the auxiliary engines to meet the requirements of subsection (e)(1);

b. the person determined that the vessel's auxiliary engines in fact will not meet the requirements of subsection (e)(1) using any of the fuel purchased under paragraph 3.a. above; and

c. the vessel is already on its way to California, and there are no other ports of call on the vessel's route where fuel can be purchased sufficient to meet the requirements of subsection (e)(1).

(D) ***Payment of Fees***. Upon meeting the requirements of paragraph (A) in this subsection (h)(2), the person shall pay the fees for every port visit during the period of time the person does not meet the requirements of subsection (e)(1), as specified in subsection (h)(5) below.

(E) ***Executive Officer Review***. For the purposes of verifying the demonstration of need as specified in subsection (h)(2)(A), the Executive Officer may consider and rely on any facts or circumstances the Executive Officer believes are appropriate, including but not limited to: the fuel supplier's ability or failure to provide adequate fuel ordered by the person; any material misrepresentation by the fuel supplier concerning the fuel specifications; the reasonableness of the person's reliance on fuel suppliers with a history of supplying fuel inadequate for meeting the requirements of subsection (e)(1); and force majeure.

(3) Noncompliance for Vessels To Be Taken Out of Service for Modifications

If a person cannot meet the requirements of subsection (e)(1) without vessel modifications, and such modifications cannot be completed prior to the effective date of subsection (e)(1), the Executive Officer may permit the person to pay the fees as specified in this subsection. This provision also applies to vessels that will undergo modifications pursuant to an Executive Officer approved Alternative Compliance Plan. The vessel must be scheduled to complete the necessary modifications (e.g. during a dry dock operation) as soon as possible, but no later than 5 years after the effective date of this section. For this provision to apply, the person shall meet all of the following criteria:

(A) ***Demonstration of Need.*** The person shall provide the Executive Officer a Compliance Retrofit Report, signed by the Chief Engineer of the person's vessel, which:

1. identifies the specific vessel modifications ("modifications") (e.g. installation of additional fuel tanks) the person plans to use for meeting the requirements of subsection (e)(1) or an Alternative Compliance Plan;

4. identifies the specific date by which the modifications will be completed (e.g. while the vessel is in dry dock); and

3. demonstrates to the satisfaction of the Executive Officer that the modifications will be made at the earliest possible date (e.g. the vessel has been scheduled for the earliest available dry dock appointment).

(B) ***Payment of Fees.*** Upon meeting the requirements of paragraph (A) in this subsection (h)(3), the person shall pay the fees for every port visit until the dry dock modifications are completed, as specified in subsection (h)(5) below,.

(C) ***Proof of Modifications Actually Performed.*** Within ten (10) business days after the scheduled or actual completion of the modifications, whichever occurs first, the person shall provide written certification to the Executive Officer that the modifications specified under this subsection (h)(3) have been completed. If the modifications have not been completed, the person shall certify which modifications have been completed, which have not, and the anticipated completion date for the remaining modifications. The notification requirement specified in this paragraph, the notification requirements in subsection (h)(1) above, and the fee provisions in subsection (h)(5) below shall apply until all the modifications have been completed.

(4) Noncompliance Based on Infrequent Visits and Need for Vessel Modifications

If a person cannot meet the requirements of subsection (e)(1) without vessel modifications, and this vessel will make no more than two California port visits per calendar year, and no more than 4 California port visits after January 1, 2007 during the life of the vessel, the Executive Officer may permit the person to pay the fees as specified in this subsection.

(A) ***Demonstration of Need.*** The person shall demonstrate to the satisfaction of the Executive Officer that modifications to the vessel are necessary to meet the requirements of subsection (e)(1), and that the vessel shall meet the visitation limits specified in this subsection (h)(4).

(B) ***Payment of Fees***. Upon meeting the requirements of paragraph (A) in this subsection (h)(4), the person shall pay the fees for every port visit up to a maximum of 4 visits, as specified in subsection (h)(5) below.

(5) Calculation and Payment of Fees

For each California port, roadstead, or terminal facility in Regulated California Waters at which the person's vessel stops or anchors ("port visit"), the person who elects to pay the fees shall pay the applicable fees shown in Table 1. For each port visit, the person shall deposit the fees in the port's Noncompliance Fee Settlement and Air Quality Mitigation Fund prior to leaving the California port:

(A) After January 1, 2007, each instance of a vessel stopping or anchoring at a port shall count as one port visit, and the port visits shall be cumulative.

Table 1: Noncompliance Fee Schedule, Per Vessel

Visit	Fee	
	Diesel-Electric Vessels	Other Vessels
1st Port Visited	$32,500	$13,000
2nd Port Visited	$65,000	$26,000
3rd Port Visited	$97,500	$39,000
4th Port Visited	$130,000	$52,000
5th or more Port Visited	$162,500	$65,000

(B) The fees shown in Table 1 shall be assessed by the Executive Officer at the time of the port visit. However, if for any reason the person is not notified by the Executive Officer of the assessed fee by the end of the port visit, the person shall nevertheless be responsible for payment of the appropriate fee as specified in this subsection (h) prior to leaving the California port.

(C) The Executive Officer shall enter into enforceable agreements with each port that will receive the fees. The agreements shall require that the fees be used by the ports only to fund projects that will substantially reduce air pollution from on-site sources, sources within 2 miles of port boundaries, or oceangoing vessels operated within the Regulated California Waters, except that the fees shall not be used to fund projects on vessels from which noncompliance fees were paid. Fees intended for ports that do not have such agreements at the time the fees are paid shall be deposited into the California Air Pollution Control Fund.

(i) Test Methods

The following test methods or alternative test methods that are demonstrated to the written satisfaction of the Executive Officer to be equally or more accurate, shall be used to determine compliance with this section:

(3) Test methods used to determine whether fuels meets the requirements of marine gas oil (DMA or DMX) or marine diesel oil (DMB), as specified in subsection (e)(1), shall be the methods specified in International Standard ISO 8217 (as revised in 1996), which is incorporated herein by reference.

(4) The sulfur content of fuels shall be determined per International Standard ISO 8754 (as adopted in 1992), which is incorporated herein by reference.

(j) Sunset, Technology Re-evaluation, and Baseline and Test Method Review

(6) If the Executive Officer determines that the International Maritime Organization or the United States Environmental Protection Agency have adopted regulations that will achieve equivalent or greater emission reductions from oceangoing vessels in California compared to the emission reductions resulting from this regulation, the Executive Officer shall propose to the Board for its consideration the termination of the requirements of this section or other modifications to the section as deemed appropriate by the Executive Officer.

(7) On or before July 1, 2008, the Executive Officer shall re-evaluate the feasibility of the emission limits based on using marine gas oil with no greater than 0.1 percent sulfur by weight in auxiliary diesel engines. The re-evaluation shall consider, but not be limited to:

(A) the availability of 0.1 percent sulfur marine gas oil at bunkering ports worldwide;

(B) the ability of petroleum refiners and marine fuel suppliers to deliver 0.1 percent sulfur fuel by January 1, 2010;

(C) fuel lubricity and compatibility of the 0.1 percent sulfur marine gas oil with heavy fuel oil during fuel transitions; and

(D) the additional cost of 0.1 percent sulfur fuel compared to marine gas oil with other levels of sulfur content.

(8) Pursuant to paragraph (2) of this subsection (j), if the Executive Officer determines that modifications to subsection (e)(1)(B) are necessary, the Executive Officer shall propose appropriate changes to the Board prior to January 1, 2009.

(9) The Executive Officer shall periodically review the California baseline determinations by the National Oceanic and Atmospheric Administration (NOAA) to determine if updates to the baseline maps incorporated by reference in this

section are necessary. If modifications to the baseline maps are determined to be necessary, the Executive Officer shall conduct a public hearing as soon as practicable to amend this section accordingly.

(10) The Executive Officer shall periodically review the test methods incorporated by reference in this section to determine if updates to the referenced methods are necessary. If updates to the test methods are determined to be necessary, the Executive Officer shall conduct a public hearing as soon as practicable to amend this section accordingly.

(k) Severability

Each part of this section shall be deemed severable, and in the event that any part of this section is held to be invalid, the remainder of this section shall continue in full force and effect.

NOTE: Authority cited: Sections 39600, 39601, 39650, 39658, 39659, 39666, 41510, 41511, Health and Safety Code. Reference: Sections 39650, 39658, 39659, 39666, 41510, and 41511, Health and Safety Code.

TITLE 13. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER THE ADOPTION OF A DIESEL PARTICULATE MATTER CONTROL MEASURE FOR ON-ROAD HEAVY-DUTY DIESEL-FUELED VEHICLES OWNED OR OPERATED BY PUBLIC AGENGIES AND UTILITIES

The Air Resources Board (the Board or ARB) will conduct a public hearing at the time and place noted below to consider adoption of a diesel control measure for on-road heavy-duty diesel-fueled vehicles owned or operated by public agencies or utilities. Municipalities and privately owned utilities have responsibilities under the proposal. This notice summarizes the proposed control measure. The staff report presents the control measure in greater detail.

DATE: December 8, 2005

TIME: 9:00 a.m.

PLACE: California Environmental Protection Agency
Air Resources Board
Byron Sher Auditorium
1001 I Street
Sacramento, California 95814

This item will be considered at a two-day meeting of the Board, which will commence at 9:00 a.m., December 8, 2005, and may continue at 8:30 a.m., December 9, 2005. This item may not be considered until December 9, 2005. Please consult the agenda for the meeting, which will be available at least 10 days before December 8, 2005, to determine the day on which this item will be considered.

If you have a disability-related accommodation need, please go to http://www.arb.ca.gov/html/ada/ada.htm for assistance or contact the ADA Coordinator at (916) 323-4916. If you are a person who needs assistance in a language other than English, please contact the Bilingual Coordinator at (916) 324-5049. TTY/TDD/Speech-to-Speech users may dial 7-1-1 for the California Relay Service.

INFORMATIVE DIGEST OF PROPOSED ACTION AND POLICY STATEMENT OVERVIEW

Sections Affected: Proposed adoption of sections 2022 and 2022.1 of article 4 within chapter 3, division 3, title 13, California Code of Regulations (CCR).

Background: In 1998, ARB identified diesel particulate matter (PM) as a toxic air contaminate. In response to this identification, the Board adopted a plan in 2000 to reduce PM emissions from diesel-fueled engines and vehicles called the Diesel Risk

Reduction Plan. Specifically listed in the plan are control measures for on-road public fleets and other public and private fleets. The emission reductions obtained from this proposed regulation will result in lower ambient PM levels and reductions of exposure to primary and secondary diesel PM. Lower ambient PM levels and reduced exposure, in turn, would result in a reduction of the prevalence of the diseases attributed to PM and diesel PM, including hospitalizations for cardio-respiratory disease, and premature deaths. ARB staff estimates that approximately 37 deaths would be avoided by the year 2020 as a result of cumulative emission reductions of primary and secondary PM obtained through this regulation.

Proposed Actions: Diesel-fueled vehicles owned and operated by public agencies and utilities are a concern because they operate in residential communities on a regular basis, in turn increasing the communities' risk of exposure to toxic emissions and oxides of nitrogen. ARB proposes to mandate municipalities and utilities that own and operate on-road heavy duty vehicles to reduce their diesel emissions through application of best available control technology. The proposed sections 2022 and 2022.1 comprise the control measure for these vehicles.

1. Scope and Applicability

The proposed regulation applies to municipal and utility vehicle owners, whether private or government entities. The proposed regulation mandates the reduction of diesel PM emissions from 1960 to 2006 engine model year on-road diesel-fueled heavy-duty vehicles with a manufacturer's gross vehicle weight rating greater than 14,000 pounds.

2. Compliance Requirement for Municipalities and Utilities

Compliance with the proposed rule requires use of best available control technology, as defined, implementation according to the specified schedule, and record keeping. In addition, there are provisions for compliance extensions and special circumstances.

Best Available Control Technology

Four different options are offered to meet the requirement to use best available control technology. The first option is to use a diesel engine or power system that is certified to the 0.01 grams per brake horsepower-hour (g/bhp-hr) particulate emission standard. The second option is to use an engine or power system that is certified to the 0.1 g/bhp-hr particulate emission standard in conjunction with the highest level diesel emission control strategy. The third option is to use an alternative fuel engine, heavy-duty pilot ignition or gasoline engine. The fourth option is to apply the highest level diesel emission control strategy or system verified by ARB for a specific engine, and which the manufacturer or authorized dealer agrees can be successful on the specific engine and vehicle combination.

Implementation Schedule

Staff proposes two implementation schedules. The first one is for all fleets and the second schedule is an optional one that municipalities or utilities located in specified "low population counties" can elect to follow. The implementation schedule for all fleets phases in compliance by the model year of the engine. The implementation schedule begins December 31, 2006 and ends December 31, 2011. For municipalities or utilities located in a low population county the implementation schedule begins in December 31, 2008 and ends December 31, 2017. The proposed regulation describes the required equations needed to calculate the total fleet size.

Compliance Extensions

Staff believes owners may experience conditions that would justify a compliance extension. The compliance extensions proposed in the rule are: an extension granted for early implementation of a specified portion of an owner's fleet, an extension granted because there is no verified diesel emission control strategy, dual fuel or bi-fuel engine, engine near retirement, use of an experimental diesel emission control strategy, and an accelerated turnover option for municipalities or utilities located in a low population county.

Special Circumstances

Owners would be required to maintain best available control technology on each vehicle once that vehicle is in compliance, and would not be required to upgrade to a higher level of best available control technology. Certain specified special circumstances, however, are described. These include use a fuel strategy diesel emission control strategy, failure or damage of the diesel emission control strategy within or outside of the warranty period of the device, discontinuance of a fuel verified as a diesel emission control strategy, and limitation in time and use of a diesel emission control strategy verified to Level one (25 to 49 percent particulate matter reduction).

Record Keeping Requirement for Municipalities or Utilities

Staff proposes that specific records pertaining to compliance be kept at the terminal and in the vehicle. Each owner must keep these records for the life of the vehicle while it operates in California. If a vehicle is sold, the records should be transferred with that vehicle.

Non-Compliance

Staff proposes a specific reference to civil penalties for violations of the compliance provisions.

AVAILABILITY OF DOCUMENTS AND AGENCY CONTACT PERSONS

The Board staff has prepared a Staff Report: Initial Statement Of Reasons (ISOR) for the proposed action, which includes a summary of the economic and environmental impacts of the proposal. The report is entitled: Proposed Diesel Particulate Matter Control Measure for On-Road Heavy-Duty Diesel-Fueled Vehicles Owned or Operated by Public Agencies and Utilities.

Copies of the ISOR, and the full text of the proposed regulatory language may be accessed on the Board's website listed below, or may be obtained from the Board's Public Information Office, ARB, Visitors and Environmental Services Center, 1001 I Street, 1st Floor, Sacramento, California 95814, (916) 322-2990 at least 45 days prior to the scheduled hearing on December 8, 2005.

Upon its completion, the Final Statement of Reasons (FSOR) will also be available and copies may be requested from the agency contact persons in this notice, or may be accessed on the website listed below.

Inquiries concerning the substance of the proposed regulation may be directed to Ms. Sharon Lemieux, Lead Staff, by email to sclemieu@arb.ca.gov or by phone at (626) 575-7067, or to Ms. Kathleen Mead, Manager, by email to kmead@arb.ca.gov or by phone at (916) 324-9550.

Further, the agency representative and designated back-up contact persons to who nonsubstantive inquiries concerning the proposed administrative action may be directed are Artavia Edwards, Manager, Board Administration & Regulatory Coordination Unit, (916) 322-6070, or Amy Whiting, Regulations Coordinator, (916) 322-6533. The Board has compiled a record for this rulemaking action, which includes all the information upon which the proposal is based. This material is available for inspection upon request to the contact persons.

This notice, the ISOR and all subsequent regulatory documents, including the FSOR when completed, will be available on the ARB Internet site for this rulemaking at http://www.arb.ca.gov/regact/dpmcm05/dpmcm05.htm.

COSTS TO PUBLIC AGENCIES AND TO BUSINESSES AND PERSONS AFFECTED

The determinations of the Board's Executive Officer concerning the costs or savings necessarily incurred by public agencies and private persons and businesses in reasonable compliance with the proposed regulations are presented below.

The Executive Officer has determined that the proposed regulatory action will create costs or savings, as defined in Government Code section 11346.5(a)(5) and 11346.5(a)(6), to a state agency or in federal funding to the state, costs or mandate to any local agency or school district whether or not reimbursable by the state pursuant to

part 7 (commencing with section 17500), division 4, title 2 of the Government Code, or other non discretionary costs or savings to local agencies, except as discussed below.

In accordance with Government Code sections 11346.3(c) and 11346.5(a)(11), the Executive Officer has found that the reporting requirements of the regulation which apply to businesses are necessary for the health, safety, and welfare of the people of the State of California.

The Executive Officer has made an initial determination that the proposed regulatory action will not have a significant statewide adverse economic impact directly affecting businesses, including the ability of California businesses to compete with businesses in other states, or on representative private persons. The ARB is not aware of any cost impacts that a representative private person or business would necessarily incur in reasonable compliance with the proposed action.

Fiscal Effect On State Government

Two separate costs may exist at the state government level: ARB's costs to implement and enforce the regulation, and costs to state agencies that own diesel vehicles. ARB estimates that three additional staff will be required to enforce the regulation and to provide guidance for implementation. The cost to hire and support three additional staff members is approximately $300,000 annually. Staff expects the additional staff members to be required beginning FY 2005.

According, to DMV registration data, the State of California owns approximately 1,275 diesel-fueled vehicles as of 2004; however this number is expected to grow to approximately 1,311 vehicles by 2006. The initial undiscounted cost for FY 2006 would be $803,727.

Fiscal Effect on Local Government

The proposed regulation is expected to have a significant impact on public agencies statewide that own and operate diesel-fueled vehicles. The average total statewide dollar costs for local agencies were derived from the application of the average discounted capital costs plus the average operation and maintenance costs for the retrofit of approximately 22,839 vehicles. There is no cost associated with implementation during the current FY 2005. The total initial undiscounted costs for FY 2006 are $14,002,207. The average discounted costs for FY 2006 are $2,030,000.

These government agencies are required to maintain certain records; however the time to maintain these records will vary depending on the number of vehicles, but would not be considered an additional cost as the additional paperwork is within the scope of normal paperwork.

Some public agencies provide services on a fee basis, such as a water district, and may eventually require ratepayers to a pay higher cost for services, but a majority of public

agencies will absorb the costs of compliance. According to the *California State Controller's Special Districts Annual Report, FY 2001-2002*, there are approximately 4,754 special districts that could potentially pass the cost of compliance on to the ratepayers. Staff was unable to calculate a cost per household as ARB does not have enough data on how each public agency will pass on costs to the public.

Fiscal Impact of Businesses

Staff has determined that the adoption of the proposed regulatory action may have an economic impact on private utilities that provide natural gas, electricity or water services if those businesses are unable to increase their rate for these utility services. However, since a variety of compliance methods are provided in the rule, utilities may not experience any adverse economic impacts because they have the ability to recover costs through rate increases. Adoption of the proposed rule will not affect the ability of California businesses to compete with businesses in other states.

Businesses that provide technology or services mandated under this proposal, such as engines, diesel emission control systems, or installation services, may experience significant economic benefit from this rule. Some, but not all, of those businesses are located in California.

In accordance with Government Code section 11346.3, the Executive Officer has determined that the proposed regulatory action will affect the creation or elimination of jobs within the State of California, the creation of new businesses or elimination of existing businesses within the State of California, or the expansion of businesses currently doing business within the State of California. A detailed assessment of the economic impacts of the proposed regulatory action can be found in the Staff Report.

Finally, the Executive Officer has determined that there will be no, or an insignificant, potential cost impact, as defined in Government Code section 11346.53(e), on private persons or businesses directly affected resulting from the proposed action. Finally, the Executive Officer has also determined that the proposed regulatory action will affect small businesses.

Costs to the Public

Staff was unable to determine a cost per household or individual since it is unknown in what manner municipalities or utilities will pass on the cost of compliance. If the entire cost of regulation was passed onto each individual residing in California, the cost per capita would be approximately $6.00 in total (or $0.35 per person annually for 2006 to 2022).

Consideration of Alternatives

The Executive Officer has considered proposed alternatives that would lessen any adverse economic impact on businesses and invites you to submit proposals. Submissions may include the following considerations:

(i) The establishment of differing compliance or reporting requirements or timetables which take into account the resources available to businesses.
(ii) Consolidation or simplification of compliance and reporting requirements for businesses.
(iii) The use of performance standards rather than prescriptive standards.
(iv) Exemption or partial exemption from the regulatory requirements for businesses.

Before taking final action on the proposed regulatory action, the Board must determine that no alternative considered by the agency or that has otherwise been identified and brought to the attention of the agency would be more effective in carrying out the purpose for which the action is proposed or would be as effective and less burdensome to affected private persons than the proposed action.

SUBMITTAL OF COMMENTS

The public may present comments relating to this matter orally or in writing at the hearing, and in writing or by e-mail before the hearing. To be considered by the Board, written submissions must be received by **no later than 12:00 noon, December 7, 2005** and addressed to the following:

Postal Mail is to be sent to:

Clerk of the Board
Air Resources Board
1001 I Street, 23rd Floor
Sacramento, California 95814

Electronic mail is to be sent to: **dpmcm05@listserv.arb.ca.gov** and received at the ARB no **later than 12:00 noon, December 7, 2005.**

Facsimile submissions are to be transmitted to the Clerk of the Board at (916) 322-3928 and received at the ARB **no later than 12:00 noon, December 7, 2005.**

The Board requests, but does not require, that 30 copies of any written statement be submitted at least 10 days prior to the hearing so that ARB staff and Board Members have time to fully consider each comment. The ARB encourages members of the public to bring to the attention of the staff in advance of the hearing any suggestions for modification of the proposed regulatory action.

Additionally, the Board requests but does not require, that persons who submit written comments to the Board reference the title of the proposal in their comments to facilitate review.

STATUTORY AUTHORITY AND REFERENCES

This regulatory action is proposed under that authority granted in sections 39600, 39601, and 39658 of the Health and Safety Code. This action is proposed to implement, interpret and make specific sections 39002, 39003, 39655, 39656, 39657, 39658, 39659, 39660, 39661, 39662, 39664, 39665, 39667, 39669, 39674, 39675, 43000, 43013, 43018, 43101, 43102, 43104, 43105 and 43700 of the Health and Safety Code.

HEARING PROCEDURES

The public hearing will be conducted in accordance with the California Administrative Procedure Act, title 1, division 3, part 1, chapter 3.5 (commencing with section 11340) of the Government Code.

Following the public hearing, the Board may adopt the regulatory language as originally proposed, or with non-substantial or grammatical modifications. The Board may also adopt the proposed regulatory language with other modifications if the text as modified is sufficiently related to the originally proposed text that the public was adequately placed on notice that the regulatory language as modified could result from the proposed regulatory action; in such event the full regulatory text, with the modifications clearly indicated, will be made available to the public, for written comment, at least 15 days before it is adopted.

The public may request a copy of the modified regulatory text from the Board's Public Information Office, 1001 "I" Street, Sacramento, California 95814, (916) 322-2990.

CALIFORNIA AIR RESOURCES BOARD

Catherine Witherspoon
Executive Officer

Date: October 11, 2005

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS

PROPOSED DIESEL PARTICULATE MATTER CONTROL MEASURE FOR ON-ROAD HEAVY-DUTY DIESEL-FUELED VEHICLES OWNED OR OPERATED BY PUBLIC AGENCIES AND UTILITIES

Date of Release: October 21, 2005
Scheduled for Consideration: December 8-9, 2005

State of California
California Environmental Protection Agency
AIR RESOURCES BOARD

PROPOSED DIESEL PARTICULATE MATTER CONTROL MEASURE FOR ON-ROAD HEAVY-DUTY DIESEL-FUELED VEHICLES OWNED OR OPERATED BY PUBLIC AGENCIES AND UTILITIES

Staff Report

October 2005

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LIST OF ACRONYMS

$/lb	Dollars per pound
AB	Assembly bill
ARB, or the Board	Air Resources Board
ATCM	Air toxic control measure
BACT	Best available control technology
CCR	California Code of Regulations
CO	Carbon monoxide
DECS	Diesel Emission Control System or Strategy
DOC	Diesel Oxidation Catalyst
DRRP, or Diesel Risk Reduction Plan	Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles Risk Reduction Plan
DTSC	Department of Toxic Substances Control
g/bhp-hr	Grams per brake horsepower-hour
GVWR	Gross vehicle weight rating
HC	Hydrocarbon
H&SC	Health and Safety Code
$\mu g/m^3$	Microgram per cubic meter
MY	Model year
Moyer Program	Carl Moyer Memorial Air Quality Standards Attainment Program
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
NOV	Notice of violation
OEHHA	Office of Environmental Health Hazard Assessment
O & M	Operation and maintenance
PM	Particulate matter
Ppmw	Parts per million by weight
SCAQMD	South Coast Air Quality Management District
SJVAPCD	San Joaquin Valley Air Pollution Control District
TAC	Toxic air contaminant
Tpd	Tons per day
Ultra low sulfur diesel fuel	Diesel fuel with less than 15 ppmw sulfur content
U. S. EPA	United States Environmental Protection Agency
VIN	Vehicle identification number
VOC	Volatile organic compound

EXECUTIVE SUMMARY

The Air Resources Board's (ARB or Board) mission is to provide healthful air to all Californians. In 1998, the Board identified diesel particulate matter (PM) as a toxic air contaminant and established a goal of reducing emissions of diesel PM to the lowest practicable levels. Diesel PM is by far the largest contributor to adverse health impacts from all toxic air contaminants identified, comprising 70% of statewide risk.

In 2000, the Board adopted a comprehensive plan to reduce PM emissions from diesel-fueled engines and vehicles (ARB 2000b). The ARB has already adopted several control measures recommended in that plan, including rules for transit buses, solid waste collection vehicles, stationary engines, diesel portable equipment, transportation refrigeration units, idling controls, new cleaner exhaust standards for heavy-duty trucks and off-road equipment, and ultra-low sulfur diesel fuel in mid-2006.

The Diesel Risk Reduction Plan included control measures for on-road public fleets and other public and private fleets. This proposed regulation will meet that commitment. It will reduce ambient PM levels and exposure to primary and secondary diesel PM, in turn, reducing the prevalence of the diseases attributed to PM and diesel PM including hospitalizations for cardio-respiratory disease, and premature deaths. ARB staff estimates that approximately 37 deaths would be avoided by the year 2020 as a result of cumulative emission reductions obtained through this regulation.

The ARB staff recommends that the Board adopt new sections 2022 and 2022.1 in Title 13, California Code of Regulations (CCR), as set forth in the proposed Regulation Order in Appendix A.

I. INTRODUCTION

The Air Resources Board's (ARB or Board) mission is to provide clean healthful air to all Californians. In 1998, the Board identified diesel particulate matter (PM) as a toxic air contaminant and established a goal of reducing emissions of diesel PM to the lowest practicable levels. Diesel PM is the largest contributor to adverse health impacts from all toxic air contaminants identified thus far, comprising 70% of statewide risk.

In 2000, the Board adopted the "Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles" (Diesel Risk Reduction Plan) at a public meeting. Among other objectives, the Plan directs staff to develop "new retrofit requirements for existing on-road, off-road, and stationary diesel-fueled engines and vehicles where determined technically feasible and cost-effective."

The ARB has already adopted several of the recommended control measures, including rules for transit buses, solid waste collection vehicles, stationary engines, diesel portable equipment, transportation refrigeration units, idling controls, 2007 model year (MY) emission standards for heavy-duty trucks and off-road equipment, and ultra-low sulfur diesel fuel in mid-2006.

The Diesel Risk Reduction Plan included a specific commitment to develop control measures for on-road public fleets and other public and private fleets. The proposed regulations are part of ARB's continuing efforts to implement the Plan and reduce the public's exposure to harmful diesel PM exhaust.

A. Heavy-Duty Diesel Vehicles Operated by Public Agencies and Utilities

California municipal or public fleets include all federal, state, county and city government fleets plus universities and special districts such as water, utility and irrigation districts. Airports, school districts and ports also are considered to be public fleets. In 2002, ARB contracted for a survey of public agencies to be used to develop an inventory of heavy-duty public fleet vehicles (TIAX LLC 2003). ARB staff followed up on the contractor's work and surveyed additional fleets not captured by the contractor. These include vehicles owned or operated by shareholder-owned utilities that provide natural gas, water or electricity services.

Most public agencies have fleets of fewer than 15 vehicles (80.7%); 16.7 percent have 15 to 99 vehicles, and 2.6 percent have 100 or more vehicles (Table 1). Although the majority of fleets have fewer than five vehicles, they account for less than 7% of the 23,227[1] diesel fueled vehicles with over 14,000 gross vehicle weight rating (GVWR) owned by state and local agencies. On the other hand, only 2.6% of the fleets surveyed owned over 100 vehicles, but these fleets account for 46% of the vehicles owned by state and local agencies (Table 1).

---

[1] *Vehicle Numbers estimated by 2003 Department of Motor Vehicles (DMV) registered exempt license plates.*

Table 1. Public Agency Fleet Distribution

Fleet Size	Number of Fleets	Percent (%) of Fleets	Total # of Vehicles (%)
0-4	324	56.5	6.9
5-14	139	24.2	12.7
15-49	81	14.1	23.6
50-99	15	2.6	10.7
100-999	15	2.6	46.0
Total	**574**	**100**	**100**

The picture for private utilities includes many small investor-owned water companies with one or two heavy-duty diesel-fueled vehicles each (90% of the utilities), about 15 to 20 medium-sized utilities with 40 to 50 vehicles each (8% of the utilities) and a small number of large private utilities with 500 to 1,500 vehicles each (2% of the utilities).

The TIAX report provided additional details on the types of vehicle types used by public agencies. Staff analyzed only the diesel-fueled trucks over 14,000 lbs gross vehicle weight rating (GVWR) reported by public agencies in the TIAX report. Based on this, there are ten vehicle types that comprise 71 percent of the total number of diesel trucks over 14,000 GVWR (Table 2).

Table 2. Public Agencies' Diesel-Fueled Heavy-Duty Trucks By Application

Application	Percent of Fleet
Dump Truck	22
Plow & Spreader Truck	15
Sweeper	7
Cargo Truck	7
Tractor Truck	5
Sewer Truck	4
Service Truck	3
Flatbed Truck	3
Aerial Lift Truck	3
Crane Truck	2
Total:	71

Private utilities have more highly specialized vehicles when compared to public agencies. The three most common applications are specifically designed for working on and stringing power lines (Table 3) and comprise nearly half the total number of vehicles. *For utilities, the top ten vehicle types account for 81 percent of the diesel-fueled vehicle types.*

Table 3. Private Utilities' Diesel-Fueled Heavy-Duty Trucks Top Ten Vehicles by Application Type

Application	Percent of Fleet
Aerial Lift Truck	23
Bucket Truck	14
Line Truck	11
Material Handling Truck	9
Dump Truck	6
Flatbed Truck	5
Mechanic Truck	5
Pickup Truck	3
Welding Truck	3
Flatbed with Crane	2
Total:	81

Engine model year is particularly important for developing the emission inventory and analyzing the applicability of different technologies for reducing emissions. Staff also analyzed the diesel-fueled vehicles by engine type and model year. For the combined public agency and private utility fleet, half of the engines, as of 2004, were in the 1994 to 2006 MY engine group (Table 4). These engines were certified at 0.1 gram per brakehorsepower-hour (g/bhp-hr) PM. Staff estimates that an additional 4% of new vehicles will be added when the regulation begins.

Table 4. Public and Utility Heavy-Duty Diesel-Fueled Vehicles by Model Year Group in 2004

Engine Model Year	PM Certification (g/bhp-hr)	No. of Vehicles	Percent
1960-1987	--	6,165	21
1988-1990	0.60	3,225	11
1991-1993	0.25	3,988	13
1994-2006	0.10	16,491	55
Total		29,869	100

The predominant engines by manufacturer are International, Cummins, and Caterpillar for these medium and heavy heavy-duty diesel vehicles (Table 5).

Table 5. Public Agencies' Engine Manufacturers

Engine Manufacturer	Distribution
International	36.8%
Cummins	16.9%
Caterpillar	16.5%
Not Listed	10.9%
Ford	5.9%
Detroit Diesel	5.5%
GMC	3.8%
Navistar	1.7%
Other	2.0%
Total	99.9%

B. Regulatory Authority

The Federal Clean Air Act (CCA) grants California the authority to control emissions from mobile sources. The California Clean Air Act (Health & Safety Code (H&SC) sections 39002, 43013, and 43018) establishes the ARB as the state agency that sets standards for mobile sources. Most important to this regulation, the California Legislature also granted ARB the authority to identify toxic air contaminants and establish airborne toxic control measures to reduce risk.

1. Control of Toxic Air Contaminants

In 1983, the California Legislature adopted Assembly Bill (AB) 1807 to enact a program to identify the health effects of toxic air contaminants and reduce exposure to these contaminants in order to protect public health (H&SC sections 39650 - 39674). The Legislature established a two-step process to address the potential health effects once a toxic air contaminant is identified: the first step is the risk assessment or identification phase while the second is the risk management or emission reduction phase.

The Board is directed to address specific issues pursuant to the need for regulation (H&SC section 39665). These requirements were addressed in detail in the Diesel Risk Reduction Plan (DRRP), including the extent of present and anticipated future emissions, the estimated levels of human exposure, and the risks associated with those levels. The DRRP (ARB 2000b) describes the physical and chemical characteristics of diesel PM and the contribution to emissions by present sources, as well as the costs, availability, technological feasibility of control measures, and the potential adverse health or environmental impacts. Each of these issues is considered in the development of diesel PM regulations and will be discussed in this report specifically as each relates to this control measure.

2. Other Authority that Provides for Exemptions

Although they are owned and operated by public agencies, emergency vehicles and military tactical support vehicles are exempt from this rulemaking under other statutes and rules.

The smoke inspection program which operates pursuant to H&SC section 43701 does not make a specific reference to "motor vehicle pollution control devices." That section authorizes the adoption of standards, but does not mandate that those standards must be achieved by use of a "device." Thus emergency vehicles are subject to the requirements designed to reduce visible smoke emissions.

With regards to military tactical support equipment, the federal exemption for military tactical vehicles is stated in 40 Code of Federal Regulations (CFR) part 85, section 1703, which refines the definition of "motor vehicle" stated in section 216(2) (42 USCA 7550(2))of the CAA. California recognizes the federal military tactical vehicle exemption in section 1905 of title 13 CCR.

3. Related California Statewide Regulations

California has adopted regulations to ensure compliance with smoke emissions standards. California's Heavy Duty Vehicle Inspection and Periodic Smoke Inspection Programs require that owners eliminate excessive smoke emissions and prohibit exhaust system tampering on diesel-fueled vehicles over 6,000 lbs GVWR; the rules apply to all trucks traveling within California. These regulations impose limits on the opacity of smoke from diesel engines when measured in accordance with a snap-acceleration test procedure and have been in effect since 1991, with amendments adopted in 1997.

In February 2000, the Board adopted a new fleet rule for transit agencies and more stringent emission standards for new urban bus engines and vehicles (ARB 1999, ARB 2000c). The transit bus rule was designed to reduce NOx and PM by setting fleet emission reduction requirements, requirements for zero-emission bus (ZEB) demonstrations and acquisition and new more stringent mid- and long-term new bus purchasing standards.

In September 2003, the Board adopted regulations for in-use solid waste collection vehicles. This rule requires best available control technology (BACT) on all diesel collection vehicles over 14,000 lbs GVWR. From 2004 through 2020, staff estimates that this rule will result in the elimination of over 2.26 million lbs of diesel PM from the air. Similar rules have been adopted for stationary engines, transportation refrigeration units, and portable equipment.

The Board has also adopted limits on idling of diesel engines. In general, buses and commercial vehicles may idle no longer than 5 minutes. More stringent restrictions apply to vehicles idling near a school.

4. Related Local Regulations

The South Coast Air Quality Management District (SCAQMD) has adopted several fleet rules that apply to diesel vehicles. These rules generally require the affected public or private operator of fleets with more than fifteen vehicles to procure only alternative-fuel engines when purchasing new vehicles. In the case of school buses, the requirement is tied to the availability of grants.

- Rule 1186.1 – Less Pollution Street Sweepers
- Rule 1192 – Clean On-Road Transit Buses
- Rule 1193 – Clean On-Road Residential and Commercial Refuse Collection Vehicles
- Rule 1195 – Clean On-road School Buses
- Rule 1196 – Clean On-Road Heavy-Duty Public Fleet Vehicles

Some local air districts have enacted ordinances to encourage use of low-emission vehicles and retrofitting of existing vehicles. The Sacramento AQMD established the "Model Green Contracting Ordinance" and the "Model Low-Emission Vehicle and Fleet Ordinance" in October 2002, aimed at reducing ozone precursors in the Sacramento region. These ordinances encourage contractors to operate low-emission vehicles and amended local codes that regulate procuring and retrofitting of vehicles for public agency fleets.

The Sacramento Area Council of Government's (SACOG) Board of Directors approved a strategic plan to implement a $70 million incentive program to help clean up the region's air. This program is known as the Sacramento Emergency Clean Air and Transportation (SECAT). SECAT will provide funds to vehicle owners to replace old engines with newer engines, use clean diesel formulations such as emulsified diesel, and retrofit in-use diesel engines with after-treatment.

The San Joaquin Valley Air Pollution Control District has established a heavy-duty engine program, which provides incentive funds for the differential cost, associated with reduced emission technology as compared with the cost of conventional technology. Eligible funding categories include various heavy-duty on- and off-road vehicles and engines.

5. California Voluntary and Incentive Programs

Voluntary efforts play a key role in helping to achieve air quality goals. Incentives or early implementation credits can induce vehicle owners to reduce vehicle emissions prior to compliance deadlines or in excess of regulatory requirements. Several incentive programs exist in California which have reduced diesel PM emissions over the last several years.

The California Legislature established the Carl Moyer Memorial Air Quality Standards Attainment Program (Moyer Program) in 1998 to reduce NOx emissions from existing vehicles. The Moyer Program funds the incremental cost of repower, retrofit, or purchase of new, cleaner engines that meet a specified cost-effectiveness level for NOx reduction. Recently, the Moyer Program has been expanded to include agricultural sources of air pollution as well as cars and light-duty trucks. Programs that may also be funded reduce hydrocarbon (HC) and PM pollution. The total Moyer Program is funded at approximately $140 million per year for the next 10 years.

In 2000, the Legislature approved new funds to reduce emissions from school buses. The goal of this incentive program is to reduce the exposure of school children to both cancer-causing and smog-forming compounds. This program utilizes two strategies to attain these goals: pre-1987 model year school bus replacement and in-use controls for later model year diesel-fueled school buses. Funding for fiscal year 2005 to 2006 is $25 million.

6. Federal Programs

The U.S. EPA established a Voluntary Diesel Retrofit Program in 2000 to address pollution from diesel construction equipment and heavy-duty on-highway vehicles. This program verifies technology that reduces emissions and allows fleet operators to choose appropriate, U.S. EPA-verified technologies that will reduce the emissions of the vehicles and engines in their fleets. U.S. EPA has also identified potential funding sources to assist air quality planners and fleet operators as they create and implement retrofit programs. The program assists air quality planners in determining the number of State Implementation Plan credits produced by their retrofit projects. The U.S. EPA has also established a program to fund school bus retrofits and replacements from penalty revenues.

The Energy Bill authorizes up to $8.5 billion for federal Congestion Mitigation and Air Quality (CMAQ) programs and expresses a strong preference for funding diesel retrofit projects. In June 2005, the U.S. Senate passed an amendment to the Energy Bill called the Diesel Emissions Reduction Act (DERA) of 2005 that provides funding to cut emissions from high-polluting diesel engines. DERA would create a national program to fund the cleanup of all types of diesel-powered vehicles, including trucks, buses, tractors, ships, and trains. The legislation authorizes $200 million per year over five years in grants and loans for states and organizations to clean up existing diesel fleets.

II. PUBLIC OUTREACH

The ARB is committed to ensuring that all California communities have clean, healthful air by addressing not only the regional smog that hangs over our cities but also the nearby toxic pollution that is generated within our communities. The ARB works to ensure that all individuals in California, especially the children and elderly, can live, work and play in a healthful environment that is free from harmful exposure to air pollution.

A. Environmental Justice

The ARB is committed to integrating environmental justice in all its activities. On December 13, 2001 (ARB 2001), the Board approved Environmental Justice Policies and Actions,[2] which formally established a framework for incorporating environmental justice into the ARB's programs, consistent with the directives of State law. 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.*

To achieve this ambitious goal, the ARB has established a Community Health Program and placed new emphasis on community health issues in our existing programs. The Neighborhood Assessment Program is a key component in the Community Health Program. The Neighborhood Assessment Program Work Plan presents a plan that the ARB staff proposes to use to develop guidelines for evaluating and reducing air pollution impacts at the neighborhood-scale (ARB 2000a).

The Environmental Justice Policies intends to promote the fair treatment of all Californians and cover the full spectrum of ARB activities. Underlying these Policies is a recognition that we need to engage community members in a meaningful way as we carry out our 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 stakeholders; communities, environmental and public health organizations, industry, business owners, other agencies, and all other interested parties to successfully implement these Policies.

This control measure is in direct response to the environmental justice policy to reduce health risks from toxic air pollutants in all communities, especially low-income and minority communities. This control measure, when adopted, will provide immediate air-quality benefits by reducing diesel PM emissions from public and utility vehicles which operate in neighborhoods. The actions we have taken in applying these policies in our rulemaking reflect the Board's commitment to the fair treatment of all people throughout California.

B. Outreach Efforts

As part of the environmental justice policy to strengthen our outreach and education efforts in all communities, staff held seven public workshops, and many focused meetings in the development of this rule from April 2003 to August 2005. The workshops were held at times and locations that encouraged public participation. Attendees included representatives from local, state, and federal public agencies, utilities, environmental organizations, engine manufacturers, diesel emission control

[2] Complete information for these programs can be found at http://www.arb.ca.gov/ch/ej.htm.

manufacturers, and other interested parties. These individuals participated both by providing data, reviewing draft regulations and by participating in open forum workshops, in which staff directly addressed their concerns. In addition to this, ARB staff participated in a Diesel Emission Reduction for Public Agency and Utility Fleets Technical Conference sponsored by the California Air Pollution Control Officers Association (CAPCOA) in Sacramento on August 15-16, 2005. This conference was attended by over 500 individuals representing municipal and utility fleet managers, aftreatment device manufacturers, installers, engine manufacturers, fuel producers and environmental groups.

Staff met with a number of stakeholders' groups throughout the rulemaking process. Representatives from various public agencies and private utilities assisted ARB in gathering data about their fleets and provided input in developing our data survey forms. Alternatives were suggested to the proposed regulation and explored by staff. Staff met several times with representatives of the Regional Council of Rural Counties (RCRC) and presented at a RCRC board meeting on August 11, 2004, to specifically discuss compliance issues unique to small population counties and what special provisions could be provided in the rule.

Workshops were in held in Sacramento and El Monte. The Sacramento workshops were broadcast over the internet (webcast), to provide opportunity for stakeholders throughout California to participate (Table 6). Over 3,000 individuals and companies were notified through a series of mailings. In addition, notices were posted to the web site and e-mailed to subscribers of ARB's electronic list server.

Table 6. Workshop Locations and Times

Date	Location	Time
April 3, 2003	El Monte	2:30 – 4:30 PM
December 2, 2003	El Monte	10:00 – 12:00 PM
December 3, 2003*	Sacramento	10:00 – 12:00 PM
May 17, 2004*	Sacramento	10:00 – 12:00 PM
May 18, 2004	El Monte	10:00 – 12:00 PM
October 7, 2004	El Monte	10:00 – 12:00 PM
October 8, 2004*	Sacramento	10:00 – 12:00 PM

*Webcasted workshops

To generate additional public participation and to enhance the information flow between ARB and interested persons, staff made all documents, including workshop presentations, available via the ARB's web site.[3] The web site provides background information on diesel PM, including fact sheets, workshop dates and locations, and other diesel related information and serves as a portal to other web sites with related information.

[3] Located at http://www.arb.ca.gov/msprog/publicfleets/publicfleets.htm.

III. NEED FOR REDUCTION OF EMISSION REDUCTIONS

A. Particulate Matter

PM emissions result primarily from incomplete combustion of fuel in the cylinder and lubrication oil that has entered the cylinder incidentally. Secondarily produced diesel PM is formed as a result of atmospheric reactions with diesel NOx emissions. The majority of diesel PM, approximately 98 percent, is smaller than ten microns in diameter. Diesel PM is a mixture of materials containing over 450 different components, including vapors and fine particles coated with organic substances. More than 40 chemicals in diesel exhaust are considered TACs by the State of California.

Diesel PM has been linked to a wide range of serious health problems. Particles that are deposited deep in the lungs can result in lung cancer, increased hospital admissions; increased respiratory symptoms and disease; decreased lung function, particularly in children and individuals with asthma; alterations in lung tissue and respiratory tract defense mechanisms; and premature death. Increased PM exposure causes increased cardiopulmonary mortality risk as demonstrated in a validity and causality analysis of 57 epidemiological studies. (Dab, et al. 2001). Significant positive associations exist between lung cancer incidence and the number of days per year that respirable particulates (PM_{10}) exceeded several thresholds (Beeson, et al. 1998). Long-term ambient concentrations of PM_{10} are associated with increased risks of all natural-cause mortality in males, mortality with any mention of nonmalignant respiratory causes in both sexes, and lung cancer mortality in males (Abbey, et al., 1999; McDonnell, et al., 2000).

B. Ozone

Ground-level ozone is created by the photochemical reaction between NOx and reactive organic gases (ROG). Breathing ozone can trigger a variety of health problems including chest pain, coughing, throat irritation, shortness of breath, and congestion. It can worsen bronchitis, emphysema, and asthma. Ozone can also reduce lung function and inflame the linings of the lungs. Repeated exposure may permanently scar lung tissue. The elderly, children, and people with compromised respiratory systems are among those persons who may be most affected by exposure to ozone.

Ground-level ozone also damages vegetation and ecosystems. It leads to reduced agricultural crop and commercial forest yields, reduced growth and survivability of tree seedlings, and increased susceptibility to diseases, pests, and other stresses such as harsh weather. Ground-level ozone also damages the foliage of trees and other plants, affecting the landscape of cities, parks and forests, and recreational areas.

NOx is considered an important outdoor pollutant not only because it is an essential precursor in the formation of ground-level ozone, but also because it contributes to the formation of atmospheric acids and secondary particles. In addition, nitrogen dioxide is a reactive gas capable of damaging the cells lining the respiratory tract. The ARB staff is currently reviewing the NO2 standard for possible revision.

IV. ENGINE AND EMISSION INVENTORY

An improved engine and emission inventory was developed for this rule's proposal, including a survey of vehicles used in California's public fleets. The ARB contracted with TIAX LLC (formerly Arthur D. Little) to survey California public fleets to allow staff to develop a comprehensive understanding of vehicles and equipment used by various public agencies (TIAX LLC 2003). The survey started in February 2002 and was completed in February 2003. The final database contained data for 178 fleets representing 57 percent of the DMV estimated heavy-duty vehicles over 8,500 GVWR and equipment owned and operated by public agencies. The report also conveyed data on engine make, model, model year, vehicle types, as well as activity characteristics of vehicles (i.e., mileage and fuel consumption) used in public fleets in California.

Federal agencies, some large public agencies and all private, shareholder-owned utilities were not included in the TIAX study, so staff continued the survey in 2004. In addition to the public agencies, staff contacted the three largest investor-owned private utilities[4] to request vehicle information. All responded with some information about their fleets. Two of the utilities provided detailed information on their vehicles such as engine make, model, model year, vehicle type and current odometer. In addition, staff surveyed smaller utilities and contacted them by telephone for information on their vehicles.

A. Engine Inventory

Staff estimates the population of diesel vehicles over 14,000 GVWR owned by state and local agencies is 23,227 based on analysis of the 2003 Department of Motor Vehicles (DMV) database for exempt vehicle license plates[5]. We gathered engine and fleet data for approximately 57 percent of the vehicles used by these public fleets and 79 percent of the vehicles used by utilities. Staff extrapolated these data to obtain a picture of the entire fleet of California's public and utility owned on-road diesel vehicles. The population is expected to remain relatively stable or increase slowly during the implementation of this regulation because of budgetary constraints. Public agencies tend to keep a vehicle in service for over ten years on average and thus fleet turnover (the time a vehicle is retired from service) is expected to remain relatively slow.

Staff estimates there are 3,979 heavy-duty vehicles (as of 2004) owned or operated by private utilities subject to this rule. Approximately 3,130 of these are owned or operated by the three largest investor-owned utilities: Southern California Edison, PG&E, and Sempra Energy (Southern California Gas Company and San Diego Gas & Electric). In

[4] Pacific Gas and Electric, Sempra Energy (Southern California Gas, San Diego Gas and Electric), Southern California Edison

[5] This number excludes emergency vehicles, school buses, solid waste collection vehicles and transit buses.

addition, staff identified about twenty additional utilities with 664 heavy-duty vehicles that are listed in the ARB's Periodic Smoke Inspection Program (PSIP) database. Staff identified about 185 small water companies from the California Public Utilities Commission (CPUC) lists. Telephone contact with these small water companies determined that, on average, each has about one vehicle per company that may be impacted by this regulation. For federal fleets, the United States Postal Service (USPS), several military bases, and the federal General Service Administration (GSA) also submitted survey information on their heavy duty diesel vehicles accounting for approximately 2,663 vehicles subject to the rule.

Combining these data, staff estimated the 2004 population of public agency and private utility vehicles covered by this proposal to be 29,869.

B. Emission Inventory

The California on-road vehicle emission inventory data consists of two elements: engine emissions and vehicle activity. The emissions-related data reflect new vehicle testing information and the latest vehicle registration data from the DMV. The activity-related data are updated by the regional transportation agencies that estimate the daily vehicle miles of travel, the distribution of travel by speed, and the number of starts per vehicle per day by year. In addition, staff conducted a temperature exhaust study to determine the percentage of vehicles that would be amenable to passive diesel emission control systems. A summary of this study is provided in Section VI.E. The on-road emission inventory is then derived using a mathematical model developed by ARB named EMission FACtor (or EMFAC).

Staff calculated the emission inventory for public agency and private utility vehicles using the EMFAC model. Certain parameters such as vehicle age distribution, population and turn over (useful life) were updated based on the surveys staff did to support this regulatory purpose and incorporated into the revised inventory (Appendix B). Gasoline vehicles, alternative fueled and vehicles less than 14,001 lbs GVWR were not included in the emissions analysis.

The baseline emissions for pubic agency and private utility vehicles (Table 7) gradually decline over time naturally with the introduction of cleaner engines in the 2007 and 2010 model years.

Table 7. **Baseline Public Agency and Private Utility Inventory (Tons Per Year)**

Calendar Year	PM	NO_x	HC	CO
2000	165	4061	365	895
2005	140	4148	103	837
2010	93	3680	84	730
2015	63	3093	72	644
2020	45	2676	59	600

V. SUMMARY OF PROPOSED CONTROL MEASURE

Staff recommends that the Board adopt new sections 2022 and 2022.1, as set forth in Appendix A. The core of this proposal is a requirement that each municipality and private utility apply best available control technology (BACT) to its on-road heavy-duty diesel vehicles to reduce diesel PM emissions and associated health impacts according to the rule's schedule. The proposed rule is based on the proposed control measure listed in the Diesel Risk Reduction Plan (ARB 2000).

A. Scope and Applicability

The proposed rule applies to municipalities and private utilities that own or operate one or more diesel-fueled on-road vehicles with a GVWR greater than 14,000 lbs, powered by a heavy-heavy or medium-heavy duty 1960 to 2006 MY engines. Medium and heavy heavy-duty diesel trucks have the highest diesel PM emissions when compared to all medium duty/light heavy-duty trucks and thus focusing on these vehicles is a cost-effective mechanism for diesel PM reduction, as will be discussed later. The regulation does not apply to emergency vehicles described in the California Vehicle Code 27156.2 or military tactical vehicles which in general are exempt from certain air pollution control requirements. It also does not include solid waste collection vehicles, school buses, transit buses or off-road vehicles which are subject to separate state regulations or programs. Gasoline vehicles are excluded if they do not meet the standards specified in these regulations.

A municipality is defined in section 2020, title 13 of the California Code of Regulations (CCR) as a city, county, city and county, special district, or a public agency of the United States of America or the State of California, and any department, division, public corporation, or public agency of this State or of the United States, or two or more entities acting jointly, or the duly constituted body of an Indian reservation or rancheria. A utility is a new definition proposed by the regulation and is defined as a privately-owned company that provides the same or similar services for water, natural gas, and electricity as a utility operated by a municipality.

B. Best Available Control Technology (BACT)

The proposed rule requires that a municipality or utility reduce diesel PM emissions through application of BACT by the applicable implementation dates.

BACT is defined in this section as one of four compliance options:

(1) Use of a engine or power system certified to the 0.01 g/bhp-hr particulate emission standard; or

(2) Use of an engine or power system certified to the 0.1 g/bhp-hr particulate emission standard, in conjunction with the highest level verified diesel emission control strategy (DECS); or

(3) Use of an alternative-fuel, heavy-duty pilot-ignition, or gasoline engine; or

(4) Use of an existing engine used in conjunction with the highest level verified DECS.

A public agency or utility that chooses to repower a vehicle with an engine certified to the 0.01 g/bhp-hr PM standard (option 1), would use an engine certified to either the optional 0.01 g/bhp-hr particulate emission standard as specified in title 13, CCR, section 1956.8(a)(2), or the 0.01 g/bhp-hr particulate emission standard as specified in title 13, CCR, section 1956.8(a), when it becomes effective in 2007. This option has a greater cost, as it entails either purchasing a replacement vehicle or engine (also called engine repowering), but may be preferred by a public agency or utility when the vehicle being replaced is nearing the end of its useful life. Engines certified to 0.01 g/bhp-hr PM, however, will not be generally available for vehicles until the 2007 MY.

A public agency or utility that chooses to repower a vehicle with an engine certified to a 0.1 g/bhp-hr particulate emission standard (option 2) as specified in title 13, CCR section 1956.8, must also install the highest level DECS that is verified in accordance with 13 CCR section 2702(f). The DECS must be the highest level that the retrofit manufacturer or authorized dealer agrees that can be used on that engine.

No additional controls are required to reduce diesel PM emissions from alternative-fueled or gasoline vehicles (option 3) because, by definition, alternative-fuel or gasoline vehicles do not emit diesel PM. Staff wanted to ensure that only the cleanest alternative fueled or gasoline engines would be considered BACT, therefore for MY 2004-2006 alternative fueled engines must be certified to the optional reduced emission standards specified in title 13 CCR section 1956.8(a)(2)(A). Similarly, in order for gasoline engines to be considered BACT, they must be certified to the 2005 model year and later emission standards for heavy-duty Otto cycle engines specified in title 13 CCR section 1956.8(c)(1)(B) and 1976(b)(1)(F). Beginning in 2007, both alternative fuel and gasoline engines will be required to meet the stringent standards set for diesel fueled engines. A certified dual-fuel engine, however, uses both diesel fuel and an alternative-fuel, and is not considered to meet BACT because of the relatively high proportion of diesel fuel used. Thus an owner with a dual-fuel vehicle must still comply with the rule, for example by installation of a verified diesel particulate filter. A heavy-duty pilot-ignition engine is treated like an alternative-fuel engine in this rule because of its relatively low proportion of diesel fuel compared to alternative-fuel usage. This engine would use diesel fuel in less than ten percent of its duty cycle for engine ignition and cannot operate or idle solely on diesel fuel at any time. It should be noted at this time no such engine is currently certified in California.

The last option (4 above) is to install a verified DECS to meet the BACT requirement. This is the least expensive option. If a municipality or utility plans to comply using this option, the technology must be verified by ARB. Several DECSs have received approval under the Verification Procedure for In-Use Strategies to Control Emissions from Diesel Engines (title 13, CCR, sections 2700-2710).

Under this procedure, diesel PM control devices can be verified to one of three levels: Level 1, greater than 25 diesel PM reduction; Level 2, greater than 50 percent; and Level 3, 85 percent and greater diesel PM reduction. BACT is determined by Level, not by percent emission reduction. Thus a technology that reduces diesel PM by, for example, 45 percent is equivalent, under this rule, to one that reduces diesel PM by 25 percent. Both get the same credit in this rule as Level 1 DECS. Table 8 shows the PM emission levels which result when the three levels of verified devices are applied to various engine model years. A DECS can also be optionally verified to reduce NOx emissions by a minimum of 15 percent reduction. ARB has verified a few DECS that are verified to reduced PM and NOx emissions.

Table 8. Potential Reductions from the Use of DECSs.

Engine MYs	**New Engine Particulate Standard (g/bhp-hr)**	**PM Emissions (g/bhp-hr)**		
		Level 3	**Level 2**	**Level 1**
1960 – 1987	None	85% reduction	50% reduction	25% reduction
1988 – 1990	0.6	0.09	0.30	0.45
1991 – 1993	0.25	0.04	0.13	0.19
1994 – 2006	0.1	0.02	0.05	0.08
2007+	0.01	NA	NA	NA

In this rule, BACT is evaluated on a vehicle-by-vehicle basis. A municipality or utility must evaluate the highest level DECS that can be installed and operated successfully for each combination of an engine and vehicle. If a Level 3 DECS is available for the engine, this option must be applied to the engine provided the DECS manufacturer or authorized dealer agrees that the DECS will work in that vehicle. A municipality or utility is required to investigate the highest level DECS appropriateness to a particular vehicle, prior to installation of a lower level DECS. If a Level 3 is not available or feasible, then a

Level 2 option must be explored. A device verified to this level, for example, might be employed for those vehicles that do not have the appropriate PM to NOx ratio or exhaust temperature for a Level 3 DECS such as a passive diesel particulate filter.

A Level 1 DECS is acceptable only if it is the only option available for the engine or application. It should be noted that the regulation does not allow 1960 to 1987 MY engines (Group 1) to use Level 1 technology, unless the municipality or utility is located in a county meeting the "low-population" definition. If no DECS is verified and feasible, the municipality or utility may apply for an implementation delay, as discussed later, but will eventually have to repower or otherwise replace the engine with one meeting the 0.01 g/bhp-hr PM standard, an alternative fuel engine, a heavy-duty pilot ignition, or gasoline engine. Technologies to meet the BACT option are discussed in more detail in *Section VI*.

The general approach of applying BACT is consistent with the solid waste collection vehicle rule previously adopted by the Board.

C. Implementation Schedule

Staff proposes two different implementation schedules. The first is for all municipalities or utilities (Table 9). The second is an optional schedule that a municipality or utility, located in a specified low population county may elect to follow (Table 11). The purpose of the optional schedule is to reduce costs by lengthening the compliance period.

1. General Schedule

Table 9. Implementation Schedule for 1960 to 2006 MY Engines

Group	Engine MY	Percentage of Group to Use Best Available Control Technology	Compliance Deadline
1[a]	1960 – 1987	20	December 31, 2007
		60	December 31, 2009
		100	December 31, 2011
2	1988 – 2002	20	December 31, 2006
		60	December 31, 2008
		100	December 31, 2010
3	2003 – 2006	50	December 31, 2009
		100	December 31, 2010

[a]Group 1: A municipality or utility not use Level 1 technology as BACT

Currently, the higher emitting, mechanically controlled, MY 1960 to 1987 engines (Group 1), are more difficult to retrofit. The best option to reduce PM emissions from these vehicles may be to purchase a new vehicle with a 2007 MY engine. Although replacement with a new 2007 MY vehicle is not required by this rule, staff has adjusted the starting implementation date for this group to December 31, 2007, to allow owners to take advantage of these engines. This compliance mechanism would produce the largest overall reductions in diesel PM emissions.

A municipality or utility could also replace a 1960 to 1987 MY engine with a newer mechanically controlled engine (i.e., MY 1991-1993), and then retrofit this engine with the highest level verified DECS. This would result in the engine moving from the Group 1 to the Group 2 in the compliance schedule.

Group 2, or 1988 through 2002 MY engines, begin implementation in December 31, 2006, one year earlier than the Group 1 engines. ARB has verified Level 3, Level 2 and Level 1 DECS for all MY engines in this group, thus an earlier compliance deadline is justified.

Vehicles with 2003 to 2006 MY engines (Group 3) are to be brought into compliance by the end of 2010. This group currently comprises the smallest portion of the fleet (four percent) and exhaust gas recirculation (EGR) is widely used on these engines to control NOx emissions. Currently there is one Level 3 passive DPF verified for use with an engine that employs exhaust gas recirculation (EGR). However, there are several level 1 and one level 2 currently verified DECS for this MY group.

2. Municipality or Utility Located in a Low Population County

Staff recognizes that a municipality located in a low population county may have less access to revenue sources such as vehicle license fees, road tax, property taxes, sales taxes, etc. than those located in other areas in the state and utilities have fewer customers. Therefore, staff proposes a special, optional implementation schedule for public agencies and utilities located in counties with populations below 125,000 as of July 1, 2005, based upon 2001 population projections by the California Department of Finance. These counties are considered "low population" and are listed in Table 10. Figure 1 shows a map where these counties are located with the overlay of the California air districts in bold.

Table 10. Low Population Counties: Populations Under 125,000

COUNTY	Projected Population as of July 2005
ALPINE	1,300
SIERRA	3,700
MODOC	10,100
TRINITY	13,800
MONO	14,200
INYO	18,800
MARIPOSA	19,600
PLUMAS	21,900
COLUSA	24,200
DEL NORTE	31,500
GLENN	31,800
AMADOR	37,600
LASSEN	39,800
SISKIYOU	47,200
CALAVERAS	47,800
TUOLUMNE	62,200
TEHAMA	63,400
SAN BENITO	63,600
YUBA	66,000
LAKE	69,200
SUTTER	90,400
MEDOCINO	95,500
NEVADA	106,300

[1]Reference: State of California, Department of Finance, *Interim County Population Projections.*Sacramento, California, June 2001

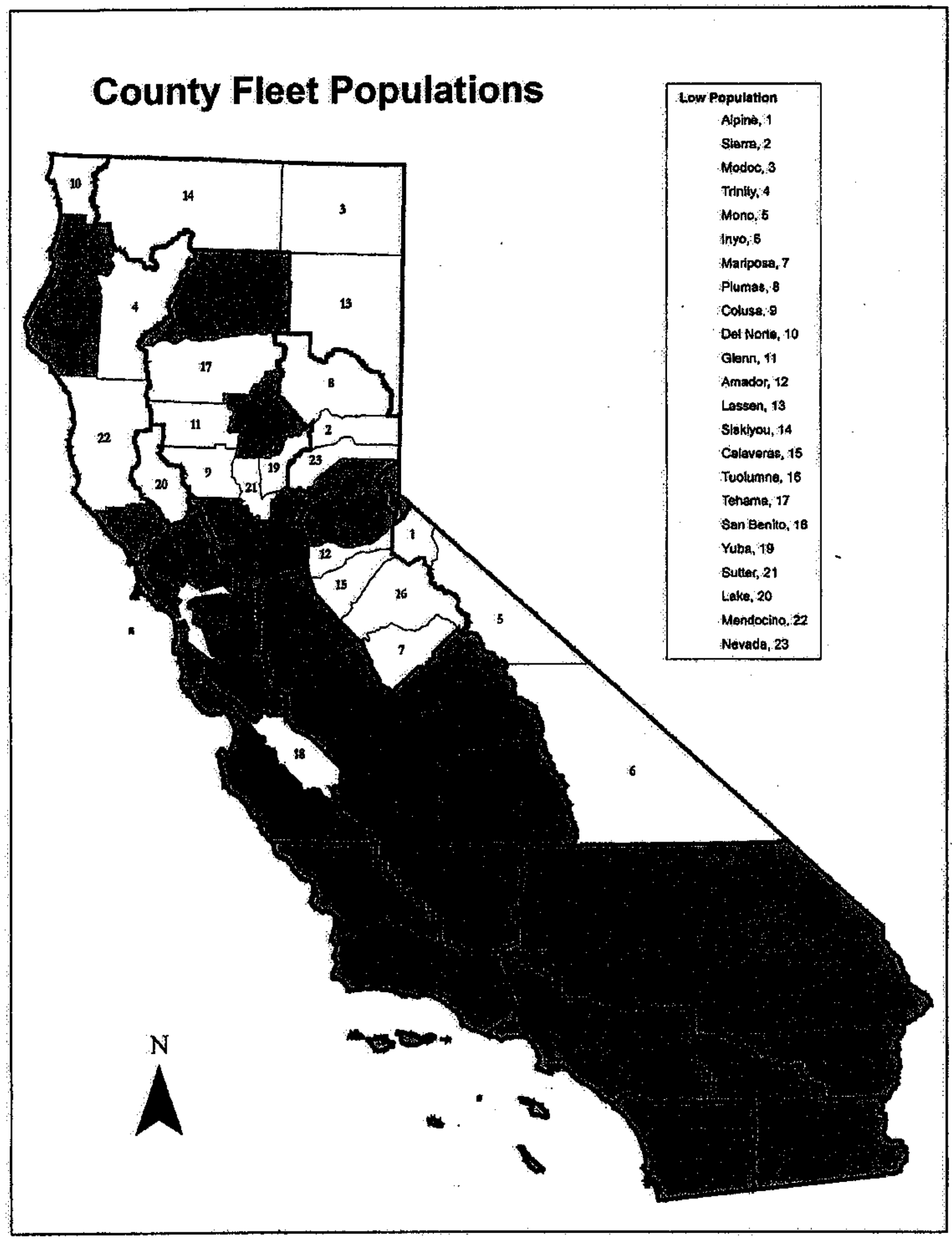

Figure 1. Map Showing Locations of Low Population Counties

These municipalities or utilities may follow the alternate compliance schedule provided below (Table 11):

Table 11. Implementation Schedule for a Municipality or Utility Located in a Low-Population County

Group	Engine Model Years	Percentage of Group to Use Best Available Control Technology	Compliance Deadline, as of December 31st
1	1960 – 1987	20	2009
		40	2011
		60	2013
		80	2015
		100	2017
2	1988 – 2002	20	2008
		40	2010
		60	2012
		80	2014
		100	2016
3	2003 – 2006 (Includes dual-fuel and bi-fuel engines)	20	2011
		40	2012
		60	2013
		80	2014
		100	2015

At the request of Regional Council of Rural Counties[6], staff also included a special provision that allows the use of Level 1 DECS on 1960 to 1987 (Group 1) engines for municipalities or utilities located in low population counties.

3. *Municipalities or Utilities Located in a Low Population County Accelerated Turnover Option*

Many municipalities located in low population counties stated they still would be unable to comply with the rule even with the extended implementation schedule. Therefore, based on this input from low population counties, Regional Council of Rural Counties and several Air Pollution Control Districts, staff developed the accelerated turnover option.

This option requires that a municipality or utility located in a low population county commit to retiring all their 1993 and older engines by December 31, 2020. An owner could elect to retire the vehicle or repower the vehicle with a 1994 or newer engine to comply. This option also requires that the owner apply BACT to their total fleet by December 31, 2025. The municipality or utility must notify the ARB by July 31, 2008, if

[6] Regional Council of Rural Counties letter to ARB dated November 9, 2004, September 9, 2004, and September 7, 2005.

this compliance option is selected. The municipality or utility would still be required to comply with all other requirements of the rule such as record keeping.

D. Calculating Fleet Size for Implementation

The total number of vehicles comprising a fleet may vary from year to year because of new purchases and retirement of older vehicles, thus complicating the calculation of the number of vehicles that must be in compliance each year. Staff has therefore developed formulas to specify how an owner must calculate the number of vehicles to be brought into compliance each year.

To determine compliance during the phase-in, the municipality or utility needs to calculate its fleet size January 1st of each year where a compliance deadline is applicable. For example, the first compliance date is January 1, 2006. The following equations are used to calculate fleet size for any given year.

Total number (by group) of municipality or utility's fleet vehicles ($\#MUV_{by\ group}$) is equal to the total number of engines subject to the rule ($\#Engines_{by\ group}$) including gasoline or alternative fueled engines that meets the definition of BACT, plus the number of vehicles retired in the previous year ($TotRetire_{by\ group}$), beginning with January 1st of the initial applicable compliance deadline. For example, for Group 2 vehicles, only vehicles retired in the 2006 calendar year or later would be counted as retired. Note also that, under this proposed rule, "retirement" means that the engine is scrapped, sold out of state, or converted for use in a "low usage vehicle." If an engine (or vehicle) has BACT applied prior to sale, it may be counted as a retired vehicle; however an engine (or vehicle) that is simply sold within the state is not included in the calculation as a retired vehicle, but *disappears from the fleet in the annual count of engines. This is shown in* equation (1) below:

$$(1) \quad \#MUV_{by\ group} = \#Engines_{by\ group} + TotRetire_{by\ group}$$

The total number of vehicles that must be phased in during a given year by group ($TotVeh_{by\ group}$) is calculated by taking the percentage of vehicles that must meet BACT for that particular year (Group%BACT) multiplied by the municipality's or utility's total fleet number as of January 1st of that compliance year ($\#MUFV_{by\ group}$) from equation (1). This is shown by equation (2).

$$(2) \quad TotVeh_{by\ group} = Group\%BACT * (\#MUV_{by\ group})$$

After the first year of compliance, to calculate how many additional vehicles are required to meet BACT by the next compliance deadline ($TotAddComp_{by\ group}$), then the total vehicles are calculated as shown in equation (1) and (2), then the number of vehicles in already in compliance ($TotBACT_{by\ group}$) and the number of vehicles which have been removed the model year group by retirement in prior years ($TotRetire_{by\ group}$) are subtracted. Again, only engines that have been retired through scrapping, sale out of state or has had BACT applied if sold within the state can be counted as retired. All engines retired since the initial compliance year (for example, 2006 for Group 2) may be included in ToTRetire. This is shown in equation (3).

$$(3) \quad \mathbf{TotAddComp_{by\ group} = TotVeh_{by\ group} - TotBACT_{by\ group} - TotRetire_{by\ group}}$$

In the final compliance year for each group, all remaining vehicles must be brought into compliance. *If the number of vehicles to be brought into compliance is not equal to a* whole number (TotAddComp), the municipality or utility is expected to round to the nearest whole vehicle. A municipality should round up when the fractional part of number of additional vehicles to be brought into compliance (TotAddComp) is greater than or equal to one-half of a vehicle, and round down to the nearest vehicle when the fractional part of TotAddComp is less than one-half of a vehicle. It should be noted, gasoline vehicles that do not meet the emission standards specified for BACT are excluded from the initial total fleet number ($\#MUV_{by\ group}$); while gasoline engines meeting the requirements for BACT are counted in the total fleet number and are counted as a compliant vehicle for determining $TotBACT_{by\ group}$ in Equation 3.

Five sample fleet size calculations are given in Appendix E to illustrate various cases a municipality or utility might experience.

E. Compliance Extensions

Under a variety of conditions, owners may be justified in requesting and receiving compliance extensions. During the public workshop process, staff identified six different circumstances that would potentially justify a request for a compliance extension: early implementation, no verified DECS, fleets located in a low population county, dual-fuel or bi-fuel vehicle, engines near retirement, and participation in an experimental DECS project.

1. Early Implementation

Many public agencies and utilities have proactively taken steps to reduce emissions from their vehicles through early application of BACT. Staff proposes to give some allowance to these fleets in the following two situations.

If a municipality or utility has applied BACT to 50 percent of its vehicles in Group 1 (MY 1960 – 1987) before December 31, 2007, the owner may delay 100 percent compliance of the Group 1 vehicles to December 31, 2012. Likewise, if a municipality or utility applied BACT to 50 percent of its vehicles in Group 2 (MY 1988 – 2002) before December 31, 2006, the owner may delay 100 percent compliance of the Group 2 vehicles to December 31, 2012. A municipality or utility may count each vehicle that meets BACT, as defined in section 2022.1(b) as of January 1, 2005 as a compliant vehicle. This allows a municipality or utility that has previously converted a vehicle to alternative fuel, for example, to subtract this vehicle out of the calculation for additional vehicles required to be brought into compliance for a given calendar year.

A municipality or utility that implements early will not be required to install a higher level DECS if one becomes available between the time the DECS is installed early and the mandated compliance date. A compliance extension for early implementation allows municipalities and utilities to stretch out implementation beyond required dates while at the same time implementing early in at least half of the vehicles. In addition, municipalities and utilities may qualify for incentive funding based on early implementation because it is voluntary and occurs prior to the mandated implementation dates.

2. No Verified Diesel Emission Control Strategy

Staff proposes to allow a municipality or utility a delay in implementing BACT if no verified DECS exists for an engine and application. This delay recognizes the higher cost of an engine repower or replacement and provides the owner additional time to plan for this cost. In addition, during the time allowed for a delay, effective DECS may become verified. This extension applies only after the owner has applied DECS to every applicable engine.

Two methods of granting delays are proposed. Either the Executive Officer would grant a blanket one-year compliance extension or, if the municipality or utility may apply for a compliance extension. Staff proposes the Executive Officer grant a one-year implementation delay without requiring documentation as to the unavailability of verified technology in the event no DECS has been verified for a specific engine or application, or one is not commercially available, by ten months prior the implementation date for that group.

In the second case, a DECS could be verified for an engine, but not able to be used in a specific application. In this case, staff proposes an owner may apply no later than July 31st of the year for which he or she is requesting an extension. The owner must provide documentation that all verified DECSs have been investigated and shown not to work on a particular engine or set of engines, or for that vehicle's particular application. Evidence convincing to ARB would include, for example, a letter from a DECS manufacturer showing evidence of data collected that demonstrates the DECS will not function on that particular vehicle because of its duty cycle. Other examples of justified reasons for an owner applying for an implementation delay would be if the engine is under an original engine warranty and application of a DECS would void that warranty, or if a DECS is not commercially available. In these cases, the documentation should be provided to validate the need for a delay.

ARB has an existing procedure for responding to requests for extension as codified in title 17, CCR, section 60030. Within 90 days after the application is accepted for filing, the Executive Officer will issue his/her approval or disapproval of the compliance extension request.

Staff proposes, however, that an owner not be granted extensions indefinitely because there are other BACT options. Staff proposes that if no DECS for a specific engine or application is available through 2012 for MY 1960 to 1987 (Group 1) engines, the owner would be required to use one of the following BACT: an engine that achieves the 0.01 g/bhp-hr PM standard, a newer 1988 to 2002 (Group 2) engine that can use a verified DECS or an alternative-fueled, heavy-duty pilot ignition or gasoline engine, by December 31, 2011. Similarly, for MY 1988 to 2002 engines, compliance extensions are not given for longer than to December 31, 2011. The municipality or utility would, therefore, be required to employ another BACT by December 31, 2012. No compliance extensions are proposed for MY 2003 to 2006 (Group 3) engines.

3. Dual Fuel or Bi-Fuel Engine

Staff proposes that a dual-fuel and bi-fuel engine of any model year implement BACT according to the 2003 to 2006 MY engine compliance schedule in recognition of its relatively lower certified NOx emissions and because many public agencies purchased these vehicles as part of programs to reduce NOx emissions. A delayed implementation schedule for these vehicles allows public agencies to plan for the additional cost of a retrofit. A public or utility fleet vehicle with a dual-fuel engine retrofitted with a verified level 3 diesel particulate filter is in compliance with the BACT requirement.

4. Engine Near Retirement

Staff proposes to allow a compliance extension for engines within one year of retirement. Retirement, as discussed earlier, refers in this regulation to sale outside of the State of California, scrappage of the engine, or conversion to use only in a low-usage vehicle[7]. If the engine is within one year of retirement as of the applicable compliance date, then staff proposes that the owner could take advantage of a one year delay for compliance. Similarly, if an installed DECS fails and it cannot be repaired, and the vehicle is within one year of retirement, the DECS would not be required to be replaced or upgraded. In the case of this compliance extension, staff envisions that the only case in which this would be used is in the final compliance year. In previous years, the owner needs to apply a DECS to all applicable engines.

5. Use of Experimental Diesel Emission Control Strategy

Many municipalities and utilities have participated in demonstrations of experimental technology designed to reduce diesel PM. This regulation requires the use of verified DECS, and by its nature an experimental technology will not have received verification. Staff, therefore, proposes a municipality or utility be allowed to install experimental technology on no more than twenty vehicles or ten percent of the fleet (whichever is less) for testing and evaluation. Each vehicle being used for the demonstration would be deemed to be in compliance with this rule for the duration of the experiment, provided the experimental technology reduces diesel PM and a valid experimental permit has been obtained from ARB. At the termination of the experiment, the

[7] A low usage vehicle is defined in the proposed regulation as a vehicle that is operated for fewer than 1000 miles or 50 hours per year, based on a five-year rolling average.

experimental technology would be removed, unless it has received appropriate verification from ARB, and replaced with the verified DECS as required, within six months of termination of the experiment. No experimental DECS may be used after December 31, 2012, to meet the BACT requirement.

These provisions provided in sections V.E.1-5 are consistent with the previously adopted rule for the Solid Waste Collection Vehicles.

6. Accelerated Turnover Option

Staff has included an Accelerated Turnover Option for municipalities or utilities located in low population counties. To participate in this option, these municipalities or utilities must notify ARB in writing by July 31, 2008. This date is six months prior to the first implementation deadline for municipalities or utilities located in low population counties.

If a fleet elects to participate in this option, they would send a letter to the ARB indicating that they would be participating in this option. The fleet would then be required to label all their trucks by December 31, 2006, as participating in the "accelerated turnover option". The fleet would not be required to do anything to their vehicles until 2020, when they would be required to retire all their vehicles with engines 1993 and older, and replace these with vehicles with engines newer than 1994. The fleet could also repower all their vehicles with 1993 engines with 1994 and newer engines to comply with this option. Then the fleet would not do anything until 2025, when they would be required to apply BACT all their vehicles.

F. Diesel Emission Control Strategy Special Circumstances

Staff has included in the proposed rule provision to address special circumstances that may arise during its implementation.

1. Fuel Strategy DECS

A municipality or utility must apply the highest level DECS available for a particular engine. There could be a situation where a fuel based strategy may be the highest level DECS for a small number of vehicles in a municipality or utility's fleet. Some fuel based DECS strategies require the fuel be stored in a dedicated tank, and for a small number of vehicles the infrastructure cost could be unreasonable. Therefore, staff has included a provision where a fleet could request the use of a lower level non fuel-based DECS on these vehicles where the highest level DECS would only be a fuel based strategy. For example, say a fleet has 100 vehicles and 90 could use a level 3 passive diesel particulate filter and 10 meet the criteria to use a level 2 diesel emulsified fuel. Use of this fuel would require installation of a dedicated fuel tank. In this case, the fleet could request to use a level 1 diesel emission control strategy for these 10 vehicles provided they are not in the oldest group of vehicles (1960 to 1987 engine MY).

Another situation could exist where a fleet decides to use a fuel based DECS across its entire fleet. However, the highest level DECS for certain vehicles within the fleet may be a Level 3 hardware device. In this case, the fleet could request to use a lower DECS on the few vehicles that are amenable to a Level 3 DECS, in order to accommodate a minimum Level 2 fuel based DECS across the entire fleet.

2. Failure or Damage of a DECS

For various reasons, a DECS might fail or be damaged during the lifetime of an engine. The intent of this regulation is to reduce diesel PM emissions for the life of an engine. Staff proposes if a DECS fails or is damaged while it is within its warranty period, the municipality or utility be allowed to repair or replace the DECS with the same or comparable DECS, as provided under the DECS manufacturer's warranty. If, however, the DECS fails or is damaged outside of its manufacturer-provided warranty, staff proposes the municipality or utility would then be required to install the highest verified level DECS available. For example, if a vehicle initially is retrofitted with a Level 1 DECS or another BACT, and a Level 2 or Level 3 DECS becomes available after the Level 1 DECS warranty expires and the DECS fails, then the municipality or utility would be required to upgrade the DECS to the higher level DECS.

3. Discontinuation of Fuel as a DECS

If a municipality or utility chooses to discontinue use of fuel verified as a DECS under section 2022.1(b) of the proposed regulation, it would be required to use another BACT. In the event another BACT is not commercially available within 30 days from the date of discontinuation of a fuel verified as a DECS, a compliance plan must be submitted to the Executive Officer no later than 30 days after discontinuation of the use of the fuel verified as a DECS. This plan must demonstrate how the municipality or utility will bring its vehicles into compliance within six months.

4. Limited Use of a Level 1 DECS

While use of a Level 1 DECS is allowed in most cases when no level 2 or 3 DECS is available, the relatively low level of PM reduction (25 percent) is a concern. Widespread use of Level 1 DECSs would not achieve the goals of 75 percent diesel PM reduction by 2010 and 85 percent diesel PM reduction by 2020. Therefore, staff proposes to allow a municipality or utility to use a Level 1 DECS for a limited time period as a BACT. The time limit for Group 2 (MY 1988 – 2002) is ten years.

A municipality or utility is not allowed to use a Level 1 DECS on MY 1960-1987 (Group 1) engines due to their extremely high PM emission rates. An owner would be required to apply at least a Level 2, Level 3 or another BACT to these engines. If no DECS is verified or available for Group 1 vehicles, then the owner would be eligible to apply for a compliance extension, after which the owner would have to repower or replace the engine as per sections 2022.1 (b)(1), or (b)(2). Alternatively, a municipality or utility could repower a vehicle with a newer engine such that it would be amenable to a verified DECS. It should be noted that the regulation does allow Level 1 DECS to be used on 1960-1987 (Group 1) engines located in low population counties to meet BACT. However, the use of a Level 1 DECS even on these engines would be limited to ten years. This provision was provided at the request of the Regional Council of Rural Counties and several air pollution control districts. This would provide a certain level of PM reduction for the oldest trucks and allow additional time for agencies or utilities located in low population counties to procure newer vehicles that could be amenable to higher level DECS.

Staff proposes that the time limit for use of a Level 1 DECS on Group 3 (MY 2003-2006) vehicles be five years since it is anticipated there will be level 3 or 2 technologies available for most engines during the rule's implementation timeframe. Therefore, it is proposed that a fleet owner be required to upgrade a level 1 DECS after five years, since these vehicles will be in the fleet for a very long time.

G. Record Keeping Requirement

Municipalities and utilities must keep records as required by the regulation, and make those records available for inspection during enforcement audits by ARB personnel. Certain records as described by section 2022.1(f) must be kept at the terminal where the vehicle normally resides and others must be kept in the vehicle. If a municipality or utility is found to be out of compliance with this record keeping requirement, enforcement actions may be initiated.

1. Records Accessible at Terminal

Records to be kept at the facility where the vehicle normally resides (or other centralized location) include a list of the vehicles covered by the proposed regulation that identifies each vehicle by type, engine manufacturer, engine model, engine model year, series, engine family, and status as a low usage vehicle (if applicable). That information must be tied to specific DECS that are installed in each vehicle.

DECS information required includes the type of DECS, its serial number, manufacturer, model, level, and date of installation, or first date of use if a fuel DECS. The reason for choosing a Level 1 or Level 2 verified DECS must also be maintained. If a Level 3 verified DECS is available, then the DECS manufacturer or authorized dealer must provide reasoning for not using that DECS. DECS maintenance records would also need to be available. In the case of fuel or fuel additives used as a DECS, purchase records would need to be kept for the most current two years worth of purchases.

If a municipality is following the implementation schedule in for a low population county, then it must maintain documentation affirming that the vehicles are not at any time operated in a metropolitan statistical area as defined by the U.S. Census Bureau.

2. Records Kept in Vehicle

Staff also proposes that a municipality or utility be required to keep certain information in the vehicle, which can be accessed during roadside inspections. In order to have vehicle records easily accessible, ARB proposes a label with the required information be affixed to the driver's side door jam, or another location known by the driver and readily visible to an inspector.

For a vehicle with an installed DECS, the information required is the same as that required under the Verification Procedure in section 2706 (g). This includes the manufacturer's name, address, and phone number; the DECS family name; product serial number, month and year of manufacture plus the date of installation of the DECS, or date of first use if the DECS is a fuel.

Staff believes this information is needed to enforce the rule. Without this information, an inspector might have to dismantle a muffler housing, for example, to determine that a diesel particulate filter was installed. In addition, other regulations require certain records be kept in vehicles, such as manifests, therefore staff believes it is not unreasonable to require these records be kept in vehicles.

3. Requirement for Transfer of Records

The regulation requires that once a vehicle is in compliance it must remain in compliance with this regulation. Therefore, if ownership of a vehicle is transferred, the seller shall give these records to the buyer, or a third party sales representative.

H. Contractor Compliance Requirement

Staff has proposed that municipalities and utilities include compliance contract language when hiring a private company for services that a municipality or utility would normally provide. For instance, because many municipalities do street sweeping, a contract to provide this service would be subject to this condition. The compliance contract language is in section 2202.1(g) and proposes that municipalities and utilities add a statement in all contracts that a company is in compliance with all applicable air pollution control laws in order to be considered for bid. A similar provision was adopted in the solid waste collection vehicle rule where it was discovered many existing contracts already have boiler plate language similar to this one proposed. This simply provides another level of back-up that both municipalities and contractors are required to comply with all existing air pollution control regulations, local ordinances, and any future retrofit rules for private companies.

I. Non-Compliance and Enforcement

To ensure compliance with this rule, ARB staff will inspect the records and verify installation of DECS during inspections under the Periodic Smoke Inspection Program[8]. If a fleet is in non-compliance with the regulation a penalty of up to $1,000 per vehicle per day can be imposed. If further investigation determines the municipality or utility neglected or intentionally violated the regulation, penalties of up to $10,000 per vehicle per day may be imposed.

VI. TECHNOLOGICAL FEASIBILITY OF CONTROL MEASURE

Reducing emissions from diesel engines is an area of active research and development. Engine manufacturers are close to deploying engines that meet the California and federal 2007 engine standards for demonstration in fleets, and they are developing technologies to further reduce NOx emissions for the 2010 standards. The field of exhaust aftertreatment, or retrofitting engines, is growing rapidly, spurred both by the research and development ongoing to new engines and by California's diesel emission reduction regulations. Based on its evaluation of the technology available today and an assessment of technology likely to be available in the near future, staff is confident that the proposed control measure is technologically feasible. The following sections describe the availability and feasibility of various exhaust emission control technologies.

A. Availability of Ultra-low Sulfur Diesel Fuel

Many diesel emission control technologies are adversely affected by sulfur in the fuel. Ultra-low sulfur (15 ppmw or less sulfur content) diesel fuel is therefore required for effective functioning of many, although not all, diesel emission control strategies (DECS). New, 2007 MY engines will require ultra-low sulfur diesel fuel to enable proper functioning of the catalyzed diesel particulate filter that manufacturers will use to reduce diesel PM emissions to 0.01 g/bhp-hr.

The U.S. EPA and California adopted regulations that mandate the sale of ultra-low sulfur diesel fuel beginning July 1, 2006. One refiner, BP, has been making and selling ultra-low sulfur fuel in California since 2002. California transit agencies subject to the Fleet Rule for Transit Agencies have been required to use the fuel since July 1, 2002. Some cities have also been using ultra-low sulfur diesel fuel since it became widely available in 2002 when BP certified fuel resellers to handle the low sulfur diesel fuel, thus making the product available by truck. BP is also selling low sulfur diesel fuel through its ARCO stations that carry diesel fuel. By July 2006, ultra-low sulfur diesel fuel will be available statewide through the pipeline distribution system.

[8] Details of ARB's Period Smoke Inspection Program can be found at http://www.arb.ca.gov/msprog/hdvip/hdvip.htm

B. Verification of Diesel Emission Control Strategies

The Board adopted a procedure to verify diesel emission control strategies in 2002, codified in title 13, California Code of Regulations, Section 2700 et seq. Verification is a stamp of approval from ARB, which tells end users that the verified device achieves advertised emission reductions and is durable. The manufacturer is required to provide *a warranty that includes coverage of* engine damage caused by the DECS. To protect the end user, only ARB-verified DECS can be used in all of ARB's mandated programs and most of its voluntary programs.

ARB has received over one hundred applications for verification, but not all of those applications are active. The procedure requires considerable data to prove emission reductions and durability. Any DECS that uses a fuel additive must also demonstrate that it is non-toxic in all media by going through a *multimedia assessment*. As of September 2, 2005, ARB has verified the DECS shown in the tables below. Not all of these DECS are applicable to public or utility fleet vehicles.

Table 12. Verified Level 3 DECS

Product Name	Technology Type	PM Reduction	NOx Reduction	Applicability
Cleaire Flash and Catch CRT	DPF	85%	25%	1994+ on-road (limited - Cummins defeat device); 15 ppm sulfur diesel.
Cleaire Flash and Catch DPX	DPF	85%	25%	1994+ on-road (limited - Cummins defeat device); 15 ppm sulfur diesel.
Cleaire Longview	Lean NOx Catalyst and DPF	85%	25%	1993-2003 model year on-road; 15 ppm sulfur diesel.
CleanAIR Systems PERMIT	DPF	85%	N/A	Stationary emergency generators; 15 ppm sulfur diesel.
Donaldson	DPF	85%	N/A	1994-2002 on-road; 15 ppm sulfur diesel.
International Truck and Engine Corporation DPX	DPF	85%	N/A	1994-2003 on-road Navistar (International); 15 ppm sulfur diesel.
Johnson Matthey CRT	DPF	85%	N/A	1994-2004 on-road; 2002-2006 Cummins ISM and ISB with EGR;15 ppm sulfur diesel or B20.
Johnson Matthey CCRT	DPF	85%	N/A	1994-2004 on-road; 2002-2006 Cummins ISM and ISB with EGR;15 ppm sulfur diesel.
Johnson Matthey EGRT	EGR/DPF	85%	40%	2000 International DT-466, 2000 Cummins ISM 2001 Cummins ISB, 2001 Cummins ISC, 2001 Cummins ISL, 2001 MY DDC - 50, and 2001 DDC - 60. on-road; 15 ppm sulfur diesel.
Lubrizol ECS Purifilter	DPF	85%	N/A	1994-2003 on-road; 15 ppm sulfur diesel.
Lubrizol ECS Unikat Combifilter	DPF	85%		1996-2004 off-road; 15 ppm sulfur diesel or carb diesel.

Table 13. Verified Level 2 DECS

Product Name	Technology Type	PM Reduction	NOx Reduction	Applicability
Environmental Solutions Worldwide Particulate Reactor	Flow Through Filter	50%	N/A	1991-1993 on-road, CARB diesel.
Lubrizol PuriNOx	Alternative Fuel	50%	15%	1988-2003 on-road.
Lubrizol AZ Purimuffler/Purifier	DOC + Alt Fuel	50%	20%	1996-2002 off-road; PuriNOx

Table 14. Verified Level 1 DECS

Product Name	Technology Type	PM Reduction	NOx Reduction	Applicability
Cleaire Flash and Match	DOC	25%	25%	1993+ on-road (limited – Cummins defeat device); 15 ppm sulfur diesel or CARB diesel.
Donaldson	DOC	25%	N/A	1988-1990 on-road; 15 ppm sulfur diesel or CARB diesel.
Donaldson	DOC + crankcase filter	25%	N/A	1988-1990 on-road; 15 ppm sulfur diesel or CARB diesel.
Donaldson	DOC + crankcase filter	25%	n.a	1991+ on-road/1996 + off-road port equipment; CARB diesel.
Donaldson	DOC	25%	n.a	1991+ on-road; 15 ppm sulfur diesel.
Donaldson	DOC + crankcase filter	25%	n.a	1994+ on-road/1996 + off-road port equipment; 15 ppm sulfur diesel.
Extengine	DOC + SCR	25%	80%	1991-1995 Cummins 5.9 liter off-road; 15 ppm sulfur diesel or CARB diesel.
Lubrizol ECS AZ Purifier & Purifmuffler	DOC	25%	N/A	1991-2003 Cummins and Navistar on-road; 15 ppm sulfur diesel. 1973-1993 DDC 2 stroke; CARB diesel.
Lubrizol ECS AZ Purifier & Purifmuffler	DOC	25%	N/A	1996-2002 off-road; 15 ppm sulfur diesel.

In order to determine if a particular DECS will work with a specific engine and vehicle combination, the conditions contained in the Executive Order or Verification Letter must be followed. The EO or Verification Letter lists the engines by engine family and other conditions of verification, such as minimum engine exhaust temperature. Additional evaluations may then be needed, such as use of a datalogger that records engine exhaust temperatures over a typical duty cycle.

This list is subject to changes as additional systems are verified. The most current list of verified DECS, applicable engine families, as well as the EO and verification letters may be found on our web site at:

http://www.arb.ca.gov/diesel/verdev/verdev.htm

C. Diesel Emission Control Strategies for In-use Public and Utility Fleet Vehicles

A variety of retrofit strategies can be used for controlling emissions from in-use diesel engines. The main types of technologies discussed here are hardware, add-on technologies such as diesel particulate filters (DPF), flow through filters (FTF), or oxidation catalysts (DOC), and fuels or fuel additives.

1. Hardware Diesel Emission Control Strategies

Currently, hardware DECS consist of the DPF, including both passive and active regenerated versions, and the DOC. Each of these technology types has been used in both on- and off-road vehicles and equipment for many years. More recently, another device, a catalyzed wire mesh filter, also known as a flow-through-filter (FTF), was developed and verified.

a. Diesel Particulate Filter

A passive DPF reduces PM, and catalyzed DPFs will also reduce CO and HC emissions through catalytic oxidation and filtration. Most DPFs sold in the United States use substrates consisting either of a ceramic wall-flow monolith or a silicon carbide substrate. These substrates are either coated with a catalyst material, typically a platinum group metal, or a separate catalyst is installed upstream of the particulate filter. The filter is positioned in the exhaust stream to trap or collect a significant fraction of the particulate emissions while allowing the exhaust gases to pass through the system.

Effective operation of a DPF requires a balance between PM collection and PM oxidation, or regeneration. The volume of PM generated by a diesel engine will fill up and plug a DPF over time; thus the trapped PM must be burned off or "regenerated" periodically. Regeneration is accomplished by either raising the exhaust gas temperature or by lowering the PM ignition temperature through the use of a catalyst. The type of filter technology that uses a catalyst to lower the PM ignition temperature is termed a passive DPF, because no outside source of energy is required for regeneration.

Verified passive DPFs have demonstrated reductions in excess of 90 percent for PM, although the ARB verification Level 3 lists 85 percent PM reduction as its minimum level. A passive catalyzed DPF also reduces CO and HC by approximately the same amount as the PM reduction. A passive catalyzed DPF is a very attractive means of reducing diesel PM emissions because of the combination of high reductions in PM emissions and minimal operation and maintenance requirements.

Several passive DPF systems have been verified in California for use on a variety of diesel applications including the most popular engine series of the major engine manufacturers for model-year engines 1993 to 2004. The Executive Orders or EOs include restrictions for these verifications and a list of applications and engine families for which the device has been approved. These EOs are available at http://www.arb.ca.gov/diesel/verdev/verdev.htm

An active DPF system uses an external source of heat to oxidize the PM. The most common methods of generating additional heat for oxidation involve electrical regeneration by passing a current through the filter medium, injecting and burning additional fuel to provide additional heat for particle oxidation, or adding a fuel-borne catalyst or other reagent to initiate regeneration. Some active DPFs induce regeneration automatically on-board the vehicle or equipment when a specified backpressure is reached. Others use an indicator, such as a warning light, to alert the operator that regeneration is needed, and require the operator to initiate the regeneration process. Some active systems collect and store diesel PM over the course of a full shift and are regenerated at the end of the shift with the vehicle or equipment shut off. A number of the filters are removed and regenerated externally at a regeneration station.

For applications in which the engine-out PM is relatively high, and/or the exhaust temperature is relatively cool, actively regenerating systems may be more effective than a passive DPF. Because active DPFs are not dependent on the heat carried in the exhaust for regeneration, they potentially have a broader range of application than passive DPFs. ARB has verified Lubrizol ECS Unikat Combifilter for certain off-road applications (Executive Order DE-04-012, dated December 13, 2004). This filter is an actively regenerated non-catalyzed diesl particulate filter that is regenerated via an electrically-heated regeneration system. Currently, no active DPF systems are verified for on-road applications, although retrofit manufacturers are currently conducting field studies to verify such systems.

b. Catalyzed Wire Mesh Flow Through Filter

Flow-through filters (FTF) employ a catalyzed wire mesh substrate that has an intermix of flow channels creating turbulent flow conditions. Unlike a DPF, in which only gases can pass through the substrate, the FTF does not physically trap and accumulate PM. Instead, it acts list a DOC but achieves a greater PM reduction due to enhanced contact of PM with catalytic surfaces and longer residence times. Any particles that are not oxidized within the FTF flow out with the rest of the exhaust and do not accumulate. Consequently, the filtration efficiency of an FTF is lower than that of a DPF, but the FTF is much less susceptible to plugging because of high PM emissions and low exhaust temperatures. Therefore, this type of filter may be suitable for specific duty cycles where a typical DPF would not be applicable.

The ARB has verified the Environmental Solutions Worldwide (ESW) Particulate Reactor™ system for specific 1991 through 1993 model year diesel engines used in on-road applications operating on standard CARB diesel fuel. The Particulate Reactor™ system employs a catalyzed wire mesh substrate to achieve at least a 50 percent reduction in particulate matter emissions, qualifying it for a Level 2 verification. Specific engine families and conditions for which the Particulate Reactor™ has been approved may be found in the Executive Order DE-04-011 (September 13, 2004) and its attachment.

c. Diesel Oxidation Catalyst

A DOC reduces emissions of CO, HC, and the soluble organic fraction of diesel PM through catalytic oxidation alone. Exhaust gases are not filtered in DOCs. In the presence of catalytic material and oxygen, CO, HC, and the soluble organic fraction of the PM undergo a chemical reaction and are converted into carbon dioxide and water. Some manufacturers integrate HC traps (zeolites) and sulfate suppressants into their oxidation catalysts. HC traps enhance HC reduction efficiency at lower exhaust temperatures and sulfate suppressants minimize the generation of sulfates at higher exhaust temperatures. A DOC may reduce total PM emissions by up to 30 percent.

On November 7, 2002, the ARB verified three Donaldson Company DECSs (Verification Letter November 7, 2002). The first system consists of the Donaldson DCM DOC muffler with 6000 Series catalyst formulation plus closed loop crankcase with Donaldson Spiracle™. The second system consists of the same Donaldson DOC but with the 6100 Series catalyst formulation. The third system resembles the second system but is applicable to different model year vehicles.

In September 2004, ARB extended the verification of the DCM DOC muffler with 6000 Series catalyst formulation alone and the DCM DOC muffler with the Donaldson Spiracle™ closed crankcase filtration system used with California diesel fuel or fuel with a lower sulfur content for model years 1988-1990 (DE-04-009 September 8, 2004).

2. Fuel-based Diesel Emission Control Strategies

Fuel-based DECS utilize the fueling system and fuel for emission reductions. All fuel-based DECS must undergo an assessment of multimedia toxicity effects by the California Environmental Policy Council as required by Health and Safety Code 43830.8 prior to ARB verification.

a. Fuel-Water Emulsion

A demonstrated alternative to diesel fuel that reduces both PM and NO_x emissions is an emulsion of diesel fuel and water. The process blends water into diesel fuel along with an additive to keep the mixture from separating. The water is suspended in droplets within the fuel, creating a cooling effect on the fuel that decreases NO_x emissions. A fuel-water emulsion creates a leaner fuel environment in the engine, thus lowering PM emissions also (U.S. EPA 2002).

Lubrizol's PuriNOx™ is verified by the ARB for 1988 through 2003 MY diesel engines used in on-road applications (Executive Order, DE-04-008, dated August 5, 2004). PuriNOx™ is an emulsified diesel fuel that achieves at least 50 percent reduction in PM and 15 percent reduction of NOx and is categorized as a Level 2 system. PuriNOx™ is verified as an emulsified mix of water and CARB diesel fuel. It is verified for use with Luribrizol ECS DOC (Executive Order, DE-04-007, dated October 29, 2004) for certain off-road engines; however it is not verified for use with any on-road hardware DECS. Lubrizol requires that fleets that use PuriNOx™ must install a recirculation pump in the products' storage tank and vehicles fueled with product must be used on a daily basis.

b. Fuel Additives

A fuel additive is a substance designed to be added to fuel or fuel system so that it is present in-cylinder during combustion and its addition causes a reduction in exhaust emissions. Additives can reduce the total mass of PM, with variable effects on PM, CO, oxides of nitrogen (NO_x) and gaseous HC production. The range of PM reductions that have been published in studies of fuel additives is from 15 to 50 percent reduction in mass. Most additives are fairly insensitive to fuel sulfur content and will work with a range of sulfur concentrations as well as different fuels and other fuel additives (DieselNet 2002).

A fuel-borne catalyst (FBC) is a substance that is added to diesel fuel in order to aid in soot oxidation in DPFs by decreasing the ignition temperature of solid carbon. An FBC can be used in conjunction with both passive and active filter systems to aid system performance, and decrease mass PM emissions. FBC/DPF systems are in wide spread use in Europe in both on-road and off-road, mobile and stationary applications and typically achieve a minimum of 85 percent reduction in PM emissions.

No fuel additive is currently verified by ARB, although some retrofit manufacturers are actively pursing verification. Fuel additives must be used with a Level 3 filter unless proven safe when used without one.

c. Biodiesel

Biodiesel is a mono-alkyl ester-based oxygenated fuel made from vegetable oils, such as oilseed plants or used vegetable oil, or animal fats. It has similar properties to petroleum-based diesel fuel, and can be blended into petroleum-based diesel fuel at any ratio. B20 is a biodiesel blend into petroleum-based diesel fuel at 20 percent. Pure biodiesel is called B100. B20, which is a common concentration used in California, would not reduce PM emissions enough to reach the Level 1 threshold of a minimum of 25 percent PM reduction. In order for a hardware DECS to be used with a biodiesel blended fuel, the DECS manufacturer must specifically request verification on this fuel. ARB has verified Johnson-Matthey, Inc. CRT Particulate Filter for use with B20 (Executive Order DE-04-06-05, dated August 15, 2005.) ARB is encouraging other hardware DECS manufacturers to similarly apply for verification of their hardward DECS on biodiesel blends.

Using publicly available data, the U.S. EPA analyzed the impacts of biodiesel on exhaust emissions from heavy-duty on-road engines (U.S. EPA 2002). While biodiesel and biodiesel blends decrease PM, HC, and CO emissions, NO_x emissions, increase proportionally with the increase of biodiesel fraction. For B20, the NO_x increase is reported to be two percent, with reductions of ten percent PM, 21 percent HC, and 11 percent CO. In addition, the U.S. EPA states a B20 blend is predicted to reduce fuel economy by one to two percent. The data were qualified with conclusions that the impact of biodiesel on emissions varied depending on the type of biodiesel (soybean, rapeseed, or animal fats) and the quality of the diesel fuel used in biodiesel blends.

Although B20 meets the definition of California diesel fuel, no biodiesel blend or B100 has been verified to reduce emissions under California's program. In order to be verified as a DECS, biodiesel fuel, like other alternative diesel fuel, must undergo a multimedia assessment.

3. Combination Systems

Systems combining a hardware and fuel strategy are under development and in-use. In order to receive ARB verification, the hardware and fuel strategy must be approved together as a system. As previously discussed, ARB has verified Lubrizol ECS's PuriNox and DOC together as a combination system (Executive Order DE-04-007).

The U.S. EPA has verified two combination systems under its voluntary program (U.S. EPA 2004b). Clean Diesel Technologies, Inc manufactures the two products U.S. EPA has verified. One is the Platinum Plus Purifier System, which is a fuel borne catalyst plus DOC verified for on-road, medium-heavy and heavy-heavy duty, 4 cycle, 1988 – 2003 MY, turbocharged or naturally aspirated engines. The other is the Platinum Plus Fuel Borne Catalyst/Catalyzed Wire Mesh Filter (FBC/CWMF) System, which is verified for on-road, medium-heavy duty, 4 cycle, 1991 to 2003 MY, non-EGR, turbocharged or naturally aspirated engines. The U.S. EPA does not assign a level for PM reduction as California does, but describes the fuel-borne catalyst plus DOC as achieving 25 to 50 percent PM reduction and the fuel-borne catalyst plus wire mesh filter as achieving 55 to 76 percent PM reduction. ARB is currently evaluating these systems under California's program. Because these systems use a fuel additive, they must to undergo a multimedia assessment prior to receiving verification.

4. In-Use Experience

Around the world, counties and cities have long required the reduction of in-use and new diesel engine emissions, with a focus on reducing diesel PM. Retrofitting offroad diesel engines with DOCs has been taking place for over 20 years; particulate filters have been in use for over ten years. In Europe and Asia, mandates have been in place and are working to clean up the air.

a. Diesel Oxidation Catalysts

In the past 20 years, over 250,000 DOCs have been installed primarily on underground mining and materials handling equipment, and over 40,000 DOCs have been installed on urban buses and on-road trucks in the U.S. and Europe. The U.S. EPA's urban bus retrofit/rebuild program required that urban buses with engines older than 1994 MY (1995 MY in California) retrofit with DOCs, resulting in over 15,000 retrofits. In addition, over 3,000 trucks have been retrofitted in Mexico and in Hong Kong about 40,000 urban buses are beginning to be retrofitted (MECA 2002, 2004b).

b. Diesel Particulate Filters

The use of DPFs is not as widespread as DOCs in part because of the requirement for very low fuel sulfur content for effective operation of a DPF. Nevertheless, MECA estimated that over 130,000 DPFs have been retrofitted on heavy-duty vehicles worldwide (MECA 2000a). One notable program is Sweden's Environmental Zone Program, which requires on- and off-road vehicles operating in specified urban areas to be retrofitted. In the U.S., California and New York have taken the lead in aggressive programs to reduce diesel PM through the use of DPFs. In addition, the City of Los Angeles adopted a motion in 2000 to require the retrofit of all city-owned diesel trucks with DPFs by February 2004.

As of September 2005, the City of Los Angeles has outfitted approximately 370 diesel Solid Waste Collection Vehicles (SWCV), 252 dual fuel (liquefied natural gas and diesel) SWCV, and 487 general service vehicles (e.g. asphalt haulers, dump trucks, sweepers, and tractors) with DPFs. The City of LA has stated that they have been satisfied with their retrofit experience, and have had few maintenance or performance problems associated with vehicles installed DPFs (Wilson, pers. comm.).

Several other public fleets have retrofitted or are actively investigating the applicability of passive DPFs in their in-use vehicles with grant money from the Carl Moyer and ERC programs. These include City of Azusa, City of Chino, Los Angeles County, City of Los Angeles Airports, Rancho California Water District, City of Cucamonga, Riverside County, City of Riverside, City of Pasadena and City of San Diego.

D. Engine Technology for Public and Utility Fleet Vehicles

1. Current Engine Availability

Heavy-duty engines sold in California are required to meet the engine exhaust standards shown below in Table 15.

Table 15. Emission Standards for New Heavy-Duty Engines

Emissions Standards (g/bhp-hr)		
Model Year	**NOx**	**PM**
Diesel Derived Engines		
1988-1989	6.0	0.60
1990	6.0	0.60
1991-1993	5.0	0.25
1994-1997	5.0	0.10
1998-2003	4.0	0.10
October 2002	2.2 (a)	0.10
2004-2006	2.2 (a)	0.10
2007-2009	1.2 (b)	0.01
2010 and subsequent	0.20	0.01
Otto Cycle Engines		
	NHMC+NOx	**PM**
2005-2007	1.0(c)	n/a
	NOx	**PM**
2008 and subsequent	0.20	0.01

a. Nominal NOx value of 2.2 g/bhp-hr is based on emission standards of 2.4 g/bhp-hr for NOx plus non-methane hydrocarbons (NMHC) or 2.5 g/bhp-hr NOx plus NMHC with 0.5 g/bhp-hr NMHC cap, which took effect in October 2002 for those engines subject to U.S. EPA Consent Decrees and the California Settlement Agreements. The Consent Decree-complying engines had to comply with 2004 standards by October 1, 2002.

b. Between 2007 and 2009, U.S. EPA requires 50 percent of heavy-duty diesel engine family certifications to meet the 0.2 g/bhp-hr NOx standard. Averaging is allowed, and it is expected that most engines will conform to the fleet NOx average of approximately 1.2 g/bhp-hr.

c. A manufacturer may request to certify to the Option 1 or Option 2 federal NOx plus NMHC standards as set forth in 40 CFR §86.005-10(f). For engine families certified to the Option 1 or 2 federal standards the Family Emission Limit must not exceed 1.5 g/bhp-hr.

Beginning with the 2007 model year, every heavy-duty engine will have to meet the 0.01 g/bhp-hr PM standard and lower NOx emission standards. The following websites provides information on MY 2005 and 2006 California certified engines:

http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2005/2005.php
http://www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2006/2006.php

2. Future Engine Availability (2007 – 2009)

a. Diesel-fueled Engines

All major manufactures have announced that they will be using exhaust gas recirculation (EGR) to meet the 2007 NOx emission standard and diesel particulate filters to meet the particulate standard. EGR causes a portion of the exhaust gases to circulate through a heat exchanger to cool the exhaust before reintroducing the gases into the engine intake manifold. EGR has been used in some engines since 2003, but engine manufacturers have further refined the systems to allow lower NOx emissions.

Caterpillar, Cummins, and DDC plan to offer a full line of medium- and heavy-duty diesel engines; International focuses on the school bus and collection vehicle engine markets; and Mack/Volvo focuses on engines for collection vehicles.

Dual fuel systems for collection vehicles are no longer available in the U.S., as Clean Air Power, the sole manufacturer of these systems, has concentrated its efforts in Europe. Increased interest in its product may, however, prompt Clean Air Power to develop and certify in California a 2007 product for collection vehicles.

The Diesel hybrid-electric is another technology that reduces both emissions and fuel use and that will be available in 2007. While not classified by ARB as an alternative-fuel technology, diesel hybrid-electric technology achieves lower emissions and better fuel economy than equivalently sized diesel buses or trucks. Emissions testing studies at ARB and other facilities indicate a fuel consumption reduction of 25 percent and NOx emission reduction of about 50 percent for diesel-fueled hybrid-electric buses (HEBs) compared to conventional diesel transit buses. This technology is being applied primarily in delivery vehicles and transit buses.

b. Alternative-fuel Engines

Manufacturers of natural gas engines are likely to be able to meet the upcoming 2007 standard with three-way catalyst aftertreatment technology similar to that being used on passenger cars. Cummins, through its joint partnership with Westport Innovations, Cummins Westport Inc., and John Deere has stated they will offer alternative fuel products to meet the 2007 emission standards. Although we have only preliminary data, it appears that these manufacturers of alternative-fuel engines or systems will certify to the more stringent 2010 0.20 g/bhp-hr NOx and 0.01 g/bhp-hr PM standards.

John Deere currently only certifies urban bus and medium heavy-duty natural gas engines, but is developing a heavy heavy-duty engine that could be suitable for use in waste collection vehicles. John Deere has stated is intends to produce a 250-325 horsepower, 9 liter natural gas engine meeting the 0.20 g/bhp-hr NOx level by 2007. This engine could be used in transit buses, school buses, and refuse trucks.

Cummins will be marketing the natural gas engines developed by Cummins Westport Inc. Cummins is currently providing bids on both diesel and natural gas buses for 2007. Cummins Westport Inc. has partnered with U.S. DOE's NREL to develop a lower emission version of the L Gas Plus (8.9 L) engine for use in medium-duty trucks, refuse trucks, and urban buses. This engine is scheduled to be commercially available in early-2007. The SCAQMD is also currently sponsoring a project with Cummins to commercialize the C Gas Plus engine (8.2 L) to 0.2 g/bhp-hr NOx by 2007.

In 2004, Ford and General Motors stated that they would no longer be producing their smaller CNG engines used in cutaway vehicles. As a result, BAT Technologies, Clean Energy, and Teleflex/GFI Control Systems have jointly proposed a contract with the SCAQMD and the state of New York to "develop and certify in California a retrofit system that converts 2005 and subsequent model year gasoline-powered Ford Crown Victoria and E-450 cutaway vehicles to dedicated CNG operation" (South Coast Air Quality Management District, 2004). It is anticipated that once retrofitted, the engines will meet SULEV emission levels. This technology is scheduled to be certified by mid-year 2005.

ISE Corporation currently offers a California-certified gasoline hybrid electric bus and is developing hybrid electric systems with compressed natural gas, diesel, and hydrogen fuels, also for urban buses. While ISE focuses on the urban bus market, it is considering expanding into other vocations that use heavy heavy-duty engines, such as waste collection vehicles.

c. Gasoline Engines

Emission standards for heavy duty Otto-cycle engines used in heavy-duty vehicles over 14,000 GVWR for model year 2007 are 1.0 g/bhp-hr NMHC+NOx with no PM standard. Beginning in model year 2008 the emission standards are lowered to 0.20 g/bhp-hr for NOx and 0.01 g/bhp-hr for PM. It is expected that only minor modifications to current gasoline engine technology will be required to meet these standards.

3. Engine Availability (2010 and beyond)

Engine technology for 2010 will most likely rely upon selective catalytic reduction (SCR), NOx adsorbers, and further improvements in engine technology to reduce NOx emissions.

Two aftertreatment technologies that will most likely play a large role in meeting the 2010 NOx standard are selective catalytic reduction (SCR) and the NOx adsorber.

SCR catalysts use ammonia as a NOx reductant to reduce stationary sources emissions. Urea may also used as the source of ammonia. In recent years, considerable effort has been invested in developing urea SCR systems that could be applied to heavy-duty diesel vehicles with low sulfur diesel fuel. Urea SCR systems are being used to comply with the EURO IV heavy-duty diesel emission standards

(U.S. EPA, 2004b). U.S. manufacturers are working on SCR systems for vehicles that could be used in 2010.

Unlike catalysts, which continuously convert NOx to N_2, NOx adsorbers are materials that store NOx under lean conditions and release and catalytically reduce the stored NOx under rich conditions. NO and NO_2 are acidic oxides and can be trapped on basic oxides. Fuel sulfur can be converted to stable sulfates providing competition with NOx for storage sites, thus poisoning the catalysts, therefore low sulfur fuel is required.

E. ARB Exhaust Temperature Study

From October 2003 to July 2004, ARB conducted an exhaust temperature study to evaluate the various vehicle types that are typically used by municipalities and/or utilities. The study's goal was to determine what percent of the vehicles have the operational characteristics to use DECS that rely on exhaust temperature to function properly.

Based upon the study, ARB determined that at least 56% of the vehicles meet the criteria for Level 3 passive DPFs, 67% of the vehicles meet the temperature criteria for the Level 2 Flow Through Filter, and 96% met the temperature criteria for a Level 1 DOCs. Details of the study can be found in Appendix D. Overall the study shows nearly all vehicles could use a temperature dependent DECS; provided adequate space is available for device installation.

F. Implementation Assistance

Staff is committed to provide the necessary compliance assistance to fleets for successful implementation of the rule. Upon adoption of the rule, staff is prepared to conduct statewide workshops, develop compliance guidance documents, sample recordkeeping forms and labels to assist fleets with implementation. All these activities are consistent with ARB's efforts with other fleets rules already adopted. In addition, staff is also working on developing an interactive web-based "look-up" table to help fleets identify verified DECS that may be applied to a vehicle based upon engine manufacturer and model-year.

VII. REGULATORY ALTERNATIVES

Staff believes the proposed regulation is the most cost efficient method for reducing diesel PM from municipality and utility fleet vehicles. A comparison of emission reductions from each regulatory alternative considered can be found at the end of this section (Table 16).

A. Do Not Adopt This Regulation

Not adopting this regulation would disregard the adverse health risk posed by diesel PM. In consideration of the potential health impacts discussed earlier, and ARB's mandate to protect the public health of all Californians, this alternative is not considered a reasonable option. ARB staff does not recommend this alternative because it would result in approximately 80 percent greater PM emissions over the next few decades than the proposed plan, thus adversely impacting the health of Californians.

With full implementation of this control measure, the estimated reduction in diesel PM ranges from 78 percent in 2010, to 84 percent in 2020, when compared to the 2000 PM baseline. The recommended actions in this plan will reduce the localized risks associated with activities that expose nearby individuals to diesel PM emissions. This diesel PM control measure will result in additional benefits associated with reducing diesel PM emissions, including reducing NOx emissions by 35% percent from baseline in 2020, reducing ambient fine PM levels, increasing visibility, reducing material damage due to soiling of surfaces, and reducing incidences of non-cancer health effects, such as bronchitis and asthma.

B. Rely on Voluntary Programs

The federal rules for new diesel engines will not be implemented for several years and do not affect existing vehicles. The U.S. EPA developed the Voluntary Diesel Retrofit Program to reduce diesel PM emissions in the immediate future. The program addresses pollution from diesel construction equipment and heavy-duty vehicles on the road today by providing a voluntary certification program for technology. Participation is voluntary and available incentive funds are currently limited. The U.S. EPA program is not sufficient for meeting ARB's overall goals.

The Carl Moyer Program is a California program which encourages use of cleaner engines by funding the incremental cost of repower, retrofit, or purchase of new, cleaner engines. Although the Moyer Program is funded at approximately $140 million per year for the next 10 years, participation is still voluntary, available incentive funds are limited and it does not require fleets to clean up their existing fleet.

Therefore, given the over 1.2 million diesel engines in California, reliance on purely voluntary programs is inadequate for meeting California's risk reduction goals. ARB staff does not recommend this alternative because it would result in only minor diesel PM emission reductions.

C. Require Repowered Engines or New Vehicle Purchases

Another alternative staff considered, which would result in similar reductions in diesel PM emissions, is to require all public and utility fleet vehicles to repower with diesel engines certified to the 0.01 g/bhp-hr particulate standard beginning in 2007. This option is significantly more expensive than the proposed alternative. The estimated capital cost of repowering all engines in 2007 is approximately $650 million, which is three times higher than the $213 million cost to implement this proposed regulation, for a similar reduction in diesel PM. The estimated cost could be even higher than this as many vehicles cannot be repowered. A repower may be incompatible with older engine and drive train technology or the size of the engine compartment, thus the owner would have to purchase a new vehicle to accomplish the lower PM emissions.

Staff predicts a complete turnover of public and utility vehicles by 2020 would reduce diesel PM emissions by up to 90 percent. This is an estimated reduction of 0.06 tpd, which is slightly higher than the recommended alternative in 2020 (Table 16). ARB staff does not recommend mandating this as the sole option, however, because of the high cost of implementation compared to the amount of PM emissions reduced and significantly poorer cost effectiveness.

D. Require Alternative Fuel

The last alternative staff considered but did not recommend was the requirement to repower all applicable vehicles with alternative fueled engines. This would have resulted in the same PM reductions as the alternative to repower with all 2007 engines; however it may result in a small NOx benefit from 2007 to 2009. ARB staff does not recommend mandating this as the sole option, however, because of the limited alternative fueled engine availability for public and utility fleet vehicles, and the high cost of implementation compared to the amount of PM emissions reduced and significantly poorer cost effectiveness.

Table 16. Diesel PM Reductions by Alternative Compared to the Proposal.

Year	Proposal (tpd)	Regulatory Alternatives Reductions (tons/day)			
		Adopt Nothing	Voluntary	Repower to 0.01 Engine	Alt Fuel Engines
2010	**0.15**	0	n.q.	0.13	0.13
2020	**0.05**	0	n.q.	0.06	0.06

n.q. – not quantified

VIII. ECONOMIC IMPACT

The total discounted cost of the rule in 2005 dollars for all municipalities and utilities is $213 million. This cost is to apply BACT to approximately 31,076 vehicles (estimated to be in the fleet in 2006). The cost per vehicle is estimated at $6,857. This is lower than the estimated cost per truck of $13,000 for implementation of the solid waste collection vehicle rule adopted by the Board in 2003.

A. Legal Requirement

Sections 11346.3 and 11346.5 of the Government Code require 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.

State agencies are also required to estimate the cost or savings to any state or local agency and school districts in accordance with instruction adopted by the Department of Finance. This estimate is to include any nondiscretionary costs or savings to local agencies and the costs or savings in federal funding to the state.

B. Affected Manufacturers

No manufacturer will incur any direct costs as a result of this proposed rule because it only applies to government agencies and utilities that operate fleets, and their choices on purchasing existing engines and emission control technologies.

C. Estimated Costs to Investor-Owned Private Utilities

Staff estimates a total of 209 private utilities operating an estimated 3,979 vehicles as of 2004 will be impacted by this regulation. Staff collected data from the four largest investor-owned private utilities that provide natural gas, electricity and/or water services in California. These four large utilities account for 3,130 vehicles that are subject to this rule. In addition, staff identified about twenty additional utilities with 664 vehicles from the ARB PSIP database. Lastly, staff identified about 185 small water companies from the California Public Utilities Commission's (CPUC) lists. Telephone contact with these small water companies shows that on average they have about one vehicle per company that may be impacted by this regulation.

Staff does not have access to financial records for any investor-owned utilities; therefore the number of vehicles owned by a company was used as a surrogate to determine small business status. The criteria staff used for a small business was a company that owns fewer than 15 vehicles. Based on these criteria, staff determined that all small water companies would be considered small businesses, which is 88 percent of the total companies potentially directly affected by this regulation but less than one percent of the total California municipal and utility fleet vehicles.

1. Retrofit Implementation Scenario

Staff assumed utility vehicle owners would choose the least expensive of the best available control technologies to comply with this regulation. Staff, therefore, assumed a diesel emission control strategy would be employed in lieu of more expensive options of repowering or replacing the vehicle or engine, unless that was the only option available to those vehicles or the fleet operator needed to replace the vehicle in the near future for other reasons. Typically, particulate matter (PM) emissions and exhaust temperatures dictate the type of diesel emission control strategy a vehicle can use. Based on available data on DECS currently available to the vehicle fleet, staff created a "most-likely" retrofit scenario to determine an average economic impact (Table 17).

This scenario is based on those DECS that are expected to be available during the implementation period (Table 18). DECS include Level 3 verified diesel particulate filters; Level 2 verified flow through filters and a fuel-water emulsified fuel; and Level 1 verified technology of a diesel oxidation catalysts. Table 18 also includes an active DPF[9]. The only other technologies available to these vehicles are engine repower or replacement. The scenario assumes more Level 1 technologies will be verified, and for current verified Level 1, 2 and 3 technologies to have verifications extended to additional MY engines.

[9] Active DPFs do not rely on exhaust temperature for regeneration, thereby having a wide range of retrofit applications.

Table 17. Most-Likely Verification Retrofit Scenario[g] (Applies to Municipal and Utility Fleets)

Group	MY	%BACT	Implementation Date	Level 1[a]	Level 2[d]	Level 3	Repower
1	1960-1987[e]	20%	12/31/2007		10%		8%
		60%	12/31/2009				28%
		100%	12/31/2011			11%	33%
		Delay	12/31/2012				10%
2a	1988-1993	20%	12/31/2006	5%	5%	8%	
		60%	12/31/2008	2%	10%	25%	
		100%	12/31/2010			35%	
		Delay	12/31/2011			10%	
2b	1994-2002[d, f]	20%	12/31/2006	5%	5%	8%	
		60%	12/31/2008	2%	10%	25%	
		100%	12/31/2010			35%	
		Delay	12/31/2011			10%	
3	2003-2006[b,c]	50%	12/31/2009		20%	30%	
		100%	12/31/2010		20%	30%	

Notes:
[a]Assumes current Level 1 verification will be extended to 1960-1993 model years.
[b]Assumes current Level 3 verification will be extended to 2003-2006 model years.
[c]Assumes current Level 1 verification will be extended to 2003-2006 model years.
[d]Assumes current Level 2 verification will be extended to all model years
[e]Assumes a Level 3 verification will be available for some 1960-1987 model years.
[f]Assumes a Level 3 active DPF verification will be available for some 1988-2002 model years.
[g]Percentage add to 100% for each model year group

2. Implementation Costs

The initial cost per truck will vary depending on the best available control technology used for the truck. The initial costs listed in this section are based on capital and operation and maintenance costs applied to the retrofit scenarios discussed in the previous paragraph. Capital costs per vehicle and technology are listed in Table 18. Staff assumed that the only capital cost required for the fuel-water emulsion option is for one fuel re-circulation pump per terminal since it is assumed that fleets that use this operation already have an existing fuel tank on-site. No additional cost was added for those DECS that specify use of ultra-low sulfur fuel because the federal and state ultra low sulfur diesel fuel rule will be effective for all on-road diesel vehicles as of July 1, 2006 (six months prior to the first implementation deadline).

Table 18. Average Capital Costs for Diesel Emission Control Strategies

COST DESCRIPTION			
DECS	**Low**	**High**	**Average**
Passive Diesel Particulate Filter	$6,000	$11,000	$8,500
Diesel Oxidation Catalyst	$1,000	$2,000	$1,500
Flow Though Filter	$3,500	$6,500	$5,000
Fuel Recirculation Pump/Terminal	$1,000	$10,000	$4,000[10]
Lean Nox Catalyst with DPF	$13,000	$17,000	$15,000
Active DPF	$10,000	$12,500	$11,000
EGR+DPF	$14,000	$18,000	$16,000

Table 19. Incremental Annual Operation and Maintenance Costs for a Retrofitted Municipality or Utility Vehicle

Cost Description	Average Cost for Passive and Active DPF and Oxidation Catalyst	Average Cost for Fuel-Water Emulsion	Average Cost Savings for Engine Repower[c]
Maintenance	$33 [a]	$0	<$176>
Fuel[b]	$0	$355	<$264>
Total	$33	$355	<$440>

Notes:
[a]Includes increased cleaning and maintenance estimated at 1 hour for diesel particulate filters and oxidation catalyst crankcase filter replacement interval required once per three years based upon low mileage accumulation.
[b]Incremental fuel cost if a fuel-based DECS is selected.
[c]Decreased maintenance and fuel costs are associated with the use of new engines.

The average total statewide dollar costs were then derived from the application of the average discounted capital costs plus the average operation and maintenance costs from FY 2006 to 2022 for the most-likely retrofit implementation scenario, totaling approximately $28,390,000 (Table 20) for the retrofit of the total number of utility vehicles expected to be in the fleet in 2006 (approximately 4,140 vehicles).

Staff developed average capital costs for each BACT option listed in the most-likely retrofit scenario (Table 17). Staff surveyed various retrofit manufacturers and installers to get an average cost for a level 1, 2, and 3 DECS. Staff also surveyed engine dealerships and fleets to get an average cost to repower a diesel vehicle. These capital

[10] Based upon most common size fuel pump utilized by fleets, Lubrizol 2004.

costs were discounted over the period of ten years for the DECS or repower. See small businesses section below for complete description of how costs were derived and Appendix C for more detailed retrofit cost assumptions.

Table 20. Average Total Statewide Costs of Most-Likely DECS Verification Implementation Scenarios for Utilities

Fiscal Year	Discounted Average Annual Capital Costs (in 2005 dollars)	Average Annual O&M Costs (in 2005 dollars)	Total Average Annual Cost (in 2005 dollars)
2006	$333,000	$35,000	$368,000
2007	$806,000	$53,000	$859,000
2008	$1,520,000	$43,000	$1,563,000
2009	$2,188,000	$19,000	$2,207,000
2010	$2,932,000	-$22,000	$2,910,000
2011	$3,162,000	-$39,000	$3,123,000
2012	$3,115,000	-$60,000	$3,056,000
2013	$2,912,000	-$56,000	$2,856,000
2014	$2,721,000	-$52,000	$2,669,000
2015	$2,543,000	-$49,000	$2,494,000
2016	$2,208,000	-$64,000	$2,144,000
2017	$1,811,000	-$70,000	$1,742,000
2018	$1,303,000	-$59,000	$1,244,000
2019	$828,000	-$47,000	$781,000
2020	$323,000	-$24,000	$299,000
2021	$87,000	-$13,000	$75,000
2022	$0	$0	$0
Total	$28,792,000	-$405,000	$28,390,000

Capital and operation and maintenance costs will vary depending on the year of implementation, due to the phase-in schedule. Staff expects the costs to be borne by the end user, since this is a regulation requiring retrofits of in-use vehicles.

D. Potential Impact on Utilities

The average cost per vehicle for small utilities and typical utilities are the same. The average investor-owned private utility company has approximately five vehicles to which this rule applies, while the four largest investor-owned utilities have an average of 783 vehicles each to which this rule applies. Staff chose to calculate the average cost using five vehicles. The average size for a typical fleet was calculated by taking the total number utility vehicles (4,140) and subtracting the percentage of vehicles owned by large utilities (79%). This number (869) was then divided by 205 which is the number of private utilities if the four largest utilities are not included.

Staff assumed 22 percent of the vehicles would fall under 1960-1987 MY (Group 1) engines, 74 percent of the vehicles would fall under 1988-2002 MY (Group 2) engines, and 4 percent would fall under the 2003-2006 MY (Group 3) engines for implementation phase-in, based on survey information. The capital costs, and operating and maintenance costs are listed in Table 21 for the years of implementation, FYs 2006 to 2011.

Table 21. Initial and Annual Costs Average Small Utility with 5 Vehicles

Fiscal Year	Discounted Average Annual Capital Costs (in 2005 dollars)	Average Annual O&M Costs (in 2005 dollars)	Total Average Annual Cost (in 2005 dollars)
2006	$402	$43	$444
2007	$974	$64	$1,038
2008	$1,836	$51	$1,888
2009	$2,642	$23	$2,665
2010	$3,541	-$26	$3,514
2011	$3,819	-$47	$3,772

In order to arrive at the discounted capital costs for the small/typical business, staff annualized the capital costs by multiplying the net present value of the capital costs by the capital recovery factor.[11] Staff assumed a lifetime of the DECS based on a minimum lifetime of ten years with an annual interest rate of seven percent.[12] It is quite likely that a DECS will last much longer in a well-maintained vehicle, as some DECSs have been operating for over ten years on solid waste collection vehicles in Europe.[13]

To determine the operation and maintenance costs in current dollars, staff multiplied the yearly costs by the net present value factor. Also, the operation and maintenance costs are higher than would be expected with just hardware DECS used, because the fuel-water emulsion DECS is included the overall operation and maintenance costs at an average of $355 per vehicle annually, and not all utilities will utilize this option.

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[11] Net Present Value is the cost multiplied by 1/(1+r)^(n+1), where r = the annual interest rate, and n = the number of years in the future. For example, FY2004-2005 is considered to be n = 0, and for FY 2005-2006 n = 1. Capital Recovery Rate Factor is (r*(1+r)^N)/[(1+r)^N-1], where r = the annual interest rate, and N = lifetime of project (in years) (Linsley, 1977).

[12] For federal decision-making, Office of Management and Budget suggests using this annual interest rate. (OMB Circulate A-94, http://www.whitehouse.gov/omb/circulars/a094/a094.html)

[13] *Bauner, David.* March 2002. Raw data submitted to ARB for contract to determine European retrofit experience.

E. Potential Impact on Businesses

The regulation allows municipalities and utilities a variety of options to meet the proposed regulation requirements. The proposed regulation may have some cost impact on companies involved in the manufacture and production of engines and vehicles by creating the need for new engines and vehicles.

While this regulation applies to existing businesses and uses technology from existing businesses, it may lead to the creation of businesses. Businesses that may be created include those that manufacture DECS and those that install, repair, or clean DECS. Staff believes businesses will be altered or augmented in lieu of creating new businesses. Some used trucks businesses; however, may be adversely affected because these businesses may experience a reduction in demand for their used truck services. Staff believes, however, that these businesses are likely to change their business focus to refurbishment and upgrading of engines for resale.

Specific to the retrofit requirements, California businesses capable of performing engine retrofits will be positively affected with increased workload. There are seven DECS manufacturers located in California that may be positively affected by this regulation.

F. Potential Impact on Business Competitiveness

The proposed regulation is not expected to impact the ability of California businesses to compete with businesses in other states because utilities generally do not compete with each other because each has their own specific service territories. As indicated above, many of the businesses that produce the products needed to meet the proposal are located in other states. By requiring new, clean technology, this proposal may actually provide new opportunities for California businesses engaged in advanced technology. Utilities providing water, natural gas and electricity services will remain in California to provide effective and efficient services to their customers.

G. Potential Impact on Employment

The proposed regulation will likely create a market for manufacturers of heavy-duty diesel or natural gas engines, vehicles, and emission control systems. For those businesses located in California, the creation of new jobs is expected to meet this demand. Services to retrofit existing public and utility vehicles are expected to create new opportunities for existing businesses.

H. Potential Impact on Business Creation, Elimination or Expansion

The proposed regulation could impact California companies involved in the manufacture and production of engines, vehicles, and DECS. Currently seven DECS manufacturers and numerous OEM dealerships are located in California. Allowing new, cleaner engine and vehicle purchases as a means to meet the diesel PM control measure could create new business opportunities for manufacturers of heavy-duty diesel, natural gas, or gasoline engines, vehicles, and DECS.

I. Potential Costs to Local Agencies

The proposed regulation is expected to have a significant impact on public agencies statewide that own and operate diesel-fueled vehicles. The average total statewide dollar costs for local agencies (i.e., city, county and special districts) were derived from the application of the average discounted capital costs plus the average operation and maintenance costs from FYs 2006 to 2022. Implementing the retrofit scenario (Table 17) would cost approximately $156.6 million for the retrofit of approximately 22,839 vehicles expected to in the fleet by 2006. Capital costs were discounted over the period of ten years for the DECS.

The average discounted costs for the first year of implementation in FY 2006 are $2,030,000 (Table 22). The average annual costs are based on discounted average capital costs plus average operation and maintenance costs (Table 18 and 19) for the most-likely DECS verification implementation scenario.

In order to arrive at the discounted capital costs for the proposed regulation, staff annualized the capital costs by multiplying the net present value of the capital costs by the capital recovery factor.[14] Staff assumed a lifetime of the DECS based on a minimum lifetime of ten years with an annual interest rate of seven percent.[15] It is quite likely a DECS will last much longer in a well-maintained vehicle, as some DECS have been operating for over ten years in vehicles in Europe without replacement.[16]

To determine the operation and maintenance costs in 2005 dollars, staff multiplied the yearly costs by the net present value factor. The cost analysis assumes a fleet composition of 22 percent of the Group 1 vehicles; 74 percent of the Group 2 vehicles; and 4 percent of the Group 3 vehicles, and a retrofit scenario shown in Table 17. Staff estimates 22,839 vehicles are owned by local public agencies throughout California, and 3,087 vehicles would be brought into compliance in FY 2006.

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[14] Net Present Value is the cost multiplied by 1/(1+r)^(n+1), where r = the annual interest rate, and n = the number of years in the future. For example, FY2003-2004 is considered to be n = 0, and for FY 2004-2005 n = 1. Capital Recovery Rate Factor is (r(1+r)^N)/[(1+r)^N-1], where r = the annual interest rate, and N = lifetime of project (in years) (Linsley, 1977).

[15] For federal decision-making, Office of Management and Budget suggests using this annual interest rate. (OMB Circulate A-94, http://www.whitehouse.gov/omb/circulars/a094/a094.html)

[16] Bauner, David. March 2002. Raw data submitted to ARB for contract to determine European retrofit experience.

Table 22. Average Local Government Costs to Implement Public and Utility Fleet Vehicle Regulation

Fiscal Year	Number of Vehicles Retrofit	Discounted Annual Capital Costs (in 2005 dollars)	Average Annual O&M Costs (in 2005 dollars)	Total Average Annual Cost (in 2005 dollars)
2005	0	$0	$0	$0
2006	3,087	$1,835,000	$195,000	$2,030,000
2007	3,416	$4,448,000	$292,000	$4,740,000

J. Potential Costs to State Agencies

Two separate costs may pertain at the state government level: costs to state agencies that own diesel vehicles to bring the vehicles into compliance, and costs for the ARB to implement and enforce the regulations. ARB estimates three additional staff will be required to enforce the regulation and to provide guidance for implementation. The cost for three additional ARB staff is approximately $300,000 annually. Staff anticipates the need for added staff beginning FY 2005.

According, to DMV registration data, the State of California owns approximately 1,275 diesel-fueled vehicles as of 2004; however this number is expected to grow to approximately 1,327 vehicles by 2006. The total cost to the state just to bring these vehicles into compliance is approximately $9.1 million. If we include the cost to the state to implement and enforce the regulation, the initial discounted cost for FY 2006 would be $418,000. Assuming the cost of compliance is discounted over ten years, the estimated cost of compliance for California for current fiscal year and the next two fiscal years are shown below (Table 23):

Table 23. Average Costs to the State to Implement Municipality and Utility Fleet Regulation

Fiscal Year	Number of Vehicles Retrofit	Discounted Annual Capital Costs (in 2005 dollars)	Average Annual O&M Costs[17] (in 2005 dollars)	Total Average Annual Cost (in 2005 dollars)
2005	0	$0	$300,000	$300,000
2006	179	$107,000	$311,000	$418,000
2007	198	$258,000	$317,000	$575,000

Most state agencies will have to absorb the cost of compliance in their general budget since they do not charge specific fees for services provided by their diesel vehicles (e.g., CalTrans freeway sweeping.)

[17] O&M costs include vehicle retrofit costs and costs to implement and enforce the regulation.

K. Cost to Federal Agencies

Staff was unable to determine the exact number of vehicles owned by the federal government operating in California, since most are not registered by the DMV. However, the United States Postal Service, several military bases, and the federal General Services Administration submitted survey data on their vehicles subject to the rule. Based on these, staff estimated the total federal fleet vehicles subject to the rule is 2,663 as of 2004. This number is expected to grow to approximately 2,771 by 2006. The total cost for federal agencies discounted to 2005 dollars is estimated at $19 million.

L. Cost to Municipalities and Utilities Located in Low Population Counties

Municipalities and utilities located in low population counties typically have older vehicles. Based on an analysis DMV data, approximately 1,070 municipal and utility vehicles subject to the rule are registered in low population counties. Forty-six percent (46%) are Group 1 vehicles, 54% are Group 2 vehicles, and less than 1% are Group 3 vehicles. The majority of Group 1 vehicles will likely be replaced as shown in the retrofit scenario in Table 17 since these are less amenable to retrofit. The total discounted cost for these fleets is estimated at $9.2 million if they do not select any optional compliance schedule.

Based on discussion with these fleets and the Regional Council of Rural Counties, staff assumes most fleets will take advantage of the optional implementation schedule in Table 11 or the accelerated turnover option. This would result in a lower discounted total cost since the full implementation period is extended out a minimum six years (depending what option is selected.)

M. Cost to the Average Household for Utilities

Utilities have the ability to pass the cost of compliance on to their ratepayers. Some special districts also provide services on a fee basis (i.e., water district) and may be able to pass on the cost of compliance to their ratepayers. A utility ratepayer may eventually pay higher costs for natural gas, electric or water services.

To estimate an order of magnitude for the cost to an individual ratepayer, staff calculated the average increase to an individual ratepayer for the largest utility in California. This utility owns approximately 1,472 vehicles subjected to the regulation as reported to ARB in 2004 (this number is estimated to grow to 1,531 vehicles by 2006). The total cost of compliance discounted to 2005 dollars is $10.5 million. If this cost was equally distributed to the 4,756,159 utility's customer accounts[18], it would result in a one time increase per ratepayer of $2.20.

[18] California Public Utility Commission 2001 Utility Electric Sales

IX. ENVIRONMENTAL IMPACT AND COST-EFFECTIVENESS

The proposed regulation would provide cost-effective diesel PM emission reductions throughout California, especially at the neighborhood level. The air quality benefits statewide would be not only from reduction of diesel PM emissions, but also from reduction of CO, NO_x, and HC emissions. Staff calculated the average cost per diesel PM pound reduced by 2010 is about $159 and the average cost per NOx pound reduced is $11.47

The cost-effectiveness of this regulation is higher than other similar PM control measures; however the health benefits of the regulations provides a cost savings as discussed in section IX.C.

A. Statewide Emission Benefits

ARB staff estimates the proposed diesel PM control measure would result in the reduction of between 0.15 tpd of diesel PM emissions in 2010 and 0.05 tpd diesel PM reduced in 2020 (Table 24). The reduction of diesel PM emissions attributed to this regulation peaks around 2010 because the majority of vehicles are expected to meet the diesel PM control measure by 2010 (except for about 1,070 vehicles located in low-population counties, which have a later final implementation date). After 2010 the benefits attributed to this regulation decline to 0.05 tpd in 2020 as vehicles are retired and replaced with new engines that meet the federal 2007 0.01 g/bhp-hr PM standard.

Table 24. Statewide Diesel PM Emission Reduction Benefits.

Calendar Year	Baseline Inventory (tpd)	Diesel PM Retrofit Reduction (tpd)	% Reduction from Baseline
2006	0.36	0.02	6%
2010	0.25	0.15	60%
2015	0.17	0.10	59%
2020	0.12	0.05	42%

Other air quality benefits also exist as a result of the use of the various BACT, including reduced emissions of CO, HC, and NOx. The reductions in HC are also accounted for in the State Implementation Plan. Based on expected reduction capabilities from the various DECS that might be used (Table 25), reductions of up to 1.18 tons of CO per day (Table 26), 0.15 tons of HC per day (Table 27), and 0.30 tons of NOx per day (Table 28) will be realized .

Table 25. Other Pollutant Reductions

Diesel Emission Control Strategy	Emission Reduction (Percent)			
	PM[a]	CO	HC	NO_x
Passive Diesel Particulate Filter	85	90[b]	95[b]	0[c]
Fuel-Water Emulsion[h]	50	35[d]	60[d]	50[d]
Average Diesel Oxidation Catalyst	25	47[e, f]	76[e, f]	0[c]

[a]Verified Level Reduction Goals for ARB. Strategies will not be verified without meeting this standard at a minimum.
[b]Allansson, R, Cooper, BJ, Thoss, JE, Uusimaki, A, Walker, AP, Warren, JP. 2001. European Experience of High Mileage Durability of Continuously Regenerating Diesel Particulate Filter Technology. SAE. 2001-01-0480.
[c]Majewski, W. Addy. 2001. *Diesel Net Technology Guide: Diesel Particulate Traps.* www.dieselnet.com.
[d]Diesel Net Technology Guide: Emission Control Technologies, 1998. www.dieselnet.com.
[e]Diesel Net Technology Guide: Diesel Oxidation Catalyst, 1999. www.dieselnet.com.
[f]Khair, Magdi; McKinnon, Dale L. Performance Evaluation of Advanced Emission Control Technonlogies for Diesel Heavy-Duty Engines. SAE. 1999-01-3564.
[h]Fuel-water emulsion increases CO and HC emissions. Although can be verified alone for the purposes of simplifying calculations, assumed it would be used in conjunction with a diesel oxidation catalyst to decrease impact of increase. Choose least decrease to account for offset of increase from fuel-water emulsion.

Table 26. Statewide Diesel CO Emission Reduction Benefits

Calendar Year	Baseline Inventory (tpd)	Diesel CO Reduction (tpd)
2006	2.2	0.17
2010	2.0	1.18
2015	1.8	0.85
2020	1.6	0.46

Table 27. Statewide Diesel HC Emission Reduction Benefits

Calendar Year	Baseline Inventory (tpd)	Diesel HC Reduction (tpd)
2005	0.27	0.02
2010	0.23	0.15
2015	0.20	0.11
2020	0.16	0.05

Table 28. Statewide Diesel NOx Emission Reduction Benefits

Calendar Year	Baseline Inventory (tpd)	Diesel NOx Reduction (tpd)
2006	11.2	0.03
2010	10.1	0.30
2015	8.5	0.18
2020	7.3	0.09

B. Impacts on the State Implementation Plan for PM_{10}

The draft State Implementation Plan (SIP) for in the San Joaquin Valley projects attainment for the federal PM10 standard by 2010. As a "serious" nonattainment area, the San Joaquin Valley must use best available control measures for all sources of PM_{10} and must also achieve five percent annual emission reductions in PM_{10} and its precursors. The San Joaquin Valley has ten percent of the statewide municipal and utility vehicles and will see a benefit of 0.02 tpd of PM reduced by 2010. In addition, the NOx and volatile organic carbon (VOC) benefits of the proposed rule are contained in the plan, as they are precursors to secondary PM formation.

The South Coast air basin is also classified as "serious" for PM_{10} but its attainment deadline is 2006, before most of the benefits of the proposed rule will be achieved. Nonetheless, the proposed rule will help that District maintain compliance with the federal PM_{10} standard. The rule also serves as a down payment on future plans to achieve the federal $PM_{2.5}$ standards and California's own, more stringent standards. Thirty-five percent of California's public and utility fleet vehicles are in the South Coast region. By 2010, the proposed rule will reduce emissions from those vehicles by 0.05 tpd.

All other PM_{10} nonattainment areas in California will benefit from the proposed rule in a general way. Every district except Lake County is in nonattainment for the California PM_{10} standard. In addition, four other areas in California are nonattainment for the federal PM_{10} standards: Owens Valley, Searles Valley, Coachella Valley, and Imperial Valley.

For ozone SIPs there is a similar situation. The ARB adopted the statewide element and approved the comprehensive SIP for the South Coast Air Basin and the PM10 SIP for the Coachella Valley on October 23, 2003. ARB submitted the South Coast and Coachella SIPs to U.S. EPA on January 9, 2004.

As with PM_{10}, all other ozone nonattainment areas in California will benefit from the proposed rule in a general way as it reduces the precursors to ozone formation (see Tables 27 and 28).

C. Health Benefits of Reductions of Diesel PM Emissions

This section examines the health benefits of reducing diesel PM emission and provides an analysis of the number of premature deaths prevented by the reduction of diesel PM. It also provides the cost savings to society for each prevented premature death. In addition, a brief discussion of health benefits of reducing ozone precursors is included.

Staff estimates that approximately 40 premature deaths will be avoided from the implementation of this proposal. The proposed regulation is expected to reduce $PM_{2.5}$ emissions by a cumulative amount of 538 tons by the end of year 2022, and therefore prevent an estimated 38 premature deaths (19 - 57, 95 percent confidence interval (95% CI)) by year 2022. In addition, staff estimates that the proposed regulation is expected to accrue a cumulative reduction of 1,005 tons of NOx by the end of 2022, therefore avoiding an estimated 2 premature deaths (1 – 2, 95% CI).

Lloyd and Cackette estimated that, based on the Krewski *et al.* study[19], a statewide population-weighted average diesel $PM_{2.5}$ exposure of 1.8 $\mu g/m^3$ resulted in a mean estimate of 1,985 premature deaths per year in California (Lloyd/Cackette, 2001). The diesel PM emissions corresponding to the direct diesel ambient population-weighted PM concentration of 1.8 $\mu g/m^3$ is 28,000 tons per year (ARB, 2000). Based on this information, we estimate that reducing 14.11 tons per year of diesel PM emissions would result in one fewer premature death (28,000 tons/1,985 deaths).

Comparing the PM2.5 emissions before and after this regulation, the proposed regulation is expected to reduce PM2.5 emissions by a cumulative amount of 538 tons by the end of year 2022, and therefore prevent an estimated 38 premature deaths (19 - 57, 95 percent confidence interval (95% CI)) by year 2022.

Lloyd and Cackette also estimated that indirect diesel $PM_{2.5}$ exposures at a level of 0.81 $\mu g/m^3$ resulted in a mean estimate of 895 additional premature deaths per year in California, above those caused by directly emitted formed diesel PM. The NOx emission levels corresponding to the indirect diesel ambient PM concentration of 0.81 $\mu g/m^3$ is 1,641 tpd (598,965 tpy). Following the same approach as above, we

[19] Although there are two mortality estimates in the report by Lloyd and Cackette – one based on work by Pope *et al.* and the other based on Krewski *et al.*, we selected the estimate based on the Krewski's work. For Krewski *et al.*, an independent team of scientific experts commissioned by the Health Effects Institute conducted an extensive reexamination and reanalysis of the health effect data and studies, including Pope *et al.* The reanalysis resulted in the relative risk being based on changes in mean levels of $PM_{2.5}$, as opposed to the median levels from the original Pope *et al.* study. The Krewski *et al.* reanalysis includes broader geographic areas than the original study (63 cities vs. 50 cities). Further, the U.S. EPA has been using Krewski's study for its regulatory impact analyses since 2000. (Krewski et al., 2000) (Pope, 1995)

estimate that reducing 669 tons of NOx emissions would result in one fewer premature death (598,965 tons/895 deaths). Therefore, with a NOx reduction of 1,005 tons that is expected to accumulate by the end of 2022, an estimated 2 deaths (1 – 2, 95% CI) would be avoided.

1. Social Benefit - Cost Analysis

As discussed below, staff calculated the value of avoiding one premature death, as well as the estimated cost of control to prevent a 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 (U.S. 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 (U.S. EPA, 2000). Based on these rates, and the annual avoided deaths, 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.

The ARB calculates the cost of avoiding a premature death, following these steps:

- For each year, note the annualized cost and the annual premature deaths avoided.
- Allocate a portion of the costs to PM and the rest to NOx, in proportion to the premature deaths prevented by the regulation. Since 96% of the estimated deaths prevented by this regulation would be attributed to PM emission reduction, we allocate 96% of these costs to $PM_{2.5}$ emission reductions and 4% to NOx reductions.
- Take the time value of money into account, by discounting the cost in each year to 2005, using a 3 percent discount rate and a 7 percent discount rate.
- Calculate a cost per premature death avoided in each year.
- Calculate a weighted average of these values, using the weights proportional to the annual premature deaths avoided.
- *Results using a 3 percent discount rate.* The average cost per premature death avoided is about $4 million.[20]
- *Results using a 7 percent discount rate.* The average cost per premature death avoided is about $3 million.

The results presented here are point estimates. Their values are actually uncertain. For example, we reported the confidence interval on the number of premature deaths

[20] The value is the same whether the premature deaths avoided result from reductions of PM or reductions of NOx. That is because the costs allocated to each pollutant are proportional to the number of premature deaths avoided. Thus, the ratio of cost to deaths comes out the same for both pollutants.

avoided. Not all of the uncertainties are quantified, so it would be misleading to calculate and report a confidence interval for the results of the valuation calculations.

2. Health Benefit From 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 from diesel engines in urban areas would make a considerable contribution to reducing exposures to ambient ozone. Controlling emissions of ozone precursors would reduce the prevalence of the types of adverse respiratory effects associated with ozone exposure and would reduce hospital admissions and emergency visits for respiratory effects.

D. Cost-Effectiveness of Proposed Regulation

The estimated average cost-effectiveness of this proposed diesel PM emission reduction regulation is approximately $159/lb of PM reduced annually from fiscal years 2006 to 2010. The costs and emission reductions associated with this regulation and how they were derived are discussed in Appendix C. Both capital costs, such as the purchase and installation of a DECS, and O & M costs, such as incremental fuel cost for fuel DECS, are included in this analysis. This cost-effectiveness does not include a number of benefits and costs, which could not be quantified. These benefits and costs are described in the assumptions section in Appendix C as well.

E. Potential Negative Impacts

Certain potential negative impacts could be associated with elements of this proposed regulation. Those potential negative impacts are discussed below.

1. Creation Of Nitrogen Dioxide By Passive Catalyzed Diesel Particulate Filters

Nitrogen dioxide (NO_2) is a component of NOx and its presence in the atmosphere can be correlated with emissions of NOx. There has been a steady decline in NO_2 values over the years due primarily to the implementation of tighter controls on both mobile and stationary sources. However, statewide emission trends still predict NOx levels of 761 tons/day per year from on-road diesel vehicles by year 2010.

At higher concentrations than are normally found in the atmosphere, NO_2 is an acute irritant. Health effects from prolonged exposure to NO_2 include upper respiratory problems, bronchitis, and pulmonary edema, and NO_2 has been linked to causes of severe asthma and bronchial infections in children.
Measurements of NO_X emissions (NO and NO_2) from heavy-duty diesel vehicles equipped with passive catalyzed filters have shown an increase in the NO_2 fraction, though total NO_X emissions remain approximately the same. Passive catalyzed filters oxidize NO to NO_2, which burns soot captured in the filter. More NO_2 is created than is actually used in the regeneration process and the excess is emitted. In fact, the NO_2 to

NO_X ratios could range from 20 to 70 percent, depending on factors such as the diesel particulate filter system, sulfur level in diesel fuel, and the duty cycle. Diesels without passive catalyzed filters typically emit less than 10 percent NO_2 as a fraction of total NOx.

Based on an ARB study conducted in 2002 (ARB 2002), a cap of 20 percent of NO_2 to NOx emission ratio was established for all verified diesel emission control technologies, to assume that measured NO_2 emission caused no increase in ambient air pollution. In December 2003, the Board made the decision to delay the effective date of the 20 percent NO_2 limit, which was to go into effect on January 1, 2004, to provide more time for manufacturers of DECS to reduce the NO_2 fraction. ARB established a working group comprised of scientists, health professionals, and manufacturers around the world to re-evaluate the limit. Staff is now working on the rulemaking effort to refine the NO_2 specific requirements for verification. ARB staff held a workshop to propose an alternative limit. Details of the workshop can be found at http://www.arb.ca.gov/diesel/verdev/mailoutmsc0504.pdf.

2. Diesel Oxidation Catalysts

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. 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. However, diesel oxidation catalysts are usually recycled for their precious metal content and thus are not managed as hazardous wastes in practice. Recycling also reduces any potential impact on landfill capacity.

3. Ash Management

Diesel particulate filter technology may generate a new hazardous waste stream. The carbonaceous component of the PM captured by the filter is burned off when the filter regenerates. Any inorganic components left behind after regeneration as ash in the filter must eventually be cleaned from the filter. Based on preliminary data from two samples, the ash may be classified as hazardous waste because of its zinc content.

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 HS&C, division 20; title 22, CCR, division 4.5; and title 40 of the Code of Federal Regulations. Staff recommends that owners who install a diesel particulate filter on a vehicle contact both the manufacturer of the DECS and the California Department of Toxic Substances Control (DTSC) for advice on waste management.

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.[21]

X. ISSUES

Over the course of development of this proposal, staff has met with various stakeholders and received written and verbal comments. Although staff has considered each comment, not all issues could be resolved while achieving ARB's goals to reduce diesel PM emissions from public and utility vehicles. Following is a discussion of major outstanding issues.

A. Low Population Definition

Staff has proposed an extended compliance schedule municipalities or utilities located in counties with populations 125,000 or less. Several fleets located in counties with populations over 125,000 but less than 300,000 still have the same fiscal limitations needs as smaller "rural" counties. Counties with population greater than 125,000 but less than 300,000 are listed below (Table 29):

[21] Information can be obtained from local duty officers and from the website: http://www.dtsc.ca.gov.

Table 29. Counties with Populations Between 125,000 to 300,000

County	Population
HUMBOLDT	132,500
NAPA	135,700
KINGS	149,600
MADERA	152,600
IMPERIAL	182,500
SHASTA	185,700
EL DORADO	187,000
YOLO	188,600
BUTTE	235,000
MERCED	239,900
MARIN	257,600
SANTA CRUZ	284,500
SAN LUIS OBISPO	287,000

Several of these counties include urban areas. If these counties are included in the current definition of low population they would account for 17% of the rule's benefit. Staff does not believe these mid size counties should be treated as rural counties with a delayed implementation schedule. Other provision of the rule, such as low use vehicle exemption, and exclusion of dedicated snow removal equipment, may help reduce the cost of the rule to these counties.

B. Biodiesel

The biodiesel industry and entities subject to the Federal Energy Policy Act (EPAct) expressed concerns that implementation of the rule would functionally preclude the use of biodiesel. This is a concern for public fleets such as the military since these agencies are using biodiesel blends in their heavy duty trucks to accumulate alternative fuel credits for compliance with EPAct. This concern was raised several times during outreach activities when no DECS was verified for use with biodiesel blends; however since this time, ARB has verified the Johnson-Matthey CRT with the use of B20 (EO DE-04-006-05). Based on this staff is confident that other DECS manufacturers will also apply for extension of existing DECS verifications to be used with biodiesel blends dispelling the concerns raised earlier in the rulemaking process.

The biodiesel industry has also requested several times to allow biodiesel blends to be considered BACT in the rule. Since ARB is mandating the application of BACT on in-use engines, biodiesel and biodiesel blends could only be considered BACT if the fuel goes through ARB's verification procedure. This would ensure the user that the fuel would carry the same warranty as other DECS against damage to the engine. Other impediments to the use of biodiesel blends have been the lack of fuel specifications for the neat fuel. ARB has formed a Biodiesel Working Group to facilitate the development of possible biodiesel specifications. This group consists of a broad range of stakeholders, including biodiesel producers, distributors, petroleum refiners, regulatory agencies, and biodiesel end users. Information of this effort can be found at http://www.arb.ca.gov/fuels/diesel/altdiesel/altdiesel.htm

C. Alternative Compliance Plan or Alternative Early Compliance Plan

Several commentors have requested the inclusion of alternative compliance plans or early compliance plans. The rationale behind this request is that some municipalities or utilities have proactively purchased alternative fuel engines or retrofitted their vehicles with BACT. Therefore, the early implementation of BACT should generate credits that would allow delaying the proposed implementation schedule. Staff evaluated this proposal, but believed that implementation of such a provision would be too difficult to enforce. Staff also noted that many municipalities and/or utilities applied BACT to vehicles with the use of grant money. Therefore, no early credit can be given, since most grant money is also tied to emission reduction requirements. Therefore these alternative implementation options were not included in the regulation.

D. Cost to Local Government Agencies

Several government agencies that do not have the ability to collect fees have stated that the cost of compliance for this rule is too high. Staff believes based on the variety of verified DECS available, and the phased-in implementation makes the rule technically feasible and cost effective. The concept of BACT is to give owners several options to choose from whether it is staggering their new vehicle purchases with already complying engines, repowering older vehicles with cleaner engines, or retrofit existing engines with verified technology. BACT is a much more attractive option to accelerated fleet turnover because it does give the owner the choice of less costly options. Staff also tried to stagger implementation schedules that were more in line with fleets' routine plans for vehicle replacement and engine repowering. In addition, staff built in several extensions based on technology unavailability and low population county concerns. Any further relaxing of the proposal would not deliver the near term needs of reducing the public's exposure to diesel PM.

E. Applicability of Proposed Rule to Federal Agencies

The United States Postal Service (USPS) has submitted several comment letters presenting a legal argument that while other governmental fleets may be regulated, federal fleets like USPS may not be regulated until privately-owned fleets are similarly regulated citing section 118(a) of Clean Air Act (CAA). ARB's legal staff determined that USPS's reading of this statute is not consistent with the statute itself and is also inconsistent with other provisions of the CAA. In cases regarding the applicability of state and local regulations to federal agencies, the courts have held that Congress waived its sovereign immunity with respect to independent state or local air pollution control laws. Therefore, staff has determined that federal fleets including the USPS are subject to the proposed regulation.

XI. SUMMARY AND STAFF RECOMMENDATION

ARB staff recommends the Board adopt new sections 2022, and 2022.1, title 13, chapter 1, article 4, CCR, in its entirety. The regulation is set forth in the proposed regulation order in Appendix A.

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APPENDIX A

PROPOSED DIESEL PARTICULATE MATTER CONTROL MEASURE FOR ON-ROAD HEAVY-DUTY DIESEL-FUELED VEHICLES OWNED OR OPERATED BY PUBLIC AGENCIES AND UTILITIES

Adopt article 4 within chapter 3, division 3, title 13, California Code of Regulations, and new sections, 2022 and 2022.1, to read as follows: (Note: The entire text of sections 2022 and 2022.1 set forth below is new language proposed to be added to the California Code of Regulations.)

Section 2022. Diesel Particulate Matter Control Measure for Municipality or Utility On-road Heavy-Duty Diesel-fueled Vehicles

(a) **Scope and Applicability.** Sections 2022 and 2022.1 apply to any municipality or utility that owns, leases, or operates an on-road diesel-fueled heavy-duty vehicle with a 1960 to 2006 model-year medium heavy-duty or heavy heavy-duty engine and manufacturer's gross vehicle weight rating greater than 14,000 pounds. These sections do not apply to a vehicle subject to the solid waste collection vehicle rule commencing with title 13, California Code of Regulations, section 2021 or to the fleet rule for transit agencies commencing with section 2023, or to a school bus as defined in Vehicle Code section 545, or to a military tactical support vehicle, as described in title 13, California Code of Regulations, section 1905 and title 40, Code of Federal Regulations, Part 86, section 1785, or off-road vehicles as described in title 13, California Code of Regulations, sections 2401, 2421, 2411 and 2432.

(b) **Definitions.** The definitions in section 2020 shall apply to sections 2022 and 2022.1. In addition, the following definitions apply only to sections 2022 and 2022.1.

"Dedicated Snow Removal Vehicle" means a vehicle that has permanently affixed snow removal equipment such as a snow blower or auger and is operated exclusively to perform snow removal operations.

"Low-Population County" means a county with a population of less than 125,000, based upon the California Department of Finance estimates as of July 1, 2005, and as listed in Table 2 of title 13, California Code of Regulations section 2022.1.

"Low Usage Vehicle" means a vehicle that is operated for fewer than 1000 miles or 50 hours per year, based on a five-year rolling mileage or engine-hour average.

"Low-Population County Low Usage Vehicle" means a vehicle that is owned or operated by a municipality or utility located in a low-population county and is operated, based on a five-year rolling mileage or engine hour average for fewer than 3000 miles or 150 hours, excluding mileage or engine hours used during snow removal operations.

"Retirement" or "Retire" means an engine or vehicle subject to this rule that will be withdrawn from a municipality or utility fleet in California, or that meets the provisions of title 13, California Code of Regulations, section 2022.1(b) if it is transferred to a fleet within California. The engine may be sold outside of California, scrapped, converted for use in a low usage vehicle or low population county low usage vehicle.

"Total Fleet" means the total of a municipality's or utility's on-road heavy-duty vehicles with a 1960 to 2006 model year medium heavy-duty or heavy heavy-duty engine and a manufacturer's gross vehicle weight rating greater than 14,000 pounds, excluding low usage vehicles; low-population county, low usage vehicles; dedicated snow-removal vehicles; and gasoline fueled vehicles[1].

"Utility" means a privately-owned company that provides the same or similar services for water, natural gas, and electricity as a public utility operated by a municipality.

NOTE: Authority cited: Sections 39600 and 39601, Health and Safety Code. Reference: Sections 39002, 39003, 39655, 39656, 39657, 39658, 39659, 39660, 39661, 39662, 39664, 39665, 39667, 39669, 39674, 39675, 43000, 43013, 43018, 43101, 43102, 43104, 43105, and 43700, Health and Safety Code.

[1] Gasoline vehicles that do not meet the best available control technology (BACT) requirements specified in title 13, California Code of Regulations, section 2022.1(b)(3) are excluded from the total fleet calculation.

Section 2022.1. Determining Compliance for a Municipality or Utility.

(a) **Compliance Requirements.** Beginning with the applicable effective dates, a municipality or utility is required to comply with this diesel particulate matter control measure for each vehicle in its total fleet. Compliance requires all of the following:

(1) Use of a best available control technology for each vehicle in the total fleet as specified in subsection (b);

(2) Implementation for each vehicle in the total fleet as specified in subsection (c);

(3) If a compliance deadline extension is granted by the Executive Officer per subsection (d), the municipality or utility shall be deemed to be in compliance as specified by the Executive Officer's authorization;

(4) Special circumstances must be followed as specified in subsection (e);

(5) Records must be kept as specified in subsection (f); and

(6) Continuous compliance: municipality or utility is required to keep each vehicle in compliance with this regulation, once it is in compliance, so long as the municipality or utility is operating the vehicle in California.

(b) **Best Available Control Technology.** Each municipality or utility shall use one of the following best available control technologies on each applicable vehicle in its total fleet as required by the implementation schedule in subsection (c):

(1) An engine or power system certified to the optional 0.01 g/bhp-hr particulate emission standard as specified in title 13, California Code of Regulations, section 1956.8(a)(2), or the 0.01 g/bhp-hr particulate emission standard as specified in title 13, California Code of Regulations, section 1956.8(a), as appropriate for the engine's model year; or

(2) An engine or power system certified to the 0.10 g/bhp-hr particulate emission standard, as specified in title 13, California Code of Regulations, section 1956.8, used in conjunction with the highest level diesel emission control strategy as defined in subsection (b)(4) applied by the implementation schedule in subsection (c); or

(3) An alternative fuel engine, heavy-duty pilot ignition engine, or gasoline engine; model year 2004 – 2006 alternative fuel engines must be certified to the optional, reduced emission standards as specified in title 13, California Code of Regulations, section 1956.8 (a)(2)(A); gasoline engines must be certified to the emission standards as specified in title 13,

California Code of Regulations, for heavy-duty Otto-cycle engines used in heavy-duty vehicles over 14,000 pounds gross vehicle weight, sections 1956.8(c)(1)(B) and 1976(b)(1)(F); or

(4) The highest level diesel emission control strategy per title 13, California Code of Regulations, section 2702 (f), Table 1, that is verified for a specific engine to reduce diesel particulate matter and which the diesel-emission-control strategy manufacturer or authorized dealer agrees can be used on a specific engine and fleet-vehicle combination, without jeopardizing the original engine warranty in effect at the time of application.

(c) **Implementation Schedule.**

(1) A municipality or utility shall comply with the schedule in Table 1 - Implementation Schedule for a Municipal and Utility Total-Fleet Vehicle, 1960 to 2006 Model-Year Engines for the specified percentage of vehicles by each applicable compliance deadline.

Table 1 - Implementation Schedule for a Municipal and Utility Total-Fleet Vehicle, 1960 to 2006 Model-Year Engines.

Group	Engine Model Years	Percentage of Group to Use Best Available Control Technology[b]	Compliance Deadline, As of December 31st
1[a]	1960 – 1987	20 60 100	2007 2009 2011
2	1988 – 2002	20 60 100	2006 2008 2010
3	2003 – 2006 (Includes dual-fuel and bi-fuel engines)	50 100	2009 2010

[a]An owner may not use Level 1 technology as classified pursuant to title 13, California Code of Regulations section 2700, as best available control technology on a Group 1 engine or vehicle.

(2) Municipality or Utility Located in a Low-Population County. A municipality or utility that is headquartered in a county in Table 2 may elect to follow the option in Table 3 below in lieu of the implementation schedule in Table 1.

Table 2 – Low-Population Counties

COUNTY	Population as of July 1, 2005
ALPINE	1,300
AMADOR	37,600
CALAVERAS	47,800
COLUSA	24,200
DEL NORTE	31,500
GLENN	31,800
INYO	18,800
LAKE	69,200
LASSEN	39,800
MARIPOSA	19,600
MEDOCINO	95,500
MODOC	10,100
MONO	14,200
NEVADA	106,300
PLUMAS	21,900
SAN BENITO	63,600
SIERRA	3,700
SISKIYOU	47,200
SUTTER	90,400
TEHAMA	63,400
TRINITY	13,800
TUOLUMNE	62,200
YUBA	66,000

Table 3 - Implementation Schedule for a Municipality or Utility Located in a Low-Population County.

Group	Engine Model Years	Percentage of Group to Use Best Available Control Technology[a]	Compliance Deadline, as of December 31st
1	1960 – 1987	20 40 60 80 100	2009 2011 2013 2015 2017
2	1988 – 2002	20 40 60 80 100	2008 2010 2012 2014 2016
3	2003 – 2006 (Includes dual-fuel and bi-fuel engines)	20 40 60 80 100	2011 2012 2013 2014 2015

(3) Accelerated Turnover Option for Municipality or Utility Located in a Low-Population County. A municipality or utility headquartered in a county listed in Table 2 may elect to follow the option in Table 4 below in lieu of the implementation schedules in Table 1 or 3.

Table 4 – Accelerated Turnover Option for a Municipality or Utility Located in a Low-Population County

Engine Model Year	Fleet Percent to Repower with a 1994 or newer engine	Compliance Date as of Dec 31st	Percent of Fleet to use BACT	Compliance Date as of Dec 31st
1960 –1993	100%	2020	100%	2025
1994 - 2006	N/A	N/A	100%	2025

(4) Calculating Number of Total Fleet Vehicles Required for Implementation. A municipality or utility shall calculate the size of its total fleet as of January 1st of each year where a compliance deadline is applicable, ($\#MUV_{by\,group}$) based on the model year of each engine ($\#Vehicles_{by\,group}$) plus the number of vehicles removed from the model-year group by retirement in prior years, beginning with January 1 of the initial applicable compliance deadline year for each group ($TotRetire_{by\,group}$), and determine the number of vehicles required for implementation as follows. If a vehicle has left the total-fleet for reasons other than retirement, it may not be included in this calculation.

$$\mathbf{\#MUV_{by\,group} = \#Vehicles_{by\,group} + TotRetire_{by\,group}}$$

(A) The municipality or utility shall determine the total number of vehicles required to be in compliance by the compliance deadline in Table 1 ($TotVeh_{by\,group}$) by multiplying "Percentage of Group to Use Best Available Control Technology" ($Group\%BACT_{by\,group}$) for that year by the sum of the number of vehicles in an engine model year group ($\#MUV_{by\,group}$) as in this following expression:

$$\mathbf{TotVeh_{by\,group} = (Group\%BACT)_{by\,group} \times (\#MUV)_{by\,group}}$$

(B) After the first compliance deadline for each group, the municipality or utility shall determine the additional number of vehicles to be brought into compliance each year when a compliance deadline is applicable ($TotAddComp_{by\,group}$) by subtracting the number of vehicles brought into compliance since the earliest compliance deadline using the method listed in subsection (b) ($TotBACT_{by\,group}$) or by retirement ($TotRetire_{by\,group}$) from the total number of vehicles required to be in compliance ($TotVeh_{by\,group}$), as in the following expression. If a vehicle has left the total-fleet for reasons other than retirement, it may not be included in this calculation.

$$\mathbf{TotAddComp_{by\,group} = TotVeh_{by\,group} - TotBACT_{by\,group} - TotRetire_{by\,group}}$$

(C) Notwithstanding subsection (B) above, in the 100 percent compliance deadline year for each engine model-year group, the municipality or utility shall bring the remaining vehicles into compliance.

(D) If the $TotVeh_{by\,group}$ or $TotAddComp_{by\,group}$ is not equal to a whole number, the municipality or utility shall round up a whole number when the fractional part of $TotAddComp_{by\,group}$ is greater than 0.5, and round down if less than 0.5.

(d) **Compliance Extensions**. A municipality or utility may be granted an extension to a compliance deadline specified in subsection (c) for one of the following reasons:

(1) Compliance Extension Based on Early Implementation. A municipality or utility shall be granted an extension based on compliance with one or more of the following early implementation schedules, provided the Executive Officer has received a letter by the applicable early compliance deadline stating the municipality's or utility's intent to comply with one of the following conditions and meets the requirements set forth in paragraphs (A) or (B):

(A) If a municipality or utility has implemented best available control technology on fifty percent or more of its Group 1 vehicles in its total fleet by December 31, 2007, then the municipality or utility may delay the intermediate and final compliance deadlines for the remaining Group 1 vehicles to July 1, 2012.

(B) If a municipality or utility has implemented best available control technology on fifty percent or more of its Group 2 vehicles in its total fleet by December 31, 2006, then the municipality or utility may delay the intermediate and final compliance deadlines for the remaining Group 2 vehicles to July 1, 2011.

(C) For purposes of complying with this section, a municipality or utility may count a vehicle that meets the requirements of section 2022.1(b) as of January 1, 2005, in its calculation for determining early compliance.

(2) Compliance Extension Based on No Verified Diesel Emission Control Strategy. If the Executive Officer has not verified a diesel emission control strategy, or one is not commercially available, for a particular engine and vehicle combination, an annual extension in compliance may be granted by the Executive Officer under one of the conditions specified below:

(A) Executive Officer Compliance Extension. The Executive Officer shall grant a blanket one-year compliance extension if a diesel emission control strategy is not verified for an engine ten months prior to each compliance deadline specified in subsection (c).

(i) For a Group 1 engine for which there is no verified diesel emission control strategy, the Executive Officer shall grant a one-year extension, after which the municipality or utility shall comply with subsection (b). If no diesel emission control strategy for the engine is verified during the extension period, the Executive Officer shall grant an additional one year extension. The executive Officer may grant one-year extensions until December 31, 2012, (or December

31, 2018 for a municipality or utility located in a low population county), after which the municipality or utility shall comply with subsection (b).

(ii) For a Group 2 engine for which there is no verified diesel emission control strategy, the Executive Officer shall grant a one-year extension, after which the municipality or utility shall comply with subsection (b). If no diesel emission control strategy for the engine is verified during the extension period, the Executive Officer shall grant an additional one-year extension. The Executive Officer may grant one-year extensions until December 31, 2011, (or December 31, 2017 for a municipality or utility located in a low-population county), after which the municipality or utility shall comply with subsection (b)

(B) Municipality or Utility Application Compliance Extension. A municipality or utility may apply to the Executive Officer for a compliance extension for an engine six months prior to each compliance deadline specified in subsection (c). The municipality or utility shall apply a diesel emission control strategy to each engine as required before requesting this extension. The municipality or utility shall meet the following application conditions and documentation requirements by providing the following to the Executive Officer:

(i) Identification of each engine, by vehicle identification number; engine manufacturer, model-year, family, and series; and type of vehicle for which no diesel emission control strategy has been verified; or

(ii) Identification of each engine, by vehicle identification number; engine manufacturer, model year, family, and series; and type of vehicle for which a specific diesel emission control strategy would void the original engine warranty and a statement from the engine manufacturer or authorized dealer stating the original engine warranty would be voided; or

(iii) Identification of each engine and vehicle combination, by vehicle identification number; engine manufacturer, model-year, family, and series; and type of vehicle for which no diesel emission control strategy is commercially available and a list of manufacturers that have been contacted, with the manufacturers' responses to a request to purchase; and

(iv) A description of the reason for the request for a compliance extension for each engine or engine and fleet-vehicle combination; and

(v) A copy of the statement of compliance as required in subsection (f)(1)(I); and

(vi) Submission of the application for compliance extension to the Executive Officer no later than July 31 annually beginning 2006. For a Group 1 engine, the Executive Officer will accept an annual compliance-extension application until July 31, 2011, (or July 31, 2017, for a municipality or utility located in a low-population county, after which the municipality or utility shall comply with subsection (b) by December 31, 2012, (or December 31, 2018, for a municipality or utility located in a low-population county.) The Executive Officer will only grant one compliance extension for an engine in Group 1. For a Group 2 engine, the Executive Officer will accept an annual compliance extension application until July 31, 2010, (or July 31, 2016, for a municipality or utility located in a low-population county), after which the municipality or utility shall comply with subsection (b) by December 31, 2011, (or December 31, 2017, for a municipality or utility located in a low-population county.)

(3) Compliance Extension for a Municipality or Utility that Operates a Dual-Fuel or Bi-Fuel Engine. A municipality or utility may delay implementation of a Group 1 or 2 dual-fuel or bi-fuel engine to the Group 3 compliance deadlines.

(4) Compliance Extension for an Engine Near Retirement. If a municipality or utility has applied best available control technology to all engines as required, and the next engine subject to implementation under subsection (c) is scheduled to be retired from the total fleet within one year of the applicable compliance deadline, then the municipality or utility shall be exempted from applying the best available control technology as defined in subsection (b) to that engine for a maximum of one year, provided documentation of the expected retirement date is kept in records as specified in subsection (f) and the engine is retired by the stated anticipated date.

(5) Use of Experimental Diesel Emission Control Strategy. A municipality or utility may use an experimental diesel emission control strategy provided by, or operated by, the manufacturer in no more than 20 vehicles, or ten percent of its total fleet, whichever is less, for testing and evaluation purposes. The municipality or utility shall keep documentation of this use in records as specified in subsection (f). Each vehicle will be considered to be in compliance for the duration of the experiment to a maximum of two years. The municipality or utility must bring the vehicle into compliance within six months of the end of the testing and evaluation

period. No experimental diesel emission control strategy may be used on a vehicle after December 31, 2012.

(6) Accelerated Turnover Option. A municipality or utility located in a low-population county may follow the accelerated turnover option provided in subsection (c)(3), provided the Executive Officer has received a letter by the July 31, 2008, stating the municipality's or utility's intent to comply with this option.

(e) **Diesel Emission Control Strategy Special Circumstances.** A municipality or utility shall maintain the original level of best available control technology on each engine once that engine is in compliance, and is not required to upgrade to a higher level of best available control technology, except under specified special circumstances, as follows:

(1) Fuel Strategy Diesel Emission Control Strategy.

(A) If a municipality or utility determines that the highest level diesel emission control strategy for a small percentage of their fleet would be a level 2 fuel-based strategy, and implementation of this diesel emission control strategy would require installation of a dedicated storage tank, then a municipality or utility shall request prior approval from the Executive Officer to allow use of a lower level diesel emission control strategy; or

(B) If a municipality or utility elects to use fuel-based diesel emission control strategy across its fleet, and some vehicles can use a level 3 hardware diesel emission control strategy, then a municipality or utility shall request prior approval from the Executive Officer to allow use of a lower level diesel emission control strategy. This provision is only available if a minimum level 2 diesel emission control strategy is used.

(2) Diesel Emission Control Strategy Failure or Damage. In the event of a failure or damage of a diesel emission control strategy, the following conditions apply:

(A) Failure or Damage During the Warranty Period. If a diesel emission control strategy fails or is damaged within its warranty period and the diesel emission control strategy manufacturer or authorized dealer determines it can not be repaired, the municipality or utility shall replace the diesel emission control strategy with either the same level diesel emission control strategy or another best available control technology as defined in subsection (b).

(B) Failure or Damage Outside of Warranty Period. If a diesel emission control strategy fails or is damaged outside of its warranty period, and it cannot be repaired, the municipality or utility shall apply the best available control technology at the time of replacement, as defined in subsection (b).

(3) Discontinuation of Fuel Verified as a Diesel Emission Control Strategy. If a municipality or utility discontinues use of a fuel verified as a diesel emission control strategy, the municipality or utility shall apply best available control technology within 30 days of the date of discontinuation or submit a compliance plan to the Executive Officer no later than 30 days after discontinuation that demonstrates how the municipality or utility will bring the vehicles into compliance within six months of the date of discontinuance.

(4) Limited Use of Level 1 Diesel Emission Control Strategy. If a Level 1 diesel emission control strategy is identified as the best available control technology pursuant to subsection (b), a municipality or utility is subject to the following limitations:

(A) Group 1. A municipality or utility may not use a Level 1 diesel emission control strategy on any Group 1 engine, except that a municipality with its total fleet located in a low-population county (Table 2) may use a Level 1 diesel emission control strategy on a Group 1 engine.

(B) Group 2. A municipality or utility may use a Level 1 diesel emission control strategy in a Group 2 engine for up to ten years, after which the municipality or utility shall replace the Level 1 diesel emission control strategy with the best available control technology from subsection (b), except that a Level 1 diesel emission control strategy cannot be installed or the vehicle is owned/operated by a municipality or utility located in a low-population county.

(C) Group 3. A municipality or utility may use a Level 1 diesel emission control strategy in a Group 3 engine for up to five years, after which the municipality or utility shall replace the Level 1 diesel emission control strategy with the best available control technology from subsection (b), except that a Level 1 diesel emission control strategy cannot be installed or the vehicle is owned/operated by a municipality or utility located in a low-population county.

(f) **Record Keeping Requirement.** A municipality or utility shall maintain the following records. The municipality or utility shall provide the following records upon request to an agent or employee of the Air Resources Board for all vehicles in its total fleet subject to compliance with this regulation.

(1) Records Accessible at Terminal. The municipality or utility shall keep the following records accessible either in hard-copy format or as computer

records at the terminal where a vehicle normally resides beginning December 31, 2006:

(A) A list by vehicle identification number of vehicles identifying each vehicle type; engine manufacturer, model-year, family, and series; and status as a total-fleet or low-usage vehicle; and

(B) Correlated to each vehicle, the installed diesel emission control strategy family name, its serial number, manufacturer, installation date, and if using a Level 1 or Level 2 verified diesel emission control strategy, the reason for the choice; and

(C) Records of maintenance for each installed diesel emission control strategy; and

(D) For fuel or fuel additives used as a diesel emission control strategy, the most recent two years' worth of records of purchase that demonstrate usage; and

(E) For each low usage vehicle, or low population county low-usage vehicle, as of December of each year beginning 2006, mileage records correlated to the information in paragraph (1)(A) above; and

(F) If a municipality or utility is located in a low-population county, documentation affirming that the vehicle is not operated at any time in a metropolitan statistical area as defined by the U.S. Census Bureau; and

(G) For each engine for which a municipality or utility is claiming an exemption pursuant to paragraph (d)(4), the retirement date correlated to the information in paragraph (1)(A) above; and

(H) For each engine for which a municipality or utility is claiming an extension pursuant to paragraph (d)(5), the records of the test plan, including start and end dates of the experiment; diesel emission control strategy manufacturer name and contact information (representative, address, and phone number); name and type of experimental diesel matter emission control strategy; and targeted data to be generated by experiment and correlated to the information in paragraph (1)(A) above; and

(I) For each engine for which a municipality or utility located in a low-population county is following the accelerated turnover path in Table 3, the date of each engine repower correlated to the information in paragraph (1)(A) above; and

(J) A statement of compliance, prepared beginning December 31, 2006, and renewed each December 31, thereafter until December 31, 2012, with low-population counties continuing until December 31, 2018, certifying that the municipality's or utility's engines are in compliance as required, including the following:

(i) "The [insert name of municipality or utility] vehicles at terminal [insert terminal identification number or address] are in compliance with title 13, California Code of Regulations, section 2022"; and

(ii) The municipality's or utility's name, address, and business telephone; and the signature of the municipality's or utility's agent and the date signed.

(2) Records Kept in the Vehicle. For each vehicle, beginning December 31, 2006, the municipality or utility shall keep the following information affixed in the form of a legible and durable label to the driver's side door jamb, or another readily accessible location known to the driver of each vehicle:

(A) For each installed diesel emission control strategy, the diesel emission control strategy family name, and the installation date; or

(B) Engine model year and planned compliance date, and a statement that the vehicle is following the accelerated turnover option, if applicable; or

(C) Designation as a low-usage vehicle or low-population county low usage vehicle (as applicable) and the vehicle's mileage as of January 1 of each year beginning January 1, 2007; or

(D) Engine model year and terminal where the vehicle is permanently housed if the municipality or utility is located in a low-population county; or

(E) Engine model year and retirement date for an engine for which a municipality or utility is claiming an extension pursuant to paragraph (d)(4); or

(F) Engine model year and the beginning and the ending dates for the test plan of an engine for which a municipality or utility is claiming an extension pursuant to paragraph (d)(5).

(3) Each municipality or utility shall maintain these records for each vehicle until it is sold outside of the State of California or is no longer owned or operated by the municipality or utility. If ownership is transferred, the seller shall convey these records to the buyer, or a third-party sales representative.

(g) **Contractor Compliance Requirement.** In any contract for services that the municipality or utility enters that has an effective date of December 31, 2006, or later, a municipality or utility shall include language requiring the contractor to be in compliance with all applicable California air pollution control laws and regulations.

(h) **Non-Compliance.** Any violations of this section may carry civil penalties as specified in state law and regulations, including, but not limited to, Health and Safety Code Section 39674.

(1) A municipality or utility that fails to maintain the required records in paragraph (f)(1) may be subject to civil penalties of not less than $100 per day for every day past the required recordkeeping date.

(2) A municipality or utility that fails to maintain the required records in the vehicle as specified in paragraph (f)(2) may be subject to civil penalties of not less than $100 per day per vehicle for every day past the required recordkeeping date.

NOTE: Authority cited: Sections 39600, 39601, and 39658, Health and Safety Code. Reference: Sections 39002, 39003, 39655, 39656, 39657, 39658, 39659, 39660, 39661, 39662, 39664, 39665, 39667, 39669, 39674, 39675, 43000, 43013, 43018, 43101, 43102, 43104, 43105 and 43700, Health and Safety Code.