PUBLIC MEETING AGENDA

November 17,2005

9:00 am

Agenda Items to be heard;

05-11-2:05-11-2: 05-11-3

05-11-4

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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.)

November 17, 2005
9:00 a.m.

Agenda Item #

05-11-1: Report to the Board on a Health Update -- Ozone Exposure and Death: Results from Three Recently Published Meta-Analyses

Staff will present the results of three recently published meta-analyses that have found an association between short-term exposure to ozone and mortality. Conducted by three independent groups of researchers, the studies showed that an increase in the ambient ozone concentration was associated with an increase in daily mortality in the United States as well as other parts of the world. The results support ARB's assessment of the health impacts of ozone exposures developed for the ozone ambient air quality standard review.

05-11-2: Public Hearing to Consider the Adoption of Proposed Airborne Toxic Control Measure for Cruise Ship Onboard Incineration

In 2004, Assembly Bill 471 (AB 471) was passed by the California Legislature, signed by the Governor, and codified in Health and Safety Code HSC section 39630 et seq. AB 471 prohibits cruise ships from conducting onboard incineration while operating within three (nautical) miles of the California coast. This law became effective January 1, 2005. By prohibiting incineration within three nautical miles of the California coast, the potential for adverse public health impacts will be reduced for residents who live or work near ports and along the coast. AB 471 states that the Air Resources Board (ARB/Board) shall enforce this legislation and may adopt standards, rules, and regulations for this purpose. ARB staff is proposing this airborne toxic control measure (ATCM) to implement AB 471 and ensure that it is adequately enforced. The proposed ATCM is expected to reduce exposure to emissions from toxic air contaminants, such as polychlorinated dibenzo-*p*-dioxins (dioxins), polychlorinated dibenzofurans (furans), and toxic metals.

05-11-3: Public Hearing to Consider Proposed Amendments to the Current Inboard and Sterndrive Boat Regulations

The Board will consider amendments to allow engine manufacturers an option to delay the introduction of a more stringent emission standard provided that there is no loss of emissions benefits. The Board will also consider additional amendments to ensure high performance boat engines carry an appropriate warranty and useful life consistent with current practices.

05-11-4: Public Meeting to Consider Revisions to the Carl Moyer Incentive Program Guidelines and to Establish the Agricultural Assistance Program

The Board will consider revisions to the Carl Moyer Program Guidelines to address new and forthcoming regulations; update remission factors; and reflect new legislative direction per Assembly Bill 923 (Firebaugh) and Assembly Bill 1394 (Levine).

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California Environmental Protection Agency

Air Resources Board

PUBLIC MEETING AGENDA

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November 17, 2005
9:00 a.m.

TITLE 17. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER THE ADOPTION OF PROPOSED AIRBORNE TOXIC CONTROL MEASURE FOR CRUISE SHIP ONBOARD INCINERATION

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 the public exposure to toxic air contaminants emitted from cruise ship onboard incineration at California ports and terminals and along the California coast.

DATE: November 17, 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 ARB, which will commence at 9:00 a.m. on Thursday, November 17, 2005, and may continue at 8:30 a.m., Friday, November 18, 2005. This item may not be considered until November 18, 2005. Please consult the agenda for the meeting, which will be available at least ten days before November 17, 2005, to determine the day on which this item will be considered.

If you have a disability-related accommodation need, please go to *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 title 17, California Code of Regulations (CCR) section 93119. Adoption of the National Oceanic and Atmospheric Administration (NOAA) Nautical Charts: Chart Number 18600 - *Trinidad Head to Cape Blanco* [January 2002], Chart Number 18620 - *Point Arena to Trinidad Head* [June 2002]), Chart Number 18640 - *San Francisco to Point Arena* [July 2000], Chart Number 18680 - *Point Sur to San Francisco* [March 2001], Chart Number 18700 - *Point Conception to Point Sur* [July 2003], Chart Number 18720 - *Point Dume to Purisima Point* [January 2005], and Chart Number 18740 - *San Diego to Santa Rosa Island* [August 2003]), incorporated by reference in title 17, CCR section 93119(d)(10).

Background:

In 2004, Assembly Bill 471 (AB 471) was passed by the California Legislature, signed by the Governor, and codified in Health and Safety Code (HSC) section 39630 *et seq.* AB 471 prohibits cruise ships from conducting onboard incineration while operating within three miles of the California coast, but does not specifically say how the three-mile limit is to be applied. This law became effective January 1, 2005. By prohibiting incineration within three miles of the California coast, the potential for adverse public health impacts will be reduced for residents and off-site workers who live or work near ports and along the coast. AB 471 is expected to reduce exposure to emissions of toxic air contaminants, such as polychlorinated dibenzodioxins (dioxins), polychlorinated dibenzofurans (furans), and toxic metals. The ARB staff is proposing this airborne toxic control measure (ATCM) to implement AB 471, clarify where the three-mile limit is, and help ensure that AB 471 is adequately enforced. There are currently no local air district or State regulations for cruise ship onboard incinerators.

Description of the Proposed Regulatory Action:

The proposed ATCM would affect owners or operators of cruise ships that travel within three miles of the California coast, including while at California ports or terminals. Based on 2004 data, 11 cruise ship lines had approximately 45 vessels that entered one or more California ports. To meet the definition of a cruise ship, the vessel must have the capacity to carry 250 or more passengers and must have berths or overnight accommodations for passengers.

Under the proposed ATCM, cruise ship owners or operators are prohibited from conducting onboard incineration within three miles of the California coast. The phrase "within three miles of the California coast" is defined in the ATCM as between the California coast and the Three Nautical Mile Line, as shown on the following National Oceanic and Atmospheric Administration Nautical Charts, as authored by the NOAA Office of Coast Survey, which are incorporated by reference in the proposed regulation.

- Chart 18600, Trinidad Head to Cape Blanco (January 2002).
- Chart 18620, Point Arena to Trinidad Head (June 2002).
- Chart 18640, San Francisco to Point Arena (July 2000).
- Chart 18680, Point Sur to San Francisco (March 2001).
- Chart 18700, Point Conception to Point Sur (July 2003).
- Chart 18720, Point Dume to Purisima Point (January 2005).
- Chart 18740, San Diego to Santa Rosa Island (August 2003).

In addition, the proposed ATCM requires cruise ship owners or operators to maintain records containing the following information for each segment of a voyage if, during any portion of that segment, the cruise ship travels within three nautical miles of the California coast.

- The date and time of start and stop of incineration (in local time).
- The position of the ship in latitude and longitude for each start and stop time of incineration.
- The estimated amount incinerated in cubic meters (m^3).
- The name or signature of officer in charge of the operation.

Records shall be maintained in English and kept onboard the cruise ship for two years. During an onboard inspection, these records shall be made available to ARB personnel, district personnel, or their delegates. In addition, upon written request by the Executive Officer of the ARB or Air Pollution Control Officer from a district, the owner or operator of the cruise ship shall provide copies of the records within 30 calendar days of the request.

The recordkeeping requirements in the proposed ATCM are also required under Regulation 9 of Annex V of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78). Cruise ships currently maintain this information in a garbage record log book.

COMPARABLE FEDERAL REGULATIONS

The International Maritime Organization (IMO) is a specialized agency of the United Nations which is responsible for measures to improve the safety and security of international shipping and to prevent marine pollution from ships. The IMO, along with other maritime nations, has developed standards that are set forth in the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78). MARPOL 73/78 is a combination of two treaties adopted in 1973 and 1978 and has been updated by amendments over the years. MARPOL 73/78 includes six technical annexes which include regulations aimed at preventing and minimizing pollution from ships. Compliance with MARPOL 73/78 is mandatory.

MARPOL 73/78 contains two regulations for onboard cruise ship incinerators. Annex V primarily deals with garbage recordkeeping requirements for onboard incineration. Annex VI prohibits the incineration of certain wastes and imposes additional operating requirements for the incinerators. MARPOL 73/78 is implemented in the United States by the Act to Prevent Pollution from Ships (33 U.S.C. section 1901 *et seq.*). The United States Coast Guard is responsible for prescribing and enforcing regulations pursuant to MARPOL 73/78. The proposed ATCM does not differ substantially from the incinerator and recordkeeping requirements of MARPOL 73/78.

The U.S. Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), is responsible for regulations and policies governing the handling and disposal of regulated garbage to prevent the introduction of foreign animal and plant disease and pests. These regulations are contained in title 7, Code of Federal Regulations (CFR), section 330.400 and title 9, CFR section 94.5. "Regulated garbage," as defined by the CFR, is derived in whole or in part from fruits, vegetables, meats, or other plants or animal material, and other refuse associated with the material onboard, including food scraps, table refuse, galley refuse, food wrappers or packing materials and other waste material from stores, food preparation areas, passenger or crew quarters, dining rooms and other areas. Most of the regulated garbage onboard cruise ships are subject to APHIS regulations.

Under APHIS regulations, regulated garbage within the territorial waters or the territory of the United States is required to be destroyed by incineration to an ash or sterilization by cooking to an internal temperature of 212 degrees Fahrenheit for 30 minutes. Regulated garbage may also be ground and disposed of in an APHIS approved sewer system.

The proposed ATCM differs from the APHIS regulations in that APHIS allows incineration within territorial waters (within 12 nautical miles of the coast), while the proposed ATCM prohibits incineration within 3 nautical miles of the coast.

AVAILABILITY OF DOCUMENTS AND AGENCY CONTACT PERSONS

ARB staff has prepared a Staff Report: Initial Statement of Reasons (ISOR) for the proposed regulatory action, which includes a summary of the economic and environmental impacts of the proposal. The report is entitled, "Staff Report: Initial Statement of Reasons for the Proposed Airborne Toxic Control Measure for Cruise Ship Onboard Incineration."

Copies of the ISOR and the full text of the proposed regulatory language may be accessed on the ARB's website listed below, or 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 (November 17, 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 regulation may be directed to the designated agency contact persons, Richard Boyd, Manager of the Emissions Evaluation Section, Emissions Assessment Branch, Stationary Source Division at (916) 322-8285 and Michelle Komlenic, Air Pollution Specialist, Stationary Source Division at (916) 322-3926.

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/csoi/csoi.htm.

COSTS TO PUBLIC AGENCIES AND TO BUSINESSES AND PERSONS AFFECTED

The determinations of the Executive Officer of the ARB concerning the cost or savings necessarily incurred by public agencies and private persons and businesses in reasonable compliance with the proposed regulatory action are presented below.

The ARB's Executive Officer has determined that the proposed regulatory action will create costs, as defined in Government Code section 11346.5(a)(6), to State agencies. Any such costs should be minimal, and affected State agencies should be able to absorb these costs within existing budgets and resources. The Executive Officer has also determined that the proposed regulatory action will not create costs or savings 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 nondiscretionary cost or savings to State or local agencies.

In developing this regulatory proposal, the ARB staff evaluated the potential economic impacts on representative private persons or businesses. 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. This is because Health and Safety Code section 39632, enacted by AB 471, already prohibits onboard incineration on cruise ships while operating within three miles of the California Coast, and MARPOL 73/78 already requires maintenance of the records proposed to be required.

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.

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

The Executive Officer has also determined, pursuant to title 1, CCR, section 4, that the proposed regulatory action will not affect small businesses because the affected industry is composed of only large businesses.

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 ATCM which apply to businesses are necessary for the health, safety, and welfare of the people of the State of California.

Before taking final action on the proposed regulatory action, the ARB must determine that no reasonable alternative considered by the agency or that has otherwise been identified and brought to the attention of the Board 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 or businesses 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 **no later than 12:00 noon, November 16, 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: csoi@listserv.arb.ca.gov and received at the ARB **no later than 12:00 noon, November 16, 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, November 16, 2005**.

The Board requests but does not require 30 copies of any written statement be submitted and that all written 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 Board 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.

STATUTORY AUTHORITY AND REFERENCES

This regulatory action is proposed under the authority granted to the ARB in the Health and Safety Code sections 39516, 39600, 39601, 39631, 39632, 39650, 39656, 39658, 39659, 39666, 40000, 41700, and 41510. This action references Health and Safety Code sections 39630, 39631, 39632, 39650, 39656, 39659, 39666, 41700, and 41806.

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 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 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, CA 95814, (916) 322-2990.

CALIFORNIA AIR RESOURCES BOARD

Catherine Witherspoon
Executive Officer

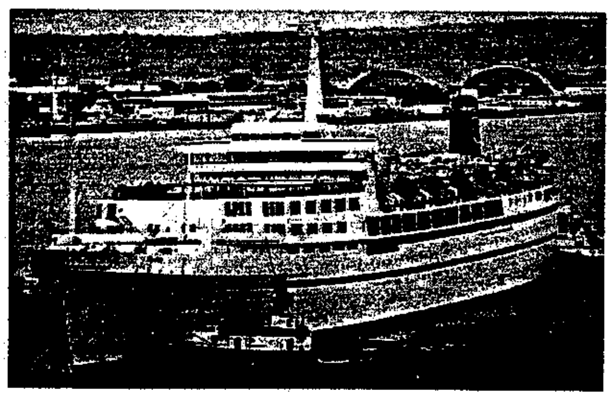
Date: September 20, 2005

California Environmental Protection Agency

Air Resources Board

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR THE PROPOSED AIRBORNE TOXIC CONTROL MEASURE FOR CRUISE SHIP ONBOARD INCINERATION

Stationary Source Division
Emissions Assessment Branch



Release Date:
September 30, 2005

State of California
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

Public Hearing to Consider

ADOPTION OF THE PROPOSED AIRBORNE TOXIC CONTROL MEASURE FOR CRUISE SHIP ONBOARD INCINERATION

To be considered by the Air Resources Board on November 17, 2005, at:

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

Air Resources Board
P.O. Box 2815
Sacramento, California 95812

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State of California
AIR RESOURCES BOARD

PROPOSED AIRBORNE TOXIC CONTROL MEASURE FOR CRUISE SHIP ONBOARD INCINERATION

Staff Report

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September 2005

ACKNOWLEDGMENTS

The ARB would like to acknowledge the assistance of the following individuals, agencies, and organizations for their participation and assistance:

Diane Kiyota, Office of Legal Affairs, ARB
Reza Mahdavi, Research Division, ARB
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Sande George, Stefan George Associates
Randall Fiebrandt, Norwegian Cruise Lines
Tom Greene, Crystal Cruises
Ted Thompson, International Council of Cruise Lines
Teri Shore, Bluewater Network

Staff Report: Initial Statement of Reasons for the Proposed Airborne Toxic Control Measure for Cruise Ship Onboard Incineration

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State of California
AIR RESOURCES BOARD

Staff Report: Initial Statement of Reasons for the Proposed Airborne Toxic Control Measure for Cruise Ship Onboard Incineration

Executive Summary

I. INTRODUCTION

In California, there has been growing concern over the waste disposal practices of the cruise ship industry. Port communities and other members of the public have become increasingly concerned about the potential health risk from toxic air contaminants (TACs) and other air pollutants from marine vessels. Marine vessels, which include cruise ships, can be a major contributor of emissions at California ports. In addition to air emissions from the main engine exhaust, additional sources of emissions include diesel generators, auxiliary boilers, and onboard incinerators.

In 2004, Assembly Bill 471 (AB 471) was passed by the California Legislature, signed by the Governor, and codified in Health and Safety Code (HSC) section 39630 *et seq.* AB 471 prohibits cruise ships from conducting onboard incineration while operating within three (nautical) miles of the California coast. This law became effective January 1, 2005.

II. BACKGROUND

1. <u>Why is the staff proposing an ATCM for cruise ship onboard incineration?</u>

The cruise ship industry in California is a fast growing industry. Over the past several years, the number of port calls (visits) has increased in the State. In 2004, there were approximately 650 port calls to California ports. Emissions from onboard incineration can be a significant source of air pollution. By prohibiting incineration within three nautical miles of the California coast, the potential for adverse public health impacts will be reduced for residents and offsite workers who live or work near ports and along the coast. AB 471 states that the Air Resources Board (ARB/Board) shall enforce this legislation and may adopt standards, rules, and regulations for this purpose. ARB is proposing this airborne toxic control measure (ATCM) to implement AB 471 and to ensure this law is adequately enforced. The proposed ATCM is expected to reduce emissions from toxic air contaminants (TACs), such as polychlorinated dibenzodioxins (PCDDs or dioxins), polychlorinated dibenzofurans (PCDFs or furans), and toxic metals.

2. <u>What are the current regulations for cruise ship onboard incineration?</u>

Cruise ship onboard incinerators are subject to regulations set forth in the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78). In general terms, MARPOL 73/78 is the international treaty regulating disposal of wastes generated by normal operation of vessels. MARPOL 73/78 contains two regulations for onboard cruise ship incinerators: Regulation 9 of Annex V of MARPOL 73/78 which primarily deals with garbage recordkeeping requirements for onboard incineration; and Annex VI which prohibits the incineration of certain wastes and imposes additional operating requirements for the incinerators. MARPOL 73/78 is implemented in the United States (U.S.) by the Act to Prevent Pollution from Ships (33 U.S.C. section 1901 *et seq.*). The United States Coast Guard is responsible for prescribing and enforcing regulations pursuant to MARPOL 73/78.

The United States Department of Agriculture, Animal, and Plant Health Inspection Service (APHIS), is responsible for regulations and policies governing the handling and disposal of regulated garbage to prevent the introduction of foreign animal and plant diseases and pests. Garbage is regulated on cruise ships as a result of movements outside of the United States and certain other movements. Regulated garbage includes waste such as: vegetables, meats, food scraps, table refuse, galley refuse, food wrappers or packing materials and other waste material from stores, food preparation areas, passenger or crews quarters, dining rooms and other areas. Regulated garbage within the territorial waters or the territory of the United States is required to be destroyed by incineration to an ash or sterilization by cooking to an internal temperature of 212 degrees Fahrenheit for 30 minutes. Regulated garbage may also be ground and disposed of in an APHIS approved sewer system. Garbage on vessels that have not been outside the U.S. for the previous two years or have gone through an APHIS sanctioned "purging" process is not regulated.

There are currently no California regulations specific to cruise ship onboard incineration.

III. PUBLIC OUTREACH

An open public process that involves all parties affected by the proposed ATCM is an important component of all of ARB's actions. As part of ARB's outreach program, staff made extensive personal contacts with industry representatives, as well as other parties, through meetings, telephone calls, and electronic mail. Staff developed a workgroup consisting of industry and environmental group representatives. Staff held several workgroup meetings and conducted two public workshops. ARB staff also attended a site visit to a cruise ship to get a better understanding of current waste incineration practices.

IV. CRUISE SHIP ONBOARD INCINERATOR SURVEY

1. What is the Cruise Ship Onboard Incinerator Survey and what were the results of the Survey?

In April 2005, ARB sent out the Cruise Ship Onboard Incinerator Survey (Survey). The Survey requested cruise ship operators to gather and submit information to ARB on incinerator and waste handling practices. Information collected from the Survey included the amount and type of waste incinerated, the operating schedule of the onboard incinerator(s), control equipment, and alternative waste treatment for onboard incineration.

The Survey results showed that prior to January 1, 2005, the effective date of AB 471, only 2 out of 26 (eight percent) of the cruise ships incinerated waste within three nautical miles of the California coast. For these two ships, the amount of waste incinerated within three nautical miles of the California coast (prior to January 1, 2005) made up about three percent of all waste incinerated aboard cruise ships for the 22 cruise ships which reported waste in cubic meters. However, for 2004, one of these ships, which incinerated about 70 percent of its total waste within three nautical miles of the California coast, accounted for about 25 percent of the total port calls to Los Angeles/Long Beach.

The Survey also showed that cruise ships incinerate a wide variety of wastes, such as paper, rags, glass, metal, bottles, crockery, and light plastics (for example, food packaging and wrapping). On average, cruise ships operate their incinerator(s) 12 hours per day five to six days per week. About 40 percent of the Survey respondents specified that the cruise ship's incinerator(s) was equipped with some type of air pollution control device(s). The Survey also showed that many ships have sophisticated recycling programs. Many Survey respondents indicated that their hazardous waste and recyclable materials are picked up at port by authorized vendors.

V. POTENTIAL HEALTH IMPACTS OF SUBSTANCES EMITTED FROM ONBOARD INCINERATION

1. What are the potential health impacts remaining after implementation of the proposed ATCM?

ARB staff conducted a multipathway health risk analysis (HRA) to estimate the potential cancer and noncancer health impacts remaining after implementation of the proposed ATCM. Because the standard (i.e., no incineration within three miles of the California coast) was already set forth in AB 471, staff focused its efforts on assessing the potential health risk remaining after implementation to ensure that it was adequately health protective.

Since emissions data specific to cruise ship onboard incineration were not available, staff used controlled emissions data from land-based municipal waste incinerators along with stack data (e.g., stack height, stack diameter) from cruise ship onboard incinerators. These emissions were adjusted because the majority of cruise ships incinerator stacks are uncontrolled. Exposure pathways used in the analysis include inhalation, soil ingestion, mother's milk ingestion, and dermal exposure. The following TACs were included in the analysis: dioxins, furans, polycyclic aromatic hydrocarbons, arsenic, beryllium, cadmium, hexavalent chromium, hydrochloric acid, lead, manganese, mercury, and nickel.

For the analysis, incinerator emissions from 379 cruise ships were spread across the most heavily traveled southern shipping lane of the Ports of Los Angeles and Long Beach which handle the vast majority of cruise ship traffic. The number of cruise ships used in the health risk assessment represents the number of cruise ship port calls to Los Angeles and Long Beach for 2004. The incineration of materials was assumed to be taking place from three miles to 30 miles out at sea. The incineration time in this 27-mile zone was estimated to be approximately one and one-half hours each way traveling inbound and outbound from three to 30 miles out to sea.

The multipathway HRA estimates that the potential cancer risk remaining after implementation of the proposed ATCM is approximately 1.5 chances per million at the shoreline for residential exposure. The potential cancer risk for an off-site worker at the shoreline is approximately 0.6 chances per million. For noncancer chronic health impacts, the hazard index for both the resident and worker is less than 0.1. For acute health impacts the hazard index is less than 0.3. In general, a hazard index less than one is not a concern to public health.

VI. SUMMARY OF THE PROPOSED ATCM

1. Who is affected and what does the proposed ATCM require?

The proposed ATCM would affect owners or operators of cruise ships that travel within three nautical miles of the California coast, including while at California ports or terminals. To meet the definition of a cruise ship, the vessel must have the capacity to carry 250 or more passengers and must have berths or overnight accommodations for passengers. The proposed ATCM would not apply to noncommercial vessels, warships, non-profit vessels, and vessels operated by the State of California, the United States, or a federal government.

Cruise ship owners or operators are prohibited from conducting onboard incineration within three nautical miles of the California coast. Cruise ship owners or operators are required to maintain certain records for each segment of a voyage.

These records are only required if, during any portion of that segment, the cruise ship travels within three nautical miles of the California coast. It should be noted that all California ports and terminals are within three nautical miles of the California coast.

The definition for "within three miles of the California coast" is defined as the Three Nautical Mile Line shown on official National Oceanic and Atmospheric Administration (NOAA) Nautical Charts. These charts have been incorporated by reference into the proposed ATCM.

2. What happens when the NOAA nautical charts are revised?

A nautical chart is a graphic portrayal of the marine environment showing the nature and form of the coast, the general configuration of the sea bottom (including water depths), locations of dangers to navigation, locations and characteristics of man-made aids to navigation, and other features useful to the mariner. NOAA periodically updates its charts to reflect changes to any of these features, including changes unrelated to the Three Nautical Mile Line. Staff is proposing that when NOAA updates its charts, the Executive Officer may revise the definition of "within three miles of the California coast" to incorporate the updated charts by publishing the revision in the California Notice Register and notifying potentially affected cruise ship owners or operators at least 30 days before the updates take effect.

3. What are the key unresolved issues?

Some industry stakeholders do not believe that the recordkeeping requirements for the amount of waste burned should be required in the proposed ATCM because it was not specified in AB 471. However, staff has determined that this piece of information would be critical for determining the appropriate monetary penalties should a violation of the ATCM occur. In addition, the cruise ship operators are already required to record this information under existing international regulations; therefore, there would be minimal additional regulatory burden for the industry.

Some industry stakeholders have also expressed concern about the definition used for "within three miles of the California coast". The proposed ATCM incorporates by reference specific NOAA nautical charts. These charts show the Three Nautical Mile Line which will be used to enforce the regulation. Industry argues that a more ambiguous definition should be used because not all cruise ships use NOAA nautical charts. Some cruise ships may use British Admiralty nautical charts or other charts which may not show the Three Nautical Mile Line. ARB staff is concerned that an ambiguous definition, which is subject to interpretation, would present enforcement difficulties. We have indicated to the industry that it is not a requirement to purchase or use the NOAA charts, but rather the NOAA charts provide a bright line which will be used for enforcement purposes. Ship navigators could plot the Three Nautical Mile Line on other nautical charts if they did not wish to purchase the NOAA nautical charts. It should be noted that a set of NOAA charts costs about $100 to purchase.

VII. ECONOMIC AND ENVIRONMENTAL IMPACTS OF THE PROPOSED ATCM

1. What will the ATCM cost?

The proposed ATCM is not expected to result in any significant economic impacts and is not expected to cause a change in employment, business status, or competitiveness. ARB does not expect an impact on the creation or elimination of jobs, or the creation or elimination of cruise ships traveling to California.

While costs to the cruise ship industry are expected to be negligible, some costs were identified for the ARB. It is estimated that ARB costs will be approximately $25,000 annually for enforcement activities.

2. Are there any significant adverse environmental impacts associated with the proposed ATCM?

ARB staff evaluated potential water quality impacts, potential increase in diesel emissions, diversion of waste to landfills and land-based municipal waste incinerators, and public health impacts from storing garbage. ARB has determined that no significant adverse environmental impacts are expected to occur.

ARB is committed to evaluating community impacts of proposed regulations, including environmental justice concerns. Because some communities experience higher exposure to toxic pollutants, it is a priority of ARB to ensure that full protection is afforded to all Californians. The proposed ATCM will ensure that Californians who live or work near ports or coastal areas are not negatively impacted by emissions from cruise ship onboard incinerators.

VIII. RECOMMENDATION

ARB staff recommends that the Board adopt the proposed ATCM for Cruise Ship Onboard Incineration. In order to implement and interpret State law (AB 471), staff is proposing provisions that prohibit cruise ships from incinerating within three nautical miles of the California coast. This ATCM clarifies the three nautical mile limit for incineration along the California coast and also establishes recordkeeping and reporting requirements to facilitate enforcement efforts. Benefits from the proposed ATCM are reduced public exposure to TACs for residents and off-site workers living or working near ports and along the California coast. Exposure to these TACs can cause cancer and noncancer health impacts.

I. INTRODUCTION

In California, there has been growing concern over the waste disposal practices of the cruise ship industry. In response to this concern, the California Legislature enacted Division 37 of the Public Resources Code to gather information and evaluate potential impacts on the environment. The law required the California Environmental Protection Agency (Cal/EPA) to convene a multi-agency Cruise Ship Environmental Task Force (CSETF or Task Force) to gather information on environmental practices and waste streams for cruise ships. The Task Force was required to prepare a report for the California Legislature which includes their findings and recommendations.

The Task Force Report, entitled *Regulation of Large Passenger Vessels in California (August 2003)*, evaluated all types of waste discharged from cruise ships such as wastewater, hazardous waste, ballast water, solid waste, as well as air emissions. One conclusion made by the Task Force was that cruise ships, along with other marine vessels, are a significant source of air pollutants in California, including criteria pollutants and toxic air contaminants (TACs). The Task Force also recommended that cruise ships be regulated by the State and that an inspection and monitoring program be implemented to protect the State's air, water quality, and marine environment. (CSETF, 2003)

Port communities have become increasingly concerned about the potential health risk from criteria pollutants and TACs from marine vessels. Marine vessels, which include cruise ships, can be a major contributor of emissions at California ports and along the coast. In addition to air emissions from the main engines' exhaust, additional sources of emissions include diesel generators, auxiliary boilers, and incinerators. The proposed airborne toxic control measure (ATCM) addresses emissions from cruise ship onboard incinerators only. Air Resources Board (ARB) staff is currently developing a separate regulation to address emissions from auxiliary engines from oceangoing vessels.

In 2004, Assembly Bill 471 (AB 471) was passed by the California Legislature, signed by the Governor, and codified in Health and Safety Code (HSC) section 39630 *et seq*. AB 471 prohibits cruise ships from conducting onboard incineration while operating within three (nautical) miles of the California coast (see Appendix G for a copy of the legislation). This law became effective January 1, 2005. By prohibiting incineration within three nautical miles of the California coast, the potential for adverse public health impacts will be reduced for residents who live or work near ports and along the coast. This ATCM is expected to reduce exposure to emissions from TACs, such as polychlorinated dibenzo-*p*-dioxins (dioxins), polychlorinated dibenzofurans (furans), and toxic metals. ARB staff is proposing this ATCM to implement AB 471 and to ensure that it is adequately enforced.

II. BACKGROUND

A. Cruise Ship Industry in California

The cruise ship industry in California is a fast growing industry. In 2003, California ports experienced a 14 percent growth in cruise embarkations and boarded approximately 807,000 passengers for these cruises (ICCL, 2004). In April 2003, the Port of Long Beach opened to cruise ships, handling 272,000 of these 807,000 passengers (ICCL, 2004). In 2003, the cruise industry estimated a 25 percent increase in the number of vessels that will operate in the waters of the State over the next ten years. In 2002, there were approximately 280 port calls to San Diego, Los Angeles/Long Beach, San Francisco and Monterey (CSETF, 2003). For 2004, those same ports handled about 620 port calls by cruise ships. Of those 620 port calls, approximately 160 were to Long Beach.

1. Cruise Ship Port Calls to California

The California State Lands Commission (CSLC) maintains a database of all cruise ships entering California ports. For 2004, the database showed that 47 different cruise ships entered California ports, for a total of 652 port calls (CSLC, 2004). Table II-1 shows a breakdown of the port calls to California ports.

Table II-1. Cruise Ship Port Calls to California Ports in 2004

Port Name	Number of Port Calls
Los Angeles & Long Beach	361
San Diego	179
San Francisco	76
Avalon/Catalina	23
Monterey	5
Oakland	3
Port Hueneme	2
Humboldt	2
Santa Barbara	1
Total	652

Source: CSLC, 2004. Port calls to Los Angeles and Long Beach are reported as a total and are not separated out.

The CSLC database does not include data on the number of cruise ships that traveled within three nautical miles of the California coast without making a port call in California. However, staff recognizes that cruise ships conducting onboard incineration while traveling within three nautical miles of the California coast can increase the public's exposure to toxic air contaminants (TACs). This could occur even if the cruise ship does not make a port call in California.

B. Cruise Ship Onboard Incineration

Cruise ship onboard incineration is the combustion or burning of any materials or wastes for the purpose of volume reduction, destruction, sanitation, or sterilization, aboard a cruise ship. In general, cruise ship incinerators burn a variety of wastes. Although discussed further in Chapter IV, the most common waste streams incinerated aboard cruise ships which travel in California include paper, rags, glass, metal, bottles, crockery, plastics, and cardboard.

A variety of hazardous waste is also generated onboard. Many ships have their hazardous waste picked up by waste management professionals while at port. Some hazardous waste, however, is incinerated, such as medical and bio-hazardous waste, used oil, oily sludge, and outdated pharmaceuticals (CSETF, 2003).

1. Toxic Air Contaminants Associated with Waste Incineration

There are a wide variety of TACs commonly associated with waste incineration. On a national level, municipal and medical waste incineration are associated with emissions of TACs. These types of sources are commonly identified in emission inventories as the largest group of emitters of polychlorinated dibenzo-*p*-dioxins (PCDDs or dioxins) and polychlorinated dibenzofurans (PCDFs or furans), a group of highly toxic compounds. However, in California, the number of medical waste incinerators has dropped sharply since the 1990's. Additionally, there are only three land-based municipal waste incinerator facilities currently operating in California, all of which are equipped with air pollution control devices.

Emissions of TACs can vary depending on the characteristics of the incinerator, the waste stream, and control equipment. However, the following TACs are generally associated with waste incineration.

- Heavy metals: arsenic, beryllium, cadmium, chromium, lead, mercury, and nickel;
- Hydrochloric acid; and
- Organic compounds (including dioxins and furans) and polycyclic aromatic hydrocarbons.

Additional information on these compounds can be found in Chapter V and Appendix F. Note that criteria pollutants, such as oxides of nitrogen (NOx), oxides of sulfur (SOx), and particulate matter (PM) can also be emitted from waste incineration.

2. <u>Cruise Ship Waste Stream</u>

Cruise ships produce large and diverse waste streams. Waste management onboard cruise ships is generally handled by a variety of processes depending on the waste stream. Wastes are incinerated onboard, picked up at port, or disposed of at sea. Air Resources Board (ARB) staff conducted a survey to get a better understanding of cruise ship incinerator practices (detailed results of the survey can be found in Chapter IV). Table II-2 shows the types of waste that can be generated onboard a cruise ship (CSETF, 2003).

Table II-2. Types of Waste Generated Onboard a Cruise Ship

Types of Waste	
Hazardous waste	Medical waste
Oil sludge and slops	Bilge water
Oily Waste	Used oil
Oil filters	Ballast water
Sewage or blackwater	Incinerator residue (ash)
Dry cleaning solvents	Paint and solvents
Used sand or bead blasting residue	Food wastes
Plastics	Scrap metals
Photographic processing chemicals	Florescent light bulbs
Batteries	Glassware, bottles, and crockery
Swimming pool chemicals	Cleaning agents
Miscellaneous spray cans	Expired medicines/drugs
Cardboard and paper products	Miscellaneous garbage
Printer cartridges	Insecticides
Graywater	

C. International and Federal Regulations for Onboard Incinerators

1. <u>MARPOL 73/78 and Implementing Regulations</u>

The International Maritime Organization (IMO) is a specialized agency of the United Nations which is responsible for measures to improve the safety and security of international shipping and to prevent marine pollution from ships. The IMO, along with other maritime nations, has developed standards which are set forth in the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78), which has been updated by amendments over the years. MARPOL 73/78 includes six technical annexes which include regulations aimed at preventing and minimizing pollution from ships. Compliance with MARPOL is mandatory.

MARPOL 73/78 contains two regulations for onboard cruise ship incinerators. Regulation 9 of Annex V of MARPOL 73/78 primarily deals with garbage recordkeeping requirements for onboard incineration. Annex VI prohibits the incineration of certain wastes and imposes additional operating requirements for incinerators.

a. Annex V

Annex V became effective December 31, 1988. In 1995, amendments were introduced that included the requirements for garbage management plans and garbage recordkeeping. These amendments became effective July 1, 1997. Specifically, a record is to be kept of each discharge operation or completed incineration. This includes discharges at sea, to reception facilities, or to other ships. The following information is required to be recorded when garbage is incinerated:

- Date and time of start and stop of incineration;
- Position of the ship (in latitude and longitude);
- Estimated amount incinerated in cubic meters; and
- Signature of the officer in charge of the operation.

For the purpose of recordkeeping requirements under Annex V, cruise ships are required to group garbage into the following categories:

- Plastics;
- Floating dunnage, lining, or packing material;
- Ground-down paper products, rags, glass, metal, bottles, crockery, etc.;
- Paper products, rags, glass, metal bottles, crockery, etc.; and
- Food waste.

Entries are required in the garbage record book when any of the following occur:

- When garbage is discharged into the sea;
- When garbage is discharged to reception facilities ashore or to other ships;
- When garbage is incinerated; and
- Accidental or other exceptional discharges of garbage.

The garbage record book is required to be kept onboard the ship for two years. The garbage record book requirements are contained in an Appendix to Annex V (see Appendix B of this report).

b. Annex VI

Annex VI was adopted on September 26, 1997, and became effective May 19, 2005. Regulation 16 of Annex VI (Regulation 16) pertains to operating requirements and the prohibition of certain wastes for incineration. Regulation 16 requires incinerators installed after January 1, 2000, to meet certain requirements as specified in Appendix IV of Regulation 16 (Appendix IV). Onboard incinerators are required to possess an IMO Type Approval Certificate. To obtain the certificate, the incinerator must be designed and built such that it meets the standard specified in Regulation 16, section 2. Section 2 specifies that incinerators operate within certain limits. Some of the limits include operating at 6 to 12 percent oxygen in the combustion chamber and operating at 850 to 1200 degrees Celsius as the outlet combustion flue gas temperature range.

Under Annex VI the following types of waste are prohibited:

- Annex I, II, and III cargo residues and related contaminated packing materials;
- Polychlorinated biphenyls;
- Garbage, as defined in Annex V, containing more than traces of heavy metals; and
- Refined petroleum products containing halogen compounds.

Other prohibitory requirements for waste include polyvinyl chlorides except in incinerators for which IMO Type Approval Certificates have been issued. If sewage sludge and sludge oil is incinerated in the main or auxiliary power plant or boilers, it may not take place while the vessel is at ports, harbors, or estuaries.

Other requirements under Regulation 16 include regulations for monitoring flue gas outlet temperatures and operator and manual requirements. A copy of Regulation 16 and Appendix IV is provided in Appendix C.

MARPOL 73/78 is implemented in the United States (U.S.) by the Act to Prevent Pollution from Ships (33 U.S.C. section 1901 *et seq.*). The U.S. Coast Guard is responsible for prescribing and enforcing regulations pursuant to MARPOL 73/78 in U.S. waters.

The U.S. Coast Guard regulations implementing MARPOL 73/78 and the Act to Prevent Pollution from Ships are found at title 33, Code of Federal Regulations (CFR), section 151. In particular, subsection 151.55 requires the master or person in charge of the ship to maintain written records of the date and time of incineration (if incineration was conducted at a port), the name of the port, the latitude and longitude of the location where incineration was conducted and the estimated distance of that location from shore, and the amount of garbage incinerated. The records must be prepared at the time of incineration, certified by the master or person in charge of the ship, maintained on the ship for two years, and made available for inspection by the U.S. Coast Guard.

2. Animal and Plant Health Inspection Service Regulations

The U.S. Department of Agriculture, Animal, and Plant Health Inspection Service (APHIS), is responsible for regulations and policies governing the handling and disposal of regulated garbage to prevent the introduction of foreign animal and plant diseases and pests. These regulations are contained in the Code of Federal Regulations (CFR), title 7, section 330.400 and title 9, section 94.5.

Regulated garbage, as defined in the CFR, is derived in whole or in part from fruits, vegetables, meats, or other plants or animal material, and other refuse associated with the material onboard including food scraps, table refuse, galley refuse, food wrappers or packing materials and other waste material from stores, food preparation areas, passenger or crews quarters, dining rooms and other areas (ARB, 2005a). Most of the regulated garbage onboard cruise ships is subject to APHIS regulations.

Regulated garbage within the territorial waters or the territory of the U.S. is required to be destroyed by incineration to an ash or sterilization by cooking to an internal temperature of 212 degrees Fahrenheit for 30 minutes. Regulated garbage may also be ground and disposed of in an APHIS approved sewer system. Garbage on vessels that have not been outside the U.S. for the previous two years or have gone through an APHIS sanctioned "purging" process is not regulated.

D. International Council of Cruise Lines Industry Standards

All of the major cruise lines that travel to California ports are represented by the International Council of Cruise Lines (ICCL). The ICCL has established a comprehensive waste management program which is required for all ICCL members. Although not specific to incineration, ICCL industry standard E-01-01 (Revision 2) outlines the environmental standards for the industry. These standards promote reuse, recycling, waste segregation, and waste minimization to the greatest extent possible. These standards specify requirements for certain hazardous waste such as perchloroethylene (a dry cleaning solvent), photo processing waste, print shop waste fluids, photo copying and laser printer cartridges, unused and outdated pharmaceuticals, fluorescent and mercury vapor lamp bulbs, batteries, and incinerator ash. The U.S. Coast Guard has incorporated many of ICCL standards into their inspection checklists when boarding passenger vessels. Industry Standard E-01-01 (Revision 2) and attachments can be found in Appendix D.

III. PUBLIC OUTREACH AND REPORT PREPARATION

An open public process that involves all parties affected by the proposed airborne toxic control measure (ATCM) is an important component of the Air Resources Board's (ARB) actions. As part of ARB's outreach program, staff made extensive personal contacts with industry representatives, as well as other parties, through meetings, telephone calls, and electronic mail. Staff developed a workgroup consisting of industry and environmental group representatives. Staff held several workgroup meetings and conducted two public workshops. ARB staff also attended a site visit to a cruise ship to get a better understanding of current garbage incineration practices.

A. Public Involvement

As described below, affected industries, other government agencies, and organizations interested in minimizing public health impacts from cruise ship onboard incineration have been involved in the development of the proposed ATCM. All members of the public were invited to join the workgroup. ARB staff also conducted two public workshops. Additionally, to further increase the general public's participation in this assessment, staff made information available via ARB's web site (*www.arb.ca.gov/toxics/crushp/crushp.htm*).

1. Industry Involvement

Cruise ship operators have actively participated in the rule development process providing technical information on many aspects of cruise ship onboard incineration. They have provided comments and suggestions during the development of our survey, the boundary for the three mile line, recordkeeping and reporting requirements, and other issues related to the proposed ATCM. Staff also had extensive input from the International Council of Cruise Lines (ICCL), who represents all of the major cruise lines which make calls to California ports. Several workgroup meetings have provided a forum to discuss many of the issues associated with the proposed ATCM. ARB staff has also had discussions with incinerator manufacturers regarding the technical aspects of the incinerators used aboard cruise ships. Port staff has provided us with important information regarding cruise ships at ports, such as the number of port calls (visits) and the amount of time spent at port.

2. Government Agency Involvement

Other local, state, and federal agencies have provided input on certain aspects of the proposed regulation. Staff had discussions with many government agencies regarding the boundary of the three mile line specified in Assembly Bill 471 (AB 471). Participating federal agencies include: the United States Coast Guard, the United States Department of Commerce's National Oceanic and Atmospheric

Administration, and the United States Environmental Protection Agency. Staff also had extensive discussions with State agencies such as the California State Lands Commission, the California Coastal Commission, the Department of Fish and Game, and the State Water Resources Control Board. Additional discussions were held with the United States Department of Food and Agriculture regarding existing regulations for garbage generated onboard a cruise ship.

Local air districts have also been apprised of the regulatory process through the California Air Pollution Control Officers Association's Toxics and Risk Managers Committee. Some of the air district staff have provided additional information to ARB staff related to cruise ships and port activities.

B. Data Collection Tools Used to Assist in Report Preparation

1. Cruise Ship Onboard Incinerator Survey

In 2005, ARB staff developed a survey to gather information for onboard incineration garbage practices. The survey requested information on the amount and types of waste incinerated, the operating schedule of the incinerator, the air pollution control equipment, and other information related to onboard garbage incineration. Additional information was later collected for incinerator stack conditions, including flow rate, stack diameter, temperature, and other parameters used in the health risk assessment. See Chapter IV for a detailed discussion on the survey.

2. Cruise Ship Site Visit

ARB staff conducted a site visit to a cruise ship. Cruise ship staff provided ARB staff with a tour of the ship's garbage collection and incineration areas and provided an explanation of their waste management practices. ARB staff observed a sophisticated waste recycling program for cans and glass, which are landed ashore for pickup.

Cruise ship staff indicated that the majority of the waste that is incinerated is made up of paper, light plastics (including plastic bottles, clear food packaging, and plastic bags), cardboard and rags. Upon visual inspection, it appeared as though the waste awaiting incineration matched this description. The primary waste components observed were plastic bags, cardboard food containers, light plastic wrap, and paper. ARB staff also observed posted signs stating that the ship's environmental plan required that the incineration of engine oily rags and debris waste be conducted outside of 12 nautical miles from the nearest land.

Cruise ship staff also explained the process for handling special wastes, such as chemicals, spent fluorescent tubes, batteries, used paints/thinners, dry cleaning waste, and photo waste. The ship's staff indicated that these types of wastes are segregated into leak proof containers. This waste is documented and landed ashore for pick up by authorized waste management professionals.

C. Issues

Some industry sources do not believe that the recordkeeping requirements for the amount of waste burned should be required in the proposed ATCM because it was not specified in AB 471. However, staff has determined that this piece of information would be critical for determining the appropriate monetary penalties should a violation of the ATCM occur. In addition, the cruise ship operators are already required to record this information under existing international regulations; therefore, there would be minimal additional regulatory burden for the industry.

Some industry sources have expressed concern about the definition used for "within three miles of the California coast". The proposed ATCM incorporates by reference specific National Oceanic and Atmospheric Administration (NOAA) nautical charts. These charts show the Three Nautical Mile Line which will be used to enforce the regulation. Industry sources argue that a more ambiguous definition should be used because not all cruise ships use NOAA charts. Some cruise ships may use British Admiralty nautical charts or other charts which may not show the Three Nautical Mile Line. ARB staff is concerned that an ambiguous definition, which is subject to interpretation, would present enforcement difficulties. ARB staff has indicated to the industry that it is not a requirement to purchase or use the NOAA nautical charts, but rather the NOAA nautical charts provide a bright line which will be used for enforcement purposes. Ship navigators could plot the Three Nautical Mile Line on other nautical charts if they did not wish to purchase the NOAA charts. It should be noted that a set of NOAA nautical charts costs about $100 to purchase.

IV. CRUISE SHIP ONBOARD INCINERATOR SURVEY

In April 2005, the Air Resources Board (ARB) sent out the Cruise Ship Onboard Incinerator Survey (Survey). The Survey requested cruise ship operators to gather information on incinerator and waste handling practices. Specifically, the Survey asked for information on the amount and type of waste burned, operating schedule, control equipment, and alternative waste treatment to onboard incineration. Appendix E contains a copy of the Survey.

Cruise ship operators were only required to fill out the Survey if their vessel(s) currently traveled within three nautical miles of the California coast. Surveys for 54 cruise ships were returned. Of the 54 cruise ships which responded, 26 of the cruise ships indicated that they currently travel within three nautical miles of the California coast. Staff compared that number to the total number of ships that entered a California port in 2004. The California State Lands Commission (CSLC) database showed that there were 47 different cruise ships that came to a California port. These cruise ships accounted for approximately 650 port calls statewide. Although we received survey information from only 57 percent of the vessels, the 26 surveys received accounted for about 90 percent of the total California port calls. The remaining ten percent of port calls were conducted by ships which made one or two California port calls per year. There was limited information on these ships, some of which may no longer be operating within three nautical miles of the California coast.

A. Type of Waste Incinerated

The Survey was designed to obtain general information on the type of waste commonly incinerated onboard the cruise ships. The Survey asked the cruise ship operators to specify which type of waste they incinerated based on the categories in the Garbage Record Book required by Regulation 9 of Annex V of MARPOL 73/78. More information on waste categories specified under Annex V can be found in Chapter II. The Survey specified five categories of garbage from which to choose.

Table IV-1 shows the type of waste and percentage of ships that incinerate the waste. The results showed that most ships incinerate some combination of garbage. One of the limitations with the Survey is that waste was grouped into five categories. Some Survey respondents annotated the Survey with additional information, such as highlighting the specific waste in the category that is incinerated. In some cases, the percentages may be overestimated because the Survey respondents may have checked the box for the entire category; however, they may not incinerate all items listed in the category. For example, paper products are listed with rags, glass, metal, bottles, crockery, etc. Incinerator operators who incinerate only paper products and rags may have checked the box for the entire category. Based on discussions with industry, glass, crockery and metal are not commonly incinerated onboard cruise ships. Therefore, the percentages in

Table IV-1 should only be used as a general guide for the types of waste incinerated.

Table IV-1. Type of Waste and Percentage of Cruise Ships Incinerating this Waste

Type of Waste	Percentage of Cruise Ships Incinerating this Type of Waste
Paper products	88
Rags	81
Glass, metal, bottles, crockery, etc.	69
Plastics[1]	65
Ground down paper products	58
Food waste	50
Ground down rags	50
Floating dunnage, lining, or packing material	46
Ground down glass, metal, bottles, crockery, etc.	35
Other[2]	15

1. Approximately 50 percent of the ships provided additional information stating that the plastics they incinerate are either light plastics or contain no PVC. Light plastics include items such as plastic bags, food packaging and wrapping, and plastic bottles.
2. Other includes medical waste, sludge, dried black water residue, and waste oil.

1. Plastics in the Waste Stream

The most common types of plastics in the cruise ship waste stream are likely to contain polyethylene terephthalate (PET), high density polyethylene (HDPE), polyvinyl chloride (PVC), and low density polyethylene (LDPE). Plastics in the waste stream are a concern because of the potential for polychlorinated dibenzo-*p*-dioxins (dioxins), and polychlorinated dibenzofurans (furans) formation during waste incineration. Dioxins and furans, which are highly toxic, can form in the incinerator when a chlorine source such as PVC is present. PET, HDPE, and LDPE do not ordinarily contain chlorine.

PET is used in packaging applications such as plastic water bottles, ovenable film and ovenable prepared food trays, and catsup and salad dressing bottles. HDPE is used in packaging applications for items such as milk, water, juice, shampoo, grocery, trash, and retail bags. PVCs can be found in clear food and non-food packaging and medical tubing. LDPE is used in packing of bread, frozen food bags, and squeezable bottles. (APC, 2005).

Because of the potential for dioxin formation, cruise ship operators should try to minimize the amount of PVC plastics that enter the incinerator waste stream. Although many incinerator operators indicated they do not incinerate PVC, it is possible that PVC might be in clear food packaging (APC, 2005).

B. Amount of Waste Incinerated

The Survey requested the total amount of waste burned in either cubic meters (m^3) per year or in tons per year. Under Annex V, cruise ships are only required to report the amount of waste incinerated in cubic meters per year; therefore, very few cruise ships were able to provide the amount of garbage in tons per year. Without knowing the densities of the individual waste streams, it is difficult to convert from cubic meters to tons. Cruise ship representatives have indicated that they do not weigh or measure the trash before going into the incinerator. The estimate is typically made by the incinerator operator by conducting a visual inspection. Table IV-2 shows the minimum, maximum, and average amount of waste burned per cruise ship.

Table IV-2. Waste Burned Per Year[1]

	Minimum	Maximum	Average
Total waste burned per year per ship (m^3/year) (22 ships reporting)	595	8400	4323
Total waste burned per year per ship (tons/year) (4 ships reporting)	168	3190	1736

1. The total waste burned is the sum of the cruise ship's total waste (not just within three nautical miles of California coast) from all onboard incinerators. Most cruise ships reported that they have two incinerators onboard.

The Survey results showed that prior to January 1, 2005, the effective date of Assembly Bill 471 (AB 471), only two out of 26 (eight percent) of the cruise ships incinerated within three nautical miles of the California coast. This is consistent with discussions with industry representatives who indicated that their ships did not incinerate waste while at ports. Table IV-3 summarizes the amount of waste incinerated in 2004 within three nautical miles of the California coast by those two cruise ships.

Table IV-3. Waste Incinerated within Three Nautical Miles of the California Coast in 2004[1]

Cruise Ships	Waste Incinerated (m^3)
Cruise Ship One	2600
Cruise Ship Two	188
Total	2788

1. Amount reported was for incineration prior to January 1, 2005, the effective date of AB 471.

For the 26 cruise ships which responded to the Survey and travel within three nautical miles of the California coast, 22 of those reported their total waste incinerated in cubic meters. For the two ships listed in Table IV-3, the waste they incinerated within three miles of the California coast makes up about three percent of all waste incinerated for the 22 cruise ships which reported their waste in cubic meters. Cruise Ship One's waste, which accounts for approximately 70 percent of this cruise ship's total waste incinerated, incinerated 2600 cubic meters of waste within three nautical miles of the California coast prior to the effective date of AB 471. This cruise ship made approximately 100 port calls to Los Angeles/Long Beach (about 25 percent of all port calls to Los Angeles/Long Beach). Cruise Ship Two only had about five percent of its total waste incinerated within three nautical miles of the California coast. In 2004, this cruise ship only had five California port calls (two in San Diego and three in San Francisco).

C. Operating Schedule

The Survey asked cruise ship operators to include information about the incinerator operating schedule. Table IV-4 shows the minimum, maximum, and average for hours per day of operation, days per week of operation, and days per year of operation.

Table IV-4. Incinerator Operating Schedule

	Minimum	Maximum	Average
Hours per day of operation	6	24	12
Days per week of operation	3	7	5.5
Days per year of operation	156	365	287

D. Air Pollution Control Devices

Of the 26 cruise ships which responded to the survey, 11 ships (42 percent) specified that they had some type of air pollution control device on their incinerator. Table IV-5 shows the different types of control devices and the percentage and number of cruise ships with each control device. Note that some cruise ships had more than one type of control device.

Table IV-5. Air Pollution Control Devices on Cruise Ship Incinerators

Control Device	Percentage of Ships By Control Device	Number of Ships By Control Device[2]
Wet Collectors (scrubbers) - spray towers, venturi scrubbers	13	2
Dry Scrubber	13	2
Baghouse	19	3
Carbon Adsorption	13	2
Cyclone Separators	6	1
Other[1]	38	6
No Control	58	15

1. The following were listed by survey respondents as "other": 1) Flue gas cleaning system; 2) Ash removal system, automatic flue gas damper, flue gas fan; 3) combustion control system; 4) smoke density controller; 5) sodium hydrogen carbonate; and 6) flue gas cleaner (activated carbon).
2. Some cruise ships responded that they have more than one control device.

The following is a brief description of air pollution control devices commonly used on incinerators.

1. Wet Collectors, Spray Towers, and Venturi Scrubbers

Wet collectors (scrubbers) can remove particulates and acidic gases from a gas stream. They rely on a pressure drop for particulate removal and on an alkali reagent for treatment of acidic gases. Spray tower scrubbers are the simplest type of wet scrubber and generally have the lowest overall particulate collection efficiency. A venturi scrubber is used when water is readily available and provides for a high-efficiency, high energy gas cleaning as well as control for both particulate matter and acid gases.

2. Dry Scrubber

Dry scrubbers use lime to treat sulfur dioxide, hydrogen chloride, and other acidic gases by absorption and adsorption. A particulate control device (for example, a baghouse) is commonly used in conjunction with a dry scrubber.

3. Baghouse

Baghouses are particulate control devices used at many land-based incinerators. Baghouses can capture over 99.9 percent of the particulate matter (PM) and are effective in capturing some of the smaller particles. Baghouses consist of a series of permeable bags which allow gas, but not particulate matter, to flow though.

4. Adsorption (including Carbon Adsorption)

With carbon adsorption, the flue gas is directed over an adsorptive media such as activated carbon. Other adsorptive media such as silica gel, aluminum oxide, or magnesium silicate can also be used. Sometimes incineration systems can have temperatures too high for the adsorptive material to remain effective.

5. Cyclone Separators

Cyclone separators (cyclones) are mechanical collectors which use particle inertia to separate the particle from the gas stream. Cyclones can only remove particulate matter and only those particles that are relatively large.

E. Alternatives to Onboard incineration

Many of the cruise ships surveyed maintain a sophisticated waste segregation and recycling program. Onboard environmental officers typically oversee the process. Cruise ships recycle one or more of the following items: aluminum, glass, iron, steel, cardboard, plastic bottles, cans, electronics, paper, batteries, used cooking oil, toner cartridges, and polyvinyl chloride plastic buckets. Some cruise ship waste is picked up at port for recycling, landfilling, or incineration. Several cruise ships reported that special wastes such as chemicals, batteries, dry cleaning wastes, and used paints and thinners are segregated in leak-proof containers and are landed ashore to authorized waste management professionals. Some cruise ships reported that hazardous waste is landed to vendors at various ports of call.

V. POTENTIAL HEALTH IMPACTS OF SUBSTANCES EMITTED FROM ONBOARD INCINERATION

A. An Overview of Health Risk Assessment

A health risk assessment (HRA) is an evaluation or report that a risk assessor (e.g., Air Resources Board (ARB), district, consultant, or facility operator) develops to describe the potential a person or population may have of developing adverse health effects from exposure to a facility's emissions. Some health effects that are evaluated could include cancer, developmental effects, or respiratory illness. The pathways that can be included in an HRA depend on the toxic air pollutants that a person (receptor) may be exposed to, and can include breathing, the ingestion of soil, water, crops, fish, meat, milk, mother's (breast) milk, and eggs, and dermal exposure. Many of the substances emitted from waste incineration enter the body from inhalation and noninhalation exposure pathways. Such multiple exposure pathway (multipathway) assessments are traditionally used for lipophilic (fat-loving), semivolatile, or low volatility compounds such as polychlorinated dibenzodioxins (PCDDs or dioxins) and dibenzofurans (PCDFs or furans), polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs).

Generally, to develop an HRA, the risk assessor would perform or consider information developed under the following four steps. The four steps are Hazard Identification, Dose-Response Assessment, Exposure Assessment, and Risk Characterization.

1. Hazard Identification

In the first step, the risk assessor would determine if a hazard exists, and if so, would identify the pollutant(s) of concern and the type of effect, such as cancer or respiratory effects.

For this assessment, the pollutants of concern are PCDDs, PCDFs, PAHs, manganese, hydrochloric acid, and toxic metals. All of these substances have been formally identified as toxic air contaminants (TACs) under the California Toxic Air Contaminant Program (Assembly Bill 1807: Health and Safety Code sections 39660-39662). In addition, all of these pollutants have been listed as hazardous air pollutants by the United States Environmental Protection Agency (U.S. EPA) under the Federal Clean Air Act (42 U.S.C. 7412). See Appendix F for information regarding the health effects of these compounds.

2. Dose-Response Assessment

In this step of risk assessment, the assessor would characterize the relationship between a person's exposure to a pollutant and the incidence or occurrence of an adverse health effect.

This step of the HRA is performed for the ARB by the Office of Environmental Health Hazard Assessment (OEHHA). OEHHA supplies these dose-response relationships in the form of cancer potency factors (CPF) for carcinogenic effects and reference exposure levels (RELs) for non-carcinogenic effects. The CPFs and RELs that are used in California can be found in one of four references:

- The OEHHA Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part I, The Determination of Acute RELs for Airborne Toxicants, March 1999;
- The OEHHA Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part II, Technical Support Document for Describing Available Cancer Potency Factors (Revised), December 2002;
- The Air Toxics Hot Spots Program Risk Assessment Guidelines; Part III; Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels, April 2000;
- The Air Toxics Hot Spots Risk Assessment Guidelines; Part IV; Exposure Assessment and Stochastic Analysis Technical Support Document, September 2000; and
- The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments. August 2003.

These five documents are collectively referred to as the OEHHA HRA guidelines. The individual CPFs and RELs for the pollutants that we are using for this HRA are presented in Section B, Part 3 of this chapter.

3. <u>Exposure Assessment</u>

In this step of the risk assessment, the risk assessor estimates the extent of public exposure by looking at who is likely to be exposed, how exposure will occur (e.g., inhalation and ingestion), and the magnitude of exposure.

For cruise ship onboard incineration activities, the receptors that are likely to be exposed include residents living near the port and along the California coast, and off-site workers located at the port. On-site workers are not included in this HRA because the California Occupational Safety and Health Administration (Cal/OSHA) has jurisdiction over on-site workers. Exposure was evaluated for toxic metals, PCDDs and PCDFs, PAHs, manganese, and hydrochloric acid via the inhalation, soil, dermal, and mother's milk pathways. Emission estimates were compiled and computer air dispersion modeling was used to provide downwind ground-level concentrations of the TACs at near-source, residential, and off-site worker locations.

4. <u>Risk Characterization</u>

This is the final step of risk assessment. In this step, the risk assessor combines information derived from the previous steps. Modeled concentrations, which are determined through exposure assessment, are combined with the CPFs (for cancer risk) and RELs (for non-cancer effects) determined under the dose-response assessment. This step integrates this information to quantify the potential cancer risk and non-cancer health impacts.

B. Tools and Information Used for this Risk Assessment

The tools and information that are used to estimate the potential health impacts from a source include an air dispersion model and pollutant-specific health values. Information required for the air dispersion model includes emission estimates, physical descriptions of the source, and emission release parameters. Combining the output from the air dispersion model and the pollutant-specific health values provides an estimate of the off-site potential cancer and non-cancer health impacts from the emissions of a TAC. For this assessment, ARB staff is estimating the potential health impacts from the pollutants emitted during onboard waste incineration that complies with the proposed airborne toxic control measure (ATCM). A description of the emission estimates, air dispersion modeling, and pollutant-specific health values is provided in this chapter.

ARB staff conducted an HRA to determine the potential health risk remaining after implementation of the ATCM. Because the standard (i.e., no incineration within three miles of the California coast) was already set forth in Assembly Bill 471, staff focused its efforts on assessing the potential health risk remaining after implementation to ensure that it was adequately health protective.

1. Emission Estimates

In order to estimate emissions of TACs from onboard incineration ARB staff used a variety of tools. Specifically, the Cruise Ship Onboard Incinerator Survey (Survey) was used to obtain information on the stack heights and control equipment. In conjunction with this information, emission testing reports from land-based municipal waste incineration in California were used to estimate emission rates for the TACs of concern.

Emissions data from land-based municipal waste incinerators were used to estimate emissions for cruise ship onboard incinerators because staff was not able to locate any emissions testing for actual cruise ship incinerators. It is important to note that the variability in the waste stream between each cruise ship and between cruise ship and land-based municipal waste incineration can have an impact on emission estimates. However, land-based municipal waste incinerators typically incinerate general household waste and have some similar waste streams to cruise ships, including food waste, packaging, paper and cardboard items, general light plastic waste, rags, etc. Many of the same items recycled on cruise ships are also recycled by households or by municipal material recovery facilities and are not typically part of the waste stream for municipal waste incineration.

Because emissions data from the land-based municipal waste incinerators are based on controlled emissions (and most of the cruise ship incinerator emissions are uncontrolled), staff adjusted the emission rates used in the HRA. ARB staff increased the emissions used in the HRA by assuming 99 percent control efficiency on the municipal waste incinerators. ARB staff estimated that about ten percent of the port calls (visits) in 2004 were by ships with control efficiency similar to the municipal waste incinerators. Another 30 percent had some type of control device but most likely were not controlled to the efficiency of the municipal waste incinerators. Therefore, for this analysis, ARB staff assumed ten percent of the port calls were made by ships with 99 percent control efficiency and the rest were uncontrolled.

For this HRA, staff evaluated the potential health impacts remaining after implementation of the ATCM at the Port of Los Angeles. Staff adjusted emissions by using the annual number of port calls at the Port of Los Angeles and the Port of Long Beach (Ports) since they are in close proximity to each other and the combination of both Ports could cumulatively impact the potential health impacts for workers at the port or residents living near the Ports. Staff chose these Ports for the HRA since they are the most highly visited by the cruise ships in California. Wilmington meteorological data was used because it is the closest available data to the Ports.

Emissions were spread across the most heavily traveled southern shipping lane of the Ports. This shipping lane handles the vast majority of cruise ship traffic. The incineration of materials was assumed to be taking place from the Three Nautical Mile Line, as specified on the National Oceanic and Atmospheric Administration (NOAA) Nautical Charts, to 30 miles out at sea. The incineration time in this 27-mile zone was estimated to be approximately one and one-half hours each way (ARB, 2005c), traveling inbound and outbound from the Three Nautical Mile Line.

2. <u>Air Dispersion Modeling</u>

Air dispersion models are used to estimate the downwind, ground-level concentrations of a pollutant after it is emitted from a facility. The downwind concentration is a function of the quantity of emissions, release parameters at the source, and appropriate meteorological conditions. The model that was used during this HRA was Hot Spots Analysis and Reporting Program (HARP) (ARB, 2005b). HARP includes the ISCST3 air dispersion model, which is recommended by U.S. EPA for refined air dispersion modeling (U.S. EPA, 1995). HARP is a recommended tool for risk analysis in California that can be used for most source types (e.g., point, area, and volume sources) and is currently used by ARB, districts, and other states.

Cruise ship operators provided ARB staff with information on incinerator design and information such as stack height, diameter, temperature, and flow rates. This data was used in the air dispersion modeling analysis to estimate downwind concentrations.

3. <u>Pollutant-Specific Health Effects Values</u>

Dose-response or pollutant-specific health values are developed to characterize the relationship between a person's exposure to a pollutant and the incidence or occurrence of an adverse health effect. A CPF is used when estimating potential cancer risks and RELs are used to assess potential non-cancer health impacts.

As presented in Appendix F, exposure to TACs may result in both cancer and non-cancer health effects. The inhalation and oral CPFs and non-cancer acute and chronic RELs that are used for this HRA are listed in Table V-1. Also included in Table V-1 are the non-cancer acute and chronic toxicological endpoints for the pollutants. Table V-1 reflects the most current OEHHA-adopted health effects values for these compounds.

Table V-1. Pollutant-Specific Health Values Used for Determining Potential Health Impacts[1]

Chemical	Cancer Risk		Non-Cancer Effects					
	Inhalation Cancer Potency Factor $(mg/kg\text{-}d)^{-1}$	Oral Slope Factor $(mg/kg\text{-}d)^{-1}$	Acute Inhalation $(\mu g/m^3)$	Acute Target Organs	Chronic Inhalation $(\mu g/m^3)$	Chronic Inhalation Target Organs	Chronic Oral (mg/kg/d)	Chronic Oral Target Organs
Arsenic (Inorganic)	1.2E+01	1.5E+00	1.9E-01 AveP	Developmental, Reproductive	3.0E-02	Cardiovascular, Developmental, Nervous	3.0E-04	Cardiovascular, Skin
Beryllium	8.4E+00				7.0E-03	Immune, Respiratory	2.0E-03	Alimentary
Cadmium	1.5E+01				2.0E-02	Kidney, Respiratory	5.0E-04	Kidney
Chromium (Treated as five percent hexavalent chromium for HRA)	5.1E+02				2.0E-01	Respiratory	2.0E-02	Hematologic
Hydrochloric Acid (Hydrogen chloride)			2.1E+03	Eye, Respiratory	9.0E+00	Respiratory		
Lead (inorganic)	4.2E-02	8.5E-03						
Manganese					2.0E-01	Nervous		
Mercury (Inorganic)			1.8E+00	Developmental, Reproductive	9.0E-02	Nervous	3.0E-04	Immune, Kidney
Nickel	9.1E-01		6.0E+00	Immune, Respiratory	5.0E-02	Hematologic, Respiratory	5.0E-02	Alimentary
Polychlorinated Dibenzo-p-Dioxins (PCDD) (Treated as 2,3,7,8-TCDD for HRA)[2]	1.3E+05	1.3E+05			4.0E-05	Alimentary, Developmental; Endocrine; Hematologic, Reproductive, Respiratory	1.0E-08	Alimentary, Developmental; Endocrine; Hematologic, Reproductive, Respiratory
Polychlorinated Dibenzofurans (PCDF) (Treated as 2,3,7,8-Tetrachlorodibenzo-p-Dioxin for HRA)[2]	1.3E+05	1.3E+05			4.0E-05	Alimentary, Developmental; Endocrine; Hematologic, Reproductive, Respiratory	1.0E-08	Alimentary, Developmental; Endocrine; Hematologic, Reproductive, Respiratory
Polycyclic Aromatic Hydrocarbon (PAH) (Treated as Benzo(a)Pyrene for HRA)	3.9E+00	1.2E+01						

Footnotes: see next page.

The CPF describes the excess cancer risk associated with exposure to one milligram of a given chemical per kilogram of body weight. A REL is defined as a concentration level at or below which no adverse health effects are anticipated and is used as an indicator of potential non-cancer adverse health effects. RELs are designed to protect sensitive individuals in the population by including safety factors in their development and can be created for both acute and chronic exposures. An acute exposure is defined as one or a series of short-term exposures generally lasting less than 24 hours. Consistent with risk guidelines, a one-hour exposure is used to determine acute non-cancer impacts. Chronic exposure is defined as long-term exposure usually lasting from one year to a lifetime.

C. Risk Assessment Results

ARB staff conducted a multipathway HRA to evaluate cancer and noncancer health impacts remaining after implementation of the proposed ATCM. Section B provides information on the emissions and modeling estimates used in the analysis. Additional information on the HRA methodology can be found in Appendix H. Compounds considered in the analysis are shown in Table V-1. Pathways included for evaluation include inhalation, dermal, soil ingestion, and mother's milk. These four pathways are the minimum pathways that should be evaluated when assessing compounds with multipathway effects.

Footnotes for Table V-1:

1. Health effect values were obtained from:
   a. The OEHHA Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part I, The Determination of Acute RELs for Airborne Toxicants, March 1999;
   b. The OEHHA Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part II, Technical Support Document for Describing Available Cancer Potency Factors (Revised), December 2002;
   c. The Air Toxics Hot Spots Program Risk Assessment Guidelines; Part III; Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels, April 2000; and
   d. The Air Toxics Hot Spots Risk Assessment Guidelines; Part IV; Exposure Assessment and Stochastic Analysis Technical Support Document, September 2000.

2. Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans (also referred to as chlorinated dioxins and dibenzofurans): OEHHA has adopted the World Health Organization 1997 (WHO_{-97}) Toxicity Equivalency Factor scheme for evaluating the cancer risk due to exposure to samples containing mixtures of polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) and determining cancer risks for a number of specific PCB congeners. See Appendix A of OEHHA's *Technical Support Document For Describing Available Cancer Potency Factors* for more information about the scheme. See Appendix E of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* for the methodology for calculating 2,3,7,8-equivalents for PCDDs, PCDFs and a number of specific PCB congeners. See section 8.2.3 of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* for conducting health risks when total (unspeciated) chlorinated dioxins and furans are reported.

AveP. Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans (also referred to as chlorinated dioxins and dibenzofurans): OEHHA has adopted the World Health Organization 1997 (WHO_{-97}) Toxicity Equivalency Factor scheme for evaluating the cancer risk due to exposure to samples containing mixtures of polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) and determining cancer risks for a number of specific PCB congeners. See Appendix A of OEHHA's *Technical Support Document For Describing Available Cancer Potency Factors* for more information about the scheme. See Appendix E of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* for the methodology for calculating 2,3,7,8-equivalents for PCDD, PCDFs and a number of specific PCB congeners. See section 8.2.3 of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* for conducting health risks when total (unspeciated) chlorinated dioxins and furans are reported.

As previously mentioned, staff evaluated the potential health impacts remaining after implementation of the proposed ATCM from onboard incineration for the Ports of Los Angeles and Long Beach because these Ports handle the largest amount of cruise ship traffic. San Diego is the next most heavily traveled port with about half of the calls compared to Los Angeles and Long Beach. Due to a significantly lower number of port calls at other ports throughout California, it is expected that the potential health impacts at other ports would be lower than the potential health impacts at the Ports of Los Angeles and Long Beach.

For this analysis we assumed that all cruise ships (379) are incinerating while coming into port (from 30 miles out at sea to the Three Nautical Mile Line) and while leaving port (from the Three Nautical Mile Line to 30 miles out at sea). This is a conservative estimate since it is unlikely that all cruise ships would be incinerating during that time. One industry representative indicated that some ships, when coming into and out of port, cease incineration at 12 nautical miles away from the coast.

Table V-2 shows the potential cancer risk based on our analysis for the Ports. Table V-3 shows the distribution of the potential cancer risk by pathway. The results show that the residential potential cancer risk onshore remaining after implementation of the proposed ATCM is estimated to be about 1.5 chances per million. The residential risk is based on a 70-year exposure duration. The off-site worker (worker) potential risk onshore is estimated to be about 0.6 chances per million. The exposure duration for a worker is assumed to be 40 years.

Table V-2. Potential Health Impacts from the Proposed ATCM[1]

	Potential Cancer Risk 2004 (chances per million)	Potential Cancer Risk 2015[2] (chances per million)
On-shore Point of Maximum Impact - Residential[3]	1.5	1.9
On-shore Point of Maximum Impact - Off-site Worker[4]	0.6	0.8

1. All numbers are rounded. Based on OEHHA guidelines and ARB Interim Risk Management Policy (ARB, 2003). Pathways evaluated include: inhalation, soil, dermal, and mother's milk. Assumes ten percent of port calls from controlled ships.
2. Assumes a 25 percent increase in (vessels) port calls over ten years until 2015.
3. Based on a 70-year exposure duration.
4. Based on 40-year exposure duration.

Table V-3. Distribution of Potential Cancer Risk by Pathway[1]

Exposure Pathway	Residential (percent)	Worker (percent)
Inhalation	19	41
Soil Ingestion	45	42
Dermal Exposure	20	17
Mother's (Breast) Milk	15	0

1. All numbers are rounded.

The cruise ship industry estimates a 25 percent increase in the number of vessels that will operate in the waters of the State over the next ten years (CSETF, 2003). Therefore, for our analysis, we assumed a 25 percent increase in the number of Port calls. The potential cancer risk in 2015 would be approximately 1.9 chances per million for the residential onshore cancer risk and about 0.8 chances per million for the worker.

For noncancer chronic health impacts, the hazard index for both the resident and worker is less than 0.1. For acute health impacts the hazard index is less than 0.3. In general, a hazard index less than one is not a concern to public health.

Lead was evaluated by comparing the modeled 30-day concentration to the lead levels found in the ARB's Risk Management Guidelines for New, Modified, and Existing Sources of Lead (ARB, 2001). The onshore modeled 30-day concentration is well below the concentration that would be considered a significant risk for lead in a high exposure area.

Based on the risk assessment results presented in Table V-2, the estimated risk ranges from about 0.6 to 1.9 chances per million. It is important to note that the HRA is an estimate based on several assumptions in the analysis. The potential health risk could be overestimated given the conservative assumptions built into the analysis. For example, it is unlikely that all 379 ships would be incinerating at the same location. However, the potential health risks could also be underestimated, for example, if a significant portion of the waste stream is made up of hazardous waste. This is probably unlikely since many ships indicated that hazardous wastes are landed ashore for disposal.

VI. THE PROPOSED CONTROL MEASURE

This chapter contains a summary of the proposed airborne toxic control measure (ATCM). It also reviews the basis and rationale for selecting the provisions being proposed. A copy of the ATCM is located in Appendix A.

The proposed ATCM prohibits a cruise ship owner or operator, agent, representative, or employee from conducting onboard incineration while operating within three nautical miles of the California coast. The ATCM is expected to reduce potential health impacts for residents and off-site workers living or working near ports or along the California coast.

A. Summary of the Proposed Control Measure

1. Affected Sources

The proposed ATCM would affect cruise ships that travel within three nautical miles of the California coast, including while at California ports or terminals. To meet the definition of a cruise ship, the vessel must have the capacity to carry 250 or more passengers and must have berths or overnight accommodations for passengers. Based on 2004 vessel data from the California State Lands Commission database, Air Resources Board (ARB) staff estimated that 11 cruise ship lines had approximately 45 vessels which entered one or more California ports in 2004.

2. Exemptions

The proposed ATCM does not apply to noncommercial vessels, warships, non-profit vessels, and vessels operated by the State of California, the United States, or a federal government. In addition, it does not apply to vessels without berths or overnight accommodations for passengers.

3. Requirements for Cruise Ship Owners or Operators

Cruise ship owners or operators are prohibited from conducting onboard incineration within three miles of the California coast. "Within three miles of the California coast" is defined as between the coast and the Three Nautical Mile Line as shown on the following National Oceanic and Atmospheric Administration (NOAA) Nautical Charts, as authored by the NOAA Office of Coast Survey.

- Chart 18600, Trinidad Head to Cape Blanco (January 2002);
- Chart 18620, Point Arena to Trinidad Head (June 2002);
- Chart 18640, San Francisco to Point Arena (July 2000);
- Chart 18680, Point Sur to San Francisco (March 2001);

- Chart 18700, Point Conception to Point Sur (July 2003);
- Chart 18720, Point Dume to Purisima Point (January 2005); and
- Chart 18740, San Diego to Santa Rosa Island (August 2003).

a. Use of the NOAA Nautical Charts for Determining the Baseline (Coast)

ARB staff recognizes that other California agencies use different baselines for various purposes, including for determining the coastal zone, state waters, coastal waters, and California's territorial boundaries. In most cases, these baselines broaden the agencies' jurisdictional authority. However, ARB staff interprets "within three miles of the California coast, to the extent allowed by federal law," as provided in AB 471 and HSC section 39632, to mean within the Three Nautical Mile Line recognized by federal law which is depicted on NOAA nautical charts.

b. Updates to the NOAA Charts

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 United States Baseline Committee. It is anticipated that NOAA will be updating the charts for the California coast in the near future. As the NOAA charts are recognized by federal law and mandated by State law for purposes of this proposed ATCM, the Three Nautical Mile Line will be based on the current NOAA charts. The Executive Officer may revise the definition of "within three miles of the California coast" to incorporate the updated charts by publishing the revision in the California Notice Register and notifying potentially affected cruise ship owners or operators at least 30 days before the updates take effect.

c. Availability of NOAA Nautical Charts

For information on obtaining copies of the NOAA nautical charts, please visit NOAA's website at *http://chartmaker.ncd.noaa.gov/staff/charts.htm*.

4. Recordkeeping and Reporting Requirements

Cruise ship owners or operators are required to maintain records containing the following information for each segment of a voyage if, during any portion of that segment, the cruise ship travels within three nautical miles of the California coast.

- The date and time of start and stop of incineration (in local time);
- The position of the ship in latitude and longitude for each start and stop time of incineration;

- The estimated amount incinerated in cubic meters (m^3); and
- The name or signature of officer in charge of the operation.

This information is required if, during any segment of the voyage, the cruise ship travels within three nautical miles of the California coast or visits California ports or terminals.

Records are to be maintained in English and kept onboard the cruise ship for two years. During an onboard inspection, these records are to be made available to ARB personnel, local air district personnel, or their delegates. In addition, upon written request by the Executive Officer of ARB or Air Pollution Control Officer of a District, the owner or operator of the cruise ship shall provide copies of the records within 30 calendar days of the request. Records may be kept electronically, if desired.

The recordkeeping requirements in the proposed ATCM are also required under Regulation 9 of Annex V of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (Annex V). Cruise ships currently are required to maintain this information in a garbage record log book.

5. <u>Definitions</u>

Several definitions have been included in subsection (d) of the proposed ATCM to ensure clarity. These definitions were taken from Bureau of Customs and Border Protection regulations, cruise ship industry documents, and prior ARB rulemakings.

6. <u>Other Considerations</u>

Based on the definition of "onboard incineration," the proposed ATCM would not apply during those periods when the onboard incinerator is not burning any waste and is only burning fuel for the specific purpose of maintaining a minimum temperature to reduce the effects of thermal cycling. Thermal cycling refers to rapid, extreme, and frequent changes of the temperature inside the incinerator. Such changes can cause damage to incinerators, depending on their design. Several industry representatives expressed concern over this issue. In order to accommodate their concerns, staff excluded, from the definition of "onboard incineration", the burning of fuels for this purpose. However, the burning of fuels for the purpose of volume reduction, destruction, sanitation, or sterilization, aboard a cruise ship, would be subject to the ATCM.

B. Basis and Rationale for the Control Measure

Effective January 1, 2005, AB 471 prohibited cruise ships from onboard incineration within three (nautical) miles of the California coast. The purpose of the proposed ATCM is to ensure that this legislation is implemented and adequately enforced.

On a national level, land-based garbage and municipal waste incineration have been associated with emissions of large amounts of toxic air contaminants (TACs). Incineration of waste is associated with emissions of various air pollutants, including polychlorinated dibenzodioxins (PCDDs or dioxins), polychlorinated dibenzofurans (PCDFs or furans), and toxic metals which can cause cancer and noncancer health impacts. ARB has previously identified and developed regulations for dioxins, furans, and certain metal compounds as TACs and these compounds are listed as hazardous air pollutants by the United States Environmental Protection Agency (U.S. EPA). PCDDs and PCDFs are the most toxic compounds which have been identified by the ARB. These toxic chemicals can be inhaled directly or can contaminate vegetation and be consumed by animals and humans. PCDDs and PCDFs then accumulate in the body. Many studies, including U.S. EPA's Dioxin Reassessment, have shown that PCDDs and PCDFs can cause cancer and other health problems including birth defects and liver damage.

Regulations are currently in place for existing land-based waste incinerators in California. Waste incinerators, such as medical and municipal waste incinerators, are subject to local air district air permitting requirements, district prohibitory rules, the Medical Waste Incinerator ATCM (Title 17, CCR section 93104), the Outdoor Residential Waste Burning ATCM (Title 17, CCR section 93113), and the Assembly Bill 2588 "Hot Spots" program (HSC 44300 *et seq.*). These programs limit the amount of land-based incinerator emissions that may be released into the environment. Additionally, there are federal requirements for municipal and medical waste incinerators.

Currently there are no incinerator emission limits or control requirements for cruise ship onboard incinerators which travel within three nautical miles of the California coast or which visit California ports or terminals. In 2004, at the port of Los Angeles, there were 220 cruise ship port calls. The average time between arrival and departure from the port was about 15 hours. In the absence of AB 471 and the proposed ATCM, cruise ships could incinerate waste while entering the port, at the port, and leaving the port. This amounts to substantial periods of time that cruise ships could be incinerating near the coast. In addition, there are three berths at the port which can be used simultaneously and where onboard incineration could occur if AB 471 and the proposed ATCM weren't implemented and enforced. As a result, public health impacts could occur to residents and off-site workers who live or work near the coast.

The recordkeeping requirements are similar to recordkeeping requirements under Annex V. This is a cost-effective approach which, along with onboard inspections, will allow ARB or District inspectors to determine compliance with the proposed ATCM.

C. Alternatives Considered

1. No Action

One alternative would have been not to develop the proposed ATCM. This alternative is not recommended. Cruise ships are equipped with incinerators that burn a variety of wastes including hazardous wastes, oil, oily sludge, sewage, medical and bio-hazardous waste, outdated pharmaceuticals, and other solid wastes such as plastics, paper, metal, glass, and food. The emissions from onboard incineration can include TACs such as dioxins, furans, hydrogen chloride, hydrocarbons, manganese, and toxic metals such as lead, cadmium, chromium, arsenic, beryllium, nickel and mercury. Criteria pollutants such as nitrogen oxide, sulfur oxide, carbon monoxide, carbon dioxide, and particulate matter can also be emitted.

If ARB did not develop a control measure, then incineration recordkeeping and reporting would not be required by the State. Without these requirements it would be difficult to determine compliance with AB 471. Therefore, the proposed ATCM is critical to determine compliance with the legislation. In addition, the proposed ATCM clarifies the three nautical mile zone in which onboard incineration is prohibited in the legislative language.

2. Eliminating Certain Recordkeeping Requirements

ARB staff considered deleting the requirement for recording the amount of waste incinerated. However, staff has determined that this is not a feasible alternative. If a cruise ship owner or operator conducted onboard incineration within three nautical miles of the California coast, then knowing the amount incinerated is necessary to assess any penalties involved. In addition, reporting the amount of waste incinerated is already required under Annex V so it is not expected to be an additional burden for the industry.

3. Extending the Prohibition Zone

ARB staff considered extending, beyond three nautical miles, the zone in which onboard incineration is prohibited. However, the risk assessment results conducted by ARB staff do not warrant this action.

4. Other Prescriptive Standards

Staff did not consider other prescriptive standards because the standard was set forth in AB 471 (i.e., no onboard incineration is permitted within three nautical miles of the California coast).

VII. ECONOMIC IMPACTS OF THE PROPOSED ATCM

This chapter discusses the impacts that the proposed airborne toxic control measure (ATCM) may have on the cruise ship industry and costs to local, state, and federal agencies. Overall, the ATCM is not expected to result in any significant economic impacts. The costs to the cruise ship industry are negligible.

The proposed ATCM is not expected to cause a change in employment, business status, or competitiveness. It is not expected to have an impact on the creation or elimination of jobs and businesses, or the competitiveness of cruise ships traveling to California ports.

Some costs were identified for public agencies. It is expected that the California Air Resources Board (ARB) costs will be approximately $25,000 annually to cover the costs for enforcement.

A. Legal Requirements

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. The estimate shall include any non-discretionary cost or savings to local agencies and the cost or savings in federal funding to the State.

Health and Safety Code section 57005 requires ARB 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 proposed ATCM is not a major regulation.

B. Affected Businesses

Approximately 11 cruise ship companies traveled into California ports during 2004. None of these companies are small businesses. These 11 companies accounted for about 45 different vessels entering California ports.

All of the vessels are foreign-flagged. According to industry representatives, the standard practice is to cease incineration before they arrive within three nautical miles of the California coast. ARB staff conducted the Cruise Ship Onboard Incinerator Survey (Survey) to get information on cruise ship waste incineration practices. Responses from that Survey showed that prior to January 1, 2005, when AB 471 took effect, only two out of 26 (eight percent) of cruise ships incinerated within three nautical miles of the California coast. For these cruise ships, a change in operating schedule of the incinerator was necessary to ensure that incineration stopped before the cruise ship arrived within three nautical miles of the California coast.

The recordkeeping requirements for the proposed ATCM are similar to the current recordkeeping requirements under Regulation 9 of Annex V of the International Convention of the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78 or Annex V). Annex V requires each cruise ship to maintain garbage record logs indicating the date and time of start and stop of incineration, the position of the ship, the estimated amount of garbage incinerated, and the signature of officer in charge. Because cruise ship operators are already required to keep these records, recordkeeping costs from this regulation would be negligible.

To ensure compliance with AB 471, reviewing the garbage record logs may be necessary. Inspectors can ask to inspect the garbage record logs to ensure that onboard incineration has not occurred within three nautical miles of the California coast. Copying costs for these records would be negligible. In addition there could be minimal costs for the cruise ship environmental officer's staff time to be present during annual inspections. It is not expected that the annual inspection would take longer than one hour.

Although many cruise ships already carry the specified National Oceanic and Atmospheric Administration (NOAA) Nautical Charts incorporated by reference in the proposed ATCM, there may be some ships which use different nautical charts. In this situation, although not a requirement, a cruise ship may wish to purchase the NOAA nautical charts to ensure that they know the location of the Three Nautical Mile Line. A set of NOAA charts can be purchased for about $100.

C. Potential Impact on Employment

For 2003, the cruise ship industry employed over 43,000 people and paid a total of 1.9 billion dollars in wages to California workers (ICCL, 2004). The proposed ATCM is not expected to cause a change in California employment because, based on ARB's Survey, prior to the effective date of AB 471, only two out of 26 (eight percent) cruise ships incinerated waste within three nautical miles of the California coast. For these two cruise ships, a change in incinerator operating schedule is not expected to impact employment. Additionally, since the recordkeeping requirements are already required under Annex V, there is no impact expected on employment due to recordkeeping and reporting requirements.

D. Potential Impact on Business Creation, Elimination, or Expansion

Because costs for the proposed ATCM are negligible, the proposed regulation is not expected to have an impact on the creation, elimination, or expansion of businesses and jobs in California.

E. Potential Impact on Business Competitiveness

The proposed ATCM is not expected to have an impact on business competitiveness. The proposed regulation is consistent with current industry practices and the requirements are identical across all cruise ships which travel to California ports.

F. Costs to Public Agencies

In order to promote statewide consistency, ARB will have the primary responsibility for enforcing the proposed ATCM. In the future, the five local air districts where cruise ships dock may wish to participate in the enforcement of the regulation. It is unknown whether or not they would choose to enforce the regulation at a future date.

1. Costs to the California Air Resources Board

The annual cost of the proposed ATCM to ARB is approximately $25,000. This is based on anticipated, annual inspection costs by ARB inspectors. The cost estimate assumes that each cruise ship that enters a California port or terminal is inspected once per year for a total of 40 to 50 annual inspections. Assuming one inspection takes eight hours (includes travel time to ports and follow-up activities) the total annual inspection time is 320 to 400 hours per year. This is approximately 0.15 to 0.20 Person Years (PY). Assuming $100,000 per PY, this computes to a cost of about $15,000 to $20,000. Mileage reimbursement of 200 miles per inspection at $0.34 per mile equals $2,720 to $3,400. The total for staff time and mileage reimbursement is less than $25,000. It is anticipated that these costs can be absorbed into the existing budget. However, the cruise ship industry estimates a significant increase in the number of cruise ships that operate in California over the next ten years. Should this occur, ARB may need additional resources to adequately enforce this growing industry.

VIII. ENVIRONMENTAL IMPACTS OF THE PROPOSED ATCM

The intent of the proposed airborne toxic control measure (ATCM) is to protect the public health by reducing the public's exposure to toxic air contaminants (TACs) from incineration aboard cruise ships. Air Resources Board (ARB) staff evaluated potential water quality impacts, potential increase in diesel emissions, diversion of waste to landfills or land-based municipal waste incinerators, and public health impacts from storing garbage. ARB staff has determined that no significant adverse environmental impacts are expected to occur.

A. Legal Requirements Applicable to the Analysis

The California Environmental Quality Act (CEQA) and ARB policy require an analysis to determine the potential adverse environmental impacts of proposed regulations. The ARB's program involving the adoption of regulations has been certified by the Secretary of Resources (see Public Resources Code section 21080.5). Therefore, the CEQA environmental analysis requirements may be included in the Initial Statement of Reasons for a rulemaking in lieu of preparing an environmental impact report or negative declaration. In addition, ARB will respond in writing to all significant environmental issues raised by the public during the public review period or at the Board hearing. These responses will be contained in the Final Statement of Reasons for the proposed ATCM.

Public Resources Code section 21159 requires that the environmental impact analysis conducted by ARB include the following: (1) an analysis of the reasonably foreseeable environmental impacts of the methods of compliance; (2) an analysis of reasonably foreseeable feasible mitigation methods; and, (3) an analysis of reasonably foreseeable alternative means of compliance with the proposed revisions to the ATCM. Regarding reasonably foreseeable 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.

B. Potential Ocean Water Quality Impacts

Since cruise ships would be prohibited from incinerating waste within three nautical miles of the California Coast, we do not expect any impact to the ocean water quality close to shore. Cruise ships are already prohibited from dumping wastes within three nautical miles of the coast (IMO, 1997) so a prohibition against incineration in this same zone would not impact ocean water quality.

C. Diesel Emissions

A negligible increase in diesel emissions could occur if the two cruise ships which incinerated within three nautical miles of the California coast prior to January 1, 2005, chose to have all or a portion of that waste picked up by solid waste collection vehicles which operate on diesel fuel. In this scenario, diesel emissions could occur from additional miles traveled by these vehicles. However, it is expected that incinerator operating schedules would be adjusted (e.g., cruise ships would incinerate after they were outside of the three nautical mile line) rather than having their waste picked up by solid waste collection vehicles. This is because onshore waste pick up may incur additional costs, whereas adjusting the incinerator operating schedules would most likely not.

D. Landfills and Land-Based Municipal Waste Incinerators

A negligible increase in solid waste to landfills or land-based municipal waste incinerators could occur if the small number of cruise ships which incinerated within three nautical miles of the California coast prior to January 1, 2005, chose to have that portion of their waste go to landfills or get picked up at a port for incineration at a land-based municipal waste incineration facility. Because only two ships incinerated their waste within three nautical miles of the California coast prior the effective date of AB 471, any additional waste going to landfills or land-based municipal waste incinerators would be negligible compared to the large volume received from local residents and businesses. Additionally, the nearest land-based municipal waste incinerators to the heaviest traveled ports of Los Angeles and Long Beach are equipped with sophisticated air pollution control devices. However, it is expected that incinerator operating schedules would be adjusted (e.g., cruise ships would incinerate after they were outside of the three nautical mile line) rather than have an additional portion of the waste diverted to landfills or land-based municipal waste incinerators.

E. Waste Storage

Because the proposed ATCM limits when cruise ship owners or operators may conduct onboard incineration, ARB staff evaluated whether this would result in infestation of plant and animal pests and diseases due to holding or stockpiling regulated garbage. Regulated garbage is defined in Code of Federal Regulations (CFR), Title 7 CFR, section 330.400 and Title 9 CFR, section 94.5. Some examples of regulated garbage onboard a cruise ship would include food scraps, table refuse, galley refuse, food wrappers or packaging materials, and other waste material from stores and food preparation. All regulated international garbage within the territories of the United States must be in leak-proof, covered containers to prevent the dissemination of plant and animal pests and diseases. (ARB, 2005a)

Although there are no requirements on how long regulated garbage may be stored on a cruise ship, the United States Department of Agriculture (USDA) has requirements for regulated garbage on land. In California and other similar climates and agricultural areas, USDA has allowed up to 72 hours (based on the life cycles of various plant pests in those climates) for storing garbage. Additional holding times are granted on a case by case basis. (ARB, 2005a)

ARB staff does not expect negative environmental impacts due to the potential for garbage storage from the proposed ATCM. Cruise ships which travel internationally do not typically stay at port or within three nautical miles of the California coast for more than 24 hours. For 2004, at the port of Los Angeles, the average time between arrival and departure from port was 15 hours with a maximum of 20 hours. In addition, it is not expected that a large amount of regulated garbage would be generated while coming into port, hoteling, or leaving the port. While at port, cruise ships may either send their wastes to landfills or land-based municipal waste incinerators.

F. Reasonably Foreseeable Alternative Means of Compliance with the ATCM

ARB is required to do an analysis of reasonably foreseeable alternative means of compliance with the ATCM. Alternatives to the ATCM are discussed in Chapter VI. ARB staff has concluded that the proposed ATCM provides clarity in implementing AB 471. The ATCM is enforceable with the least burdensome approach to reducing public health impacts from cruise ship onboard incineration.

G. Environmental Justice

ARB is committed to evaluating community impacts of proposed regulations including environmental justice concerns. Because some communities experience higher exposure to toxic pollutants, it is a priority of ARB to ensure that full protection is afforded to all Californians. The proposed ATCM is not expected to result in significant negative impacts in any community. The proposed ATCM is designed to reduce emissions of TACs, such as polychlorinated dibenzo-*p*-dioxins (dioxins), polychlorinated dibenzofurans (furans), and metals to residents and off-site workers living or working along the California coast and near California ports.

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- Chart 18640, San Francisco to Point Arena (July 2000);
- Chart 18680, Point Sur to San Francisco (March 2001);
- Chart 18700, Point Conception to Point Sur (July 2003);
- Chart 18720, Point Dume to Purisima Point (January 2005); and
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Appendix A

Proposed Regulation Order

Airborne Toxic Control Measure for Cruise Ship Onboard Incineration

PROPOSED REGULATION ORDER

AIRBORNE TOXIC CONTROL MEASURE FOR CRUISE SHIP ONBOARD INCINERATION

Adopt new section 93119, title 17, California Code of Regulations, to read as follows:

17 CCR, section 93119. Airborne Toxic Control Measure for Cruise Ship Onboard Incineration

(a) Purpose.

The purpose of this control measure is to reduce emissions of toxic air contaminants from the use of incinerators aboard cruise ships. Specifically, this regulation prohibits cruise ships from conducting onboard incineration while operating within three miles of the California coast. This control measure is expected to reduce exposure to toxic air contaminants for residents living near ports and along the California coast.

(b) Applicability.

Except as provided in subsection (c), this section applies to any person who owns or operates a cruise ship, as defined in subsection (d)(2), including foreign flagged cruise ships, which travel within three miles of the California coast or visit California ports or terminals.

(c) Exemptions.

(1) This section does not apply to vessels without berths or overnight accommodations for passengers.

(2) This section does not apply to noncommercial vessels, warships, vessels operated by nonprofit entities as determined by the Internal Revenue Service, and vessels operated by the State of California, the United States, or a federal government.

(d) Definitions. For the purposes of this section, the following definitions apply:

(1) "Air Pollution Control Officer" or "APCO" means the air pollution control or executive officer of a district, or his or her delegate.

(2) "Cruise ship" means a commercial vessel that has the capacity to carry 250 or more passengers for hire.

(3) "District" means an air pollution control or air quality management district as defined in Health and Safety Code section 39025.

(4) "Executive Officer of the Air Resources Board" means the executive officer of the California Air Resources Board or his or her delegate.

(5) "Incinerator" means any device used to conduct onboard incineration.

(6) "Onboard incineration" means the combustion or burning of any materials or wastes for the purpose of volume reduction, destruction, sanitation, or sterilization, aboard a cruise ship. Onboard incineration does not include incinerators which are only burning fuels including, but not limited to, natural gas, gas oil, marine gas oil, marine diesel fuel, fuel oil, or residual fuel oil for the specific purpose of maintaining a minimum temperature in the incinerator to minimize thermal cycling.

(7) "Owner or Operator" means a person who owns or operates a cruise ship.

(8) "Person" shall have the same meaning as defined in Health and Safety Code section 39047.

(9) "Segment" means that portion of the cruise ship's voyage from the last port of call to the next port of call.

(10) "Within three miles of the California coast" means between the California coast and the Three Nautical Mile Line 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).

(e) Requirements.

(1) Notwithstanding sections 93104 and 93113 of title 17, California Code of Regulations, no cruise ship owner or operator, agent, representative, or employee shall conduct onboard incineration within three miles of the California coast.

(2) *Recordkeeping and Reporting Requirements*

(A) *Recordkeeping Requirements*

1. Owners or operators of cruise ships subject to the requirements of this section shall maintain records for each segment of a voyage if, during any portion of that segment, the cruise ship travels within three miles of the California coast.

   a. The date and time of start and stop of incineration (in local time);
   b. The position of the ship in latitude and longitude for each start and stop time of incineration;
   c. The estimated amount incinerated in cubic meters (m^3); and
   d. The name or signature of officer in charge of the operation.

2. Records shall be maintained in English and shall be kept and maintained onboard the respective cruise ship for two years.

3. During an onboard inspection, records shall be made available to Air Resources Board personnel, District personnel, or their delegates.

(B) *Reporting Requirements*

1. Owners or operators of cruise ships that are subject to this section, shall, upon written request by the Executive Officer of the Air Resources Board or the Air Pollution Control Officer from a District, provide copies of the records as specified in subsection (e)(2)(A) within 30 calendar days of the request.

(f) Updates to NOAA Charts.

The Executive Officer shall publish in the California Regulatory Notice Register and notify potentially affected cruise ship owners or operators, regarding revisions to subsection (d)(10) with regard to Nautical Charts updated by NOAA, at least 30 days before the updates take effect in the following situations:

(1) The Executive Officer may revise subsection (d)(10) when there is a change in the chart number or name; or

(2) The Executive Officer may revise subsection (d)(10) when NOAA revises the Three Nautical Mile Line, as shown on the respective charts.

(g) 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 39516, 39600, 39601, 39631, 39632, 39650, 39656, 39658, 39659, 39666, 40000, 41700, and 41510, Health and Safety Code. Reference: Sections 39630, 39631, 39632, 39650, 39656, 39659, 39666, 41700, 41806 Health and Safety Code.

Appendix B

Appendix to Annex V of MARPOL 73/78

Appendix to Annex V

Form of Garbage Record Book

Name of ship: ____________________

Distinctive number or letters: ____________________

IMO No.: ____________________

Period: From: ___________ To: ___________

1 *Introduction*

In accordance with regulation 9 of Annex V of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78), a record is to be kept of each discharge operation or completed incineration. This includes discharges at sea, to reception facilities, or to other ships.

2 *Garbage and garbage management*

Garbage includes all kinds of food, domestic and operational waste excluding fresh fish and parts thereof, generated during the normal operation of the vessel and liable to be disposed of continuously or periodically except those substances which are defined or listed in other annexes to MARPOL 73/78 (such as oil, sewage or noxious liquid substances).

The Guidelines for the Implementation of Annex V of MARPOL 73/78* should also be referred to for relevant information.

3 *Description of the garbage*

The garbage is to be grouped into categories for the purposes of this record book as follows:

1 Plastics

2 Floating dunnage, lining, or packing material

3 Ground-down paper products, rags, glass, metal, bottles, crockery, etc.

4 Paper products, rags, glass, metal, bottles, crockery, etc.

.5 Food waste

* Refer to the Guidelines for the Implementation of Annex V of MARPOL 73/78; see IMO sales publication IMO-656E.

6 Incinerator ash.

4 *Entries in the Garbage Record Book*

4.1 Entries in the Garbage Record Book shall be made on each of the following occasions:

(a) When garbage is discharged into the sea:
- (i) Date and time of discharge
- (ii) Position of the ship (latitude and longitude)
- (iii) Category of garbage discharged
- (iv) Estimated amount discharged for each category in cubic metres
- (v) Signature of the officer in charge of the operation.

(b) When garbage is discharged to reception facilities ashore or to other ships:
- (i) Date and time of discharge
- (ii) Port or facility, or name of ship
- (iii) Category of garbage discharged
- (iv) Estimated amount discharged for each category in cubic metres
- (v) Signature of officer in charge of the operation.

(c) When garbage is incinerated:
- (i) Date and time of start and stop of incineration
- (ii) Position of the ship (latitude and longitude)
- (iii) Estimated amount incinerated in cubic metres
- (iv) Signature of the officer in charge of the operation.

(d) Accidental or other exceptional discharges of garbage
- (i) Time of occurrence
- (ii) Port or position of the ship at time of occurrence
- (iii) Estimated amount and category of garbage
- (iv) Circumstances of disposal, escape or loss, the reason therefor and general remarks.

4.2 Receipts

The master should obtain from the operator of port reception facilities, or from the master of the ship receiving the garbage, a receipt or certificate specifying the estimated amount of garbage transferred. The receipts or certificates must be kept on board the ship with the Garbage Record Book for two years.

4.3 Amount of garbage

The amount of garbage on board should be estimated in cubic metres, if possible separately according to category. The Garbage Record Book contains many references to estimated amount of garbage. It is recognized that the accuracy of estimating amounts of garbage is left to interpretation. Volume estimates will differ before and after processing. Some processing procedures may not allow for a usable estimate of volume, e.g. the continuous processing of food waste. Such factors should be taken into consideration when making and interpreting entries made in a record.

RECORD OF GARBAGE DISCHARGES

Ship's name: ____________ Distinctive No., or letters: ____________ IMO No.: ________

Garbage categories:

1: Plastic.
2: Floating dunnage, lining, or packing materials.
3: Ground paper products, rags, glass, metal, bottles, crockery, etc.
4: Paper products, rags, glass, metal, bottles, crockery, etc.
5: Food waste.
6: Incinerator ash.

NOTE: THE DISCHARGE OF ANY GARBAGE OTHER THAN FOOD WASTE IS PROHIBITED IN SPECIAL AREAS. ONLY GARBAGE DISCHARGED INTO THE SEA MUST BE CATEGORIZED. GARBAGE OTHER THAN CATEGORY 1 DISCHARGED TO RECEPTION FACILITIES NEED ONLY BE LISTED AS A TOTAL ESTIMATED AMOUNT.

Date/time	Position of the ship	Estimated amount discharged into sea (m^3)					Estimated amount discharged to reception facilities or to other ship (m^3)		Estimated amount incinerated (m^3)	Certification/ Signature
		CAT. 2	CAT. 3	CAT. 4	CAT. 5	CAT. 6	CAT. 1	Other		

Master's signature: ____________ Date: ________

Appendix C

Annex VI of MARPOL 73/78 – Regulation 16 and Appendix IV

Regulation 16
Shipboard incineration

(1) Except as provided in paragraph (5), shipboard incineration shall be allowed only in a shipboard incinerator.

(2) (a) Except as provided in sub-paragraph (b) of this paragraph, each incinerator installed on board a ship on or after 1 January 2000 shall meet the requirements contained in appendix IV to this Annex. Each incinerator shall be approved by the Administration taking into account the standard specifications for shipboard incinerators developed by the Organization.*

(b) The Administration may allow exclusion from the application of sub-paragraph (a) of this paragraph to any incinerator which is installed on board a ship before the date of entry into force of the Protocol of 1997, provided that the ship is solely engaged in voyages within waters subject to the sovereignty or jurisdiction of the State the flag of which the ship is entitled to fly.

(3) Nothing in this regulation affects the prohibition in, or other requirements of, the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972, as amended, and the 1996 Protocol thereto.

(4) Shipboard incineration of the following substances shall be prohibited:

(a) Annex I, II and III cargo residues of the present convention and related contaminated packing materials;

(b) polychlorinated biphenyls (PCBs);

* Refer to resolution MEPC 76(40), Standard specification for shipboard incinerators.

(c) garbage, as defined in Annex V of the present Convention, containing more than traces of heavy metals; and

(d) refined petroleum products containing halogen compounds.

(5) Shipboard incineration of sewage sludge and sludge oil generated during the normal operation of a ship may also take place in the main or auxiliary power plant or boilers, but in those cases, shall not take place inside ports, harbours and estuaries.

(6) Shipboard incineration of polyvinyl chlorides (PVCs) shall be prohibited, except in shipboard incinerators for which IMO Type Approval Certificates have been issued.

(7) All ships with incinerators subject to this regulation shall possess a manufacturer's operating manual which shall specify how to operate the incinerator within the limits described in paragraph 2 of appendix IV to this Annex.

(8) Personnel responsible for operation of any incinerator shall be trained and capable of implementing the guidance provided in the manufacturer's operating manual.

(9) Monitoring of combustion flue gas outlet temperature shall be required at all times and waste shall not be fed into a continuous-feed shipboard incinerator when the temperature is below the minimum allowed temperature of 850°C. For batch-loaded shipboard incinerators, the unit shall be designed so that the temperature in the combustion chamber shall reach 600°C within five minutes after start-up.

(10) Nothing in this regulation precludes the development, installation and operation of alternative design shipboard thermal waste treatment devices that meet or exceed the requirements of this regulation.

Appendix IV

Type approval and operating limits for shipboard incinerators (Regulation 16)

(1) Shipboard incinerators described in regulation 16(2) shall possess an IMO type approval certificate for each incinerator. In order to obtain such certificate, the incinerator shall be designed and built to an approved standard as described in regulation 16(2). Each model shall be subject to a specified type approval test operation at the factory or an approved test facility, and under the responsibility of the Administration, using the following standard fuel/waste specification for the type approval test for determining whether the incinerator operates within the limits specified in paragraph (2) of this appendix:

Sludge oil consisting of:	75% Sludge oil from HFO; 5% waste lubricating oil; and 20% emulsified water
Solid waste consisting of:	50% food waste 50% rubbish containing approx. 30% paper, " 40% cardboard, " 10% rags, " 20% plastic The mixture will have up to 50% moisture and 7% incombustible solids.

(2) Incinerators described in regulation 16(2) shall operate within the following limits:

O_2 in combustion chamber:	6–12%
CO in flue gas maximum average:	200 mg/MJ
Soot number maximum average:	Bacharach 3 or Ringelman 1 (20% opacity) (A higher soot number is acceptable only during very short periods such as starting up)
Unburned components in ash residues:	maximum 10% by weight
Combustion chamber flue gas outlet temperature range:	850–1200°C

Appendix D

ICCL Industry Standards

Attachment to ICCL Standard E-1-01 (Revision 2)

CRUISE INDUSTRY WASTE MANAGEMENT PRACTICES AND PROCEDURES

(REVISED: December 12, 2003)

The cruise industry is dedicated to preserving the marine environment and oceans upon which our ships sail. As a stated industry standard, ICCL members have adopted aggressive programs of waste minimization, waste reuse and recycling, and waste stream management set forth in the following. In addition ICCL members are working in a number of areas to identify and implement new technologies in order to improve the environmental performance of their ships. ICCL member lines currently have agreed to utilize waste management practices and procedures, which meet or exceed the stringent standards as set forth in international treaties and applicable U.S. laws.

Introduction

The cruise industry is inextricably linked to the environment. Our business is to bring people to interesting places in the world, over the water. Recognizing the future of the industry depends on a clean and healthy environment, cruise industry senior management is committed to stewardship of the environment and establishing industry practices that will make ICCL member cruise ship operators leaders in environmental performance.

This document outlining member line practices has been developed under the auspice of the industry's professional organizations, the International Council of Cruise Lines (ICCL), the Florida Caribbean Cruise Association (FCCA), and the Northwest Cruise Ship Association (NWCA). The purpose of this document is to set forth cruise industry waste management practices and procedures that ICCL member cruise vessel operators have agreed to incorporate into their respective Safety Management Systems.

In the development of industry practices and procedures for waste management, the members of the International Council of Cruise Lines have endorsed policies and practices based upon the following fundamental principles:

- Full compliance with applicable laws and regulations
- Maintaining cooperative relationships with the regulatory community
- Designing, constructing and operating vessels, so as to minimize their impact on the environment
- Embracing new technology
- Conserving resources through purchasing strategies and product management
- Minimizing waste generated and maximize reuse and recycling
- Optimizing energy efficiency through conservation and management
- Managing water discharges
- Educating staff, guests and the community.

Discussion

Just as on shore, ship operations and passengers generate waste as part of many daily activities. On ships, waste is generated while underway and in port. Because ships move, the management of these wastes becomes more complicated than for land-based activities, as the facilities and laws change with the location of the ship. Facilities on the ships and management practices must be designed to take into account environmental laws and regulations around the world. Moreover, because waste management ultimately becomes a local activity, the local port infrastructure, service providers, and local waste disposal vendors are factors in the decision-making processes.

On an international level, environmental processes are an important part of the International Maritime Organization's (IMO's) policies and procedures for the maritime industry. ICCL member lines have agreed to incorporate environmental performance into Safety Management Systems (SMS) and MARPOL mandated Waste Management Manuals. Under agreements and laws specific to many nations, these programs are routinely reviewed by Port States to ensure compliance. For example, in the United States, the US Coast Guard has jurisdiction over environmental matters in ports and waterways and conducts passenger ship examinations that include review of environmental systems, SMS documentation and such MARPOL-mandated documents as the Oil Record Book and the Garbage Record Book.

The industry effort to develop waste management practices and procedures has focused on the traditional high volume wastes (garbage, graywater, blackwater, oily residues (sludge oil) and bilge water), pollution prevention, and the small quantities of hazardous waste produced onboard. In the process, ICCL members have shared waste management strategies and technologies, while focusing on a common goal of waste reduction.

The process of waste reduction includes waste prevention, the purchasing of products that have recycled content or produce less waste (e.g. source reduction), and recycling or reuse of wastes that are generated. The ultimate goal is to have the waste management culture absorbed into every facet of cruise vessel operation. A fully integrated system beginning with the design of the vessel should address environmental issues at every step.

Management practices for waste reduction should start before a product is selected. Eco-purchasing and packaging are vital to the success of any environmental program, as are strategies to change packaging, processes and management to optimize the resources used.

The commitment of the industry to this cooperative effort has been quite successful, as companies have shared information and strategies.

Industry Standard Waste Handling Procedures

ICCL member lines have agreed that hazardous wastes and waste streams onboard cruise vessels will be identified and segregated for individual handling and management in accordance with appropriate laws and regulations. They have further agreed, hazardous wastes will not be discharged overboard, nor be commingled or mixed with other waste streams.

A. **<u>Photo Processing, Including X-Ray Development Fluid Waste</u>:** *ICCL member lines have agreed to minimize the discharge of silver into the marine environment through the use of best available technology that will reduce the silver content of the waste stream below levels specified by prevailing regulations or by treating all photo processing and x-ray development fluid waste (treated or untreated) as a hazardous waste and landing ashore in accordance with RCRA requirements.*

There are several waste streams associated with photo processing operations that have the potential to be regulated under the Resource Conservation and Recovery Act (RCRA). These waste streams include spent fixer, spent cartridges, expired film and silver flake.

Photographic fixer removes the unexposed silver compounds from the film during the developing process. The spent fixer can have as much as 2000-3000 parts per million (ppm) of silver. Silver bearing waste is regulated by RCRA as a hazardous waste if the level of silver exceeds 5 ppm as determined by the Toxicity Characteristic Leaching Procedure (TCLP) test.

Silver recovery units may be used to reclaim the silver from the used fixer waste stream. There are two types of recovery units. These are active (with electricity) and passive (without electricity) units. The active unit uses electricity to plate silver onto an electrode. The passive unit uses a chemical reaction between steel wool and silver to remove most of the silver from solution. Utilizing the best available technology, the equipment currently onboard ICCL member cruise ships is conservatively estimated to reduce the silver content of this effluent below 4 mg/l (milligrams/l or ppm)

The effluent from the silver recovery process must be tested before it can be discharged as a non-hazardous waste to be further diluted by addition to the ship's gray water. After the photographic and X-ray development fluids are treated for the removal of silver, the treated, non-hazardous effluent is then blended with the ship's graywater. In general, assuming that an entire week's photographic and X-ray development treated effluent stream is introduced into a single day's accumulation of graywater, the concentration of silver in the resulting mixture would be less than one-half of one part per billion (<0.5 micrograms/liter). Such mixing is not done on a weekly basis. Even at this assumed extreme however, it is expected that the silver concentration would only be approximately one fifth (1/5) the surface water quality standard for predominately marine waters specified in one state where cruise ships operate. When mixing is done on a daily basis it is evident that the resulting immediate concentration would be almost an order of magnitude less than this (1/50 of the current surface water quality standard). Additionally, it is evident that total mass of any discharges of silver would be negligible. Member lines have agreed that this discharge would be carried out only while their vessels are underway. Also, it should be noted that these estimates were carried out considering the largest cruise ships in service, which would produce the greatest amount of waste.

<u>Handling Method 1 Employed by Member Lines:</u>

Treat used photographic and x-ray development fluids to remove silver for recycling.

Verify that the effluent from the recovery unit is less than 5 parts per million (ppm) silver, as measured by EPA-approved methodology.

After treatment, the residual waste stream fluid is non-hazardous and landed ashore or discharged in accordance with the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) and other prevailing regulations.

<u>Handling Method 2 Employed by Member Lines:</u>

Used photographic and x-ray development fluids, either treated or untreated, may be assumed to be a hazardous waste. In this event, they are landed ashore in accordance with the requirements of the Resource Conservation and Recovery Act (RCRA).

B. **<u>Dry-cleaning waste fluids and contaminated materials</u>**: *ICCL member lines have agreed to prevent the discharge of chlorinated dry-cleaning fluids, sludge, contaminated filter materials and other dry-cleaning waste byproducts into the environment.*

Shipboard dry cleaning facilities use a chlorinated solvent called perchlorethylene (also known as PERC or tetrachloroethylene) as a dry cleaning fluid. This is the approved dry cleaning solvent for these units. Operators must receive specific required training for the correct use of this chemical and its associated precautions. This solvent should be used in accordance with all safety procedures including appropriate personal protective equipment (PPE).

The dry cleaning units produce a small volume waste from condensate, the bottoms of the internal recovery stills, waste products from button and lint traps, spent perchloroethylene and filter media. This waste is comprised of dirt, oils, filter material, and spent solvent. Each ship utilizing these dry-cleaning units produces approximately two pounds of waste material weekly. However, the amounts may vary greatly by season and passenger load. This material is classified as hazardous waste under RCRA and must be disposed of accordingly.

<u>Handling Method 1 Employed by Member Lines:</u>

Perchloroethylene (PERC) and other chlorinated dry-cleaning fluids, contaminated sludge and filter materials are hazardous waste and landed ashore in accordance with the requirements of RCRA.

C. **<u>Print Shop Waste Fluids</u>:** *ICCL member lines have agreed to prevent the discharge of hazardous wastes from printing materials (inks) and cleaning chemicals into the environment.*

Print shop waste may contain hazardous waste. Printing solvents, inks and cleaners all may contain hydrocarbons, chlorinated hydrocarbons, and heavy metals that can be harmful to human and aquatic species. Recent advances in printing technology and substitution of chemicals that are less hazardous reduces the volume of print shop waste generated and reduces the impact of these waste products.

ICCL member lines have agreed to utilize, whenever possible, printing methods and printing process chemicals that produce both less volume of waste and less hazardous waste products, that shipboard printers will be trained in ways to minimize printing waste generated, and that alternative printing inks such as soy based, non-chlorinated hydrocarbon based ink products will be used whenever possible. The member lines have further agreed that all print shop waste including waste solvents, cleaners, and cleaning cloths will be treated as hazardous waste, if such waste contains chemical components that may be considered as hazardous by regulatory definitions, and that all other waste may be treated as non-hazardous.

Handling Method 1 Employed by Member Lines:

When using traditional or non-soy based inks and chlorinated solvents, all print shop waste is treated as hazardous, and discharged ashore in accordance with RCRA.

Handling Method 2 Employed by Member Lines:

Shipboard printing processes use non-toxic based printing ink such as soy based, non-chlorinated solvents, and other non-hazardous products to eliminate hazardous waste products.

D. **Photo Copying and Laser Printer Cartridges**: *ICCL member lines have agreed to initiate procedures so as to maximize the return of photocopying and laser printer cartridges for recycling, and in any event, have agreed that these cartridges will be landed ashore.*

Increased use of laser and photo copying equipment on shore as well as onboard ship results in the generation of increased volumes of waste cartridges, inks, and toner materials. ICCL member lines have agreed to use only such inks, toners and printing/copying cartridges that contain non-hazardous chemical components, and that none of these cartridges or their components should be disposed of by discharge into the marine environment. In recognition of the member lines' goal of waste minimization, they have further agreed these cartridges should, whenever possible, be returned to the manufacturer for credit, recycling, or for refilling.

Handling Method Employed by Member Lines:

ICCL member lines have agreed that wherever possible, photo copying and laser printer cartridges will be collected, packaged and returned for recycling and when this is not possible, that these materials will not be discharged into the sea or other bodies of water but will be handled as other shipboard waste that is landed ashore for further disposal.

E. **Unused And Outdated Pharmaceuticals**: *ICCL member lines have agreed to ensure that unused and/or outdated pharmaceuticals are effectively and safely disposed in accordance with legal and environmental requirements.*

In general ships carry varying amounts of pharmaceuticals. The pharmaceuticals carried range from over-the-counter products such as anti-fungal creams to prescription drugs such as epinephrine. Each ship stocks an inventory based on its itinerary and the demographics of its passenger base. ICCL member lines have agreed that all pharmaceuticals will be managed to ensure that their efficacy is optimized and that disposal is done in an environmentally responsible manner.

ICCL member lines have further agreed that when disposing of pharmaceuticals, the method used will be consistent with established procedures, and that pharmaceuticals and medications which are off specification or which have exceeded their shelf-life, and stocks that are unused and out of date, cannot be used for patients and therefore will be removed from the ship. Further, each regulatory jurisdiction has a posting of listed pharmaceuticals that must be considered hazardous waste once the date has expired or the item is no longer considered good for patient use.

Through onboard management of the medical facility, ICCL member lines have agreed that stocks of such listed pharmaceuticals are returned to the vendor prior to date of expiration. Pharmaceuticals that are being returned and which have not reached their expiration date are shipped using ordinary practices for new products.

Safety and Health

ICCL member lines have agreed that all expired listed pharmaceuticals will be handled in accordance with established procedures and all personnel handling this waste will receive appropriate training in the handling of hazardous materials. As guidance, the US Environmental Protection Agency (EPA) has issued a report that clarifies the fact that residuals, such as epinephrine, found in syringes after injections are not considered an acutely hazardous waste by definition and may be disposed of appropriately in sharps containers. Member lines have agreed that all Universal Precautions will be adhered to when handling sharps.

<u>Handling Method 1 Employed by Member Lines:</u>

Establish a reverse distribution system for returning unexpired, unopened non-narcotic pharmaceuticals to the original vendor.

<u>Handling Method 2 Employed by Member Lines:</u>

Appropriately destroy narcotic pharmaceuticals onboard ship in a manner that is witnessed and recorded.

<u>Handling Method 3 Employed by Member Lines:</u>

Land listed pharmaceuticals in accordance with local regulations. Listed pharmaceuticals are a hazardous waste having chemical compositions which prevent them from being incinerated or disposed of through the ship's sewer system. Listing of such pharmaceuticals may vary from state to state.

<u>Handing Method 4 Employed by Member Lines:</u>

Dispose of other non-narcotic and non-listed pharmaceuticals through onboard incineration or landing ashore.

F. **<u>Fluorescent And Mercury Vapor Lamp Bulbs</u>**: *ICCL member lines have agreed to prevent the release of mercury into the environment from spent fluorescent and mercury vapor lamps by assuring proper recycling or by using other acceptable disposal.*

The recycling of fluorescent lights and high intensity discharge (HID) lamps is a proven technology capable of reliably recovering greater that 99 percent of the mercury in the spent lights. This is done by using a crush-and-sieve method. In this process, the spent tubes are first crushed and then sieved to separate the large particles from the mercury containing phosphor powder. The phosphor powder is collected and processed under intense heat and pressure. The mercury is volatized and then recovered by condensation. The glass particles are segregated and recycled into other products such as fiberglass. Aluminum components are also recycled separately.

Storage and handling of used lights pose no compatibility problems; nevertheless, storage and shipment of the glass tubes is best done keeping the glass tubes intact. These items are classified as "Universal Waste" when they are shipped to a properly permitted recycling facility; as such, testing is not required.

Safety and Health

Fluorescent and Mercury Vapor lamps contain small amounts of mercury that could potentially be harmful to human health and the environment. To prevent human exposure and contamination of the environment, ICCL member lines have agreed that these lamps will be handled in an environmentally safe manner. Recycling of mercury from lamps and other mercury containing devices is the preferred handling method and is encouraged by various states. The recycling of fluorescent lights and HID lamps keeps potentially hazardous materials out of landfills, saves landfill space and reduces raw materials production needs.

<u>Handling Method Employed by Member Lines</u>:

Fluorescent and mercury vapor lamps are collected and recycled or landed for recycling or disposal in accordance with prevailing laws and regulations.

G. **<u>Batteries</u>**: *ICCL member lines have agreed to prevent the discharge of spent batteries into the marine environment.*

If not properly disposed of, spent batteries may constitute a hazardous waste stream. Most of the large batteries are on tenders and standby generators. Small batteries used in flashlights and other equipment and by passengers, account for the rest. There are four basic types of batteries used.

<u>Lead-acid batteries</u> – These are used in tenders and standby generators. They are wet, rechargeable, and usually six-celled. They contain a sponge lead anode, lead dioxide cathode, and sulfuric acid electrolyte. The electrolyte is corrosive. These batteries require disposal as a hazardous waste, unless recycled or reclaimed.

Lead-acid batteries use sulfuric acid as an electrolyte. Battery acid is extremely corrosive, reactive and dangerous. Damaged batteries will be drained into an acid-proof container. A damaged and leaking battery is then placed in another acid-proof container, and both the electrolyte and the damaged battery placed in secure storage for proper disposal as a hazardous waste.

<u>Nickel-cadmium (NiCad) batteries</u> – These are usually rechargeable, and contain wet or dry potassium hydroxide as electrolyte. The potassium hydroxide is corrosive and the cadmium is a characteristic hazardous waste. Therefore, NiCad batteries will be disposed of as hazardous waste, unless recycled or reclaimed.

<u>Lithium batteries</u> – These are used as a power source for flashlights and portable electronic equipment. All lithium batteries will be disposed of as hazardous waste, or sent out for reclamation.

Alkaline batteries – These are common flashlight batteries and are also used in many camera flash attachments, cassette recorders, etc. They should be recycled, properly disposed or reclaimed.

Handling Method Employed by Member Lines:

Spent batteries are collected and returned for recycling and/or disposal in accordance with prevailing regulations. Discarded batteries are isolated from the refuse waste stream to prevent potentially toxic materials from inappropriate disposal. The wet-cell battery-recycling program is kept separate from the dry battery collection process. Intact wet-cell batteries are sent back to the supplier. Dry-cell batteries are manifested to a licensed firm for recycling.

H. **Bilge and Oily Water Residues:** *ICCL member lines have agreed to meet or exceed the international requirements for removing oil from bilge and wastewater prior to discharge.*

The area of the ship at the very bottom of the hull is known as the bilge. The bilge is the area where water collects from various operational sources such as water lubricated shaft seals, propulsion system cooling, evaporators, and other machinery. All engine and machinery spaces also collect oil that leaks from machinery fittings and engine maintenance activities. In order to maintain ship stability and eliminate potential hazardous conditions from oil vapors in engine and machinery spaces, the bilge spaces should be periodically pumped dry. In discharging bilge and oily water residues, both international regulations (MARPOL) and United States regulations require that the oil content of the discharged effluent be less than 15 parts per million and that it not leave a visible sheen on the surface of the water.

All ships are required to have equipment installed onboard that limits the discharge of oil into the oceans to 15 parts per million when a ship is en route and provided the ship is not in a special area where all discharge of oil is prohibited. Regulations also require that all oil or oil residues, which cannot be discharged in compliance with these regulations, be retained onboard or discharged to a reception facility. The equipment and processes implemented onboard cruise ships to comply with these requirements are complex and sophisticated.

The term "*en route*" as utilized in MARPOL (73/78) Regulation 9(b) is taken to mean while the vessel is underway. The U.S. Coast Guard has informed ICCL that it agrees with this meaning of "*en route.*"

In accordance with MARPOL (73/78) Regulation 20, ICCL member lines have agreed that every ship of 400 gross tons and above shall be provided with an oil record book which shall be completed on each occasion whenever any of numerous specified operations take place in the ship and that operations include:

a. Ballasting or cleaning of fuel oil tanks,
b. Discharge of dirty ballast or cleaning water from the fuel oil tanks above,
c. Disposal of oily residues,
d. And discharge of bilge water that accumulated in machinery spaces.

Requirements regarding the keeping of an Oil Record Book as well as the form of the Oil Record Book are also found in MARPOL and in U.S. Coast Guard regulations (33CFR151).

Handling Method Employed by Member Lines:

Bilge and oily water residue are processed prior to discharge to remove oil residues, such that oil content of the effluent is less than 15 ppm as specified by MARPOL Annex 1.

I. **<u>Glass, Cardboard, Aluminum and Steel Cans</u>**: *ICCL member lines have agreed to eliminate, to the maximum extent possible, the disposal of MARPOL Annex V wastes into the marine environment. This will be accomplished through improved reuse and recycling opportunities. They have further agreed that no waste will be discharged into the marine environment unless it has been properly processed and can be discharged in accordance with MARPOL and other prevailing requirements.*

Management of shipboard generated waste is a challenging issue for all ships at sea. This is true for cruise vessels, other commercial vessels, military ships, fishing vessels and recreational boats. Waste products in earlier days were made from natural materials and were mostly biodegradable. Today's packaging of food and other products presents new challenges for waste management. A large cruise ship today can carry over three thousand passengers and crew. Each day, an average cruise passenger will generate two pounds of dry trash and dispose of two bottles and two cans.

A strategy of source reduction, waste minimization and recycling has allowed the cruise industry to significantly reduce shipboard generated waste. To attain this, ICCL member lines have agreed to adopt a multifaceted strategy that begins with waste minimization to decrease waste from provisions brought onboard. This means purchasing in bulk, encouraging suppliers to utilize more efficient packaging, reusable packaging, and packaging materials that are more environmentally friendly—those that can be more easily disposed of or recycled. In fact, through this comprehensive strategy of source reduction, total waste on passenger vessels has been reduced by nearly half over the past ten years.

Another important component of the industry's waste reduction strategy is product or packaging recycling. Glass, aluminum, other metals, paper, wood and cardboard are, in most cases, recycled.

<u>Handling Method Employed by Member Lines</u>:

MARPOL Annex V ship waste is minimized through purchasing practices, reuse and recycling programs, landing ashore and onboard incineration in approved shipboard incinerators. Any Annex V waste that is discharged at sea will be done in strict accordance with MARPOL and any other prevailing requirements.

J. **<u>Incinerator Ash</u>**: *ICCL member lines have agreed to reduce the production of incinerator ash by minimizing the generation of waste and maximizing recycling opportunities, and that the discharge of incinerator ash containing hazardous components will be prevented through a program of waste segregation and periodic ash testing.*

Incinerator ash is not normally a hazardous waste. Through relatively straightforward waste management strategies, items that would cause the ash to be hazardous are separated from the waste stream and handled according to accepted hazardous waste protocols. In general, source segregation for waste streams is foundational for onboard waste management and is incorporated into the waste management manual required by MARPOL. Waste management for onboard waste streams include the following: source reduction, minimization, recycling, collection, processing and discharge ashore. This allows the incinerator to be used primarily for food waste, contaminated cardboard, some plastics, trash and wood.

Member lines have agreed that incinerator ash will be tested at least once quarterly for the first year of operation to establish a baseline and that testing may then be conducted once a year. . The member lines have further agreed that a recognized test procedure will be used to demonstrate that ash is not a hazardous waste. A recognized test procedure includes the following metals as indicators for toxicity - arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. Special attention is placed on the removal of batteries from the incinerator waste stream. The use of incinerators saves landfill space and prevents the build up of material onboard that could become the breeding ground for insects, rodents and other vermin.

Handling Method Employed by Member Lines:

Proper hazardous waste management procedures are to be instituted onboard each ship to assure that waste products, which will result in a hazardous ash, are not introduced into the incinerator. Non-hazardous incinerator ash may be disposed of at sea in accordance with MARPOL Annex V. Ash identified as being hazardous is disposed of ashore in accordance with RCRA.

K. Wastewater reclamation

Because of the amounts of fresh water involved, and its restricted availability onboard ship (all fresh water must be either purchased or generated onboard), fresh water is a valuable commodity. Therefore, water management is extremely important and takes the form of both minimizing water usage and the potential reclamation and reuse of water for non-potable purposes. Many ICCL companies are researching new technology and piloting graywater treatment systems onboard their vessels. ICCL member operators also take numerous steps in onboard water management. Water management techniques include:

a. Use of technical water (for example: air conditioning condensate) where possible.
b. Use of water recovery systems (for example: filtering and reuse of laundry water – last rinse use for first wash).
c. Reclamation and reuse as technical water (flushing toilets, laundry, open deck washing) of properly treated and filtered wastewaters.
d. Active water conservation (for example: use of reduced flow showerheads, vacuum systems for toilets, vacuum food waste transportation and laundry equipment that utilizes less water).

L. **Graywater**: *ICCL member lines have agreed to discharge graywater only while the ship is underway and proceeding at a speed of not less than 6 knots; that graywater will not be discharged in port and will not be discharged within 4 nautical miles from shore or such other distance as agreed to with authorities having jurisdiction or provided for by local law except in an emergency, or where geographically limited. The member lines have further agreed that the discharge of graywater will comply with all applicable laws and regulations.*

The term graywater is used on ships to refer to wastewater that is generally incidental to the operation of the ship. The International Maritime Organization (IMO) defines graywater as including drainage from dishwasher, shower, laundry, bath and washbasin drains. The US Clean Water Act (formally know as the Federal Water Pollution Control Act) includes galley, bath and shower water in its definition of graywater. The US regulations implementing this act do not include a further definition of gray water. However, the regulations do include a provision that exempts all of the wastewater included in the IMO definition and other discharges incidental to the operation of a ship from the Clean Water Act's permitting program (formally known as the National Pollution Discharge Elimination System (NPDES) program). Finally, the US Coast Guard regulations include provisions that essentially combine the two definitions from the IMO and the Clean Water Act. None of the definitions of graywater include blackwater (discussed below) or bilgewater from the machinery spaces. Recent U.S. Legislation places limits on the discharge of graywater in the Alaska Alexander Archipelago.

Handling Method Employed by Member Lines:

Graywater is discharged only while ships are underway and proceeding at a speed of not less than 6 knots, in recognition that dispersal of these discharges is desirable and that mixing of these waters, which are discharged approximately 10-14 feet below the surface, by the action of the propellers and the movement of the ship, provides the best dispersal available.

M. **Blackwater**: *Waste from toilets, urinals, medical sinks and other similar facilities is called "blackwater." ICCL members have agreed that all blackwater will be processed through a Marine Sanitation Device (MSD), certified in accordance with U.S. or international regulations, prior to discharge. Discharge will take place only when the ship is more than 4 miles from shore and when the ship is traveling at a speed of not less than 6 knots.*

N. Advanced Wastewater Purification Systems:

To improve environmental performance, cruise lines are testing and installing wastewater purification systems that utilize advanced technologies. These onboard wastewater treatment systems are designed to result in effluent discharges that are of a high quality and purity; for example, meeting or surpassing standards for secondary and tertiary effluents and reclaimed water. Effluents meeting these high standards would not be subjected to the strict discharge limitations previously discussed.

O. Training and Educational Materials

Training is an important and ongoing part of every position and tasking onboard cruise ships. Not only is training necessary for the safe and economical operation of a ship, it is required by numerous international conventions and flag state regulations. The International Convention on Standards of Training Certification and Watchkeeping (STCW) for example, sets forth requirements for knowledge, experience and demonstrated competency for licensed officers of the deck and engineering departments and for ratings forming part of a navigation or engineering watch. These detailed requirements address not only the navigation of the ship but also the proper operation of the shipboard machinery and knowledge of and ability to assure compliance with the environmental protection requirements of MARPOL and the safety regulations of The International Convention on Safety of Life at Sea (SOLAS). SOLAS also requires that the ship's training manual (which contents are prescribed by regulation) be placed in the crew messes and recreation rooms or in individual crew cabins.

ICCL member lines have developed programs that raise the level of environmental awareness on the part of both the passengers and the crew. Each ship's crew receives training regarding shipboard safety and environmental procedures. Advanced training in shipboard safety and environmental management procedures is provided for those directly involved in these areas. Those directly responsible for processing wastes are given specific instruction in their duties and responsibilities and in the operation of the various equipment and waste management systems. Specific actions that our member lines have taken to train employees and increase passenger awareness include:

a. Announcements over the public address system and notices in ship newsletters that caution against throwing any trash overboard,
b. Signage and colorful posters placed in crew and passenger areas encouraging environmental awareness and protection,
c. Safety and environmental information booklets in crew cabins and crew lounges,
d. Regular meetings of ship safety and environmental committees consisting of officers and crew from all departments to review methods of improving performance, including better and more effective environmental practices.

STCW, SOLAS and the International Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code) require that training be fully documented. Individual training is documented in each crewmember's file. Ship training exercises, such as fire drills and emergency response exercises, are documented in the appropriate ship's logs. All of these training documents are required to be available for oversight examination by both the ship's flag state inspectors and by port state authorities such as the United States Coast Guard.

Placards warning of the prohibition of the discharge of oil are posted on all ships operating in the navigable waters of the United States as required by U.S. Coast Guard regulations (33CFR155.450). Additionally, as part of required shipboard waste management plans, both Coast Guard regulations (33CFR151.59) and MARPOL (Annex V Regulation 9) require the posting of placards that notify the passengers and the crew of the disposal requirements for garbage. These placards are to be written in the official language of the State whose flag the ship is entitled to fly and also in English or French if neither of these is the official language. Once again, oversight of compliance with these requirements is conducted by ISM audits and frequent inspections by flag states and the United States Coast Guard.

The Safety of Life at Sea Convention mandates compliance with the ISM Code. This comprehensive Code requires that each vessel operating company and each vessel participate in a very strictly defined management program, under both internal and external audit and regulatory oversight, that sets forth detailed procedures for assuring compliance with safety, environmental protection, emergency response and training mandates.

Equivalent equipment, practices and procedures

ICCL member lines have agreed that the use of equivalent or other acceptable practices and procedures shall be communicated to ICCL. As appropriate, such practices and procedures shall be included as a revision to this document. As an example, when improved systems for treating blackwater and graywater are perfected, shown to meet the requirements for MSDs and accepted by appropriate authorities for the treatment of graywater, the new systems and associated technology will be included together with their impact on the current standard of discharging graywater only while underway.

ICCL

INTERNATIONAL COUNCIL OF CRUISE LINES

ICCL INDUSTRY STANDARD E-01-01 (Revision 2)

CRUISE INDUSTRY WASTE MANAGEMENT PRACTICES AND PROCEDURES

The members of the International Council of Cruise Lines are dedicated to preserving the marine environment and in particular the pristine condition of the oceans upon which our vessels sail. The environmental standards that apply to our industry are stringent and comprehensive. Through the International Maritime Organization, the United States and other maritime nations have developed consistent and uniform international standards that apply to all vessels engaged in international commerce. These standards are set forth in the International Convention for the Prevention of Pollution from Ships (MARPOL). In addition, the U.S. has jurisdiction over vessels that operate in U.S. waters where U.S. laws, such as the Federal Water Pollution Control Act, the Act to Prevent Pollution from Ships, and the Resource Conservation and Recovery Act - which applies to hazardous waste as it is landed ashore for disposal, apply to all cruise ships. The U.S. Coast Guard enforces both international conventions and domestic laws.

The cruise industry's commitment to protecting the environment is demonstrated by the comprehensive spectrum of waste management technologies and procedures employed on its vessels.

ICCL members are committed to:

a. Designing, constructing and operating vessels so as to minimize their impact on the environment;

b. Developing improved technologies to exceed current requirements for protection of the environment;

c. Implementing a policy goal of zero discharge of MARPOL, Annex V solid waste products (garbage) by use of more comprehensive waste minimization procedures to significantly reduce shipboard generated waste;

d. Expanding waste reduction strategies to include reuse and recycling to the maximum extent possible so as to land ashore even smaller quantities of waste products;

e. Improving processes and procedures for collection and transfer of hazardous waste; and

f. Strengthening comprehensive programs for monitoring and auditing of onboard environmental practices and procedures in accordance with the International Safety Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code).

INDUSTRY WASTE MANAGEMENT STANDARDS: ICCL member cruise vessel operators have agreed to incorporate the following standards for waste stream management into their respective Safety Management Systems.

1. Photo Processing, Including X-Ray Development Fluid Waste: *Member lines have agreed to minimize the discharge of silver into the marine environment through the use of best available technology that will reduce the silver content of the waste stream below levels specified by prevailing regulations.*

2. Dry-Cleaning Waste Fluids and Contaminated Materials: *Member lines have agreed to* prevent *the discharge of chlorinated dry-cleaning fluids, sludge, contaminated filter materials and other dry-cleaning waste byproducts into the environment*

3. Print Shop Waste Fluids: *Member lines have agreed to prevent the discharge of hazardous wastes from printing materials (inks) and cleaning chemicals into the environment.*

4. Photo Copying and Laser Printer Cartridges: *Member lines have agreed to initiate procedures so as to maximize the return of photo copying and laser printer cartridges for recycling. In any event, these cartridges will be landed ashore.*

5. Unused and Outdated Pharmaceuticals: *Member lines have agreed to ensure that unused and/or outdated pharmaceuticals are effectively and safely disposed of in accordance with legal and environmental requirements.*

6. Fluorescent and Mercury Vapor Lamp Bulbs: *Member lines have agreed to prevent the release of mercury into the environment from spent fluorescent and mercury vapor lamps by assuring proper recycling or by using other acceptable means of disposal.*

7. Batteries: *Member lines have agreed to prevent the discharge of spent batteries into the marine environment.*

8. Bilge and Oily Water Residues: *Member lines have agreed to meet or exceed the international requirements for removing oil from bilge and wastewater prior to discharge.*

9. Glass, Cardboard, Aluminum and Steel Cans: *Member lines have agreed to eliminate, to the maximum extent possible, the disposal of MARPOL Annex V wastes into the marine environment. This will be achieved through improved reuse and recycling opportunities. They have further agreed that no waste will be discharged into the marine environment unless it has been properly processed and can be discharged in accordance with MARPOL and other prevailing requirements.*

10. Incinerator Ash: *Member lines have agreed to reduce the production of incinerator ash by minimizing the generation of waste and maximizing recycling opportunities.*

11. Graywater: *Member lines have agreed that graywater will be discharged only while the ship is underway and proceeding at a speed of not less than 6 knots; that graywater will not be discharged in port and will not be discharged within 4 nautical miles from shore or such other distance as agreed to with authorities having*

jurisdiction or provided for by local law except in an emergency, or where geographically limited. Member lines have further agreed that the discharge of graywater will comply with all applicable laws and regulations.

12. Blackwater: *ICCL members have agreed that all blackwater will be processed through a Marine Sanitation Device (MSD), certified in accordance with U.S. or international regulations, prior to discharge. Discharge will take place only when the ship is more than 4 miles from shore and when the ship is traveling at a speed of not less than 6 knots.*

Some member cruise lines are field-testing wastewater treatment systems that utilize advanced technologies. These onboard wastewater treatment systems, which are currently being referred to as advanced wastewater purification (AWP) systems, are designed to result in effluent discharges that are of a high quality and purity; for example, meeting or surpassing secondary and tertiary effluents and reclaimed water. Effluents meeting these high standards would not be subjected to the strict discharge limitations previously discussed.

Each ICCL cruise vessel operator has agreed to utilize one or more of the practices and procedures contained in the attached "*Cruise Industry Waste Management Practices and Procedures*" in the management of their shipboard waste streams. Recognizing that technology is progressing at a rapid rate, any new equipment or management practices that are equivalent to or better than those described, and which are shown to meet or exceed international and federal environmental standards, will also be acceptable. Member lines have agreed to communicate to ICCL the use of equivalent or other acceptable practices and procedures. As appropriate, such practices and procedures shall be included as a revision to the attached document. As an example, when improved systems for treating blackwater and graywater are perfected and shown to meet the requirements for MSDs and accepted by appropriate authorities, the new systems and associated technology will be included in the attachment as a revision.

ICCL and its Environmental Committee will continue to work with the U.S. Coast Guard, the U.S. Environmental Protection Agency and other appropriate agencies to further implement the above commitments.

ATTACHMENT: *CRUISE INDUSTRY WASTE MANAGEMENT PRACTICES AND PROCEDURES* (Revision 2)

Revised: December 12, 2003
Effective: January 1, 2004

Appendix E

Cruise Ship Onboard Incinerator Survey

California Environmental Protection Agency

Air Resources Board

Cruise Ship Onboard Incinerator Survey

(Please type or print legibly in ink)

Company information

Company Name:____

Division Name:____

Mailing Address: ____________________________________

____

____

Contact person: ____________________________________

Phone number w/area code:______________________________

E-mail address____________________fax number______________

Certification: I am an officer of the company listed above and hereby certify that all information entered by my company on this "Cruise Ship Onboard Incineration Survey" is complete and accurate to the best of my knowledge and belief.	
Print Name:	Title:
Signature:	Date:

NOTE: PLEASE PHOTOCOPY AND COMPLETE A SURVEY FOR EACH VESSEL IN YOUR FLEET.

Cruise Ship Information

Vessel Name ____

Country Flag____

Please check any of the following that apply. (You are not required to complete the remainder of the survey if any of the following apply. Please mail or fax your incomplete survey as specified at the end of page three.)

- ☐ Your vessel does not currently travel within three miles of the California coast.
- ☐ Your vessel does not meet the definition of a cruise ship (as specified in the attached legislation Assembly Bill 471).
- ☐ Your vessel does not conduct onboard incineration.

How many onboard incinerators are used for incineration?____

NOTE: IF THERE IS MORE THAN ONE ONBOARD INCINERATOR FOR THIS CRUISE SHIP PLEASE PHOTOCOPY THE REMAINDER OF THIS SURVEY AND FILL OUT THE INFORMATION FOR EACH INCINERATOR.

Waste and Incinerator Information

Please check the type of fuel that is used to run the incinerator?

- ❑ Fuel Oil
- ❑ Natural Gas
- ❑ Other________________

Please check below the types of garbage that are incinerated onboard this vessel (check all that apply).

- ❑ Plastics
- ❑ Floating dunnage, lining, or packing material
- ❑ Ground-down paper products, rags, glass, metal, bottles, crockery, etc.
- ❑ Paper products, rags, glass, metal, bottles, crockery, etc.
- ❑ Food waste

Approximately, how much waste is burned per year in this incinerator?
________ tons/year OR ________ m^3/yr

On average, how many hours do you burn waste in the incinerator per day? ______hours/day

On average, how many days per week does your incinerator operate?_________days/week

Do you currently maintain a garbage record log as specified by Annex V of MARPOL 73/78?

- ❑ Yes
- ❑ No

For the year 2003 OR 2004, please estimate the amount of waste that was incinerated within three miles of the California Coast. ________ tons/year OR ________ m^3/yr
This is for the year________.

What is the approximate distance (in meters) from the design draft water line of the ship to the top of the incinerator stack? ______meters

Does this incinerator have any of the following air pollution add-on controls (check all that apply)?

- ☐ Wet collectors (scrubbers) – spray towers, venturi scrubbers
- ☐ Dry scrubber
- ☐ Baghouse
- ☐ Electrostatic precipitator
- ☐ Carbon adsorption
- ☐ Cyclone
- ☐ Other (please list)____________________
- ☐ None

Other Waste Treatment

Besides incineration, briefly describe any other methods of waste treatment or disposal you do either in or out of port (e.g., recycling, autoclaving, etc.) ____________________

____

____

____

____

****END OF SURVEY****

Thank you for filling out this survey. **Please fax to (916) 327-6251 <u>OR</u> mail the survey back in the self-addressed envelope provided postmarked no later than May 6, 2005.** If you need additional copies of the survey or have any questions, please contact Ms. Michelle Komlenic, at (916) 322-3926 or via email at mkomleni@arb.ca.gov

Appendix F

Potential Health Effects of Pollutants Emitted from Cruise Ship Onboard Incineration

Appendix F

Potential Health Effects of Pollutants Emitted from Cruise Ship Onboard Incineration

This section summarizes the cancer and noncancer impacts that can result from exposure to pollutants emitted from cruise ship onboard incineration.

A. Arsenic (Inorganic)

Exposure to inorganic arsenic may result in both cancer and noncancer health effects. The probable route of human exposure to arsenic is by ingestion, inhalation, and permeation of skin or mucous membranes (ARB, 1997b). Table V-1 (in Chapter V) presents the current health effects values that are used in this health risk assessment for determining the potential health impacts.

1. Cancer

Evidence for carcinogenicity in humans due to inhaled arsenic is strong. Studies of workers in smelters and in the pesticide manufacturing industry have found strong, consistent associations between respiratory cancer and arsenic exposure. The effect on respiratory cancer rates of combining smoking and arsenic exposure appears to be greater than additive and at low doses may be as high as multiplicative (ARB, 1997b). Chronic exposure to high levels of arsenic in drinking water has been identified as increasing skin cancer incidence in humans (OEHHA, 2002).

The Office of Environmental Health Hazard Assessment (OEHHA) staff has performed an extensive assessment of the potential health effects of arsenic, reviewing available carcinogenicity data. OEHHA concluded that arsenic is a potential human carcinogen with no identifiable threshold below which no carcinogenic effects are likely to occur. The Air Resources Board (ARB/Board) formally identified arsenic as a toxic air contaminant (TAC) in July 1990 (ARB, 1990). Arsenic (inorganic arsenic compounds) was listed by the State of California under Proposition 65 as a carcinogen in February 1987 (OEHHA, 2005).

In 1990, the United States (U.S.) Congress listed arsenic as a hazardous air pollutant (HAP) in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). The United States Environmental Protection Agency (U.S. EPA) has classified inorganic arsenic as Group A, human carcinogen, based on sufficient epidemiological evidence (U.S. EPA, 2005). The International Agency for Research on Cancer (IARC) has classified inorganic arsenic and arsenic compounds as Group 1: Human carcinogen based on sufficient evidence in humans (IARC, 2005).

2. Noncancer

Acute inhalation exposure may result in severe irritation of the mucous membranes of the upper and lower respiratory tract with symptoms of cough, dyspnea, and chest pain. These may be followed by garlicky breath and gastrointestinal symptoms including vomiting and diarrhea. Signs of acute poisoning are dermatitis, nasal mucosal irritation, laryngitis, mild bronchitis, and conjunctivitis. The acute toxic symptoms of trivalent arsenic poisoning are due to severe inflammation of the mucous membranes and increased permeability of the capillaries. Inorganic arsenic compounds are easily absorbed through the skin; the trivalent is more rapidly absorbed than the pentavalent. Ingestion of two grams of arsenic trioxide was fatal to an adult male (OEHHA, 1999).

Persons with skin or respiratory conditions, including allergies, may be more sensitive to the toxic effects of arsenic. Persons with higher than normal intakes of arsenic, including smokers and fish and shellfish eaters, may be more sensitive to toxic effects following arsenic exposure (OEHHA, 1999).

Chronic inhalation exposure to inorganic arsenic in humans is associated with irritation of the skin and mucous membranes, while chronic oral exposure has resulted in gastrointestinal effects, anemia, peripheral neuropathy, skin lesions, and liver or kidney damage (ARB, 1997b).

Reports of human inhalation exposure to arsenic compounds, primarily epidemiological studies of smelter workers, indicate that adverse health effects occur as a result of chronic exposure. Among the targets of arsenic toxicity are the respiratory system, the circulatory system, the skin, the nervous system, and the reproductive system. Studies in experimental animals show that inhalation exposure to arsenic compounds can produce immunological suppression, developmental defects, and histological or biochemical effects on the nervous system and lung (OEHHA, 2000a).

The oxidation state of arsenic determines the teratogenic potential of its inorganic compounds; trivalent (III) arsenic compounds possess greater teratogenic potential than pentavalent (V) compounds. Chronic exposure to arsenic has been associated with decreased birth weight and an increased rate of spontaneous abortion in female smelter workers. However, this association is confounded by the presence of other toxicants in the smelting process, including lead (OEHHA, 1999). Arsenic (inorganic oxides) was listed by the State of California under Proposition 65 as developmental toxicants in May 1997 (OEHHA, 2005).

B. Beryllium

Exposure to beryllium may result in both cancer and noncancer health effects. The probable routes of human exposure to beryllium are inhalation ingestion, and dermal contact (ARB, 1997b). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

Several studies found increased incidences of lung cancer in beryllium processing workers (OEHHA, 2002). Beryllium is a federal HAP and was identified as a toxic air contaminant by the Board in April 1993 under AB 2728 (ARB, 1993). The OEHHA staff has performed an extensive assessment of the potential health effects of beryllium, reviewing available carcinogenicity data. OEHHA concluded that beryllium is a potential human carcinogen with no identifiable threshold below which no carcinogenic effects are likely to occur. Beryllium and beryllium compounds were listed by the State of California under Proposition 65 as carcinogens in October 1987 (OEHHA, 2005).

In 1990, the U.S. Congress listed beryllium compounds as HAPs in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). The U.S. EPA has classified beryllium as Group B1; probable human carcinogen (U.S. EPA, 2005). The International Agency for Research on Cancer has classified beryllium and beryllium compounds as Group 1: Human carcinogen (IARC, 2005).

2. Noncancer

Acute inhalation of high levels of beryllium can cause inflammation of the lungs in humans; these symptoms may be reversible after exposure ends (ARB, 1997b). The respiratory tract is the major target organ system in humans following the inhalation of beryllium. The common symptoms of chronic beryllium disease (CBD) include shortness of breath upon exertion, weight loss, cough, fatigue, chest pain, anorexia, and overall weakness. Most studies reporting adverse respiratory effects in humans involve occupational exposure to beryllium. Exposure to soluble beryllium compounds is associated with acute beryllium pneumonitis. Exposure to either soluble or insoluble beryllium compounds may result in obstructive and restrictive diseases of the lung, called chronic beryllium disease (berylliosis). The total number of beryllium-related disease cases has declined since the adoption of industrial standards (OEHHA, 2000a).

C. Cadmium

Exposure to cadmium may result in both cancer and noncancer health effects. The probable routes of human exposure to cadmium are inhalation and ingestion (ARB, 1997b). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

Epidemiological evidence strongly supports an association between cadmium exposure and neoplasia, including respiratory and renal cancers. Cancer resulting from inhalation exposure to several forms of cadmium has been reported in animal studies (ARB, 1997b).

OEHHA staff has performed an extensive assessment of the potential health effects of cadmium and compounds, reviewing available carcinogenicity data. OEHHA concluded that cadmium and compounds are potential human carcinogens with no identifiable threshold below which no carcinogenic effects are likely to occur. The Board formally identified cadmium and cadmium compounds as a TAC in January 1987 (ARB, 1986b). Cadmium and cadmium compounds were listed by the State of California under Proposition 65 as carcinogens in October 1987 (OEHHA, 2005).

In 1990, the U.S. Congress listed cadmium compounds as HAPs in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). The U.S. EPA classified cadmium in Group B1: Probable human carcinogen, based on human and animal studies showing an increase of lung cancer (U.S. EPA, 2005). The International Agency for Research on Cancer classified cadmium and cadmium compounds in Group 1: Human carcinogen based on epidemiological evidence of carcinogenicity in humans and carcinogenic effects observed in animals (IARC, 2005). There is limited evidence in experimental animals for the carcinogenicity of cadmium metal (ARB, 1997b).

2. Noncancer

Although ingestion is the major source of exposure, only one to ten percent of ingested cadmium appears to be absorbed systemically. Pulmonary absorption of inhaled cadmium is estimated to range from 10 to 50 percent of deposited cadmium. The biological half-life of cadmium in humans has been estimated to range from 10 to 30 years. Cadmium has moderate acute toxicity, producing gastrointestinal or pulmonary irritation effects from ingestion or inhalation, respectively. Subchronic and chronic exposures to cadmium have been associated with renal, cardiovascular, endocrine, hepatic, bone, hematological, and immunological effects. Respiratory conditions include bronchiolitis and emphysema. The U.S. EPA's Office of Air Quality Planning and Standards, for a hazard ranking under Section 112(g) of the Clean Air Act Amendments, considers cadmium oxide to be a "high concern" pollutant based on severe acute toxicity (ARB, 1997b).

Human developmental studies are limited, although there is some evidence to suggest that maternal cadmium exposure may result in decreased birth weights. Cadmium oral exposure induces testicular necrosis in experimental animals, ovarian damage, infertility, placental toxicity and embryo and fetotoxicity and teratogenicity. Developmental effects such as decreased weight gain and neurobehavioral deficits have been reported in animal studies (ARB, 1997b). Cadmium was listed by the State of California under Proposition 65 as a male reproductive and developmental toxicant in May 1997 (OEHHA, 2005).

D. Chromium

Exposure to chromium and chromium compounds may result in both cancer and noncancer health effects. The probable routes of human exposure to chromium compounds are inhalation, ingestion, and dermal contact (OEHHA, 2000). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

There are a number of human occupational studies that have demonstrated that inhalation exposure to chromium results in an increased risk of lung cancer mortality in humans. An oral chromium carcinogenicity bioassay study also shows that there is a significantly increased incidence of stomach carcinomas in female mice and benign tumors (papillomas and hyperkeratomas) in both male and female mice (OEHHA, 2002).

The OEHHA staff has performed an extensive assessment of the potential health effects of chromium (hexavalent), reviewing available carcinogenicity data. OEHHA concluded that chromium and chromium compounds are potential human carcinogens with no identifiable threshold below which no carcinogenic effects are likely to occur. The Board formally identified hexavalent chromium as a TAC in January 1986 (ARB, 1985). Chromium (hexavalent compounds) was listed by the State of California under Proposition 65 as carcinogens in February 1987 (OEHHA, 2005).

In 1990, the U.S. Congress listed chromium compounds as HAPs in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). The U.S. EPA has classified chromium (VI) in Group A: Human carcinogen and chromium (III) in Group D: Not classifiable as to carcinogenicity in humans (U.S. EPA, 2005). The International Agency for Research on Cancer has classified chromium (VI) compounds in Group 1: Human carcinogen, and metallic chromium and chromium (III) in Group 3: Not classifiable (IARC, 2005).

2. Noncancer

The principal chronic effect of chromium (VI) exposure is that Cr(VI) forms oxyanions at physiological pH ($CrO4^{2}$), which are quite similar to sulfate ($SO4^{-2}$) and phosphate ($HPO4^{-3}$) anions. Therefore, it is able to penetrate virtually every cell in the body because all cells transport sulfate and phosphate. Harmful effects are speculated to be related to the reduction of Cr(VI) to Cr(III) intracellularly when it crosses the cell membrane and forms complexes with intracellular macromolecules. Thus, Cr(VI) compounds have the potential to injure numerous organ systems. Toxicity following chronic Cr(VI) exposure has been reported in the respiratory tract, gastrointestinal system, eyes and conjunctiva, kidney, and hematopoietic system. Cr(VI) is corrosive and exposure to chromic acid mists may cause chronic skin ulcerations and upper respiratory lesions. In addition, allergic skin and respiratory reactions can occur with no relation to dose (OEHHA, 2000a).

Nasal tissue damage has been frequently observed in chromium plating workers exposed chronically to chromic acid mists. However, workers in the chromate extraction and ferrochromium industry, exposed to particulates containing soluble Cr(VI) compounds, have also reported nasal lesions. Nasal lesions include perforated septum, ulcerated septum, nasal atrophy, nosebleed, and inflamed mucosa (OEHHA, 2000a).

E. Hydrochloric Acid

Exposure to hydrochloric acid (HCl) may result noncancer health effects. The probable routes of human exposure to hydrochloric acid are inhalation and dermal contact (ARB, 1997b). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

Hydrochloric acid is a federal HAP and was identified as a TAC in April 1993 under AB 2728. No information is available on the carcinogenic effects of hydrochloric acid in humans. In one study, no carcinogenic response was observed in rats exposed by inhalation. The U.S. EPA has not classified hydrochloric acid as to its human carcinogenicity (U.S. EPA, 2005). The International Agency for Research on Cancer has classified hydrochloric acid in Group 3: Not classifiable as to its potential human carcinogenicity (IARC, 2005).

2. Noncancer

Inhalation exposure to high concentrations of HCl fumes may result in coughing, a choking sensation, burning of the respiratory tract, and pulmonary edema. Dental erosion has been reported in workers chronically exposed to low levels of gaseous hydrogen chloride. Reactive Airway Dysfunction Syndrome (RADS; acute, irritant-induced asthma) was reported in three male police officers (36 to 45 years old) who responded to a roadside chemical spill. Other reports of RADS include individual occupational cases (OEHHA, 1999).

Persons with preexisting skin, eye, gastrointestinal tract (including ulcers) or respiratory conditions or underlying cardiopulmonary disease may be more sensitive to the effects of HCl exposure. Persons also exposed to formaldehyde might be at increased risk for developing cancer (OEHHA, 1999).

The reproductive hazard of hydrogen chloride to humans is unknown. Few studies on the reproductive effects of HCl exposure were found in the literature. Maternal exposure to a high concentration of a strong acid could result in metabolic acidosis and subsequent fetal acidemia which has been linked with low Apgar scores, neonatal death, and seizures. However, there is no evidence linking HCl exposure to fetal academia (OEHHA, 1999).

F. Lead (Inorganic)

Exposure to lead may result in cancer health effects. The probable routes of human exposure to lead are inhalation and ingestion (ARB, 1997b). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

There are several inconclusive epidemiological studies of exposed workers which provided limited evidence of cancers of the kidney, stomach, and respiratory tract. Rodent studies have found increased kidney cancers following the oral administration of lead (ARB, 1997b).

OEHHA staff has performed an extensive assessment of the potential health effects of lead and lead compounds, reviewing available carcinogenicity data. OEHHA concluded that lead and lead compounds (inorganic) are a potential human carcinogen with no identifiable threshold below which no carcinogenic effects are likely to occur. The Board formally identified inorganic lead as a TAC in April 1997 (ARB, 1997a). Lead and lead compounds, lead acetate, lead phosphate, and lead subacetate were listed by the State of California under Proposition 65 as carcinogens in October 1992, January 1988, April 1988, and October 1989, respectively (OEHHA, 2005).

In 1990, the U.S. Congress listed lead compounds (including inorganic lead) as HAPs in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). U.S. EPA has classified lead in Group B2: Probable human carcinogen (U.S. EPA, 2005). The International Agency for Research on Cancer has classified lead and inorganic lead compounds in Group 2B: Possibly carcinogenic to humans, and organic lead in Group 3: Not classifiable (IARC, 2005).

2. Noncancer

Lead salts (e.g., lead acetate, lead subacetate) are considered to be forms of inorganic lead. Most significant non-workplace, outdoor air exposure to lead in California is expected to be to inorganic lead particulate. Although different lead species (e.g., lead oxide, lead sulfide, etc.) are absorbed to varying degrees following inhalation, all are capable of causing adverse health effects once they reach sensitive tissues (ARB, 1997b).

Lead is slowly excreted by the body. Exposures to small amounts of lead over a long time can slowly accumulate to reach harmful levels. Harmful effects may therefore develop gradually without warning. Short-term exposure to high levels of lead may also cause harm. Lead can adversely affect the nervous, reproductive, digestive, cardiovascular blood-forming systems, and the kidney. Symptoms of nervous system effects include fatigue and headaches. More serious symptoms include feeling anxious or irritable and difficulty sleeping or concentrating. Severe symptoms include loss of short-term memory, depression, and confusion. More severe exposures can prove fatal. Lead can also injure the peripheral nerves to cause weakness in the extremities. Children are a sensitive population as they absorb lead more readily and the developing nervous system puts them at increased risk for lead-related harm, including learning disabilities. Effects on the gastrointestinal tract include nausea, constipation, and loss of appetite. Recovery from severe effects on the nervous system or kidneys is not always complete. Other ill effects include hypertension and anemia. The toxicological endpoints considered for chronic toxicity are the kidney, cardiovascular or blood system, immune, reproductive, and central or peripheral nervous systems (ARB, 1997b).

In men, adverse reproductive effects include reduced sperm count and abnormal sperm. In women, adverse reproductive effects include reduced fertility. Still-birth, miscarriage, low birth weight, and neurobehavioral deficits may be more likely (ARB, 1997b). Lead was listed by the State of California under Proposition 65 as developmental toxicant and a male and female reproductive toxicant in February 1987 (OEHHA, 2005).

G. Manganese

Exposure to manganese and compounds may result in noncancer health effects. The probable route of human exposure to manganese and compounds is by ingestion and inhalation (ARB, 1997b). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

No studies are available regarding the carcinogenic effects of manganese and manganese compounds in humans or animals (ARB, 1997b).

In 1990, the U.S. Congress listed manganese compounds as HAPs in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). Manganese compounds were identified as TACs by the Board in April 1993 under AB 2728 (ARB, 1993). The U.S. EPA has classified manganese in Group D: Not classifiable as to human carcinogenicity (U.S. EPA, 2005). The International Agency for Research on Cancer has not classified manganese as to its carcinogenicity (IARC, 2005).

2. Noncancer

Short-term exposure to manganese may cause irritation to the eyes, nose, throat, and respiratory tract. Long-term exposure to manganese may affect the central nervous system, causing a psychosis which may include symptoms similar to Parkinson's disease. Respiratory effects may also be seen (ARB, 1997b).

I. Mercury (Inorganic)

Exposure to mercury and mercury compounds may result in noncancer health effects. The probable routes of human exposure to mercury and mercury compounds are inhalation, ingestion, and dermal contact (ARB, 1997b). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

The human studies available regarding elemental mercury and cancer are inconclusive due to lack of valid exposure data and confounding factors. No studies are available on the carcinogenic effects of methyl mercury in humans. One available animal study reported renal tumors in mice. A chronic study on mercuric chloride in rats and mice reported an increased incidence of forestomach and thyroid tumors in rats, and an increased incidence of renal tumors in mice (ARB, 1997b).

In 1990, the U.S. Congress listed mercury compounds as HAPs in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). The Board formally identified mercury as a TAC in April 1993 under AB 2728 (ARB, 1993). Methyl mercury compounds were listed by the State of California under Proposition 65 as carcinogens in May 1996 (OEHHA, 2005). The U.S. EPA has classified inorganic and methyl mercury in Group C: Possible human carcinogen; and elemental mercury in Group D: Not classifiable as a carcinogen (U.S. EPA, 2005). The International Agency for Research on Cancer has classified methyl mercury compounds in Group 2B: Possible human carcinogen, and metallic mercury and inorganic mercury compounds in Group 3: Not classifiable (IARC, 2005).

2. Noncancer

The respiratory tract is the first organ system affected in the case of acute inhalation poisonings. Acute exposure to mercury can lead to shortness of breath within 24 hours and a rapidly deteriorating course leading to death due to respiratory failure (OEHHA, 1999).

Central nervous system (CNS) effects such as tremors or increased excitability are sometimes seen in cases of acute accidental exposures. Long-term effects from a single exposure to mercury have been reported in six male workers exposed to an estimated concentration of 44 mg Hg/m^3 for a period of several hours. Long-term CNS effects included nervousness, irritability, lack of ambition, and loss of sexual drive for several years. Shortness of breath also persisted for years in all cases. Similar cases of CNS disturbances, including irritability, insomnia, malaise, anorexia, fatigue, ataxia, and headache have been reported in children exposed to vapor from spilled elemental mercury in their home (OEHHA, 1999).

Persons with preexisting allergies, skin conditions, chronic respiratory disease, nervous system disorders, or kidney diseases might have increased toxicity. Persons exposed to other neurotoxicants might have increased sensitivity. People who consume significant amounts of fish from areas with advisories for daily fish intake due to mercury contamination may be more susceptible to the acute toxicity of airborne mercury (OEHHA, 1999).

The primary effects of chronic exposure to mercury vapor are on the central nervous system. Chronic duration exposures to elemental mercury have resulted in tremors (mild or severe), unsteady walking, irritability, poor concentration, short-term memory deficits, tremulous speech, blurred vision, performance decrements, paresthesia, and decreased nerve conduction. Motor system disturbance can be reversible upon cessation of exposure; however, memory deficits may be permanent. Studies have shown effects such as tremor and decreased cognitive skills in workers exposed to approximately 25 $\mu g/m^3$ mercury vapor (OEHHA, 2000a).

The kidney is also a sensitive target organ of mercury toxicity. Effects such as proteinuria, proximal tubular and glomular changes, albuminuria, glomerulosclerosis, and increased urinary N-acetyl-β-glucosaminidase have been seen in workers exposed to approximately 25 to 60 $\mu g/m^3$ mercury vapor. Chronic exposure to mercury vapors has also resulted in cardiovascular effects such as increased heart and blood pressure and in leukocytosis and neutrophilia (OEHHA, 2000a).

In rats, elemental mercury readily crosses the placental barrier and accumulates in the placenta following inhalation. One study reported decreased crown-rump length and increased incidence of edema in hamster fetuses following single subcutaneous administration of 4 mg/kg Hg as mercuric acetate on day 8 of gestation. Exposure to 2.5 mg/kg Hg resulted in no significant developmental defects in these hamsters. This study later showed that the most common manifestations of mercury-induced embryotoxicity in hamsters were resorption, edema, and cardiac abnormalities. Pregnant rats exposed by inhalation to 1.8 mg/m^3 of metallic mercury for 1 hour or 3 hours/day during gestation (days 11 through 14 plus days 17 through 20) bore pups that displayed significant dose-dependent deficits in behavioral measurements three to seven months after birth compared to unexposed controls. Behaviors measured included spontaneous motor activity, performance of a spatial learning task, and habituation to the automated test chamber. The pups also showed dose-dependent, increased mercury levels in their brains, livers, and kidneys two to three days after birth (OEHHA, 1999). Mercury and mercury compounds were listed by the State of California under Proposition 65 as developmental toxicants in July 1987 (OEHHA, 2005).

J. Nickel

Exposure to nickel and nickel compounds may result in both cancer and noncancer health effects. The probable route of human exposure to nickel is by ingestion, inhalation, and dermal (ARB, 1997b). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

Inhalation exposure to nickel refinery dust and nickel subsulfide has been shown to cause nasal and lung cancer in refinery workers. Nickel carbonyl has been reported to cause lung tumors in animal studies. OEHHA staff concluded that based on available genotoxicity and carcinogenicity data and physiochemical properties of nickel compounds, all nickel compounds should be considered potentially carcinogenic to humans by inhalation, and total nickel should be considered when evaluating the risk by inhalation (ARB, 1997b).

OEHHA staff has performed an extensive assessment of the potential health effects of nickel, reviewing available carcinogenicity data. OEHHA concluded that nickel and compounds are potential human carcinogen with no identifiable threshold below which no carcinogenic effects are likely to occur. The Board formally identified nickel and nickel compounds as TACs in August 1991 (ARB, 1991). Nickel and certain nickel compounds (nickel acetate, nickel carbonate, nickel carbonyl, nickel refinery dust from the pyrometallurgical process, nickel subsulfide) were listed by the State of California under Proposition 65 as carcinogens in October 1987, October 1989, and May 2004 (OEHHA, 2005).

In 1990, the U.S. Congress listed nickel compounds as HAPs in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). The U.S. EPA has classified nickel refinery dusts and nickel subsulfide in Group A: Human carcinogen and nickel carbonyl in Group B2: Probable human carcinogen (U.S. EPA, 2005).

The International Agency for Research on Cancer (IARC) reviewed nickel and nickel compounds in 1990 and concluded that there is sufficient evidence in humans for the carcinogenicity of nickel sulfate, and of the combinations of nickel sulfides and oxides encountered in the nickel refining industry; there is inadequate evidence in humans for the carcinogenicity of metallic nickel and nickel alloys; there is sufficient evidence in experimental animals for the carcinogenicity of metallic nickel, nickel monoxides, nickel hydroxides and crystalline nickel sulfides; there is limited evidence in experimental animals for the carcinogenicity of nickel alloys, nickelocene, nickel carbonyl, nickel salts, nickel arsenides, nickel antimonide, nickel selenides, and nickel telluride; and there is inadequate evidence in experimental animals for the carcinogenicity of nickel trioxide, amorphous nickel sulfide and nickel titanate. IARC concluded that nickel compounds are carcinogenic to humans, classifying them in Group 1: Human carcinogen; and classified metallic nickel in Group 2B: Possible human carcinogen (ARB, 1997b).

The International Committee on Nickel Carcinogenesis in Man indicated that the epidemiological evidence points to insoluble and soluble nickel compounds as contributing to the cancers seen in occupationally exposed persons. Both insoluble and soluble nickel compounds have produced tumors in animals by a variety of routes, primarily by injection. Both soluble and insoluble nickel compounds are genotoxic in a wide variety of assays. Evidence is available indicating that the Ni^{2+} ion is probably the carcinogenic agent (ARB, 1997b). IARC has classified inorganic arsenic and arsenic compounds as Group 1: Human carcinogen based on sufficient evidence in humans (IARC, 2005).

2. Noncancer

Soluble nickel compounds appear to be the greatest concern for acute health effects. The soluble forms of nickel are absorbed as Ni^{2+}. Divalent nickel competes with copper for binding to serum albumin and is systemically transported in this way. The kidneys, lungs, and placenta are the principal organs for systemic accumulation of nickel. In contrast to the long half-life of the insoluble forms of nickel in the nasal mucosa, the elimination half-life of Ni^{2+} in the plasma is one to two days in mice (OEHHA, 1999).

The effects from long-term exposure to nickel include respiratory tract irritation and immune alterations such as dermatitis ("nickel itch") and asthma. Acute exposure to nickel and nickel compound fumes may cause irritation of the respiratory tract, skin, and eyes. A daily requirement of 50 micrograms of nickel has been estimated to be an essential element in human nutrition. Nickel carbonyl is the most acutely toxic form of nickel. Exposure to nickel carbonyl can cause irritation of the lower respiratory tract and delayed pulmonary edema. It may also injure the liver and central nervous system (ARB, 1997b).

Although there are insufficient data to assess nickel's effect on reproductive functions in humans, all forms of nickel examined to date in laboratory animals have exhibited adverse effects on male reproductive function. Animal studies also demonstrate that nickel adversely affects spermatogenesis, litter size and pup body weight; however, no teratogenic effects have been clearly demonstrated for compounds other than nickel carbonyl (ARB, 1997b). Nickel carbonyl was listed by the State of California under Proposition 65 as developmental toxicants in September 1996 (OEHHA, 2005).

K. Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans

There are 210 polychlorinated dibenzodioxin (PCDD) and dibenzofuran (PCDF) isomers. The various isomers are not equally toxic nor are they considered equally potent as carcinogens or non-carcinogens. For the purpose of assessing cancer and noncancer risk associated with these chemicals, OEHHA has adopted the World Health Organization 1997 (WHO_{97}) Toxicity Equivalency Factor scheme for evaluating the cancer and noncancer risk due to exposure to samples containing mixtures of PCDD and PCDF (OEHHA, 2003). In cases where speciation of PCDDs and PCDFs has not been performed, then 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) serves as the surrogate for PCDD and PCDF emissions (OEHHA, 2003).

Exposure to PCDDs and PCDFs may result in both cancer and noncancer health effects. The probable route of human exposure to TCDD is by ingestion, inhalation, and dermal exposure through contact with contaminated soils (ARB, 1997b). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. Cancer

Mother's milk may expose a nursing baby to 4 to 12 percent of the estimated lifetime dose. Once dioxin enters the human body, a small amount is metabolized and eliminated, while the rest bioaccumulates in body fat. As fat is metabolized, stored dioxin is released and excreted primarily in feces. The body's concentration is dependent on the rates of ingestion, elimination, and storage capacity of dioxin. The approximate half-life of dioxin in humans was estimated to range from six to ten years (ARB, 1997b).

Human studies which have reported cancer increases are inconclusive because of inadequate data. There is adequate evidence to support a conclusion that TCDD is carcinogenic in rodents and should be considered a potential carcinogen to humans. Ingestion studies in rodents have shown increases in tumors of the liver, lung, squamous cell, nasal turbinates, and hard palate (ARB, 1986a).

OEHHA staff has performed an extensive assessment of the potential health effects of PCDDs and PCDFs, reviewing available carcinogenicity data. OEHHA concluded that PCDDs and PCDFs are potential human carcinogens with no identifiable threshold below which no carcinogenic effects are likely to occur. The Board formally identified PCDDs and PCDFs as TACs in July 1986 (ARB, 1986a). PCDDs and PCDFs were listed by the State of California under Proposition 65 as carcinogens in October 1992 (OEHHA, 2005).

In 1990, the U.S. Congress listed TCDD as a HAP in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). U.S. EPA has classified hexachlorodibenzo-*p*-dioxin (HxCDD), mixture of 1,2,3,6,7,8-HxCDD and 1,2,3,7,8,9-HxCDD as B2; probable human carcinogen (U.S. EPA, 2005). The International Agency for Research on Cancer has classified TCDD as Group 1: Human carcinogen, based on sufficient evidence in humans (IARC, 2005).

2. Noncancer

Acute exposure of humans to dioxins has caused chloracne, liver toxicity, skin rashes, nausea, vomiting, and muscular aches and pains. A severe weight loss in animals has been observed following acute exposure to dioxin as have hyperkeratosis, facial alopecia, inflammation of the eyelids, and loss of fingernails and eyelashes. The immune system appears to be very sensitive to dioxin toxicity. Thymic atrophy is a prominent finding in exposed animals and has been observed in all laboratory species examined. Other lymphoid tissues such as the spleen, lymph nodes, and bone marrow are also affected. Symptoms of chronic exposure to dioxins include splenic and testicular atrophy, elevated gamma-glutamyl transpeptidase levels, elevated cholesterol levels, and abnormal neurological findings. Other effects may include risk of enzyme induction, diabetes, and endocrine changes (ARB, 1997b).

Potential effects of a toxicant on normal fetal development include fetal death, growth retardation, structural malformations and organ system dysfunction. Evidence for all four of these responses has been seen in human populations exposed to dioxin-like compounds. In these poisoning episodes populations were exposed to a complex mixture of halogenated aromatic hydrocarbons contained within PCBs, PCDFs and PCDDs mixtures thus limiting the conclusions that could be drawn from the data (OEHHA, 2000a). Animal studies have shown TCDD to be both teratogenic and fetotoxic. Reproductive and teratogenic effects observed in animals are cleft palate, kidney abnormalities, decreased fetal weight and survival, hydrocephalus, open eye, edema, resorptions, petechiae, and infertility (ARB, 1997b). TCDD was listed by the State of California under Proposition 65 as developmental toxicants in January 1988 (OEHHA, 2005).

L. Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic organic matter (POM) consists of over 100 compounds and is defined by the Federal Clean Air Act as organic compounds with more than one benzene ring that have a boiling point greater than or equal to 100°C. POM can be divided into the subgroups of polycyclic aromatic hydrocarbons (PAHs) and PAH-derivatives. PAHs are organic compounds which include only carbon and hydrogen with a fused ring structure containing at least two benzene (six-sided) rings. PAHs may also contain additional fused rings that are not six-sided. PAH-derivatives also have at least two benzene rings and may contain additional fused rings that are not six-sided rings. However, PAH-derivatives contain other elements in addition to carbon and hydrogen (ARB, 1997b).

Health values and potency equivalency factors (PEFs) have been developed for approximately 26 PAHs. When speciation of PAHs has been performed on facility emissions, these health values and PEFs should be used. In those cases where speciation of PAHs has not been performed, then benzo(a)pyrene [B(a)P] serves as the surrogate carcinogen for all PAH emissions (OEHHA, 2003).

Exposure to PAHs may result in both cancer and noncancer health effects. The probable route of human exposure to PAHs is by ingestion, inhalation, and dermal contact (ARB, 1997b). Table V-1 presents the current health effects values that are used in this HRA for determining the potential health impacts.

1. <u>Cancer</u>

Available epidemiological information is from persons exposed to mixtures such as tobacco smoke, diesel exhaust, air pollutants, synthetic fuels, or other similar materials. Several IARC publications have been dedicated to the analysis of cancer in processes which involve exposure to polynuclear aromatic compounds (PAHs). The types of cancer reported are often consistent with the exposure pathway: scrotal cancer and lung cancer in chimney sweeps exposed to soot; skin cancer (including scrotal cancer) where shale oils are used; and lung cancer where airborne exposure of PAHs occurs, such as in iron and steel foundries. In animal studies, B(a)P is carcinogenic by intratracheal, inhalation, dermal exposure, intraperitoneal injection, and when given in the diet (OEHHA, 2002).

OEHHA staff has performed an extensive assessment of the potential health effects of PAHs, reviewing available carcinogenicity data. OEHHA concluded that PAHs are potential human carcinogens with no identifiable threshold below which no carcinogenic effects are likely to occur. POM is a federal HAP and was identified as a TAC in April 1993 under AB 2728. The Board formally identified B(a)P as a TAC in April 1994 (ARB, 1994). Several POM compounds (including benzo(a)pyrene) were listed by the State of California under Proposition 65 as carcinogens in July 1987 (OEHHA, 2005).

In 1990, the U.S. Congress listed POM as a HAP in subsection (b) of Section 112 of the Federal Clean Air Act (42 U.S.C. 7412). U.S. EPA has classified benzo[a]pyrene in Group B2: Probable human carcinogen, based on sufficient evidence of carcinogenicity in animals (U.S. EPA, 2005). The International Agency for Research on Cancer has classified benzo[a]pyrene in Group 2A: Probable human carcinogen based on sufficient evidence in animals and limited evidence in humans (IARC, 2005).

2. <u>Noncancer</u>

No information is available on the acute effects of POM in humans. Enzyme alterations in the mucosa of the gastrointestinal tract and increased liver weights have been reported in animals exposed orally to several PAHs. Chronic exposure to benzo(a)pyrene in humans has resulted in dermatitis, photosensitization in sunlight, eye irritation and cataracts. Animal studies have reported effects on the blood and liver from oral exposure to benzo(a)pyrene and effects on the immune system from dermal exposure to benzo(a)pyrene (ARB, 1997b).

No information is available on adverse reproductive or developmental effects of POM in humans. Oral exposure to benzo(a)pyrene in animals has been reported to result in adverse reproductive effects, including reduced incidence of pregnancy and decreased fertility; and developmental effects such as reduced viability of litters and reduced mean pup weight, and decreased fertility in offspring. Benzo(a)pyrene has been demonstrated to cause transplacental carcinogenesis in animals (ARB, 1997b).

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Appendix G

Assembly Bill 471

Assembly Bill No. 471

CHAPTER 706

An act to add Chapter 3.3 (commencing with Section 39630) to Part 2 of Division 26 of the Health and Safety Code, relating to air emissions.

[Approved by Governor September 23, 2004. Filed with Secretary of State September 23, 2004.]

LEGISLATIVE COUNSEL'S DIGEST

AB 471, Simitian. Air emissions: cruise ships.

Existing law regulates the release of sewage sludge, oily bilgewater, hazardous waste, or other waste by large passenger vessels into the marine waters of the state.

This bill would prohibit a cruise ship, as defined, from conducting onboard incineration while operating within 3 miles of the California coast.

The people of the State of California do enact as follows:

SECTION 1. Chapter 3.3 (commencing with Section 39630) is added to Part 2 of Division 26 of the Health and Safety Code, to read:

CHAPTER 3.3. CRUISE SHIPS

39630. The Legislature finds and declares that it is in the interests of all Californians to protect the air quality from increasing volumes of cruise ship engine emissions.

39631. (a) The state board shall enforce this chapter, and may adopt standards, rules, and regulations for that purpose pursuant to Section 39601.

(b) As used in this division, "cruise ship" means a commercial vessel that has the capacity to carry 250 or more passengers for hire. "Cruise ship" does not include the following:

(1) Vessels without berths or overnight accommodations for passengers.

(2) Noncommercial vessels, warships, vessels operated by nonprofit entities as determined by the Internal Revenue Service, and vessels operated by the state, United States, or a federal government.

39632. Commencing on January 1, 2005, a cruise ship shall not conduct onboard incineration while operating within three miles of the California coast, to the extent allowed by federal law.

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Appendix H

Health Risk Assessment Methodology for Emissions from Cruise Ship Onboard Incineration

Appendix H

Health Risk Assessment Methodology for Emissions from Cruise Ship Onboard Incineration

A. Introduction

This appendix presents the methodology used to estimate the potential multipathway cancer and noncancer health impacts from exposure to cruise ship onboard incineration emissions, as discussed in Chapter V. The assumptions used to determine these potential health risks are based on a modeling scenario for incineration from cruise ships traveling in and out of both the Port of Los Angeles and the Port of Long Beach (combined). These ports were selected because they have the highest amount of port traffic (from cruise ships) in the State. The next largest port (Port of San Diego) has approximately 50 percent the traffic of the Ports of Los Angeles and Long Beach. Emissions, source release parameters, and modeling inputs are discussed in the sections which follow.

B. Emission Estimates and Source Layout

Emissions data from land-based municipal waste incinerators were used to estimate emissions for cruise ship onboard incinerators because staff was not able to locate any emissions testing for actual cruise ship incinerators. However, as discussed in Chapter V, land-based municipal waste incinerators typically incinerate general household waste and have some similar waste streams to cruise ships, including food waste, packaging, paper and cardboard items, general light plastic waste, rags, etc. Table H-1 shows the emission rates applied to cruise ship onboard incineration for this assessment.

Table H-1. Pollutant Emissions Rates

Pollutant	Controlled (lb/hr)	Uncontrolled (lb/hr)
Hydrochloric Acid (HCl)	3.65	365
Arsenic	3.92E-04	3.92E-02
Beryllium	6.99E-06	6.99E-04
Chromium	3.88E-05	3.88E-03
Lead	7.79E-04	7.79E-02
Cadmium	2.55E-05	2.55E-03
Manganese	5.23E-04	5.23E-02
Nickel	2.22E-04	2.22E-02
Mercury	1.50E-02	1.50E+00
Naphthalene	4.36E-05	4.36E-03
Total Polycyclic Aromatic Hydrocarbons (treated as Benzo(A)pyrene for HRA)	4.02E-07	4.02E-05

Data from the Cruise Ship Onboard Incinerator Survey (Survey) indicated that onboard incinerators are both controlled and uncontrolled, depending on the individual cruise ship, whereas the available data for land-based incinerators were all controlled. In order to account for this, we increased the controlled emission rates from land-based incinerators by 99 percent in order to provide an estimate for uncontrolled cruise ship emission rates. This adjustment is based on a 99 percent control efficiency of the air pollution control equipment typically used in conjunction with incineration (see Chapter IV).

ARB staff estimated that about ten percent of the port calls (visits) in 2004 were by cruise ships with a control efficiency similar to the municipal waste incinerators. Another 30 percent had some type of control device but most likely were not controlled to the efficiency of the municipal waste incinerators. Therefore, for this analysis we assumed ten percent of the port calls were made by ships with a 99 percent control efficiency and the rest were uncontrolled.

For this health risk assessment (HRA), staff evaluated the potential health impacts at the Port of Los Angeles and the Port of Long Beach (Ports). We adjusted emissions by using the annual number of port calls at the Ports since they are in close proximity to each other and the combination of both ports could cumulatively impact the potential health impacts for workers at the Ports or residents living near the Ports. Staff chose these Ports for the HRA since they are the most highly visited by the cruise ships in California. Due to a significantly lower number of port calls at other ports throughout California, it is not expected that the potential health impacts at other ports would be higher than what is seen at the Ports of Los Angeles and Long Beach. As shown in Table H-2, calls to the Ports accounted for 55 percent of total port calls statewide in 2004.

Table H-2. Cruise Ship Port Calls to California Ports[1]

Port Name	Number of Port Calls	Percent of Port Calls[2]
Los Angeles & Long Beach	361	55
San Diego	179	27
San Francisco	76	12
All Others (Avalon/Catalina, Monterey, Oakland, Port Hueneme, Humboldt, Santa Barbara)	36	6
Total	652	-

1. Source: CSLC, 2004. Port calls to Los Angeles and Long Beach are reported as a total and are not separated out.
2. Values have been rounded.

Emissions were spread across the most heavily traveled southern shipping lane of the Ports, which handles the vast majority of cruise ship traffic. The incineration of materials was assumed to be taking place from the Three Nautical Mile Line, as specified on the National Oceanic and Atmospheric Administration (NOAA) Nautical Charts, to 30 miles out at sea. ARB staff placed the ships at 21 locations between the 3 and 30-mile marks on this shipping lane; assuming the emissions are spread evenly at each emission point. The incineration time in this 27-mile zone was estimated to be approximately 1.5 hours in each direction, traveling inbound and outbound from the Three Nautical Mile Line.

C. Air Dispersion Modeling

The model that was used during this HRA was Hot Spots Analysis and Reporting Program (HARP) (ARB, 2005b). HARP includes an air dispersion model, ISCST3. U.S. EPA recommends the ISCST3 model for refined air dispersion modeling (U.S. EPA, 1995). HARP is a recommended tool for risk analysis in California and can be used for most source types (e.g., point, area, and volume sources) and is currently used by the ARB, districts, and other states.

Cruise ship operators provided ARB staff with information on incinerator design and information such as stack height, diameter, temperature, and flow rates. This data was used in the air dispersion modeling analysis to estimate downwind concentrations. The meteorological data used for this air dispersion modeling scenario is Wilmington 2001. Wilmington meteorological data was used because it is the closest available data to the Ports. Table H-3 summarizes the modeling parameters used for this analysis.

Table H-3. Modeling Parameters

Parameter	Value
Model	ISCST (Version 99155)
Emission Rates	Source Test Data
Operating Hours	3 hours per port call, 379 port calls per year for a total of 1137 hours
Source Type	Series of point sources distributed in shipping channel (21 discrete locations at 3, 5, 7, 9, 11 13, 15, 17, 19, 21, 24, and 30 miles)
Dispersion Setting	Rural
Receptor Height	1.5 meters
Stack Diameter	12 inches
Stack Height	50 meters
Stack Temperature	300 and 600 degrees Fahrenheit
Stack Exit velocity	4200 feet/minute
Time Emissions Emitted	All hours
Meteorological Data	Wilmington 2001

D. Pollutant-Specific Health Values

Dose-response or pollutant-specific health effects values are developed to characterize the relationship between a person's exposure to a pollutant and the incidence or occurrence of an adverse health effect. A cancer potency factor (CPF) is used when estimating potential cancer risks and reference exposure levels (RELs) are used to assess potential non-cancer health impacts.

As presented in Appendix F, exposure to TACs may result in both cancer and non-cancer health effects. The inhalation and oral CPFs and non-cancer acute and chronic RELs that are used for this HRA are listed in Table H-4 (at the end of this appendix). Also included in Table H-4 are the non-cancer acute and chronic toxicological endpoints for the pollutants. Table H-4 reflects the most current OEHHA-adopted health effects values for these compounds.

E. Risk Assessment

ARB staff conducted a multipathway HRA to evaluate cancer and noncancer health impacts remaining after implementation of the proposed airborne toxic control measure (ATCM). Pathways included for evaluation include inhalation, dermal, ingestion of soil, and mother's (breast) milk. These are the minimum pathways that should be evaluated when assessing compounds with multipathway effects. The risk assessment was completed using the Tier 1 multipathway methodology outlined in *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments, August 2003* (OEHHA Guidelines) (OEHHA, 2003). In conjunction with the OEHHA Guidelines, staff also followed the ARB's *Recommended Interim Risk Management Policy For Inhalation-Based Residential Cancer Risk* (ARB, 2003).

As noted in Chapter V, the cruise ship industry estimates a 25 percent increase in the number of vessels that will operate in the waters of the State over the next ten years (CSETF, 2003). Based on this, staff assumed a 25 percent increase in the number of Port calls until 2015. Noncancer chronic and acute health impacts for both residents and off-site workers are also considered. These values are reported as hazard indices. In general, hazard indices less than one are not a concern to public health. Lead, one of the pollutants of concern, was evaluated by comparing the modeled 30-day concentration to the lead levels found in ARB's *Risk Management Guidelines for New, Modified, and Existing Sources of Lead* (ARB, 2001). The results of this risk assessment are presented in Chapter V, Section C.

Table H-4. Pollutant-Specific Health Values Used for Determining Potential Health Impacts[1]

Chemical	Cancer Risk		Non-Cancer Effects					
	Inhalation Cancer Potency Factor (mg/kg-d)$^{-1}$	Oral Slope Factor (mg/kg-d)$^{-1}$	Acute Inhalation (µg/m^3)	Acute Target Organs	Chronic Inhalation (µg/m^3)	Chronic Inhalation Target Organs	Chronic Oral (mg/kg/d)	Chronic Oral Target Organs
Arsenic (inorganic)	1.2E+01	1.5E+00	1.9E-01 AveP	Developmental, Reproductive	3.0E-02	Cardiovascular, Developmental, Nervous	3.0E-04	Cardiovascular, Skin
Beryllium	8.4E+00				7.0E-03	Immune, Respiratory	2.0E-03	Alimentary
Cadmium	1.5E+01				2.0E-02	Kidney, Respiratory	5.0E-04	Kidney
Chromium (Treated as five percent hexavalent chromium for HRA)	5.1E+02				2.0E-01	Respiratory	2.0E-02	Hematologic
Hydrochloric Acid (Hydrogen chloride)			2.1E+03	Eye, Respiratory	9.0E+00	Respiratory		
Lead (inorganic)	4.2E-02	8.5E-03						
Manganese					2.0E-01	Nervous		
Mercury (Inorganic)			1.8E+00	Developmental, Reproductive	9.0E-02	Nervous	3.0E-04	Immune, Kidney
Nickel	9.1E-01		6.0E+00	Immune, Respiratory	5.0E-02	Hematologic, Respiratory	5.0E-02	Alimentary
Polychlorinated Dibenzo-p-Dioxins (PCDD) (Treated as 2,3,7,8-TCDD for HRA)[2]	1.3E+05	1.3E+05			4.0E-05	Alimentary, Developmental; Endocrine; Hematologic, Reproductive, Respiratory	1.0E-08	Alimentary, Developmental; Endocrine; Hematologic, Reproductive, Respiratory
Polychlorinated Dibenzofurans (PCDF) (Treated as 2,3,7,8-Tetrachlorodibenzo-p-Dioxin for HRA)[2]	1.3E+05	1.3E+05			4.0E-05	Alimentary, Developmental; Endocrine; Hematologic, Reproductive, Respiratory	1.0E-08	Alimentary, Developmental; Endocrine; Hematologic, Reproductive, Respiratory
Polycyclic Aromatic Hydrocarbon (PAH) (Treated as Benzo(a)Pyrene for HRA)	3.9E+00	1.2E+01						

Footnotes: see next page.

Footnotes for Table H-4:

1. Health effect values were obtained from:

   a. The OEHHA Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part I, The Determination of Acute RELs for Airborne Toxicants, March 1999;

   b. The OEHHA Air Toxics "Hot Spots" Program Risk Assessment Guidelines, Part II, Technical Support Document for Describing Available Cancer Potency Factors (Revised), December 2002;

   c. The Air Toxics Hot Spots Program Risk Assessment Guidelines; Part III; Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels, April 2000; and

   d. The Air Toxics Hot Spots Risk Assessment Guidelines; Part IV; Exposure Assessment and Stochastic Analysis Technical Support Document, September 2000.

2. Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans (also referred to as chlorinated dioxins and dibenzofurans): OEHHA has adopted the World Health Organization 1997 (WHO_{-97}) Toxicity Equivalency Factor scheme for evaluating the cancer risk due to exposure to samples containing mixtures of polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) and determining cancer risks for a number of specific PCB congeners. See Appendix A of OEHHA's *Technical Support Document For Describing Available Cancer Potency Factors* for more information about the scheme. See Appendix E of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* for the methodology for calculating 2,3,7,8-equivalents for PCDDs, PCDFs and a number of specific PCB congeners. See section 8.2.3 of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* for conducting health risks when total (unspeciated) chlorinated dioxins and furans are reported.

AveP. Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans (also referred to as chlorinated dioxins and dibenzofurans): OEHHA has adopted the World Health Organization 1997 (WHO_{-97}) Toxicity Equivalency Factor scheme for evaluating the cancer risk due to exposure to samples containing mixtures of polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) and determining cancer risks for a number of specific PCB congeners. See Appendix A of OEHHA's *Technical Support Document For Describing Available Cancer Potency Factors* for more information about the scheme. See Appendix E of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* for the methodology for calculating 2,3,7,8-equivalents for PCDD, PCDFs and a number of specific PCB congeners. See section 8.2.3 of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* for conducting health risks when total (unspeciated) chlorinated dioxins and furans are reported.

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Appendix I

Glossary of Definitions, Selected Terms, and Acronyms

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Glossary of Definitions, Selected Terms, and Acronyms

Definitions

Acute Exposure: One or a series of short-term exposures generally lasting less than 24 hours.

Acute Health Effects: A health effect that occurs over a relatively short period of time (e.g., minutes or hours). The term is used to describe brief exposures and effects which appear promptly after exposure.

Adverse Health Effect: A health effect from exposure to air contaminants that may range from relatively mild temporary conditions, such as eye or throat irritation, shortness of breath, or headaches, to permanent and serious conditions, such as birth defects, cancer or damage to lungs, nerves, liver, heart, or other organs.

Air Dispersion Modeling: Algorithms, usually performed with a computer, that relate a mass emission rate, source configuration, and meteorological information to calculate ambient air concentrations.

Air District or District: The Air Pollution Control and Air Quality Management Districts, as defined in Health and Safety Code section 39025, are the political bodies responsible for managing air quality on a regional or county basis. California is currently divided into 35 air districts.

Airborne Toxic Control Measure: Section 39655 of the Health and Safety Code, defines an "Airborne Toxic Control Measure" means either of the following:

1) Recommended methods, and, where appropriate, a range of methods, that reduce, avoid, or eliminate the emissions of a toxic air contaminant. Airborne toxic control measures include, but are not limited to, emission limitations, control technologies, the use of operational and maintenance conditions, closed system engineering, design equipment, or work practice standards, and the reduction, avoidance, or elimination of emissions through process changes, substitution of materials, or other modifications.
2) Emission standards adopted by the U.S. Environmental Protection Agency pursuant to section 112 of the federal act (42 U.S.C. Sec. 7412).

Asthma: A chronic inflammatory disorder of the lungs characterized by wheezing, breathlessness, chest tightness, and cough.

Bioaccumulation: The concentration of a substance in a body or part of a body or other living tissue in a concentration higher than that of the surrounding environment.

California Air Resources Board (ARB): The State's lead air quality management agency consisting of an eleven-member board appointed by the Governor. The ARB is responsible for attainment and maintenance of the state and federal air quality standards, and is fully responsible for motor vehicle pollution control. It oversees county and regional air pollution management programs.

Cancer Potency Factor (CPF): The theoretical upper bound probability of extra cancer cases occurring in an exposed population assuming a lifetime exposure to the chemical when the chemical dose is expressed in exposure units of milligrams/kilogram-day (mg/kg-d).

California Air Pollution Control Officers Association (CAPCOA): A non-profit association of the air pollution control officers from all 35 air quality districts throughout California. CAPCOA was formed in 1975 to promote clean air and to provide a forum for sharing knowledge, experience, and information among the air quality regulatory agencies around the state.

CCR: California Code of Regulations

Chronic Exposure: Long-term exposure, usually lasting one year to a lifetime.

Chronic Health Effect: An adverse non-cancer health effect that develops and persists (e.g., months or years) over time after long-term exposure to a substance.

Cruise Ship: A commercial vessel that has the capacity to carry 250 or more passengers for hire and has berths or overnight accommodations for passengers.

Developmental Toxicity: Adverse effects on the developing organism that may result from exposure prior to conception (either parent), during prenatal development, or postnatally to the time of sexual maturation. Adverse developmental effects may be detected at any point in the life span of the organism. Major manifestations of developmental toxicity include: death of the developing organism; induction of structural birth defects; altered growth; and functional deficiency.

Dose: A calculated amount of a substance estimated to be received by the subject, whether human or animal, as a result of exposure. Doses are generally expressed in terms of amount of chemical per unit body weight; typical units are mg/kg-day.

Dose-response Assessment: The process of characterizing the relationship between the exposure to an agent and the incidence of an adverse health effect in exposed populations.

Endpoint: An observable or measurable biological or biochemical event including cancer used as an index of the effect of a chemical on a cell, tissue, organ, organism, etc.

Epidemiology: The study of the occurrence and distribution of a disease or physiological condition in human populations and of the factors that influence this distribution.

Exposure: Contact of an organism with a chemical, physical, or biological agent. Exposure is quantified as the amount of the agent available at the exchange boundaries of the organism (e.g., skin, lungs, digestive tract) and available for absorption.

Exposure Pathway: A route of exposure by which xenobiotics enter the human body (e.g., inhalation, ingestion, dermal absorption).

Hot Spots Analysis and Reporting Program (HARP): A single integrated software package designed to promote statewide consistency, efficiency, and cost-effective implementation of health risk assessments and the Hot Spots Program. The HARP software package consists of modules that include: emissions inventory, air dispersion modeling, risk analysis, and mapping.

HSC: Health and Safety Code of the State of California.

Hazardous Air Pollutant (HAP): A substance that the U.S. Environmental Protection Agency has listed in, or pursuant to, section 112 subsection (b) of the federal Clean Air Act Amendments of 1990 (42 U.S. Code, section 7412(b)).

Hazard Identification: The process of determining whether exposure to an agent can cause an increase in the incidence of an adverse health effect including cancer

Health Risk Assessment: A health risk assessment (HRA) is an evaluation or report that a risk assessor (e.g., Air Resources Board, district, consultant, or facility operator) develops to describe the potential a person or population may have of developing adverse health effects from exposure to a facility's emissions. Some health effects that are evaluated could include cancer, developmental effects, or respiratory illness. The pathways that can be included in an HRA depend on the toxic air pollutants that a person (receptor) may be exposed to, and can include inhalation (breathing), the ingestion of soil, water, crops, fish, meat, milk, and eggs, and dermal exposure.

Hazard Index (HI): The sum of individual acute or chronic hazard quotients (HQs) for each substance affecting a particular toxicological endpoint.

Incinerator: Any device used to conduct onboard incineration.

International Maritime Organization (IMO): A specialized agency of the United Nations which is responsible for measures to improve the safety and security of international shipping and to prevent marine pollution from ships. The IMO, along with other maritime nations, has developed standards which are set forth in the International Convention for the Prevention of Pollution from Ships (MARPOL).

Industrial Source Complex Dispersion Model (ISC3): Air modeling software that incorporates three previous programs into a single program. These are the short-term model (ISCST), the long term model (ISCLT), and the complex terrain model (COMPLEX).

MARPOL: A combination of two treaties adopted in 1973 and 1978 that has been updated by amendments over the years. MARPOL includes six technical annexes which include regulations aimed at preventing and minimizing pollution from ships.

Meteorology: The science that deals with the phenomena of the atmosphere especially weather and weather conditions. In the area of air dispersion modeling, *meteorology* is used to refer to climatological data needed to run an air dispersion model including: wind speed, wind direction, stability class and ambient temperature.

Multipathway Substance: A substance or chemical that once airborne from an emission source can, under environmental conditions, be taken into a human receptor by inhalation and by other exposure routes such as after deposition on skin or after ingestion of soil contaminated by the emission.

Noncarcinogenic Effects: Noncancer health effects which may include birth defects, organ damage, morbidity, and death.

Office of Environmental Health Hazard Assessment (OEHHA): An office within the California Environmental Protection Agency that is responsible for evaluating chemicals for adverse health impacts and establishing safe exposure levels. OEHHA also assists in performing health risk assessments and developing risk assessment procedures for air quality management purposes.

Onboard Incineration: The combustion or burning of any materials or wastes for the purpose of volume reduction, destruction, sanitation, or sterilization, aboard a cruise ship. Onboard incineration does not include incinerators which are only burning gas oil, marine gas oil, marine diesel fuel, fuel oil, or residual fuel oil for the specific purpose of maintaining a minimum temperature in the incinerator to minimize thermal cycling.

PMI: The off-site point of maximum impact. A location, with or without people currently present, at which the total cancer risk, or the total noncancer risk, has the highest numerical value.

Potency: The relative effectiveness, or risk, of a standard amount of a substance to cause a toxic response.

Potency Slope: A value used to calculate the probability or risk of cancer associated with an estimated exposure, based on the assumption in cancer risk assessments that risk is directly proportional to dose and that there is no threshold for carcinogenesis. It is the slope of the dose-response curve estimated at low exposures.

Proposition 65: The Safe Drinking Water and Toxic Enforcement Act of 1986, also known as Proposition 65. This Act is codified in California Health and Safety

Code Section 25249.5, et seq. No person in the course of doing business shall knowingly discharge or release a chemical known to the state to cause cancer or reproductive toxicity into water or into land where such chemical passes or probably will pass into any source of drinking water, without first giving clear and reasonable warning to such individual.

Reference Exposure Level (REL): An exposure level at or below which no noncancer adverse health effect is anticipated to occur in a human population exposed for a specific duration. An REL is virtually the same as the terms Reference Concentration (RfC) for inhalation or Reference Dose (RFD) used by U.S. EPA, only it may be for varying amounts of time rather than lifetime only. It has been given a different name so that the values estimated by the State Office of Environmental Health Hazard Assessment can easily be distinguished from those developed by the U.S. EPA. RELs are used to evaluate toxicity endpoints other than cancer.

Reproductive Toxicity: Harmful effects on fertility, gestation, or offspring, caused by exposure of either parent to a substance.

Risk: The (characterization of the) probability of potentially adverse effects to human health, in this instance from the exposure to environmental hazards.

Risk Assessment: The characterization (in the present context) of the probability of potentially adverse health effects to people from exposure to environmental chemical hazards.

Threshold, Nonthreshold: A threshold dose is the minimally effective dose of any chemical that is observed to produce a response (e.g., enzyme change, liver toxicity, death). For most toxic effects, except carcinogenesis, there appear to be threshold doses. Nonthreshold substances are those substances, including nearly all carcinogens, that are known or assumed to have some risk of response at any dose above zero.

Toxic Air Contaminant (TAC): An air pollutant which may cause or contribute to an increase in mortality or in serious illness, or which may pose a present or potential hazard to human health (HSC Section 39655(a)). Substances, which have been identified by the United States Environmental Protection Agency as hazardous air pollutants are also identified by the Board as toxic air contaminants.

United States Environmental Protection Agency (U.S. EPA): The Federal agency charged with setting policy and guidelines, carrying out legal mandates, for the protection, and national interests in environmental resources.

Variability: The ability to have different numerical values of a parameter, such as height or weight.

Acronyms

AB	Assembly Bill
ARB	Air Resources Board
Annex V	Regulation 9 of Annex V of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978
Annex VI	Protocol of 1997, Annex VI – Regulations for the Prevention of Air Pollution from Ships
APHIS	U.S. Department of Agriculture, Animal and Plant Health Inspection Service
APCD	Air Pollution Control District
AQMD	Air Quality Management District
ATCM	Airborne Toxic Control Measure
Cal/OSHA	California Occupational Safety and Health Administration
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CPF	Cancer Potency Factors
CSLC	California State Lands Commission
Districts	Local Air Pollution Control and Air Quality Management Districts
HAP	Hazardous Air Pollutant
HRA	Health Risk Assessment
HSC	Health and Safety Code
IARC	International Agency for Research on Cancer
ICCL	International Council of Cruise Lines
IMO	International Maritime Organization
OEHHA	Office of Environmental Health Hazard Assessment
MARPOL	International Convention for the Prevention of Pollution from Ships
MEIR	Maximum Exposed Individual Resident
MEIW	Maximum Exposed Individual Worker
NOAA	National Oceanic and Atmospheric Administration
PAHs	Polycyclic Aromatic Hydrocarbons
PCDD	Polychlorinated Dibenzodioxin (dioxin)
PCDF	Polychlorinated Dibenzofuran (furan)
PM	Particulate Matter
PMI	Point of Maximum Impact
REL	Reference Exposure Level
SB	Senate Bill
SRP	Scientific Review Panel on Toxic Air Contaminants
Survey	Cruise Ship Onboard Incinerator Survey
TAC	Toxic Air Contaminant
USDA	United States Department of Agriculture
U.S. EPA	United States Environmental Protection Agency

TITLE 13. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER AMENDMENTS TO THE CURRENT INBOARD AND STERNDRIVE BOAT REGULATIONS

The Air Resources Board (ARB or Board) will conduct a public hearing at the time and place noted below to consider adopting amendments to the California regulations and test procedures for new 2007 and later spark-ignition (gasoline) inboard and sterndrive pleasurecraft. The amendments would allow engine manufacturers an option to delay the introduction of the 5.0 gram per kilowatt-hour (g/kW-hr) standard for combined hydrocarbon and oxides of nitrogen (HC+NOx) currently required for 45 percent of engines sold in model year 2007. Manufacturers choosing to certify to this option would thereafter be required to certify 100 percent of engines sold in the 2008 and later model years to the 5.0 g/kW-hr HC+NOx standard; this full 100 percent phase-in would be one year earlier than currently required. Additionally, the manufacturers certifying to this option would be required to implement a supplemental means of emission control in 2007 to compensate for the shortfall in emission benefits that year. This notice summarizes the proposed regulatory amendments. The staff report presents the proposed amendments in greater detail.

DATE: November 17, 2005

TIME: 9:00 a.m.

PLACE: California Environmental Protection Agency
Air Resources Board
Central Valley 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., November 17, 2005, and may continue at 8:30 a.m., November 18, 2005. This item may not be considered until November 18, 2005. Please consult the agenda for the meeting, which will be available at least 10 days before November 17, 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 amendments to sections 2111, 2112, 2441, 2442, 2444.2, 2445.1, 2446, and 2447, title 13, California Code of Regulations (CCR), and to the following document incorporated by reference therein: "California Exhaust Emission Standards and Test Procedures for 2001 Model Year and Later Spark-Ignition Marine Engines," as last amended June 7, 2002.

Background: Health and Safety Code sections 43013 and 43018 direct ARB to achieve the maximum feasible and cost-effective emission reductions from all mobile source categories, including marine pleasurecraft engines, through the setting of emission control and other requirements.

On July 26, 2001, the Board amended the spark-ignition marine regulations (title 13, CCR, section 2440 et. seq.) to include inboard and sterndrive engines. Those amendments included the adoption of two sets of exhaust standards and the incorporation of on-board diagnostics for inboard and sterndrive engines. The first set of standards capped HC+NOx emissions at a 16.0 g/kW-hr level for all 2003 through 2006 model year engines. This is equivalent to California's most stringent exhaust standard for engines used in personal watercraft and outboard boats. The second set of standards required the phase-in of a catalyst-based 5.0 g/kW-hr HC+NOx standard for model years 2007 through 2009. The percentages of phase-in engines that are required to meet the 5.0 g/kW-hr HC+NOx standard are 45 percent for 2007, 75 percent for 2008, and 100 percent for 2009 and later model years. Additionally, the incorporation of on-board diagnostics (OBD-M) was required for the phase-in engines beginning in 2007.

On October 24, 2004, staff presented to the Board its status review of the 2001 Inboard/Sterndrive rulemaking at its meeting at the San Joaquin Valley Unified Air Pollution Control District in Fresno, California. There the marine industry expressed concerns regarding the timeframe for introducing engines meeting the 5.0 g/kW-hr HC+NOx standard and demonstrating the compliance of engines with rated power levels greater that 373 kW (500 horsepower). Industry representatives also requested a revision to the OBD-M requirements such that the catalyst monitoring portion would be postponed until the 2012 model year. As this was a non-regulatory update to the Board, no Board action was taken. However, the Board requested staff to continue following industry's progress in developing the technology to comply with the 5.0 g/kW-hr HC+NOx standard, and, if necessary, to return to the Board to propose reasonable relief provisions.

Description of the Proposed Regulatory Action: Staff is proposing amendments to California's existing Inboard/Sterndrive regulations to provide industry with additional lead-time for complying with the 5.0 g/kW-hr HC+NOx exhaust standard, while preserving the emission benefits of the existing regulation. The amendments would allow engine manufacturers to choose from two implementation options to comply with the Inboard/Sterndrive standards. This is intended to reduce the cost of compliance to the industry by giving each manufacturer an opportunity to choose a deployment strategy best suited to its production roll-out plan. The first option proposed by staff allows manufacturers to comply with the existing Inboard/Sterndrive regulations. The second option allows manufacturers to replace the current 2007-2009 phase-in of the 5.0 g/kW-hr HC+NOx standard with full compliance by all engines in 2008, one year earlier than currently required. Manufacturers certifying to the second option would also be required to achieve additional reductions of HC and/or NOx in 2007 to compensate for the loss of emission benefits in that year.

The proposed amendments would also allow marine engine manufacturers to comply with the 5.0 g/kW-hr HC+NOx standard for engines with power ratings above 373 kW by averaging emissions with those of engines less than or equal to 373 kW, which would need to meet the fixed 5.0 g/kW-hr HC+NOx standard. Furthermore, industry would be allowed a choice to certify engines with power ratings greater than 485 kW (650 horsepower) by either providing actual emissions test data or by opting to use a default value of 30.0 g/kW-hr HC+NOx. These changes may reduce the cost of compliance for large engines without reducing the benefits of the current regulation.

A marine engine manufacturer would decide which option to use. If any manufacturer determines that compliance with the existing regulation (Option 1) is more economically advantageous than the proposed amendments, that manufacturer may continue to comply with the existing regulation. Therefore, staff's proposed changes are not expected to impact implementation costs in a negative manner, but would likely benefit engine manufacturers by providing them with additional lead-time to comply with the 5.0 g/kW-hr HC+NOx exhaust standard. A full description of the proposed amendments is presented in the "Staff Report: Initial Statement of Reasons," as described below.

COMPARABLE FEDERAL REGULATIONS

In August 2002, the United States Environmental Protection Agency (U.S. EPA) announced a proposed rulemaking aimed at controlling evaporative emissions from spark-ignition marine engines (including inboards, sterndrives, personal watercraft, and outboards; 67 FR 53049 (August 14, 2002)). However, the proposal did not address exhaust emission standards for inboard and sterndrive engines. Staff has since been told by U.S. EPA that it intends to promulgate exhaust emission standards equivalent to those required by California; U.S. EPA would also include an evaporative emission standard. Staff anticipates a final federal rule sometime in early 2007 and the implementation of the standards after some period of lead-time beyond that date.

BENEFITS OF THE PROPOSAL

Staff's proposed amendments do not require manufacturers to generate additional emission benefits, nor do they permit a decrease in benefits. The current and proposed amended regulations are expected to reduce HC+NOx emissions by 56.8 tons per day, in 2020. Staff expects no net change in implementation costs from those identified in the 2001 rulemaking, because an engine manufacturer may continue to comply with the existing regulation. Presumably, a manufacturer would choose the proposed option only if it was within its financial interests to do so. Therefore, the existing regulation remains an upper bound for cost-effectiveness, which is a favorable $2.08 to 3.39/lb HC+NOx reduced. The proposal would benefit manufacturers by providing additional flexibility, and may also benefit consumers if the flexibility results in reduced prices.

AVAILABILITY OF DOCUMENTS AND 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 economic and environmental impacts of the proposal. The report is entitled: "Staff Report: Initial Statement of Reasons for Rulemaking: Public Hearing to Consider Amendments to the Current Inboard and Sterndrive Boat Regulations."

Copies of the ISOR and the full text of the proposed regulatory language, in underline and ~~strikeout~~ format to allow for comparison with the existing regulations, may be accessed on the ARB's web site listed below, or 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 on November 17, 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 ARB's web site listed below.

Inquiries concerning the substance of the proposed regulation may be directed to the designated agency contact persons, Mr. Scott Rowland, at (626) 575-6676 or srowland@arb.ca.gov, or Mr. Jeff Lowry, at (626) 575-6841 or jlowry@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 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, are available on the ARB Internet site for this rulemaking at www.arb.ca.gov/regact/boatregs/boatregs.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, or other nondiscretionary costs or savings to state or local agencies. The ARB may incur additional implementation or enforcement costs at some future time.

In developing this regulatory proposal, the ARB staff evaluated the potential economic impacts on representative private persons or businesses. 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.

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.

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 not affect small businesses because there will be no incremental cost, or an insignificant cost, associated with staff's proposal in addition to those already needed to comply with the federal regulation.

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 that apply to businesses are necessary for the health, safety, and welfare of the people of the State of California.

Before taking final action on the proposed regulatory action, the Board must determine that no reasonable alternative considered by the board or that has otherwise been identified and brought to the attention of the board 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 not physically submitted at the hearing must be received **no later than 12:00 noon, November 16, 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: **boatregs@listserv.arb.ca.gov**, and received at the ARB **no later than 12:00 noon, November 16, 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, November 16, 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 Board 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.

STATUTORY AUTHORITY AND REFERENCES

This regulatory amendment is proposed under the authority granted in sections 39515, 39600, 39601, 43103, 43018, 43101, 43102, 43104, 43105, 43806, and 44036.2 of the Health and Safety Code. Sections 27156, 28114, and 38395 of the Vehicle Code. This action is proposed to implement, interpret, or make specific, sections 39002, 39003, 39500, 39667, 43000, 43004, 43008.6, 43009.543013, 43016, 43017, 43018, 43100, 43101, 43101.5, 43102, 43104, 43105, 43106, 43107, 43150-43154, 43202, 43205-43205.5, 43206, 43210, 43211, 43212, 43213, 43806, and 44036.2 of the Health and Safety Code. Sections 27156, 28114, 38391, and 38395 of the Vehicle Code.

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 Board may adopt the regulatory language as originally proposed, or with nonsubstantive 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 or at the following website www.arb.ca.gov/regact/boatregs/boatregs.htm.

CALIFORNIA AIR RESOURCES BOARD

Catherine Witherspoon
Executive Officer

Date: September 20, 2005

State of California
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR RULEMAKING

PUBLIC HEARING TO CONSIDER AMENDMENTS TO THE CURRENT INBOARD AND STERNDRIVE BOAT REGULATIONS

Date of Release: **September 30, 2005**
Scheduled for Consideration: **November 17, 2005**

This report has been reviewed by the staff of the California Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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EXECUTIVE SUMMARY

On June 8, 2001, the Air Resources Board (Board or ARB) adopted amendments to the spark-ignition recreational marine engine regulation to include exhaust standards for inboard and sterndrive pleasurecraft beginning with the 2003 model year. Inboard and sterndrives are used primarily for recreational purposes. Their engines are typically derived from V-8 or V-6 automotive spark-ignition truck engines. Inboard engines typically drive a long, straight propeller shaft. Sterndrive engines are situated inboard in the extreme rear-end of the boat and drive an external transmission.

The resulting 2001 regulation capped exhaust emission levels at 16.0 grams per kilowatt-hour (g/kW-hr) for combined hydrocarbon and oxides of nitrogen (HC+NOx) emissions through 2006, but then required a more stringent catalyst-based standard (5.0 g/kW-hr) to be phased-in between 2007 and 2009. The amendments also required the incorporation of marine on-board diagnostics (OBD-M) on catalyst-equipped engines to help ensure that emission control systems continued to work properly throughout an engine's useful life. Staff estimates that the statewide summer weekend emissions inventories[1] of NOx and HC for inboard and sterndrive engines will be reduced by 44.8 tons per day and 12.0 tons per day, respectively, in 2020 as a result of the Board's action. The Board also adopted in-use durability requirements and recall/warranty provisions in 2001 that invested California with full enforcement authority to ensure the regulatory compliance of inboard and sterndrive engines throughout their useful lives.

On October 28, 2004, staff returned to the Board to present the findings of a test program that it had sponsored to evaluate catalytic converter safety and durability in a fresh-water environment (SwRI 2004). At the end of testing, the contractor, Southwest Research Institute (SwRI), determined that no heat-related safety issues arose during the 480 hours of operation (cumulatively, over 1,900 hours). The contractor also determined that the catalysts continued to function efficiently throughout the test program with three managing to remain under the 5.0 g/kW-hr standard for HC+NOx. The Board accepted staff's findings, but directed staff to keep an open dialogue with the marine industry and to follow its progress in developing the technology to comply with the existing Inboard/Sterndrive regulation.

In meeting with industry as the Board directed, staff became aware of several concerns regarding feasibility and the timing of the regulation. Specifically, these concerns are 1) the effects of a saltwater environment on emission control components such as catalytic converters and oxygen sensors, 2) the difficulty and expense of equipping and testing large horsepower engines with catalytic converters, 3) the feasibility of monitoring the catalytic converter as required by the OBD-M requirements, and 4) insufficient lead time to equip 45 percent of engines with catalytic converters in 2007, the first year of the standards phase-in.

[1] Estimated 2020 benefits are based on July 2005 off-road emissions inventory data, and differ slightly from earlier calculations due to modeling refinements after the 2001 adoption of the existing regulation.

The following report presents staff's proposal to amend the existing Inboard/Sterndrive regulations. To address industry's concerns regarding the effects of salt-water and OBD-M, ARB has begun another test program to evaluate the emission control performance of inboard and sterndrive engines that are operated on the ocean. The data collection phase of this program is scheduled to be completed by the end of October 2005, and staff plans to include the findings of the program, as available, in its presentation to the Board at the November 17-18, 2005, Board Hearing. Should the findings conclusively demonstrate technical problems with the existing regulation, staff will propose to the Board further amendments to the regulation to resolve the issues at hand. To address the concerns regarding high-power engines and lead-time, staff is proposing to provide marine engine manufacturers with a choice of implementation schedules for complying with Inboard/Sterndrive standards. This is intended to reduce the burden of compliance on the industry by giving each manufacturer an opportunity to choose a deployment strategy best suited to its production roll-out goals, while preserving the emission benefits of the existing Inboard/Sterndrive regulation. Staff's proposed amendments would also permit averaging emissions from engines with rated power greater than 373 kW (500 horsepower) with those less than 373 kW beginning with the 2009 model year.

One of the implementation options proposed by staff would allow engine manufacturers to replace the 2007-2009 phase-in requirements with full compliance of all models in 2008. Although each implementation option would result in at least the same degree of emission benefits as the existing regulation, this option has the potential to increase benefits depending on the approach of the manufacturer.

The cost-effectiveness of the proposed amendments is the same or better than the current regulation, which is a favorable \$2.08 to \$3.39 per pound of HC+NOx reduced. Presumably an engine manufacturer would use the new option only if it resulted in no increase in cost. The emissions reduction of the proposed option will be at least as great as in the current regulation. The cost-effectiveness of the proposal is equal to or superior to the existing regulation.

Based on these conclusions, staff recommends that the Board adopt this proposal.

1. INTRODUCTION

This report describes the rationale and details of staff's proposal to amend California's existing regulations for new spark-ignition inboard and sterndrive pleasurecraft. On October 28, 2004, at a Public Board Meeting, the Air Resources Board (Board or ARB) directed staff to continue dialogue with the regulated marine industry regarding technological challenges and developments and to revisit the regulation should it become desirable to make amendments (ARB 2004). As a result, several issues have arisen regarding the implementation timeframe for catalyst-based standards and the compliance of marine engines rated at power levels exceeding 373 kW (500 horsepower). The changes proposed herein are meant to address these concerns and to provide additional opportunities for reducing the emission inventories of combined hydrocarbon and oxides of nitrogen (HC+NOx) in California.

2. BACKGROUND

This section provides information on the history of emissions control for recreational marine pleasurecraft, a citation of California's authority to set standards for off-road mobile sources including recreational marine pleasurecraft, the current emissions inventory for Inboard and Sterndrive engines, existing recreational marine regulations, and the steps taken to make the public and stakeholders aware of staff's proposal to amend California's current regulations.

2.1. History

Only in recent years has government regulatory activity been undertaken to control exhaust emissions from spark-ignition recreational marine engines. The United States Environmental Protection Agency (U.S. EPA) first promulgated exhaust emission standards for personal watercraft and outboard boat engines in 1996 (U.S. EPA 1996). However, revised emissions inventory modeling showed that the benefits of the federal rulemaking were not sufficient to meet California's air quality goals and State Implementation Plan (SIP) requirements. Therefore, ARB adopted exhaust emission regulations for spark-ignition recreational marine engines in 1998 (ARB 1998a). The Board approved regulations that accelerated the 2006 federal standards to begin in 2001 in California. The regulations also set more stringent standards for these engines to be implemented in 2004 and 2008. By 2008, personal watercraft and outboard engines in California will meet exhaust emission standards that are numerically 65 percent less than federal exhaust emission standards.

On July 26, 2001, the Board amended the spark-ignition marine regulations (Title 13, California Code of Regulations, section 2440 et seq.) to include inboard and sterndrive engines (ARB 2001). Although personal watercraft and outboard boats dominate the emissions inventory with respect to recreational marine engines, ARB modeling showed that inboard and sterndrive engines also contributed significantly to ozone-forming emissions in California.

Accordingly, manufacturers of inboard and sterndrive engines have been required to demonstrate compliance with an HC+NOx exhaust emissions standard of 16.0 grams per kilowatt-hour (g/kW-hr) since the 2003 model year. This standard is equivalent to California's most stringent exhaust standard for engines used in personal watercraft and outboard boats, which, for those engines, is not required until 2008.

The existing inboard and sterndrive regulations also require compliance with a more stringent HC+NOx standard beginning in 2007 on a portion of engines. Since inboard and sterndrive marine engines are similar to automobile engines, for which a number of effective emission control technologies already exist, transference of automotive control technologies (catalysts specifically) to the marine sector makes a more stringent standard feasible. In fact, the majority of inboard and sterndrive engines with rated power less than 373 kW are almost exclusively General Motors or Ford truck engines that have been marinized[2] for use on lakes and the ocean. Accordingly, the Board adopted a 5.0 g/kW-hr HC+NOx standard for these engines, which was based on the demonstrated use of three-way catalytic converters and oxygen sensor feedback control.

2.2. Authority

In addition to more general grants of authority, the California Clean Air Act, as codified in Health and Safety Code section 43013, directs the ARB to regulate off-road mobile sources of emissions. Health and Safety Code section 43018 further mandates ARB "to achieve the maximum degree of emission reduction possible" from mobile sources of pollution in order to attain California's ambient air quality standards. These off-road mobile sources include, but are not limited to, marine vessels, locomotives, utility engines, off-road motorcycles, and off-highway vehicles. This regulation focuses on spark-ignition (gasoline) inboard and sterndrive marine engines, typically found in recreational boats such as ski boats or family fishing boats.

2.3. Need for Regulatory Action

The emission standards previously adopted by the Board significantly reduce the human health and environmental impacts of ground-level ozone. This section summarizes the air quality rationale for controlling inboard and sterndrive engines.

Figure 2.1 below identifies air basins and counties that are in non-attainment with the federal eight-hour standard for ozone.

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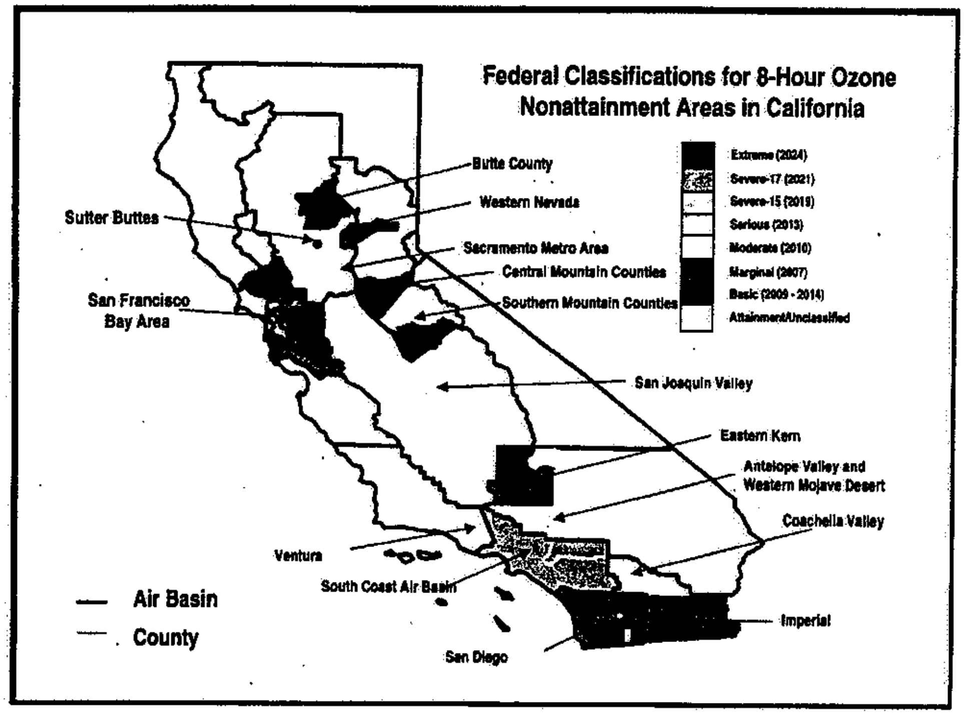
[2] Marinization is the process of modifying an existing automobile engine to operate reliably in a marine environment. Some typical modifications include upgrading the composition of exhaust components to be more resistive against rust and corrosion, incorporating a water jacket within the exhaust manifolds to reduce temperatures, and providing better insulation for electrical contacts that might otherwise be exposed to corrosive sea water.

Figure 2.1
Eight Hour Ozone Non-Attainment Areas in California



Over 50 percent of California's air basins fall within this designation. Mobile sources currently[3] account for 47 percent of the total ozone precursors statewide. Recreational marine engines are responsible for about 4 percent of ozone precursors in the mobile source inventory and Inboard/Sterndrive spark-ignition engines represent 30 percent of the ozone precursors in the recreational marine inventory (Almanac 2005).

2.3.1. Ozone

Ground-level ozone is created by the photochemical reaction between NOx and 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.

Among those persons who may be most affected are people with compromised respiratory systems, the elderly, and children. Healthy people also experience difficulty breathing when exposed to ozone pollution. Because ozone forms in hot weather, anyone who spends time outdoors in the summer may be affected, particularly children, outdoor workers and people exercising. Millions of Californians live in areas where the federal ozone health standards are exceeded.

[3] Estimates are from the California Almanac of Emissions for the 2005 calendar year.

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 harms the foliage of trees and other plants, affecting the landscape of cities, parks and forests, and recreational areas. NOx also contributes to acid deposition and the overgrowth of algae in coastal estuaries.

2.3.2. NOx and Particulate Matter Relationship

Fine secondary nitrate particles are produced in the atmosphere from the NOx emitted by internal combustion engines. This type of particulate matter consists primarily of ammonium nitrate and represents about 25 percent of measured PM10 in the Los Angeles Basin (U.S. EPA 1997). The control of secondary nitrate PM will be critical in meeting California's air quality attainment goals for the future.

2.4. Existing Regulations

The existing State, Federal, and International recreational marine standards are briefly discussed in this subsection.

2.4.1. 2003 and Later Inboard/Sterndrive Regulation

The current Inboard/Sterndrive regulation was adopted by the Board in 2001 and applies to all pleasurecraft utilizing new inboard or sterndrive engines beginning with the 2003 model year. The regulation prohibits the release of crankcase emissions directly to the ambient atmosphere, and it requires compliance with two phases of increasingly stringent exhaust emission standards. The first phase requires all engines to meet a 16.0 g/kW-hr HC+NOx standard on a corporate basis by sales-weighting engine family certification levels. The second phase requires engines to meet a more stringent HC+NOx standard of 5.0 g/kW-hr beginning on a portion of engines in 2007 and 2008, then on all engines beginning in 2009 and thereafter. Engine manufacturers have to certify at or below this standard without averaging across engine families. Further, manufacturers of marine engines rated greater than 373 kW (500 horsepower) do not have to comply with the regulation until 2009.

In addition, the current regulation established a durability period for engines certified to the 5.0 g/kW-hr NMHC+NOx standard. Emission levels would have to remain at or below the standard for at least 480 hours or for ten years (see Table 2.1). A certification test cycle (ISO 8178-4 E4) was adopted to verify that the engines meet the standard under the most representative operating conditions.

Table 2.1
Existing Inboard/Sterndrive Emission Standards

MODEL YEAR	POWER CATEGORY [kilowatts]	DURABILITY [hours]	16.0 g/kW-hr. Averaged Standard NMHC[1]+NOx	5.0 g/kW-hr Fixed Standard NMHC[1]+NOx
2003 - 2006	kW ≤ 373	-	100%	-
2007			55%	45%
2008			25%	75%
2009 and later	ALL	480[2]	-	100%

Notes:
1 ARB standards are expressed as the non-methane component of hydrocarbon (NMHC)
2 The durability period may be expressed as either 480 hours or 10 years, whichever occurs first

The regulation requires certification and environmental labels to be attached to the engine and boat, respectively, to provide prospective engine owners, current engine owners, and enforcement personnel with information about the relative cleanliness of the engine. Beginning in 2007, inboard and sterndrive pleasurecraft complying with the proposed 5.0 g/kW-hr standard will receive a four star label to highlight the fact that they are the lowest emitting recreational marine vessels available (see Figure 2.2).

Figure 2.2
Marine Engine Consumer Labels

The current Inboard/Sterndrive regulation also provides Selective Enforcement Auditing (SEA), In-Use Compliance testing, and a defects warranty program to protect consumers against poor quality products and to ensure that the engines continue to perform as designed throughout their entire useful lives.

The regulation also requires inboard and sterndrive pleasurecraft to employ on-board diagnostics (OBD-M) on engines complying with the 5.0 g/kW-hr standard to continuously monitor emission control components for proper performance and to alert the vessel operator via a dashboard light or audio alert device after a malfunction has been identified. Among the major components to be monitored by the OBD-M system are the catalyst, oxygen sensors, solenoids, fuel system, and the on-board computer itself. The OBD-M system will make consumers aware when a component fails under the warranty period which in turn will provide incentive to have the problem corrected in a timely manner since the consumer will not be liable for the repair. Furthermore, it will facilitate the repair of the malfunctioning component by providing a detailed description of the problem to the service technician via a generic scan tool, and a confirmation that the repair has been performed correctly.

2.4.2. Federal Regulations

As previously mentioned, U.S. EPA promulgated regulations in 1996 for outboard and personal watercraft; however, this regulation did not apply to inboard and sterndrive pleasurecraft. In August 2002, U.S. EPA announced a proposed rulemaking (U.S. EPA 2002) primarily aimed at controlling evaporative emissions from spark-ignition marine engines (including inboards, sterndrives, personal watercraft, and outboards).

At the time this proposal was released, U.S. EPA did not propose exhaust emission standards for inboard and sterndrive engines. Instead, it wanted to collect more information and investigate further the application of catalysts; which would not only apply to inboards and sterndrives, but quite possibly to personal watercraft and outboard engines as well. However, as of the publication of this staff report, U.S. EPA has conveyed to ARB staff that it intends to promulgate exhaust emission standards equivalent to those required by California in addition to evaporative control standards when it publishes the final rule. Staff anticipates a final rulemaking from U.S. EPA sometime in early 2007.

2.4.3. Swiss (BSO) Regulations

Beginning in 1993, boat usage on Lake Constance, which borders Switzerland, Germany, and Austria, was contingent on the boat owner possessing certification from the boat/engine manufacturer stating that the engine(s) emit less than the "Stage 1" standards. The Stage 1 standards are 15.0 g/kW-hr for NOx and range from 4.0 g/kW-hr to 5.0 g/kW-hr for HC (depending on engine power). These apply to outboards and inboards, diesel or gasoline, commercial or recreational boats.

Effective January 1996 on Lake Constance, the standards became variable according to engine power rating. A typical 120 kW (165-horsepower) inboard or sterndrive engine is required to meet a 1.3 g/kW-hr standard for HC and a 3.7 g/kW-hr standard for NOx. High-power inboard and sterndrive engines (e.g., 300 kW / 400 horsepower) are required to meet a 1.0 g/kW-hr standard for HC and a 3.8 g/kW-hr standard for NOx.

2.4.4. European Regulations

The European Community (EC) is now developing recreational marine engine emission standards. For a 50 kilowatt two-stroke engine, combining the HC and NOx emission standards yields a total of 31.0 g/kW-hr. This is more stringent than California's 2004 outboard standard of 38.0 g/kW-hr for a similar sized engine, but less stringent than

California's 2008 standards (16.0 g/kW-hr). For inboard and sterndrive engines, however, the EC standards are not as stringent as the BSO standards or California's existing standards.

2.5. Existing Emissions Inventory

Table 2.2 shows the statewide baseline inventories for the reactive organic gas (ROG[4]) component of hydrocarbon and NOx from inboard and sterndrive engines in 2007, 2010, and 2020. These baseline estimates are annual averages and include the effects of all currently adopted State and federally promulgated regulations. All emissions estimates are from the ARB's off-road emissions inventory database as of July 2005.

Table 2.2
Existing Inboard/Sterndrive Emission Inventories
Statewide Annual Averages

ENGINE TYPE	POLLUTANT	EMISSIONS INVENTORY[1] (tons per day)		
		2007	2010	2020
STERNDRIVE	ROG[2]	10.1	9.8	8.5
	NOx	11.6	11.4	10.3
	ROG[2]+NOx	21.7	21.2	18.8
INBOARD[3]	ROG[2]	8.2	8.0	6.7
	NOx	9.5	9.4	8.3
	ROG[2]+NOx	17.7	17.4	15.0
TOTAL	ROG[2]	18.3	17.8	15.2
	NOx	21.1	20.8	18.6
	ROG[2]+NOx	39.4	38.6	33.8

Notes:
1 These estimates take into account all previously adopted regulations for spark-ignition inboard and sterndrive engines
2 ARB inventory estimates are expressed as the reactive organic gas (ROG) component of hydrocarbon
3 This engine classification also includes recreational spark-ignition jet drive engines

From the table it is clear that ozone precursors from these engines are decreasing over time as a result of the Board's previous action. Between 2007 and 2020, combined ROG and NOx emissions decrease by over 4.5 tons per day. Still, this table only shows half the story. To provide the complete picture, Table 2.3 illustrates the emissions inventories for ROG and NOx from inboard and sterndrive engines during summer weekends. Recreational watercraft are used most frequently during summer months

[4] The terms "NMHC" and "ROG" are used synonymously throughout this report to represent the component of hydrocarbon most likely to form ozone. ROG is typically used to reflect inventory modeling parameters, and NMHC is typically used for emission standards.

when the temperature is hot and smog levels are high. Emission levels associated with summer weekend operation are approximately 260 percent higher than corresponding annual average levels due to increased boating activity during the summer months. This is especially relevant since the potential for ozone formation is highest during summer weekends.

Table 2.3
Existing Inboard/Sterndrive Emission Inventories
Statewide Summer Weekend

ENGINE TYPE	POLLUTANT	EMISSIONS INVENTORY[1] (tons per day)		
		2007	2010	2020
STERNDRIVE	ROG[2]	36.7	35.8	31.0
	NOx	42.3	41.4	37.5
	ROG[2]+NOX	79.0	77.2	68.5
INBOARD[3]	ROG[2]	29.8	29.1	24.4
	NOx	34.7	34.2	30.2
	ROG[2]+NOX	64.5	63.3	54.6
TOTAL	ROG[2]	66.5	64.9	55.4
	NOx	77.0	75.6	67.7
	ROG[2]+NOX	143.5	140.5	123.1

Notes:
1 These estimates take into account all previously adopted regulations for spark-ignition inboard and sterndrive engines
2 ARB inventory estimates are expressed as the reactive organic gas (ROG) component of hydrocarbon
3 This engine classification also includes recreational spark-ignition jet drive engines

This table shows that combined hydrocarbon and oxides of nitrogen will decrease by over 20 tons per day between 2007 and 2020 due to the Board's previous actions.

2.6. Public Process

In developing its proposal, staff has remained in close contact with the regulated marine industry in order to follow industry's progress regarding the 2001 regulation and to be kept apprised of any issues that might delay compliance efforts. The following provides a list of specific examples:

<u>2004 Public Board Meeting</u>
On October 24, 2004, staff presented its findings at an ARB Meeting in the San Joaquin Valley Unified Air Pollution Control District in Fresno, CA, on the freshwater catalyst demonstration program and reported on the status of the Inboard/Sterndrive rulemaking. The program was conducted between calendar years 2002 and 2004 for the purpose of demonstrating the safeness and durability of catalysts and other related emission control components in the marine environment. Staff's presentation also

brought out some of industry's concerns regarding the timeframe for introducing catalysts and demonstrating the compliance of engines with rated power levels greater that 373 kW. The National Marine Manufacturers Association (NMMA) expressed its desire to have ARB amend the regulation's implementation schedule such that instead of having the 5.0 g/kW-hr HC+NOx standard phased-in during model years 2007 through 2009, it should be fully implemented across product lines in 2008. Staff expressed a willingness to consider this amendment, but only so long as the overall emission benefits in 2007 and later could be maintained.

Industry also requested a regulatory amendment to allow corporate averaging to include engines with rated power levels greater than 373 kW. Currently, engines with rated power levels greater than 373 kW are exempt from the regulation through 2008. After 2008, however, unless these larger engines could be corporate averaged with the significantly more populous smaller engines, they would need to be equipped with catalysts to comply with the regulation, which is costly and difficult to verify emissions performance due to the lack of testing facilities capable of testing marine engines rated at power levels greater than 373 kW. Staff indicated it was amenable to the concept so long as the averaging methodology does not pose a competitive disadvantage to small volume manufacturers.

Industry also requested a revision to the on-board diagnostic requirements such that it would be split into two phases. The first phase, to begin in 2008, would not include catalyst monitoring, but would include all other monitors. The second phase would begin in 2012 and would include catalyst monitoring. Staff does not believe that industry's concerns merit delaying the OBD-M requirements as proposed. Sufficient flexibility is already built into the existing regulation to allow industry until 2012 to have implemented a fully functional and reliable catalyst monitoring system using proven technology transferred from the automotive sector (see subsection 4.2.1 for more details).

<u>Meetings with Marine Manufacturers</u>
In addition to frequent conference calls and meetings with NMMA, staff met individually with representatives from three of the six inboard and sterndrive manufacturers that currently certify engines in California between January 25 and February 9, 2005. The manufacturers were Indmar, Volvo Penta, and Mercury Marine. During each of those meetings staff heard the manufacturer's concerns regarding compliance with the existing catalyst-based standards (5.0 g/kW-hr) set to begin on a portion of production engines with the 2007 model year. These meetings were informative and helped guide the development of staff's proposed amendments to the existing regulations for inboard and sterndrive pleasurecraft.

<u>2005 U.S. EPA Authorization Hearing</u>
On February 28, 2005, U.S. EPA, at the request of NMMA, held a public hearing to evaluate the reasonableness of California's 2001 Inboard/Sterndrive rule before deciding whether or not to authorize California to regulate these engines independently of the federal government, which is allowed under provision of the Clean Air Act. Staff's

presentation at the hearing, and in subsequent comments, clearly demonstrated that ARB met the obligation for receiving authorization, namely that California's regulations would be, in the aggregate, at least as protective of public health and welfare as the applicable federal standards, that California's standards for nonroad engines such as these are necessary as part of a program to address conditions in California, and that California's regulations are not inconsistent with applicable portions of the federal Clean Air Act (Authorization 2005). U.S. EPA, however, has still not reached a decision regarding the issuance of the requested authorization. While ARB believes U.S. EPA has no basis for denying California's request, U.S. EPA's timeframe for action on it is uncertain.

Meeting with Industry to Discuss Saltwater Test Program
On April 28, 2005, staff met with NMMA and representatives from several individual marine engine and boat manufacturers at the Southwest Research Institute (SwRI) in San Antonio, Texas, to discuss a saltwater demonstration program of inboard and sterndrive engines. The mutually agreed upon test program is currently underway and staff intends to present the results of that program, as available, to the Board at the November 17-18, 2005, Board Hearing.

3. SUMMARY OF PROPOSED REGULATIONS

The staff recommends that the Board amend sections 2111, 2112, 2441, 2442, 2444.2, 2445, 2446, and 2446, Title 13, California Code of Regulations, as set forth in Attachment 1: "Proposed Amendments to the California Regulations for New 2007 and Later Spark-Ignition Inboard/Sterndrive Pleasurecraft" and Attachment 2: "Proposed Amendments to the California Exhaust Emission Standards and Test Procedures for 2001 Model Year and Later Spark-Ignition Marine Engines" of this report.

Staff's proposed amendments to the existing regulation are meant to provide industry with additional lead-time for complying with the catalyst-driven 5.0 g/kW-hr HC+NOx exhaust standard while preserving the emission benefits of the existing regulation. The amendments would allow engine manufacturers to choose from two implementation options to comply with the Inboard/Sterndrive standards. This is intended to reduce the burden of compliance on the industry by giving each manufacturer an opportunity to choose a deployment strategy best suited to its production roll-out goals. The first implementation option proposed by staff allows manufacturers to certify to the identical standards and schedule required by the existing Inboard/Sterndrive regulations. The second implementation option allows manufacturers to replace the current 2007-2009 phase-in with full-compliance in 2008, one year earlier than currently required. Manufacturers choosing the second option would also be required to provide additional emission reductions of HC and/or NOx to compensate for the loss in emission benefits occurring in 2007. The following subsections discuss the major provisions of staff's proposal in further detail.

3.1. Applicability

The regulations as amended by this proposal would continue to apply to new spark-ignition inboard and sterndrive engines produced for sale in California for the 2007 model year and later, with exceptions provided for competition racing boats. Inboard and sterndrive engines with rated power levels greater than 373 kW would remain exempt from the amended regulations through the 2008 model year.

3.2. Definitions

Staff does not propose to add additional definitions to the regulations at this time; however, the dates in several definitions are proposed to be revised to correspond with the schedule of the implementation options that staff is proposing.

3.3. Emission Standards and Averaging

The existing Inboard/Sterndrive regulation requires manufacturers to comply with a 16.0 g/kW-hr HC+NOx exhaust emissions standard for model years 2003 through 2006, and then to phase-in engines meeting the 5.0 g/kW-hr HC+NOx standard at the rates of 45 percent, 75 percent, and 100 percent for model years 2007, 2008, and 2009 and later, respectively. Manufacturers may choose to average emission levels from engines required to meet the 16.0 g/kW-hr HC+NOx standard on a corporate basis; however, the emission levels for engines required to meet the 5.0 g/kW-hr HC+NOx standard may not be averaged.

Staff proposes to keep the existing 16.0 g/kW-hr HC+NOx averaged standard for model years 2003 through 2006. Beginning with the 2007 model year, however, staff proposes that manufacturers be allowed to choose from two implementation options that achieve emission benefits equivalent to those of the existing regulation.

The first option would allow manufacturers to comply with the standards and implementation schedules provided by the existing regulation. This is necessary to avoid penalizing manufacturers who might have already altered business practices and devoted resources towards meeting the existing requirements.

The second option would allow manufacturers to comply with an overall less stringent fixed standard of 14.0 g/kW-hr HC+NOx in 2007, followed by full implementation of the 5.0 g/kW-hr HC+NOx standard for 2008 and later model years. Although this option accelerates the full penetration of the catalyst-based 5.0 g/kW-hr HC+NOx standard one year ahead of the existing schedule, an emissions shortfall results for the 2007 model year. To compensate for this shortfall, manufacturers would be required to make up the difference with some other form of emissions control technology. Staff believes that the most likely approach to be employed by industry for achieving these supplemental emission benefits will be evaporative emission control since U.S. EPA has announced its intent to require evaporative emission control in its final rulemaking for inboard and sterndrive engines.

Additionally, staff is proposing that manufacturers may average engines with power ratings greater than 373 kW with those less than 373 kW (which must also meet a fixed 5.0 g/kW-hr HC+NOx standard) beginning with the 2009 model year. In so doing, manufacturers may be able to avoid the expense of having to equip high-power engines with catalysts should they be able to certify the remainder of their engines to sufficiently low emission levels.

Staff's proposed implementation options are summarized below:

OPTION 1: Certify to the existing Inboard/Sterndrive requirements, which require 45 percent of engines sold in model year 2007 and 75 percent of engines sold in model year 2008 to comply with a 5.0 g/kW-hr HC+NOx standard;

OPTION 2: Certify all engines to a fixed exhaust emission standard of 14.0 g/kW-hr HC+NOx in 2007 and replace the fuel tank supply/return hose with a low-permeation evaporative control hose with no more than 15.0 grams per square meter per day permeation rate on CE10[5] fuel at 23º Celsius, or otherwise incorporate another verifiable and quantifiable technique for achieving equivalent emission reductions. In 2008, certify all engines with rated power equal to or less than 373 kW to a fixed exhaust standard of 5.0 g/kW-hr HC+NOx with durability of 480 hours or 10 years, and carryover or upgrade the supplemental emissions technology from 2007.

Table 3.1 below illustrates staff's proposed amended exhaust standards for inboard and sterndrive engines including the necessary supplemental reductions required for Option 2. These supplemental reductions would most likely be achieved through evaporative emission control; however, other techniques for achieving the supplemental inventory reduction would also be acceptable so long as the reduction was quantifiable and verifiable. Regardless of the technique used to achieve the supplemental inventory reductions in 2007, it must continue to be used (carried-over) for all future model years unless a more stringent form of supplemental emissions control is required or is voluntarily incorporated into the design of the engine.

[5] CE10 fuel is an "American Society of Testing and Materials" (ASTM) standardized blend of 45% toluene, 45% iso-octane, and 10% ethanol

Table 3.1
Proposed Inboard/Sterndrive Marine Engine Standards

MODEL YEAR	RATED POWER [kilowatts]	COMPLIANCE OPTION[1]	DURABILITY [hours / years]	EXHAUST STANDARD		SUPPLEMENTAL MEASURE[3]
				NMHC[2]+NOx [grams per kilowatt-hour]	TYPE	
2003 - 2006	kW ≤ 373	N/A	N/A	16.0	AVE	None
2007	kW ≤ 373	OPT 1	N/A	16.0 (55%)	AVE	None
			480 / 10	5.0 (45%)	FIXED	
		OPT 2	N/A	14.0	FIXED	Evaporative Low-Permeation Liquid Hoses
2008	kW ≤ 373	OPT 1	N/A	16.0 (25%)	AVE	None
			480 / 10	5.0 (75%)	FIXED	
		OPT 2	480 / 10	5.0	FIXED	Evaporative Low-Permeation Liquid Hoses
2009 and later	kW ≤ 373	N/A	480 / 10	5.0[5]	FIXED	Carryover[6]
	373 < kW ≤ 485		480 / 10	5.0[5]	AVE	
	kW > 485		50[4] / 1	5.0[5]	AVE	

Notes:
1. Once a manufacturer has chosen an option, that option must continue to be used exclusively across product lines
2. The non-methane component of hydrocarbon
3. Supplemental measures may be different than shown, but must provide equal and verifiable emission reductions to those indicated
4. Engine manufacturers may request a shorter durability period for high power engines provided they submit data supporting a shorter period
5. All engines ≤ 373 kW must meet a 5.0 g/kW-hr NMHC+NOx capping standard. For engines > 373 kW, the standard may be met by sales-averaging with engines equal to or less than 373 kW
6. The same or better supplemental emission control hardware used to meet the standard in 2007 must be used every model year thereafter

3.3.1. Durability Period for Engines ≥ 485 kW

Staff is proposing to shorten the durability period for engines with power ratings greater than 485 kW (650 horsepower). Industry has contended that these high-power marine engines are generally rebuilt long before the existing durability period of 480 hours has occurred. According to industry, the reference engines for high power inboard and sterndrive engines are not meant to be used in conventional automotive applications and are often sold without a manufacturer warranty. They are typically used to power drag-racing type vehicles. Further, the marine manufacturer usually replaces various assemblies on these reference engines with high performance specialty parts to achieve higher power output than for which the reference engine was originally designed. Therefore, based on this information, and recommendations by the marine manufacturers to service various core components on engines with rated power greater than 485 kW after every 50 hours of use as stated in manufacturer provided service manuals, staff proposes to lower the durability period for engines with rated power greater than 485 kW to 50 hours or one year, whichever occurs first. Should an engine manufacturer believe that a shorter durability period is appropriate for a specific application with rated power greater than 485 kW, the manufacturer may request that the Executive Officer permit a shorter durability interval provided that the manufacturer support the request with documentation showing that a large volume of that application is being rebuilt more frequently than the established durability period. The previous Table 3.1 illustrates staff's proposed durability intervals.

3.3.2. Optional Default Emissions Level for Engines ≥ 485 kW

Further, for engines with rated power levels greater than 485 kW, staff is proposing to allow manufacturers the option to use either actual test data or a default emissions value of 30.0 g/kW-hr HC+NOx for the purposes of certification. Manufacturers choosing to certify using this default value would still be required to comply with a 5.0 g/kW-hr HC+NOx standard across product lines by "averaging in" the default value for its high-power engines with the actual emissions measurements from its engines with rated power less than 485 kW. Emission measurements, conducted by U.S. EPA and Mercury Marine, of engines ranging in power from 391 kW to 802 kW have varied from approximately 12.5 g/kW-hr to 25.9 g/kW-hr HC+NOx on the standard E4 certification test cycle (DATA E and DATA M). Staff believes that the proposed default value is a conservative estimate with regards to emissions, and would likely result in an un-quantified emissions benefit since the real emission levels for the majority of high-power engines would be well under 30.0 g/kW-hr HC+NOx. Still, the proposal should provide relief to the many manufacturers of engines with power levels greater than 485 kW that do not have access to emissions test facilities capable of accommodating such high-power engines, or who do not want to commit resources towards upgrading existing facilities.

3.4. Marine On-Board Diagnostics (OBD-M)

Although the marine industry has requested that the catalyst monitoring portion of the OBD-M requirements be delayed until 2012, staff proposes to retain the existing schedule for implementation which corresponds to the introduction of engines meeting the 5.0 g/kW-hr HC+NOx standard. Under the existing regulation, OBD-M is required on 5.0 g/kW-hr engines beginning with the 2007 model year. Based on staff's proposal to allow postponed compliance with the 5.0 g/kW-hr HC+NOx standard until the 2008 model year (Option 2), OBD-M would therefore also be postponed until the 2008 model year.

Further, all relief provisions built into the original regulation will remain applicable for the same durations originally specified. For example, the existing provision exempting manufacturers from having to incorporate OBD-M diagnostics for up to two years beginning in 2007 should the existing on-board computer not be capable of supporting all OBD-M diagnostics will begin in 2008 for engines certified to Option 2, and so on. As a consequence, the sum of existing relief provisions resulting from staff's proposed revisions would, in effect, give the industry what they have asked for. Specifically, staff's amendments would not require a fully compliant catalyst monitor until the 2012 model year under Option 1 or until the 2013 model year under Option 2. A more detailed explanation of staff's position regarding OBD-M can be found in subsection 4.2.1 of this report under the discussion on technological feasibility.

3.5. Labeling

Staff proposes to change the issuing requirement of the 4-star "super ultra low emissions" label, which was adopted by the Board during the 2001 rulemaking, to correspond to any inboard or sterndrive engine meeting the 5.0 g/kW-hr standard regardless of date. Currently, only 2007 and later engines complying with the 5.0 g/kW-hr standard can display the 4-star label. Staff believes that removing the date constraint of the 4-star label will provide additional incentive for the marine industry to introduce cleaner engines earlier than required.

3.6. In-Use Compliance Program

Staff proposes to retain the existing structure of the in-use compliance program as adopted by the Board during the 2001 rulemaking, but to revise the commencement date such that manufacturers certifying under Option 2 are subject to demonstrating that their 2008 and later engines will comply with the emission standards throughout their useful lives. The existing (Option 1) requirements are applicable only to post-2008 engines because the 5.0 g/kW-hr HC+NOx standard would not have been fully phased-in until 2009 under the existing regulation. Since staff is proposing that the 5.0 g/kW-hr HC+NOx standard be completely phased-in with the 2008 model year under Option 2, the in-use compliance program should also be applicable for 2008 models under that option.

3.7. Selective Enforcement Audit (SEA)

Staff proposes to exempt engines with rated power greater than 485 kW that have been certified to the optional default emissions level of 30.0 g/kW-hr from SEA applicability. However, engines of any power rating that have been certified with actual emissions test data shall remain subject to the SEA requirements.

3.8. Defects Warranty Provisions and Emission Control Warranty Statement

Staff proposes to accelerate the three year warranty period adopted by the Board during the 2001 rulemaking to begin in 2008 for Option 2, but to retain 2009 as the commencement date for Option 1, as required by the existing regulations. This maintains staff's original intention to correlate the three year warranty to the first year that the 5.0 g/kW-hr HC+NOx standard was fully implemented across product lines. Additionally, staff proposes to limit the warranty of mechanical engine head components such as valves and seats on engines with rated power greater than 485 kW to one year, or to 50 hours if equipped with an integrated electronic control module (ECM) hour-meter. These components typically require servicing at the stated intervals due to accelerated wear resulting from the high power output of these engines. All other emissions-related components such as sensors, injectors, and the ECM itself must continue to be warranted for three years.

4. DISCUSSION

4.1. Implementation Options and Supplemental Reductions

As previously stated, staff's objective in developing the proposed amendments to the existing Inboard/Sterndrive regulation was to provide industry with additional lead-time for complying with the catalyst-driven 5.0 g/kW-hr HC+NOx exhaust standard while preserving the emission benefits of the existing regulation. Accordingly, staff is proposing that engine manufacturers be allowed to choose between two implementation options, the first retaining the implementation schedule of the existing regulation and the second providing a one year delay of the 5.0 g/kW-hr HC+NOx standard in exchange for supplemental emission reductions and an accelerated implementation schedule the following year.

To provide more flexibility, staff is proposing that manufacturers be allowed to use any verifiable method for generating the supplemental emission reductions required under Option 2 so long as that method is sufficient to compensate for the emissions shortfall in 2007 that arises from relaxing the 5.0 g/kW-hr HC+NOx standard for that year. However, staff believes that the most likely form of supplemental emissions control to be employed by the marine industry will be the replacement of the fuel tank supply/return hose with a low-permeation evaporative loss control hose. This would be a relatively simple, low-cost, and durable solution to the supplemental emissions reduction requirement. Furthermore, U.S. EPA has indicated that it will most likely require low-permeation evaporative control hoses for inboard and sterndrive engines in its final rulemaking tentatively scheduled for 2007. At present, U.S. EPA is contemplating a permeation standard of 15.0 $g/m^2/day$[6] for liquid carrying hoses. This would provide an estimated 85 percent reduction over nitrile rubber based hoses, which are most commonly used in inboard and sterndrive pleasurecraft, and for which a 100.0 $g/m^2/day$[7] reference standard has been established by the Society of Automotive Engineers (SAE J1527). Staff expects that many engine manufacturers will use some form of evaporative emissions control to comply with the proposed Option 2 since they would soon after be required to incorporate evaporative standards anyway due to the federal rule (see the Appendix for additional information on evaporative permeation).

Table 4.1 shows ARB's off-road inventory database estimates for staff's proposed Option 2 without any supplemental emissions benefit offsets. If employed exclusively by industry, the option would result in a statewide exhaust emissions shortfall in 2007 of 0.7 tons per day ROG+NOx (shaded box in Table 4.1) based on summer weekend only

[6] Based on operation at 23º Celsius and CE10 fuel - 45% toluene, 45% iso-octane, and 10% ethanol.
[7] Based on ASTM D471-98 standardized Fuel C for nitrile rubber hoses.

operation. Therefore, in order to use Option 2 (14.0 g/kW-hr HC+NOx standard in 2007) a manufacturer would have to incorporate additional emission control technology to make up its portion of the lost benefit.

Table 4.1
Existing (Option 1) vs. Proposed Option 2 Inboard/Sterndrive Exhaust Emission Inventories
Statewide Summer Weekend

ENGINE TYPE	POLLUTANT	EXHAUST EMISSIONS INVENTORY [tons per day]								
		2007			2010			2020		
		OPT 1	OPT 2	Δ	OPT 1	OPT 2	Δ	OPT 1	OPT 2	Δ
STERNDRIVE	ROG[1]	36.7	36.7	0.0	35.8	35.6	0.2[2]	31.0	30.9	0.1[2]
	NOx	42.3	42.7	(0.4)	41.4	41.5	(0.1)	37.5	37.5	0.0
	ROG[1]+NOx	79.0	79.4	(0.4)	77.2	77.1	0.1[2]	68.5	68.4	0.1[2]
INBOARD[3]	ROG[1]	29.8	29.6	0.2[2]	29.1	28.9	0.2[2]	24.4	24.4	0.0
	NOx	34.7	35.2	(0.5)	34.2	34.4	(0.2)	30.2	30.2	0.0
	ROG[1]+NOx	64.5	64.8	(0.3)	63.3	63.3	0.0	54.6	54.6	0.0
TOTAL	ROG[1]	66.5	66.3	0.2[2]	64.9	64.5	0.4[2]	55.4	55.3	0.1[2]
	NOx	77.0	77.9	(0.9)	75.6	75.9	(0.3)	67.7	67.7	0.0
	ROG[1]+NOx	143.5	144.2	(0.7)	140.5	140.4	0.1[2]	123.1	123.0	0.1[2]

Notes:
1 ARB inventory estimates are expressed as the reactive organic gas (ROG) component of hydrocarbon
2 Parenthetical values in the delta "Δ" column indicate a net (loss) in emission benefits for Opt 2 compared to existing estimates
3 This engine classification also includes recreational spark-ignition jet drive engines

Table 4.2 shows the benefits from using a 15.0 g/m^2/day low-permeation hose on the fuel tank supply/return line for the 2007 model year only, and assuming that all manufacturers choose Option 2. Benefits would decrease proportionately should some manufacturers choose to implement Option 1, but never to the extent that they would fall below the projected benefits of the existing regulation. However, actual emission benefits could be much larger than indicated for the 2010 and 2020 model years since staff's proposal would require manufacturers choosing Option 2 to continue employing the same or better supplemental emissions control technology (low-permeation hose) for all subsequent model years.

Table 4.2
Supplemental Reductions for Option 2
Statewide Summer Weekend

MODEL YEAR	INVENTORY DISPARITY[1] [tons per day]	SUPPLEMENTAL REDUCTIONS[2] [tons per day]		NET BENEFITS [tons per day]
	ROG[3]+NOx	ROG[3]	NOx	ROG[3]+NOx
2007	(0.7)	0.9[4]	-	0.2
2010	0.1	0.6[4,5]	-	0.7
2020	0.1	0.2[4,5]	-	0.3

Notes:
1 ARB projected (loss) or gain in benefits from postponing the 5.0 g/kW-hr HC+NOx standard from 2007 to 2008
2 Assuming all manufacturers will use 15 g/m^2/day low-permeation liquid fuel supply/return hoses
3 ARB inventory estimates are expressed as the reactive organic gas (ROG) component of hydrocarbon
4 The estimated benefit for California Inboard/Sterndrive engines based on recent U.S. EPA modeling
5 Benefits are based on engine population attrition and 10% permeation degradation per year

According to recent modeling of evaporative emissions by U.S. EPA[8], the effect of all manufacturers using a 15.0 g/m^2/day low-permeation fuel tank supply/return hose on California's inboard and sterndrive engines in 2007 would result in a benefit of 0.9 tons per day ROG statewide during the summer months, thereby increasing the overall net statewide reduction of combined ROG and NOx emissions by 0.2 tons per day.

4.2. Technological Feasibility

The technological feasibility of the existing Inboard/Sterndrive regulation has already been established by staff in its report to the Board during the 2001 rulemaking and follow-up test programs at SwRI. Namely, the technologies previously determined feasible were leaner air-fuel calibration, electronic fuel injection, oxygen sensor feedback fuel control, catalytic converters, and, by automotive reference, on-board diagnostics. However, Option 2 of staff's proposed amendments would likely necessitate the incorporation of an additional emission control component that was not demonstrated during that rulemaking. Low-permeation evaporative loss control hoses have been used successfully by the automotive industry (ARB 1998b) for many years and are currently required for use on other applications such as lawnmowers (ARB 2003) and highway motorcycles (RSD 2003). The ARB rulemakings for light- and medium-duty passenger vehicles and small off-road engines (i.e., lawnmowers) clearly established the feasibility of low-permeation hoses for the control of evaporative emissions. The low-permeation hoses suggested as a means for providing supplemental emission reductions in this report are expected to have similar material

[8] Evaporative estimates are based on August 2005 U.S. EPA permeation modeling (RSD 2002). These estimates have been refined since their original release in 2002 to more accurately reflect the California population distribution of inboard and sterndrive engines.

specifications. The durability of low-permeation hoses was also established as part of those rulemakings[9].

4.2.1. On-Board Diagnostics (OBD) and Post-Catalyst Oxygen Sensors

OBD is a collection of subroutines and algorithms integrated into the on-board computer of an electronically controlled engine to monitor and evaluate the performance of emission-related components and systems under actual operating conditions. When a malfunction is detected, the OBD system alerts the engine operator, typically by illuminating a warning light, and stores codes and other information so that the malfunction can be easily identified and fixed properly. OBD was first required on light-duty and medium-duty passenger vehicles in 1991. A second, more comprehensive version, known as OBD II, became effective in 1996, and has been required on all new passenger vehicles ever since. In 2001 the Board adopted OBD-M (or OBD-Marine) requirements as part of the Inboard/Sterndrive rulemaking. The introduction of OBD-M is scheduled to coincide with engines certifying to the 5.0 g/kW-hr HC+NOx standard. Since inboard and sterndrive engines are nearly identical to their on-road counterparts, OBD-M was a logical progression. Many of the required OBD-M algorithms can be transferred from on-road technology and, in fact, many are already built into existing inboard and sterndrive computer controllers. OBD-M is meant to ensure the proper performance of emission-related components and systems on inboard and sterndrive engines throughout their useful lives and to facilitate their maintenance when necessary.

The OBD-M requirements went through several revisions during the development of the inboard and sterndrive regulation in 2001. The final adopted version significantly reduced the burden on marine manufacturers to incorporate complicated monitoring strategies in response to their concerns regarding the availability of resources. For example, misfire monitoring was relegated to a conditional requirement - only to be required if necessary to protect the catalytic converter. Further, manufacturers were allowed to delay illumination of the malfunction indicator light (MIL) for oxygen sensors, the catalyst, and the fuel system until the 2009 model year. This delay provides manufacturers with additional lead-time to gain field experience to perfect the required diagnostic strategies. Furthermore, the decision to delay illumination of the MIL shields the consumer from any potential false detection by the OBD-M system during the first few years of the program.

Another element that spares manufacturer resources and facilitates compliance is the provision allowing manufacturers to certify their systems with monitors that fall short of meeting the full requirement of the regulation. Up to three "deficiencies," as these partial monitoring strategies are called, can be claimed by the manufacturer for an engine family without cost, so long as the manufacturer makes a good faith effort to meet the requirements. Further, the manufacturer would be granted up to three years

[9] The staff reports (see references ARB 1998b and ARB 2000) are available and may be downloaded from the Air Resources Board website at http://www.arb.ca.gov.

to bring the deficient monitoring strategies into full compliance with the OBD-M regulation.

Although the overwhelming majority of OBD-M strategies can be directly transferred from existing automotive OBD technology, the level of precision required of the OBD-M system to detect malfunctions is far less rigorous than for OBD-II on-road applications. The malfunction detection thresholds for automotive OBD systems are generally calibrated to a 50 or 75 percent increase in emissions, but OBD-M allows manufacturers to set their own thresholds for identifying malfunctions, within reason. This degree of flexibility represents a considerable savings in both time and money, since calibrations can be set to more convenient specifications that match off-the-shelf hardware and software.

Currently, the marine industry's primary concern regarding OBD-M is the development of a reliable and cost-effective catalyst monitor. This issue was raised during the development of the inboard and sterndrive regulation in 2001, at which time the marine industry contended that the conventional automotive technique of using oxygen sensors to monitor the catalytic converter might not be easily transferable to the marine environment due to the susceptibility of oxygen sensors to water. Although compelling data in support of this claim have yet to be made available, ARB responded to industry's concern by revising the catalyst monitoring requirement to allow other monitoring methods including uncomplicated temperature-based algorithms. The option for marine manufacturers to use oxygen sensors would also be allowed if they so prefer.

Off-the-shelf automotive grade temperature methods of catalyst monitoring may not be as readily available as oxygen sensor methods, due to the predominance of the automotive industry to use less expensive oxygen sensor methods. Nevertheless, the temperature feedback method is viable and has been investigated in great detail by several sensor suppliers and automotive manufacturers, with at least one SAE paper devoted to the subject, "Closed Loop Temperature Feedback for Controlled Catalyst Light-off and Diagnostics for ULEV" (SAE 1999). The OBD-M application of such a temperature based method for catalyst monitoring should be far less rigorous than the intended automotive application (which is the subject of the SAE paper), due to the less stringent OBD-M requirements.

Because of cost and a proven "track record," marine manufacturers will likely use the oxygen sensor method to satisfy the OBD-M requirements. In the staff's 2004 briefing to the Board on the Fresh-Water Safety and Durability Program conducted by SwRI in 2002 (see subsection 4.2.2), it was clearly shown that oxygen sensors located upstream of the catalysts were durable for the useful life of the engine (480 hours). For oxygen sensors located downstream of the catalyst, the marine industry has raised concerns that the sensors would be damaged due to water reversion. However, as demonstrated during the Fresh-Water Safety and Durability Program, the potential adverse impacts due to water reversion can be eliminated with a properly designed exhaust system. Nevertheless, if industry remains concerned over the oxygen sensor's potential exposure to water, they could opt to place the oxygen sensor between the bricks of a catalyst (mid-bed). This could be used to satisfy the catalyst monitoring requirements of the OBD-M regulation. Some automotive manufacturers have used such a mid-bed technique successfully for years. All of this evidence suggests that catalyst monitoring using oxygen sensors or temperature-based methods should be feasible within the constraints of the current OBD-M regulation (Authorization 2005).

4.2.2. 2002 Fresh-Water Safety and Durability Program

As part of the 2001 rulemaking, Board Resolution 01-23 directed staff to collaborate with industry for the purpose of demonstrating that catalysts are safe and durable when used in the marine environment. Efforts to conduct a test program using catalysts began in 2002. ARB funded the project, which was carried out with the assistance of the National Marine Manufacturers Association (which provided boats and engines) and the Manufacturers of Emission Controls Association (which provided catalysts and other emission control components). The United States Coast Guard supplied the fuel and provided operators for the boats to accumulate the desired 480 hours (i.e., useful life) of "on water" use. SwRI was contracted to conduct the test program, which included fabricating new exhaust systems (to accommodate the exhaust catalysts) and sampling the exhaust emissions. As reported to the Board at the October 2004 Public Meeting, this test program successfully demonstrated that catalysts are safe and durable when operated on freshwater (SwRI 2004). Currently a second, similar project is underway to determine the effect(s), if any, that saltwater may have on the exhaust catalysts and other emission control components (see subsection 4.2.3).

The test program confirmed that the emission control system performed properly and safely without incident. Upon successful completion of 480 hours of "on-water" operation, the boats were returned to SwRI. The engines were removed from the boats and installed in a test cell for emission testing. Compared to zero-hour baseline testing, some deterioration of the emission levels is expected after 480 hours of use. Staff was very pleased to learn however, that although demonstrating compliance to the 5.0 g/kW-hr HC+NOx standard was not the aim of this project, deterioration was low and all three 5.7L engines remained under that emission level, several years ahead of when needed to meet the standards.

With the goal of demonstrating the safety and durability of catalysts, the project was successful. There were no instances of fire or excessive heat, and the results from both the on-water and in-laboratory exhaust sampling show that catalysts are robust in the marine environment. Another notable success was the upstream oxygen sensors. These prototype sensors were designed with a shrouded tip, to make them less prone to water damage. Throughout the course of the on-water accumulation, these sensors remained undamaged and did not require replacement.

4.2.3. 2005 Salt-Water Test Program

Another test program funded jointly by ARB and U.S. EPA is currently underway to determine the durability of catalysts and the feasibility of monitoring the catalytic converter in a saltwater environment. Again, this project is being conducted in conjunction with the marine industry and SwRI has been hired as the contractor. The United States Coast Guard is also, again, supplying the fuel for the project, and the Texas Parks and Wildlife Department has volunteered to operate the boats. The goal is to operate the engines on water for as long as possible up to 480 hours; however, given the time constraints of the test program and the scheduled implementation of catalyst-based standards, it is possible that less than 300 hours may actually be accumulated. Extrapolated data will be used to project durability to the 480 hour endpoint. The engines will be tested periodically to determine whether or nor emissions performance has been compromised due to the saltwater and whether or not the hardware necessary to support OBD-M catalyst monitoring remains viable throughout the 480 hour accumulation period. Staff intends to provide a summary of available results in its presentation to the Board at the November 17-18, 2005, Board Hearing.

Staff believes that the results of this program will ultimately show similar durability for catalysts and oxygen sensors as did the fresh water test program. By comparison, ARB certification records show that at least one personal watercraft (PWC) manufacturer has been successfully using catalysts on a two-stroke engine since 2001. ARB Executive Order U-W-003-0085 can be viewed online at the ARB website[10]. This PWC operates in both freshwater and saltwater. About 200 of these PWCs are sold annually in California and 2,000 nationwide. Warranty claims for defective catalysts are virtually nonexistent for this manufacturer. By design, two-stroke engines produce much more rapid and pronounced fluctuations in exhaust pressure than the four-stroke engines of inboard and sterndrive vessels. As such, water reversion should be a greater challenge for the PWC manufacturer, yet the lack of catalyst warranty claims indicates that it has not been an issue. Furthermore, catalysts on two-stroke PWC engines also have to contend with the ingestion of lubricating oil, which should have a much higher potential for poisoning the catalyst than saltwater reversion, yet this also has not been an obstacle to compliance.

4.3. Safety Concerns

Staff is unaware of any safety-related issues being raised by the marine industry at this time regarding staff's proposed amendments to the regulation. However, with the likely incorporation of catalyzed materials in the exhaust stream to meet the 5.0 g/kW-hr HC+NOx standard, there is the potential for increased heat dissipation. However, this issue was addressed during the Freshwater Safety and Durability Program, which found that the use of catalysts is not likely to pose any threat to the safety of vessel occupants (SwRI 2004).

[10] http://arb.ca.gov/msprog/offroad/cert/2005/sime_05/u-w-003-0085.pdf

5. ENVIRONMENTAL IMPACTS AND COST-EFFECTIVENESS

The intent of staff's proposal is to provide industry with a choice of compliance flexibility options that preserve the emissions reduction goals of the existing regulation. In crafting the proposed options (explained in subsection 3.3), staff worked to ensure that the emission benefits projected as a result of the existing regulation would not be adversely affected. With respect to Option 1, which maintains the status quo in model years 2007 and 2008, it is obvious that no net change in emission reductions will occur. However, Option 2, which allows manufacturers to certify to a less stringent exhaust emissions standard in 2007 in exchange for accelerated compliance to the 5.0 g/kW-hr standard in 2008, has the potential to provide emission reductions in excess of those projected under the existing regulation. Therefore, regardless of which option each manufacturer chooses, or the mix of options that the manufacturers collectively choose, no adverse environmental impacts are expected as a result of staff's proposal.

5.1. Projected ROG+NOx Emission Benefits

A summary of emission benefits from staff's proposal is shown in Table 5.1. Since Option 1 requires the same standards and implementation schedule as the existing requirements, no net gain in benefits occurs. However, should manufacturers choose to comply with Option 2 using a low-permeation fuel tank supply/return hose, staff projects that some additional reductions could result as indicated in Table 5.1. The table also shows that the combined ROG+NOx emissions from inboard and sterndrive marine engines are reduced by about 57 tons of ROG+NOx per day in 2020 based on a summer weekend average, compared to unregulated engines. As documented in the 2001 Inboard/Sterndrive staff report, this reduction is equivalent to eliminating the exhaust emitted by approximately 1.6 million passenger vehicles.

Table 5.1
Projected Emission Benefits for Inboard[1] and Sterndrive Engines
Statewide Summer Weekend

MODEL YEAR	POLLUTANT	EMISSION BENEFITS [tons per day]			
		Option 1 (Existing)[2]	Option 2[3]	Gains[4]	
				Option 1	Option 2
2007	ROG+NOx	0.8	1.0	0.0	0.2
2010	ROG+NOx	12.2	12.9	0.0	0.7
2020	ROG+NOx	56.8	57.1	0.0	0.3

Notes:
1 This engine classification also includes recreational spark-ignition jet drive engines
2 Existing benefits differ slightly from 2001 estimates due to recent modeling refinements
3 Option 2 benefits include evaporative reductions from a low-permeation fuel tank supply/return hose
4 The gain in emission benefits vs. existing requirements (optional)

5.2. Carbon Monoxide (CO) Benefits

CO emissions from inboard and sterndrive pleasurecraft are also a concern. The United States Coast Guard and the National Institute for Occupational Safety and Health warn against the practices of wakeboarding and teak surfing because of the potential for these activities to result in serious injury or death as a result of CO inhalation from close proximity to the boat engine's exhaust. Typically, CO poisoning occurs while wakeboarders and teak surfers hold on to the back of the boat at idle or low cruising speeds. From 1990-2004, there were 43 boat-related CO poisoning cases in California according to a Boating Accident Report published by the United States Coast Guard (USCG 2004).

While ultimately staff intends to propose a CO standard for inboard and sterndrive pleasurecraft, testing is still underway to determine an appropriate level of emissions that will be sufficient to protect public health and to achieve attainment with air quality standards. Furthermore, U.S. EPA intends to promulgate a CO standard (U.S. EPA 2002) for inboard and sterndrive engines in a final rulemaking tentatively scheduled for 2007. If and when the federal CO standard is promulgated, staff will prepare to return to the Board requesting the adoption of a harmonized CO standard in California if appropriate.

With respect to staff's proposal to allow standard averaging in 2009 (subsection 3.3), which could potentially enable engines greater than 373 kW to comply with the regulation without a catalyst, staff believes the potential for these engines to be used for wakeboarding, teak surfing, or other "tow sports" is extremely low. Boats with these high power engines typically contain two engines and are on the order of 33 feet in length. The wake created by them is generally prohibitive of "tow sports" including water skiing, unless an extremely long rope (100 feet) is used. Boats with these engines are purchased primarily for racing activities.

Although the regulations at this time do not include CO standards, staff believes that significant reductions in CO will occur regardless as a result of industry's migration to three-way catalysts in 2008. Staff estimates that reductions in CO on the order of 40 to 80 percent below existing levels (150 to 200 g/kW-hr) are reasonable to expect since passenger vehicle catalysts are typically 90+ percent efficient in reducing CO.

5.3. State Implementation Plan (SIP)

The existing inboard and sterndrive marine engine regulations were adopted by the Board in 2001 and have been included as part of the baseline for SIP revisions since 2002. The emissions from this source category are most significant during the summer ozone season. Some of the changes proposed by staff could impact current SIP commitments. Staff's proposed amendments to the regulations provide the marine industry with two compliance options for model years 2007 and 2008. These options provide additional flexibility in that they allow manufacturers the opportunity to choose a path to compliance that is best suited to individual production roll-out goals. The emissions and SIP impacts of the proposed amendments are dependent on which alternative is chosen, but none is expected to have a negative impact on SIP commitments.

Option 1 of staff's proposal allows manufacturers to continue meeting the requirements of the existing regulation for model years 2007 and 2008, and would result in no change in the timing or amount of emission reductions. Option 2 allows marine manufacturers to meet a less stringent exhaust standard (14.0 g/kW-hr HC+NOx) in 2007 with full compliance to the 5.0 g/kW-hr HC+NOx standard in 2008, one year earlier than currently required. Option 2 also requires supplemental emission reductions in 2007 to compensate for the less stringent exhaust standard in that model year. Given that the most likely approach for achieving the supplemental emissions reduction would be with evaporative emissions control, Option 2 has the potential to reduce combined HC and NOx emissions below existing projected levels (see Tables 4.1 and 4.2). However, the ratio of HC to NOx in the emission reductions could change (e.g., Option 2 with evaporative control would result in decreased HC emissions and slightly increased NOx emissions compared to the existing requirements).

Even though the overall HC+NOx emissions would be the same or even lower, the slight change in the relative amounts of HC and NOx could have an impact on ozone and secondary particulate matter formation. The direction and magnitude of the impact is unknown, but likely very small. Only the portion of MY 2007 engines certified to Option 2 with evaporative control would have the higher NOx emissions. However, these engines would have lower HC emissions, which would provide the additional benefit of lowering emissions of toxic substances from gasoline evaporation, such as benzene and toluene.

By 2020, emission levels under the proposed amendments would be at or below levels required by the existing regulation, thus preserving or enhancing the long-term SIP benefits. If the Board approves these amendments, any emission impacts arising from their implementation will be reflected in the next round of SIPs.

5.4. Environmental Justice

State law defines environmental justice 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 (Senate Bill 115, Solis; Stats 1999, Ch. 690; Government Code § 65040.12(c)). The Board has established a framework for incorporating environmental justice into ARB's programs consistent with the directives of State law. The policies developed 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, which sometimes experience higher exposures to some pollutants as a result of the cumulative impacts of air pollution from multiple mobile, commercial, industrial, area-wide, and other sources. Over the past twenty years, ARB, local air districts, and federal air pollution control programs have made substantial progress towards improving the air quality in California. However, some communities continue to experience higher exposures than others as a result of the cumulative impacts of air pollution from multiple mobile and stationary sources and thus may suffer a disproportionate level of adverse health effects. Since the same ambient air quality standards apply to all regions of the State, all communities, including environmental justice communities, will benefit from the air quality benefits associated with the proposal. As additional relevant scientific evidence becomes available, the spark-ignition inboard and sterndrive marine engine standards will be reviewed again to make certain that public health is protected with an adequate margin of safety.

To ensure that everyone has had an opportunity to stay informed and participate fully in developing these proposed amendments to the spark-ignition inboard and sterndrive marine engine standards, staff has had meetings and has participated in public forums as described in subsection 2.6 of this report.

5.5. Cost-Effectiveness

The cost-effectiveness found in the 2001 rulemaking was $2.08 to 3.39/lb HC+NOx reduced (ARB 2001). Staff expects no net change in cost-effectiveness from that found in the 2001 rulemaking, because the proposed amendments, in addition to providing an option for delaying catalyst-based standards, also provide a choice for the engine manufacturer to continue complying with the existing regulation. Presumably, a manufacturer would choose the new option only if it was within its financial interests to do so. Therefore, the existing regulation remains an upper bound for cost-effectiveness. If low-permeation evaporative emission control hoses are utilized as a means of complying with the regulation, the slight increase in costs to the manufacturer ($0.40 to $0.60 per foot per a 6 foot hose on average) should be offset by the savings resulting from the relaxation of requirements to introduce engines meeting the catalyst-based 5.0 g/kW-hr HC+NOx standard prior to 2008.

6. ECONOMIC IMPACTS

The proposed regulatory amendments are not expected to result in net additional costs above the costs to comply with the existing regulation. Adoption of staff's proposal is actually expected to benefit engine manufacturers by providing them with additional lead-time to comply with the catalyst forcing 5.0 g/kW-hr HC+NOx standard that they would not otherwise have under the existing regulation. Therefore, staff maintains that the proposed amendments would have no adverse impacts on business competitiveness, California employment, or on business creation, elimination, and expansion. Furthermore, if any manufacturer determines that compliance with the existing regulation is more economically advantageous than staff's proposed amendments, that manufacturer is still able to choose to comply with the existing regulation. This section discusses, in greater detail, the potential cost and economic impacts of staff's proposed amendments.

6.1. 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 required to estimate the cost or savings to any state or local agency, and school districts. The estimate is to include any nondiscretionary cost or savings to local agencies and the cost or savings in federal funding to the state.

6.2. Affected Businesses

Staff does not expect any business to be adversely affected by the proposed amendments to the regulation, including those pertaining to farm or agriculture. Staff's amendments would provide additional lead-time and greater flexibility for any marine engine manufacturer or boat builder to comply with the regulation. Boat owners are not likely to be adversely affected because inboard and sterndrive pleasurecraft are primarily used in recreational applications and are not typically employed to support the livelihood of California residents. The amendments are directed at manufacturers, so docks, ports, and fishing and boating stores are not expected to be adversely affected by staff's proposal; in fact, the amendments may indirectly benefit them since the amendments are meant to provide relief to the marine industry.

6.2.1. Estimated Costs to Engine Manufacturers

If a manufacturer chooses to comply with staff's proposed Option 2, a slight increase in costs to the manufacturer could occur if it chooses to incorporate low-permeation evaporative tubing ($0.40 - $0.60 per foot for a 6 foot hose on average). However, this incremental cost will be more than offset by the relaxation of requirements to introduce engines equipped with catalytic converters prior to 2008. Further, manufacturers may still choose Option 1 (see subsection 3.3) that allows them to continue following the existing standards and implementation schedule if desired, which would result in no change in costs to engine manufacturers.

6.2.2. Potential Impacts on Business

Staff does not expect any business to be adversely affected by the proposed amendments to the regulation. The evaporative control technology to be incorporated under Option 2, is readily available, generally inexpensive, and does not require special expertise to install. In addition, a manufacturer will be able to choose if that is the option it wishes to follow. On the other hand, the proposed amendments are likely to benefit manufacturers because they provide additional compliance flexibility and lead-time to comply with the regulation. Inboard and sterndrive engines are primarily used in recreational applications and do not typically support the livelihood of California residents. As mentioned above, the amendments are directed at manufacturers, so docks, ports, and fishing and boating stores are not expected to be adversely affected by staff's proposal; in fact, the amendments may indirectly benefit them since the amendments are meant to provide relief to the marine industry. Further, proposed Option 1 (see subsection 3.3) allows manufacturers to continue following the existing standards and implementation schedule if desired, which would result in no change in economic impacts on businesses.

6.2.3. Potential Impact on Business Competitiveness

The proposed amendments are not expected to have a significant impact on the ability of California businesses to compete with businesses in other states since any engine produced in, or imported into, the State must comply with the proposed requirements. Staff does not expect that any business will suffer a competitive disadvantage from the proposed amendments. The evaporative control technology to be incorporated under Option 2, if selected by the engine manufacturer, is readily available, generally inexpensive, and does not require special expertise to install. Inboard and sterndrive engines are primarily used in recreational applications and do not typically support the livelihood of California residents. As noted previously, docks, ports, and fishing and boating stores are not expected to be adversely affected by staff's proposal, since the amendments are directed at manufacturers. To the extent that the amendments provide relief to the marine industry, the docks, ports, and fishing and boating stores could also benefit. Manufacturers may still choose Option 1 (see subsection 3.3) that allows them to continue following the existing standards and implementation schedule if desired, which would result in no change on business competitiveness.

6.2.4. Potential Impact on Employment

The proposed amendments are not expected to cause a noticeable change in California employment. The evaporative control technology to be incorporated under Option 2, if selected by the engine manufacturer, is readily available, generally inexpensive, and does not require special expertise to install. The adoption of staff's proposal is expected to benefit manufacturers, who would otherwise have to equip a portion of their engines with catalysts and on-board diagnostics one year sooner. Further, proposed Option 1 (see subsection 3.3) allows manufacturers to continue following the existing standards and implementation schedule if desired, which would result in no change in employment.

6.2.5. Potential Impact on Business Creation, Elimination or Expansion

The proposed amendments are not expected to have a noticeable impact on the status of California business creation, elimination, or expansion. The evaporative control technology to be incorporated under Option 2, if selected by the engine manufacturer, is readily available, generally inexpensive, and does not require special expertise to install. Manufacturers may still choose Option 1 (see subsection 3.3) that allows them to continue following the existing standards and implementation schedule if desired, which would result in no change in business creation, elimination, or expansion.

6.2.6. Potential Impact on Small Businesses

The proposed amendments are not expected to have a noticeable impact on the status of California businesses including small businesses. The evaporative control technology to be incorporated under Option 2, if selected by the engine manufacturer, is readily available, generally inexpensive, and does not require special expertise to install. Manufacturers may still choose Option 1 (see subsection 3.3) that allows them to continue following the existing standards and implementation schedule if desired, which would result in no impact on small businesses.

6.3. Potential Costs to Local and State Agencies

Staff believes the proposed requirements are the most cost-effective means of achieving emission reductions of the same magnitude as the existing regulation. The proposed amendments are not expected to result in an overall increase in costs for State or local agencies. The proposed amendments are not expected to increase workload or impact the current ARB budget. Any administrative costs related to the implementation of staff's proposed amendments would be absorbed with existing ARB resources. ARB is already responsible for verifying the implementation of the existing regulations for inboard and sterndrive, as well as other marine spark-ignition engines.

7. REGULATORY ALTERNATIVES

The staff evaluated various alternatives to the current proposal. A brief description of the alternatives and staff's rationale for finding them unsuitable follows below.

7.1. Preserve Existing California Regulations

The first alternative to this proposal would be to simply keep the existing California Inboard/Sterndrive regulations. Although staff's proposal includes allowing manufacturers to continue complying with the existing regulation, the proposed amendments also provide industry with options for additional flexibility while achieving equivalent emission benefits, and the potential to achieve additional emission benefits in Option 2. The existing regulation does not offer compliance flexibility options and may unnecessarily burden some segments of the marine industry. Therefore, staff rejected this alternative.

7.2. Wait for the Adoption of Federal Regulations

Although U.S. EPA has published a Notice of Proposed Rulemaking for inboard and sterndrive engine standards, a federal regulation is not expected to be promulgated until 2007 or implemented prior to 2009 at the earliest. Considering that California has had regulations in place since 2001, and that staff's proposed amendments preserve the emission benefits of those requirements, postponing these amendments would only serve to deny reasonable relief to the regulated industry.

The advantage of a national regulation is harmonization. Manufacturers would have to comply with only one set of regulations for all nationwide sales. The disadvantage of relying on the federal rulemaking is largely one of uncertainty and timing. Staff fully intends to continue working with U.S. EPA in its development of a federal rule to ensure consistency of standards and other requirements. If after the federal rule has been promulgated, staff determines that additional amendments will help achieve harmonization without harming the California program, staff will return to the Board with additional amendments. However, delaying action until the federal regulation is finalized would unnecessarily burden the marine industry. Therefore, staff rejected this alternative.

7.3. Accelerate Implementation of Standards

Staff examined the possibility of accelerating the implementation schedule of standards to get cleaner engines into California earlier. While this alternative would provide emission benefits sooner, manufacturers would have less lead-time to develop the necessary emission control technologies, and manufacturers would have fewer years over which to spread out and recoup the development expenses. This would also make the proposal far less cost-effective. Therefore, staff rejected this alternative.

8. FUTURE PLANS

8.1. CO Standard

As previously noted in subsection 5.2, although this proposal does not include a CO standard for inboard and sterndrive pleasurecraft, it is ultimately staff's intention to propose a CO standard. Furthermore, U.S. EPA intends to promulgate a CO standard (U.S. EPA 2002) for inboard and sterndrive engines in a final rulemaking tentatively scheduled for 2007. If and when the federal CO standard is promulgated, staff will prepare to return to the Board requesting the adoption of a harmonized CO standard in California if appropriate.

8.2. Evaporative Standards

Although staff is proposing to allow the use of low-permeation evaporative control to achieve the supplemental emission reductions required under compliance Option 2 (see subsection 3.3), no additional formal requirement to address evaporative emissions is being proposed at this time. U.S. EPA is currently developing evaporative standards to be promulgated federally on inboard and sterndrive engines in a final rulemaking tentatively scheduled for 2007. Staff expects that many engine manufacturers will use some form of evaporative emissions control to comply with the proposed Option 2 since they would soon after be required to incorporate evaporative standards anyway due to the federal rule. As appropriate, staff will return to the Board requesting the adoption of harmonized evaporative emission control standards after the final U.S. EPA rule has been published.

8.3. High Power Engines (> 373 kW)

Industry has asked for relief regarding the certification of, and the incorporation of catalysts on, high-power inboard and sterndrive engines. The primary reason for this request is the high cost (estimated $500,000) that would be incurred by individual engine manufacturers in purchasing the emissions sampling equipment necessary to test high-power engines. Flow rates and other test parameters on high-power engines often exceed the capacity of existing sampling equipment and have the potential to damage equipment in addition to rendering inaccurate measurements. Staff has responded to industry's request by proposing that engines with rated power greater than 485 kW be allowed to certify to a default emissions value of 30.0 g/kW-hr HC+NOx in lieu of having to generate actual test data. Further, staff is proposing that engines with rated power greater than 373 kW be allowed to average emission levels with lower power engines for the purpose of complying with the 5.0 g/kW-hr standard. However, staff is aware that the proposed averaging relief provision may not be adequate for some manufacturers whose product lines consist primarily or exclusively of engines with rated power greater than 373 kW. For these manufacturers, staff is still considering the best approach for providing relief. Since engines with rated power greater than 373 kW are exempt from certification requirements until model year 2009, staff intends to return to the Board prior to that date with a proposed resolution to this issue.

9. CONCLUSIONS AND RECOMMENDATIONS

Staff's objective in recommending the inclusion of additional compliance options into the Inboard/Sterndrive regulation is to provide reasonable relief for the marine industry while preserving, and possibly increasing, air quality benefits compared to existing inventory projections. The estimated California cost-effectiveness with adoption of the staff's proposal remains $2.08 to 3.39/lb HC+NOx reduced as calculated for the 2001 rulemaking. This cost-effectiveness is well within the range of other control measures adopted by the Board.

No alternative considered by the agency would be more effective in carrying out the purpose for which the amended regulation is proposed, or would be as effective as, or less burdensome, to affected private persons than the proposed regulation. Therefore, staff recommends that the Board adopt staff's proposal as contained in this report and noted in the attached proposed regulations and test procedures.

10. REFERENCES

Almanac 2005: California Air Resources Board, 2005 California Almanac of Emissions and Air Quality, Chapter 2: Current Emissions and Air Quality – Criteria Pollutants, Planning and Technical Support Division.

ARB 1998a: California Air Resources Board, Public Hearing to Consider Adoption of Emission Standards and Test Procedures for New 2001 and Later Model Year Spark-Ignition Marine Engines, October 23, 1998 (Staff Report).

ARB 1998b: California Air Resources Board, Proposed Amendments to California Exhaust and Evaporative Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles, September 18, 1998 (Staff Report).

ARB 2001: California Air Resources Board, Public Hearing to Consider Adoption of Emission Standards and Test Procedures for New 2003 and Later Spark-Ignition Inboard and Sterndrive Marine Engines, June 8, 2001 (Staff Report).

ARB 2003: California Air Resources Board, Public Hearing to Consider the Adoption of Exhaust and Evaporative Emission Control Requirements for Small Off-Road Equipment and Engines Less Than or Equal To 19 kW, August 8, 2003 (Staff Report).

ARB 2004: California Air Resources Board, Public Meeting to Consider a Status Report on Catalyst Testing of Spark-Ignition Inboard/Sterndrive Pleasurecraft, October 19, 2004 (Staff Report).

Authorization 2005: California Air Resources Board, Letter to Acting U.S. EPA Administrator Stephen L. Johnson, California State Nonroad Engine and Vehicle Pollution Control Standards; Opportunity for Public Hearing and Request for Public Comment; California Marine Spark-Ignition Engine Emission Regulations, March 28, 2005.

DATA E: Samulski, M., Spears M., United States Environmental Protection Agency, Exhaust Emission Testing of Two High-Performance SD/I Marine Engines, Draft Memorandum, Docket OAR-2004-0008, June 23, 2005.

DATA M: Mercury Marine, Marine Exhaust Emissions Analyses for High-Performance Engines 525 to 1075 Horsepower, AVL, Ann Arbor, MI, April 19-20, 2005.

RSD 2002: United States Environmental Protection Agency, Control of Emissions from Spark-Ignition Marine Vessels and Highway Motorcycles, Draft Regulatory Support Document, EPA420-D-02-003, July 2002.

RSD 2003: United States Environmental Protection Agency, Control of Emissions from Highway Motorcycles, Final Regulatory Support Document, EPA420-R-03-015, December 2003.

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SwRI 2004: Southwest Research Institute, Interim Report for the "Development of Low Emissions SD/I Boats," Project 08.05874, San Antonio, TX, September 20, 2004.

USCG 2004: United States Coast Guard, Boat-Related Carbon Monoxide (CO) Poisonings, Updated: October 2004.

U.S. EPA 1996: United States Environmental Protection Agency, Control of Air Pollution; Final Rule for New Gasoline Spark-Ignition Marine Engines, Exemptions for New Nonroad Compression-Ignition Engines at or Above 37 Kilowatts and New Nonroad Spark-Ignition Engines at or Below 19 Kilowatts; Final Rule, 61 Federal Register 52088-52169, October 4, 1996.

U.S. EPA 1997: United States Environmental Protection Agency, Control of Emissions of Air Pollution From Highway Heavy-Duty Engines; Final Rule, 62 Federal Register 54694-54730, October 21, 1997.

U.S. EPA 2002: United States Environmental Protection Agency, Control of Emissions from Spark-Ignition Marine Vessels and Highway Motorcycles; Notice of Proposed Rulemaking, 67 Federal Register 53050-53115, August 14, 2002.

APPENDIX: MODELING THEORY AND REFERENCE SPECIFICATIONS FOR VARIOUS LOW-PERMEATION EVAPORATIVE EMISSION CONTROL MATERIALS

Evaporative permeation is the rate at which liquid or gaseous hydrocarbon penetrates the material used to contain it (e.g., hoses, fuel tanks, etc.). It is usually quantified as the mass rate of diffusion per unit of time in grams per day (g/day). For the purposes of normalization and setting standards, permeation rates are further divided by the contact surface area and width of a material in order to be used as a reference for that specific type of material. For example, to calculate the permeation rate of a 6 foot long fuel supply hose with a 3/8 inch inner diameter, first find the inner surface area of the hose by multiplying its inner diameter by pi and then again by the length of the tube. After converting to SI units, this results in a contact surface of 0.055 m^2. Multiply this by the baseline permeation rate of the hose, typically 100 g/m^2/day for spark-ignition engines according to SAE J1527 and U.S. EPA modeling - although this number can fluctuate throughout the year due to changes in ambient temperature or the Reid vapor pressure of the fuel - and the result is the daily amount of hydrocarbon that hose releases to the atmosphere due to permeation (5.5 g/day). In the same example, if a low-permeation hose (15 g/m^2/day) of similar dimensions were used, the permeation rate would only be 0.83 g/day resulting in a net benefit of 4.7 g/day.

Table A.1 shows the permeation rates for various materials used in the construction of vacuum and liquid hoses for vehicular and marine engine applications. Here, the thickness of the low-permeation material in millimeters is factored into reference specification. Hoses made from fluoroelastomers provide a reasonable compromise between permeation control and cost, and would be a good choice for complying with the supplemental emission reduction requirements of staff's proposed Option 2. The shaded row in the table identifies the fluoroelastomer FKM Viton GLT. This material has been manufactured using 65 percent fluorination and, with a 14 g-mm/m^2/day permeation rate, would comply with the requirements for a supplemental emission control technology under Option 2 of staff's proposal. It should be noted, however, that this low-permeation material provides an even greater barrier to evaporative loss when Fuel C[11] is used, about one-half the permeation rate associated with the CE10[12] reference fuel (RSD 2003). Fuel C is similar to gasoline regarding permeation; therefore hoses made from this material should be able to control permeation on inboard and sterndrive engines to an even greater degree than Table A.1 specifications indicate. The cost of FKM Viton GLT is approximately $0.40 to $0.60 per foot and is typically applied as a one millimeter thick liner or layer within a hose made of more permeable material.

[11] Fuel blend consisting of 50% toluene and 50% iso-octane (ASTM D471-98)
[12] Fuel blend consisting of 45% toluene, 45% iso-octane, and 10% ethanol

Table A.1
Fuel System Material Permeation Rates at 23º Celsius by Fuel Type[1]

MATERIAL NAME	COMPOSITION	FUEL C[2]	FUEL CE10[3]	CM15[4]
		[grams-millimeter / m^2 / day]		
HDPE	high density polyethylene	35	-	35
Nylon 12, rigid	thermoplastic	0.2	-	64
EVOH	ethylene vinyl alcohol, thermoplastic	-	-	10
Polyacetal	thermoplastic	-	-	3.1
PBT	polybutylene terephthalate, thermoplastic	-	-	0.4
PVDF	polyvinylidene fluoride, fluorothermoplastic	-	-	0.2
NBR (33% ACN)	nitrile rubber	669	1028	1188
HNBR (44%ACN)	hydrogenated nitrile rubber	230	553	828
FVMQ	flourosilicone	455	584	635
FKM Viton A200 (66%F)	fluoroelastomer	0.80	7.5	36
FKM Viton B70 (66%F)	fluoroelastomer	0.80	6.7	32
FKM Viton GLT (65%F)	fluoroelastomer	2.60	14	60
FKM Viton B200 (68%F)	fluoroelastomer	0.70	4.1	12
FKM Viton GF (70%F)	fluoroelastomer	0.70	1.1	3.0
FKM Viton GFLT (67%F)	fluoroelastomer	1.80	6.5	14
FKM - 2120	fluoroelastomer	8	-	44
FKM - 5830	fluoroelastomer	1.1	-	8
Teflon FEP 1000L	fluorothermoplastic		0.03	0.03
Teflon PTFE	polytetrafluoroethylene, fluoroplastic	-	-	0.05
Teflon PFA 1000LP	fluorothermoplastic	0.18	0.03	0.13
Tefzel ETFE 1000LZ	ethylene-tetrafluoro-ethylene, fluoroplastic	0.03	0.05	0.20
Nylon 12 (GM grade)	thermoplastic	6.0	24	83
Nitrile	nitrile	130	635	1150
Silicone Rubber	silicone rubber	-	-	6500
Fluorosilicone	fluorosilicone	-	-	635
FKM	fluoroelastomer	-	16	-
FE 5620Q (65.9% fluorine)	fluorothermoplastic	-	7	-
FE 5840Q (70.2% fluorine)	fluorothermoplastic	-	4	-
PTFE	polytetrafluoroethylene, fluoroplastic	0.05	-	0.08[5]
ETFE	ethylene-tetrafluoro-ethylene, fluoroplastic	0.02	-	0.04[5]
PFA	fluorothermoplastic	0.01	-	0.05[5]
THV 500	tetra-fluoro-ethylene, hexa-fluoro-propylene, vinyledene fluoride	0.03	-	0.3

Notes:
1. From 2003 U.S. EPA Final Regulatory Support Document: Control of Emissions from Highway Motorcycles (RSD 2003)
2. Fuel blend consisting of 50% toluene and 50% iso-octane (ASTM D 471-98)
3. Fuel blend consisting of 90% Fuel C and 10% ethanol
4. Fuel blend consisting of 85% Fuel C and 15% methanol
5. Tested on a fuel blend of 80% Fuel C and 20% methanol (CM20)

ATTACHMENT A: PROPOSED AMENDMENTS TO THE CALIFORNIA REGULATIONS FOR NEW 2007 AND LATER SPARK-IGNITION INBOARD/STERNDRIVE PLEASURECRAFT

ATTACHMENT B: PROPOSED AMENDMENTS TO THE CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR 2001 MODEL YEAR AND LATER SPARK-IGNITION MARINE ENGINES

ATTACHMENT A

PROPOSED REGULATION ORDER

Title 13 California Code of Regulations

PROPOSED REGULATION ORDER

Proposed Amendments to the California Regulations for New 2007 and Later Spark-Ignition Inboard/Sterndrive Pleasurecraft

NOTE: This document is written in a style to indicate changes from the existing provisions. All existing language is indicated by plain text. All additions to language are indicated by underlined text. All deletions to language are indicated by ~~strikeout~~. Only those portions containing the suggested modifications from existing provisions are included. All other portions remain unchanged and are indicated by the symbol "* * * * *" for reference.

Amend sections 2111, 2112, 2441, 2442, 2444.2, 2445.1, 2445.2, 2446, title 13 California Code of Regulations, and amend Appendix A to article 2.1, chapter 2 division 3, title 13, California Code of Regulations, to read as follows:

§ 2111. Applicability.

(a) These procedures shall apply to:

(1) California-certified 1982 and subsequent model-year passenger cars, light-duty trucks, medium-duty vehicles, heavy-duty vehicles, motorcycles, and California-certified 1997 and subsequent model-year off-road motorcycles and all-terrain vehicles, including those federally certified vehicles which are sold in California pursuant to Health and Safety Code section 43102,

(2) California-certified motor vehicle engines used in such vehicles

(3) California-certified 2000 and subsequent model-year off-road compression-ignition engines, and

(4) California-certified 2009 and subsequent model-year spark-ignition inboard and sterndrive marine engines complying with the Option 1 requirements in Section 2442(b)(1) and California-certified 2008 and subsequent model-year spark-ignition inboard and sterndrive marine engines complying with the Option 2 requirements in Section 2442(b)(1).

* * * * *

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018 and 43105, Health and Safety Code.

Reference: Sections 43000, 43009.5, 43013, 43018, 43101, 43104, 43105, 43106, 43107, and 43204-43205.5, Health and Safety Code.

§ 2112. Definitions.

* * * * *

(l) "Useful life" means, for the purposes of this article:

* * * * *

(23) ~~For~~California-certified 2009 and subsequent model year spark-ignition inboard and sterndrive marine engines complying with the Option 1 requirements in Section 2442(b)(1) and California-certified 2008 and subsequent model-year spark-ignition inboard and sterndrive marine engines complying with the Option 2 requirements in Section 2442(b)(1), a period of ten years or 480 hours, whichever first occurs for engines 485 kilowatts and less. For engines greater than 485 kilowatts, a period of one year or 50 hours, whichever first occurs. Manufacturers of engines greater than 485 kilowatts may petition the Executive Officer for a approval of a shorter period when appropriate.

* * * * *

Appendix A
to Article 2.1

California In-Use Vehicle Emission-Related Recall Procedures, Enforcement Test Procedures, and Failure Reporting Procedures for 1982 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, Heavy-Duty Vehicles and Engines, Motorcycles, 1997 and Subsequent Model-Year Off-Road Motorcycles and All-Terrain Vehicles, 2000 and Subsequent Model-Year Off-Road Compression-Ignition Engines, and ~~2009~~2008 and Subsequent Model-Year Spark-Ignition Inboard and Sterndrive Marine Engines.

* * * * *

I. Passenger Car, Light-Duty Truck, Medium-Duty Vehicle, Motorcycle, and Inboard and Sterndrive Parameters and Specifications.

* * * * *

Authority cited: Sections 39600, 39601, 43013, 43018, 43101, 43104, 43105 and 43806, Health and Safety Code; and Section 28114, Vehicle Code.
Reference: Sections 39002, 39003, 39500, 43000, 43009.5, 43013, 43018, 43100, 43101, 43101.5, 43102, 43104, 43105, 43106, 43107, 43202, 43204-43205.5, 43206, 43210, 43211, 43212, 43213 and 43806, Health and Safety Code; and Section 28114, Vehicle Code.

§ 2441. Definitions.

(a) Definitions in section 1900(b), Division 3, Chapter 9, Title 13 of the California Code of Regulations, apply with the following additions:

* * * * *

(7) "CE10 fuel" is a blend of 45% toluene, 45% iso-octane, and 10% ethanol that has been standardized by the American Society of Testing and Materials (ASTM) as a reference fuel for evaluating the evaporative permeability of fuel-containing materials.

~~(7)~~(8) "Certification" means, with respect to new spark-ignition marine engines, obtaining an Executive Order for an engine family complying with the spark-ignition marine engine exhaust emission standards and requirements specified in Title 13, California Code of Regulations, sections 2442 and 2447.

~~(8)~~(9) "Complete engine assembly" or "complete engine configuration" means an assembly of a basic engine and all of the specific applicable components (e.g., air inlet, fuel and exhaust systems, etc.) and calibrations (e.g., carburetor jet size, valve timing, etc.) required for the assembly to be installed in a new unit of equipment.

~~(9)~~(10) "Continuous monitoring" means sampling at a rate no less than two samples per second. If for engine control purposes, a computer input component is sampled less frequently, the value of the component may instead be evaluated each time sampling occurs.

(11) "ECM hour-meter" means a device that is integrated into the engine control module (ECM) and that is capable of storing and incrementing time intervals based on the clock rate of the ECM.

~~(10)~~(12) "Emission control system" means any device, system, or element of design that controls or reduces the emission of substances from an engine.

~~(11)~~(13) "Enforcement test results" means data or information gathered through enforcement programs conducted by the Air Resources Board. These programs include, but are not limited to, field inspections, in-use compliance testing, assembly-line testing.

~~(12)~~(14) "Engine family" means a subclass of a basic engine based on similar emission characteristics. The engine family is the grouping of engines that is used for the purposes of certification.

~~(13)~~(15) "Engine identification number" means a unique specification (for example, model number/serial number combination) that allows each spark-ignition marine engine to be distinguished from other similar engines.

~~(14)~~(16) "Engine manufacturer" means the manufacturer granted certification.

~~(15)~~(17) "Engine misfire" means lack of combustion in the cylinder due to absence of spark, poor fuel metering, poor compression, or any other cause.

~~(16)~~(18) "Engine start" is defined as the point at which normal, synchronized spark and fuel control is obtained or when the engine reaches a speed 150 revolutions per minute (rpm) below the normal, warmed-up idle speed.

~~(17)~~(19) "Exhaust emissions" means matter emitted into the environment from any opening downstream from the exhaust port of a spark-ignition marine engine.

~~(18)~~(20) "Executive Officer" means the Executive Officer of the Air Resources Board or his or her authorized representative.

~~(19)~~(21) "Executive Order" means an order issued by the Executive Officer certifying engines for sale in California.

~~(20)~~(22) "Family Emission Limit" means an emission value assigned by a marine engine manufacturer to an engine family for the purpose of complying with a corporate average exhaust emission standard. The Family Emission Limit (FEL) must not exceed the limit specified in this Article.

~~(21)~~(23) "Fuel system" means all components involved in the transport, metering, and mixture of the fuel from the fuel tank to the combustion chamber(s) including, but not limited to the following: fuel tank, fuel tank cap, fuel pump, fuel lines, oil injection metering system, carburetor or fuel injection components, and all fuel system vents.

~~(22)~~(24) "Fuel trim" refers to feedback adjustments to the base fuel schedule. Short-term fuel trim refers to dynamic or instantaneous adjustments. Long-term fuel trim refers to much more gradual adjustments to the fuel calibration schedule than short-term trim adjustments. These long-term adjustments compensate for engine differences and gradual changes that occur over time.

~~(23)~~(25) "Functional check" for an output component means verification of proper response to a computer command. For an input component, functional check means verification of the input signal being in the range of normal operation, including evaluation of the signal's rationality in comparison to all available information.

~~(24)~~(26) "Inboard Engine" means a four-stroke spark-ignition marine engine not used in a personal watercraft that is designed such that the propeller shaft penetrates the hull of the marine watercraft while the engine and the remainder of the drive unit is internal to the hull of the marine watercraft.

~~(25)~~(27) "Inspection criteria" means the pass and fail numbers associated with a particular sampling plan.

(28) "Low-permeation hose" means a fuel hose that does not exceed a 15.0 grams per square meter per day permeation rate on CE10 fuel at 23º Celsius, as tested per SAE J1527.

~~(26)~~(29) "Malfunction" means the inability of an emission-related component or system to remain within design specifications. Further, malfunction refers to the deterioration of any of the above components or systems to a degree that would likely cause the emissions of an aged engine with the deteriorated components or systems present at the beginning of the applicable certification emission test to exceed the $HC+NO_x$ emission standard by more than 50 percent, unless otherwise specified, as applicable pursuant to Subchapter 1 (commencing with Section 1900), Chapter 3 of Title 13.

~~(27)~~(30) "Marine engine manufacturer" means any person engaged in the manufacturing or assembling of new spark-ignition marine engines or the importing of such engines for resale, or who acts for and is under the control of any such person in connection with the distribution of such engines. A spark-ignition marine engine manufacturer does not include any dealer with respect to new spark-ignition marine engines received by such person in commerce.

~~(28)~~(31) "Marine warm-up cycle" means sufficient engine operation such that the coolant temperature has risen by at least 40 degrees Fahrenheit from engine starting and reaches a minimum temperature of at least 140 degrees Fahrenheit.

~~(29)~~(32) "Marine watercraft" means every description of boat, ship or other artificial contrivance used, or capable of being operated on water.

(33) "Maximum Rated Power" means the maximum brake kilowatt output of an engine at rated speed, as stated in the manufacturer's sales and service literature and in the application for certification.

~~(30)~~(34) "Model year" means the engine manufacturer's annual new model production period which includes January 1 of the calendar year for which the model year is named, ends no later than December 31 of the calendar year, and does not begin earlier than January 2 of the previous calendar year. Where an engine manufacturer has no annual new model production period, model year means the calendar year.

~~(31)~~(35) "New", for purposes of this Article, means a spark-ignition marine engine or watercraft the equitable or legal title to which has never been transferred to an ultimate purchaser. Where the equitable or legal title to the engine or watercraft is not transferred to an ultimate purchaser until after the engine or watercraft is placed into service, then the engine or watercraft will no longer be new after it is placed into service. A spark-ignition marine engine or watercraft is placed into service when it is used for its functional purposes. With respect to imported spark-ignition marine engines or watercraft, the term "new" means an engine or watercraft that is not covered by an Executive Order issued under this Article at the time of importation, and that is manufactured after the effective date of a section in this Article which is applicable to such engine or watercraft, or which would be applicable to such engine or watercraft had it been manufactured for importation into the United States.

~~(32)~~(36) "Nonconformity" or "Noncompliance", for purposes of Title 13, California Code of Regulations, section 2444.1, means that:

(A) a significant number, determined by the Executive Officer, of a class of engines, although properly maintained and used, experience a failure of the same emission-related component(s) within their useful lives which, if uncorrected, results in the engines' failure to comply with the emission standards prescribed under section 2442 which are applicable to the model year of such engines; or

(B) a class of engines that at any time within their useful lives, although properly maintained and used, on average does not comply with the emission standards prescribed under section 2442 which are applicable to the model year of such engines.

~~(33)~~(37) "Operating cycle" consists of engine startup, engine run, and engine shutoff.

~~(34)~~(38) "Original equipment manufacturer" means a manufacturer who purchases engines for installation in its equipment for sale to ultimate purchasers.

~~(35)~~(39) "Outboard engine" means a spark-ignition marine engine that, when properly mounted on a marine watercraft in the position to operate, houses the engine and drive unit external to the hull of the marine watercraft.

~~(36)~~(40) "Personal watercraft engine" means a spark-ignition marine engine that does not meet the definition of outboard engine, inboard engine or sterndrive engine, except that the Executive Officer may, in his or her discretion, classify a personal watercraft engine as an inboard or sterndrive engine if it is comparable in technology and emissions to an inboard or sterndrive engine.

~~(37)~~(41) "Production-line tests" are emission tests performed on a sample of production engines produced for sale in California and conducted in accordance with Title 13, California Code of Regulations, section 2446(a).

~~(38)~~(42) "Redline engine speed" means the engine manufacturer recommended maximum engine speed as normally displayed on instrument panel tachometers, or the engine speed at which fuel shutoff occurs.

~~(39)~~(43) "Response rate," with regards to oxygen sensors, refers to the delay (measured in milliseconds) between a switch of the sensor from lean to rich or vice versa in response to a change in fuel/air ratio above and below stoichiometric.

~~(40)~~(44) "Sales" or "Eligible sales" means the actual or calculated sales of an engine family in California for the purposes of corporate averaging and production-line testing. Upon Executive Officer approval, an engine manufacturer may calculate its eligible sales through market analysis of actual federal production or sales volumes.

~~(41)~~(45) "Scheduled maintenance" means any adjustment, repair, removal, disassembly, cleaning, or replacement of components or systems required by the engine manufacturer to be performed on a periodic basis to prevent part failure or marine watercraft or engine malfunction, or those actions anticipated as necessary to correct an overt indication of malfunction or failure for which periodic maintenance is not appropriate.

~~(42)~~(46) "Spark-ignition marine engine" means any engine used to propel a marine watercraft, and which utilizes the spark-ignition combustion cycle; including, but not limited to personal watercraft, outboard, inboard and sterndrive engines.

~~(43)~~(47) "Sterndrive engine" means a four-stroke spark-ignition marine engine not used in a personal watercraft that is designed such that the drive unit is external to the hull of the marine watercraft, while the engine is internal to the hull of the marine watercraft.

~~(44)~~(48) "Test engine" means the engine or group of engines that an engine manufacturer uses during certification, production-line and in-use testing to determine compliance with emission standards.

~~(45)~~(49) "Test Procedures" means the document entitled "California Exhaust Emission Standards and Test Procedures for 2001 Model Year and Later Spark-Ignition Marine Engines," which includes the standards and test procedures applicable to 2001 and later spark-ignition personal watercraft, outboard, inboard and sterndrive marine engines, as adopted October 21, 1999 and as amended June 6, 2002. This document is incorporated by reference herein.

~~(46)~~(50) "Ultimate purchaser" means, with respect to any new spark-ignition marine engine, the first person who in good faith purchases such new spark-ignition marine engine for purposes other than resale.

~~(47)~~(51) "U.S.C." means United States Code.

~~(48)~~(52)"Used solely for competition" means exhibiting features that are not easily removed and that would render its use other than in competition unsafe, impractical, or highly unlikely.

~~(49)~~(53) "Useful life" for spark-ignition marine engines means nine years for personal watercraft engines and sixteen years for outboard, sterndrive, and inboard engines.

~~(50)~~(54) "Warranty period" means the period of time the engine or part is covered by the warranty provisions.

~~(51)~~(55) "Warranty station" means any dealer, service center or other agent that is authorized by the engine manufacturer to perform diagnostic labor, repairs or replacements of warranted engine components.

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, 43102 and 43104, Health and Safety Code.
Reference: Sections 43013, 43017, 43018, 43101, 43102, 43104, 43105, 43150-43154, 43205.5 and 43210-43212, Health and Safety Code.

§ 2442. Emission Standards.

(a) Model year 2001 and later model year spark-ignition personal watercraft and outboard marine engines:

* * * * *

(b) Model year 2003 and later model year spark-ignition inboard and sterndrive marine engines:

(1) Exhaust emissions from new model year 2003 and later spark-ignition inboard and sterndrive marine engines must not exceed the exhaust emission standards listed in Table 2 for the designated emission durability test period. Prior to Model Year 2007 certification, each engine manufacturer must select either Option 1 (OPT 1) or Option 2 (OPT 2) for its entire production for the 2007 and 2008 model years.

Table 2.

~~Inboard and Sterndrive Exhaust Emission Standards (by Implementation Date)~~		
~~**Model Year**~~	~~**$HC+NO_x$** (grams per kilowatt-hour)~~	~~**Durability Test Period** (hours)~~
~~2003-2008[1]~~	~~16.0[2]~~	—
~~2007 and Later[3]~~	~~5.0~~	~~480~~

1. ~~Engines with a maximum rated power exceeding 373 kilowatts (500 horsepower) are not required to comply with these standards.~~
2. ~~Compliance with the $HC+NO_x$ standard may be averaged on a sales-weighted basis, across the engine manufacturers' California production, based on projected California sales or the projected California percentage of national sales.~~

~~3. For model year 2007, engine manufacturers shall certify a minimum of 45% of their California production (projected California sales or projected California percentage of national sales) to the standard. For model year 2008, engine manufacturers shall certify a minimum of 75% of their California production (projected California sales or projected California percentage of national sales) to the standard.~~

Inboard/Sterndrive Marine Engine Standards

MODEL YEAR	RATED POWER [kilowatts]	COMPLIANCE OPTION[1]	DURABILITY [hours / years]	EXHAUST STANDARD: NMHC[2]+NOx [grams per kilowatt-hour]	EXHAUST STANDARD: TYPE	SUPPLEMENTAL MEASURE[3]
2003 - 2006	kW ≤ 373	N/A	N/A	16.0	AVE	None
2007	kW ≤ 373	OPT 1	N/A	16.0 (55%)	AVE	None
			480 / 10	5.0 (45%)	FIXED	
		OPT 2	N/A	14.0	FIXED	Evaporative Low-Permeation Liquid Hoses
2008	kW ≤ 373	OPT 1	N/A	16.0 (25%)	AVE	None
			480 / 10	5.0 (75%)	FIXED	
		OPT 2	480 / 10	5.0	FIXED	Evaporative Low-Permeation Liquid Hoses
2009 and later	kW ≤ 373	N/A	480 / 10	5.0[5]	FIXED	Carryover[6]
	373 < kW ≤ 485		480 / 10	5.0[5]	AVE	
	kW > 485		50[4] / 1	5.0[5]	AVE	

Notes:
1. Once a manufacturer has chosen an option, that option must continue to be used exclusively across product lines
2. The non-methane component of hydrocarbon
3. Supplemental measures may be different than shown, but must provide equal and verifiable emission reductions to those indicated
4. Engine manufacturers may request a shorter durability period for high power engines provided they submit data supporting a shorter period
5. All engines ≤ 373 kW must meet a 5.0 g/kW-hr NMHC+NOx capping standard. For engines > 373 kW, the standard may be met by sales-averaging with engines equal to or less than 373 kW
6. The same or better supplemental emission control hardware used to meet the standard in 2007 must be used every model year thereafter

~~(1)~~(A) No crankcase emissions shall be discharged into the ambient atmosphere from 2003 and later spark-ignition inboard and sterndrive marine engines.

~~(2)~~(B) Production and sale of spark-ignition marine engines that result in noncompliance with the California standard for the model year shall cause an engine manufacturer to be subject to: revocation or suspension of Executive Orders for the applicable engine families; enjoinment from any further sales, or distribution, of such noncompliant engine families, in the

State of California pursuant to section 43017 of the Health and Safety Code; and all other remedies available under Part 5, Division 26 of the Health and Safety Code. Before seeking remedial action against the engine manufacturer, the Executive Officer will consider any information provided by the equipment manufacturer.

~~(3)~~(C) For each engine family, the engine manufacturer shall submit the total number of engines produced for sale in California, or the total number of engines produced for sale nationally, ninety (90) days after the end of the model year.

(2) Compliance with the standards on a corporate averaging basis is calculated as follows:

$$\frac{\Sigma \ (PROD_{jx})(EL_{jx})}{\Sigma \ (PROD_{jx})} = \text{Corporate Average}$$

where:

n = Total number of engine families available for averaging

$PROD_{jx}$ = Number of engines in engine family j produced for sale in California in model year x.

EL_{jx} = The measured NMHC+NOx emission levels for engine family j in model year x; or for engines >485 kW, the manufacturer may choose to use 30 g/kW-hr as per paragraph (F) below.

(A) During the engine manufacturer's production year, for each engine family, the engine manufacturer shall provide the Executive Officer within 45 days after the last day in each calendar quarter the total number of spark-ignition marine engines produced for sale in California and their applicable EL(s).

(B) The Executive Order certifying the California production for a model year must be obtained prior to the issuance of certification Executive Orders for individual engine families for the model year.

(C) The engine manufacturer's average $NMHC+NO_x$ exhaust emissions must meet the corporate average standard at the end of the engine manufacturer's production for the model year. At the end of the model year, the manufacturer must calculate a corrected corporate average using sales or eligible sales rather than projected sales.

(D) Production and sale of spark-ignition marine engines that result in noncompliance with the California standard for the model year shall cause an engine manufacturer to be subject to: revocation or suspension of Executive Orders for the applicable engine families; enjoinment from any further sales, or distribution, of such noncompliant engine families, in the State of California pursuant to section 43017 of the Health and Safety Code; and all other remedies available under Part 5, Division 26 of the Health and Safety Code. Before seeking remedial action against the engine manufacturer, the Executive Officer will consider any information provided by the engine manufacturer.

(E) For each engine family , the engine manufacturer shall submit California sales data ninety (90) days after the end of the model year.

(F) Engines exceeding 485 kilowatts maximum rated power: In lieu of exhaust emission testing, manufacturers may certify using a default exhaust emissions level of 30.0 grams per kilowatt-hour of $NMHC+NO_x$ in their corporate averaging calculation.

(3) Supplemental Measures. Prior to Model Year 2007 certification, manufacturers choosing Option 2 may request Executive Officer approval of an alternative supplemental measure. In determining whether to approve a request, the Executive Officer will consider the following:

(A) Whether the proposed supplemental measure would achieve reductions in NMHC+NOx equivalent to the Evaporative Low-Permeation Liquid Hoses,
(B) The engine manufacturer's measures to ensure successful implementation of the proposed supplemental measure,
(C) The durability of the proposed supplemental measure, and
(D) Any additional information the Executive Officer deems relevant.

(c) The test equipment and test procedures for determining compliance with these standards are set forth in Parts III and IV, respectively, of the "Test Procedures."

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, 43102 and 43104, Health and Safety Code.
Reference: Sections 43013, 43017, 43018, 43101, 43102, 43104, 43105, 43150-43154, 43205.5 and 43210-43212, Health and Safety Code.

§ 2444.2. On-Board Engine Malfunction Detection System Requirements – Model Year 2007 and Later Spark-Ignition Inboard and Sterndrive Marine Engines.

(a)(1)Engines certified under Option 1 of Section 2442(b)(1):

All 2007 and 2008 model year spark-ignition inboard and sterndrive marine engines certified to the 5.0 grams per kilowatt-hour $HC+NO_x$ standard shall comply with the requirements for subsections ~~(a)~~(b) through ~~(h)~~(i) below, except as noted. For all 2009 model year and later spark-ignition inboard and sterndrive marine engines, the requirements in italics shall also apply.

(2)Engines certified under Option 2 of Section 2442(b)(1):

All 2008-2009 model year spark-ignition inboard and sterndrive marine engines shall comply with the requirements for subsections (b) through (i) below, except as noted. For all 2010 model year and later spark-ignition inboard and sterndrive marine engines, the requirements in italics shall also apply.

This section shall be implemented according to the provisions of the following subsections or by means determined by the Executive Officer to be equivalent in meeting the requirements of this section.

~~(a)~~(b) General requirements.

(1) Spark-ignition sterndrive and inboard marine engines sold as new shall be equipped with an integrated malfunction detection and notification system, hereinafter known as On-board Diagnostics-Marine (OBD-M) system, to identify emission-related malfunctions of the catalyst, fuel system, primary oxygen sensors used for feedback fuel control, secondary oxygen sensors (if equipped) used for catalyst monitoring, computer-sensed comprehensive components, and the on-board computer itself, by means of diagnostic trouble codes stored in non-volatile computer memory. For this section, a computer-sensed comprehensive component is any electronic device that:

(A) provides information to the on-board computer and significantly impacts emissions when malfunctioning; or

(B) is used to enable or disable any other OBD-M monitoring strategy.

(2) The OBD-M system shall not be required to identify engine misfire unless such monitoring is determined necessary by the Executive Officer

to preserve or protect the catalyst system. The Executive Officer shall (as part of the in-water testing and development program to be conducted in conjunction with U.S. EPA, the U.S. Coast Guard, the marine industry, and catalyst manufacturers) identify whether, and to what extent, misfire in spark-ignition inboard and sterndrive marine engines may affect catalyst durability and performance. If the Executive Officer determines that engine misfire is a significant factor in reducing the durability and/or performance of marine catalysts, engine manufacturers shall be required to incorporate appropriate misfire detection diagnostics into the OBD-M system. In that case, the provisions in subsection ~~(b)~~(c)(5) shall be considered sufficient for satisfying the obligation to monitor misfire. Alternate misfire monitoring strategies shall be considered by the Executive Officer and may be implemented in lieu of subsection ~~(b)~~(c)(5) if demonstrated by the engine manufacturer to provide an equivalent degree of catalyst protection. Otherwise the provisions of that subsection shall be voluntary. In making a determination, the Executive Officer shall consider the cost effectiveness of requiring additional monitoring to address the concerns identified by the test program in addition to the leadtime necessary to modify existing hardware and software, to add misfire detection hardware (e.g., sensors) if necessary, and to develop engine-specific calibrations to accommodate misfire monitoring. Notwithstanding, misfire monitoring shall not be required prior to the 2009 model year, and may be delayed beyond that date pending Executive Officer discretion.

(3) The OBD-M system shall not be required to detect any emissions-related malfunction that prevents the engine from starting. The OBD-M system shall not be required to monitor any emissions-related component or system if the only reliable way to accomplish such monitoring would either significantly impair engine/vessel operability or decrease the safety involved with operating the engine/vessel.

(4) OBD-M systems shall have the capability to activate an audio or visual alert device located on the marine vessel to inform vessel occupants in the event of a malfunction, and to transmit diagnostic information locally via a standardized data link connector.

(5) Spark-ignition sterndrive and inboard marine vessels shall be equipped with an audio alert device and/or visual alert device that is compatible with the activation function of the OBD-M system on the installed engine.

(A) If equipped, the audio alert device shall provide sufficient volume and intensity to be readily perceptible to vessel occupants during normal modes of vessel operation and occupant activity, but shall not exceed applicable maximum noise levels as set by authorized federal or State agencies. Further, the audio alert device shall in no way impede the function of required sound-signaling devices, or other safety-related devices, already present on the vessel. The audio alert device shall sound briefly in the engine-run key position before engine cranking to indicate that the audio alert device is functional.

(B) If equipped, the visual alert device shall provide sufficient activation and be located such that it is readily visible under normal lighting conditions, but shall in no way impede the function of any visual distress-signaling device, fog signal, or navigational light. The visual alert device shall activate in the engine-run key position before engine cranking to indicate that the visual alert device is functional and shall, when activated, display the phrase "Service Required" or an equivalent standardized phrase or symbol to be determined as specified in Subsection ~~(g)~~(h).

(6) Malfunction thresholds for catalyst, fuel system, oxygen sensor, and computer-sensed comprehensive component diagnostics shall be determined by the engine manufacturer. However, the engine manufacturer must demonstrate that the determination of these thresholds is sufficient for detecting emission-related malfunctions in a timely and meaningful manner subject to Executive Officer approval (see Subsection ~~(e)~~(f)(2)).

(7) Regarding diagnostic system monitoring and audio/visual alert device activation requirements, engine manufacturers are required to define monitoring conditions that are representative of typical in-use operation, and which will result in the routine execution and completion of all OBD-M diagnostics in-use.

(8) For model years 2007-2008 on engines complying with paragraph (a)(1) of this section, and for model years 2008-2009 on engines complying with paragraph (a)(2) of this section, activation of the audio/visual alert device upon detection of a catalyst, fuel system, or oxygen sensor malfunction shall be optional. However, there are no exemptions from storing diagnostic trouble codes in non-volatile computer memory during these model years for any malfunction. The OBD-M must be capable of fully communicating stored information to a generic scan tool via the standardized data link connector.

(9) Engine manufacturers may employ alternate statistical audio/visual alert device activation and diagnostic trouble code storage protocols to those specified in these requirements, subject to Executive Officer approval, based on comparable timeliness in detecting a malfunction and evaluating system performance.

(10) Should emission control devices/strategies be introduced on the engine in addition to those identified herein as requiring monitoring (e.g., exhaust gas recirculation), the engine manufacturers shall notify the Executive Officer and submit a plan for monitoring the new device/strategy prior to its incorporation into the OBD-M system. This would not apply to low-permeation hoses should they be used to comply with the supplemental emission reduction requirements of Option 2 in Section 2442(b)(1).

(11) Engine manufacturers may request Executive Officer approval to disable any diagnostic strategy at ambient engine starting temperatures below forty (40) degrees Fahrenheit (low ambient temperature conditions may be determined based on intake air or engine coolant temperature at engine starting), and at elevations above six thousand five hundred (6,500) feet above sea level provided the engine manufacturer submits data and/or an engineering evaluation which adequately demonstrate that monitoring would be unreliable when such conditions exist. Notwithstanding, diagnostic system disablement may be requested at other ambient engine starting temperatures if the engine manufacturer adequately demonstrates with data and/or an engineering evaluation that misdiagnosis would occur due to the impact of such ambient temperatures on the performance of the component itself.

(12) Engine manufacturers may disable individual monitors that can be affected by running out of fuel, provided disablement will not occur when the fuel level is above fifteen percent of the nominal capacity of the fuel tank.

(13) The Executive Officer may grant an extension for compliance with the requirements of this section, with respect to an engine model or engine family, if the engine manufacturer demonstrates that a present electronic control system cannot be modified in time for the 2007 or 2008 model year, as applicable per subsection (a) of this section, because major design changes, not consistent with the engine manufacturer's projected changeover schedule, would be needed to comply with the provisions of the regulation. The period of extension shall not exceed that period of time necessary to enable modification of the electronic control system in accordance with the engine manufacturer's projected changeover schedule, or a period of two years, whichever first occurs. Engine manufacturers requesting an extension shall, no later than six months prior to the applicable model year, submit to the Executive Officer a written request for exemption, setting forth the required demonstration and specifying the period for which the extension is requested.

(14) All engines certified to the 5.0 gram per kilowatt-hour NMHC+NO_x standard, including those engines certified using the corporate averaging

<u>provisions in 2442(b), must be equipped with OBD-M for the engine's emission-related components.</u>

~~(b)~~<u>(c)</u> Monitoring requirements.

(1) Catalyst monitoring.

(A) Purpose and scope:

(i) The diagnostic system shall monitor the catalyst system on spark-ignited marine engines to ensure that the performance of the catalyst has not been compromised due to engine misfire or other factors that can decrease catalyst durability.

(ii) Manufacturers of spark-ignited lean-burn marine engines may request that the Executive Officer exempt such applications from these catalyst monitoring requirements if it can be demonstrated that a reliable monitoring technology is not available. The Executive Officer shall approve such a request upon determining that all reasonable monitoring technologies have been considered to the extent possible.

(B) Malfunctioning criteria:

(i) The catalyst system shall be considered malfunctioning when the temperature of the measured catalyst(s) exceeds a threshold value, as determined by the engine manufacturer, indicating abnormally high operating temperature; or when the catalyst temperature fails to reach a minimum value, as determined by the engine manufacturer, indicating "light-off" of the catalyst after a manufacturer-specified time interval has elapsed.

(ii) Subject to executive officer approval, alternate malfunction criteria (e.g., correlating oxygen sensor frequencies to catalyst conversion efficiency) may be employed by the engine manufacturer if the alternate criteria are appropriate and would provide for enhanced monitoring capability.

(C) Monitoring conditions:

(i) The engine manufacturer shall define conditions for monitoring the catalyst with the constraints that the check shall:

a. be conducted at the earliest acceptable opportunity encountered after the beginning of each operating cycle; and

b. the monitoring system shall operate at least once per in-use operating cycle during which the engine manufacturer-defined monitoring conditions are met.

(ii) The monitoring system shall operate at least once per in-use operating cycle during which the engine manufacturer-defined monitoring conditions are met.

(D) Malfunctioning notification and diagnostic trouble code storage:

(i) Upon detection of a catalyst malfunction, the audio/visual alert device shall be activated and a diagnostic trouble code stored no later than the end of the next operating cycle during which monitoring occurs provided the malfunction is again present.

(ii) The diagnostic system shall temporarily disable catalyst monitoring when a malfunction exists that could affect the proper evaluation of catalyst efficiency.

(iii) The monitoring method for the catalyst(s) shall be capable of detecting when a catalyst trouble code has been cleared (except diagnostic system self-clearing), but the catalyst has not been replaced (e.g., catalyst overtemperature approaches may not be acceptable).

(2) Fuel system monitoring.

(A) Purpose and scope: The diagnostic system shall monitor the fuel delivery system for its ability to dynamically adjust fuel delivery.

(B) Malfunction criteria: The engine manufacturer shall establish malfunction criteria to monitor the fuel delivery system. If the engine is equipped with fuel trim circuitry, the engine manufacturer shall include as one of the malfunction criteria the condition where the trim circuitry has used up all of the trim adjustment allowed within the engine manufacturer's selected limit(s). Engine manufacturers may compensate the criteria limit(s) appropriately for changes in altitude or for other similar identifiable operating conditions when they occur.

(C) Monitoring conditions: The fuel system shall be monitored continuously for the presence of a malfunction.

(D) Malfunction notification and diagnostic trouble code storage:

(i) For fuel systems with short-term trim only capability, the diagnostic system shall store a diagnostic trouble code after the fuel system has attained the criteria limit for an engine manufacturer-defined time interval sufficient to determine a malfunction. If the malfunction criteria limit and time interval are exceeded, the audio/visual alert device shall be activated and a diagnostic trouble code stored no later than the end of the next operating cycle in which the criteria and interval are again exceeded; unless operating conditions similar to those under which the problem was originally detected (manufacturer-defined conditions) have been encountered without such an exceedance, in which case the initial temporary code and stored conditions may be erased. Furthermore, if similar operating conditions are not encountered during forty (40) operating cycles subsequent to the initial detection of a malfunction, the initial temporary code and stored conditions may be erased.

(ii) For fuel systems with long-term fuel trim capability, upon attaining a long-term based malfunction criteria limit independent of, or in combination with, the short-term trim system status, the audio/visual alert device shall be activated and a diagnostic trouble code stored no later than the end of the next operating cycle if the malfunction is again detected. If the malfunction is not detected during the second operating cycle, the audio/visual alert device shall be activated and a diagnostic trouble code stored no later than the next operating cycle in which the malfunction is again detected; unless operating conditions similar to those under which the problem was originally detected (manufacturer-defined conditions) have been encountered without an indication of a malfunction, in which case the initial temporary code and stored conditions may be erased. Furthermore, if similar operating conditions are not encountered during forty (40) operating cycles subsequent to the initial detection of a malfunction, the initial temporary code and stored conditions may be erased.

(3) Oxygen sensor monitoring.

(A) Purpose and scope:

(i) The diagnostic system shall monitor the output voltage and response rate of all primary (fuel control) oxygen (lambda) sensors for malfunction. It shall also monitor secondary oxygen sensors when used as a monitoring device for proper output voltage and/or response rate. Response rate is the time required for the oxygen sensor to switch from lean-to-rich once it is exposed to a richer than stoichiometric exhaust gas mixture or from rich-to-lean when exposed to a leaner than stoichiometric exhaust gas mixture. As a precaution, measuring oxygen sensor switching frequency may not be an adequate indicator of oxygen sensor response rate, particularly at low speeds.

(ii) Either the lean-to-rich or both the lean-to-rich and rich-to-lean response rates shall be checked. Response rate checks shall evaluate the portions of the sensor's dynamic signal that are most affected by sensor malfunctions such as aging or poisoning.

Engine manufacturers may observe the voltage envelope of the sensor when cycled at a frequency of 1.5 Hertz or greater, as determined by the engine manufacturer, to evaluate a slow response rate sensor (i.e., a slow sensor cannot achieve maximum and/or minimum voltage as will a good sensor, given a properly chosen switching frequency and fuel step change for the check). With Executive Officer approval, engine manufacturers may use alternative parameters to comply with this requirement such as voltage ranges and fuel-air switching frequencies based on a determination that the modifications will result in an accurate and timely evaluation of the sensor.

(iii) For sensors with different characteristics, the engine manufacturer shall submit data and an engineering evaluation to the Executive Officer for approval based on showing equivalent evaluation of the sensor.

(B) Malfunction criteria:

An oxygen sensor shall be considered malfunctioning when the voltage, response rate, or other criteria, as determined by the engine manufacturer, are exceeded, or when sensor output characteristics are no longer sufficient (e.g., lack of sensor switching) for use as a diagnostic system monitoring device (e.g., for catalyst efficiency monitoring).

(C) Monitoring conditions:

(i) The engine manufacturer shall define conditions for monitoring the oxygen sensor(s) with the constraints that the check shall:

a. be conducted at the earliest acceptable opportunity encountered after the beginning of each operating cycle; and

b. operate at least once per in-use operating cycle during which the engine manufacturer-defined monitoring conditions are met.

(ii) For primary oxygen sensors(s) used for fuel control, the response rate and output voltage shall be monitored for malfunction after the engine has commenced closed-loop operation. If the oxygen sensor(s) is used as part of the monitoring strategy for the catalyst, the oxygen sensor(s) diagnostics should be scheduled to execute before the catalyst diagnostics begin.

(D) Malfunction notification and diagnostic trouble code storage: Upon detection of any oxygen sensor malfunction, the diagnostic system shall store a diagnostic trouble code and the audio/visual alert device shall activate no later than the end of the next operating cycle during which monitoring occurs provided the malfunction is again present.

(4) Computer-sensed comprehensive component monitoring.

(A) Purpose and scope: The diagnostic system shall monitor for malfunction any computer-sensed electronic engine components not otherwise described in this subsection that provide input to (directly or indirectly) the on-board computer, and that: 1) can affect emissions during any reasonable in-use operating condition, or 2) are used as part of the diagnostic strategy for any other monitored system or component.

(i) The monitoring system shall have the capability of detecting, *at a minimum,* lack of circuit continuity *and out of range values to ensure proper operation of the input device. The determination of out of range values shall include logic evaluation of available information to determine if a component is operating within its normal range (e.g., a low throttle position sensor voltage would not be reasonable at a high engine speed with a high mass airflow sensor reading). To the extent feasible, said logic evaluation shall be "two-sided" (i.e., verify a sensor output is not inappropriately high or low).*

(ii) Computer-sensed comprehensive components may include, but are not limited to, the engine speed sensor, crank angle sensor, knock sensor, throttle position sensor, coolant temperature sensor, cam position sensor, and other electronic components such as sensors and fuel injectors.

(iii) *The coolant temperature sensor shall be monitored for achieving a stabilized minimum temperature level that is needed to achieve closed-loop operation within an engine manufacturer-specified time interval after starting the engine. The time interval shall be a function of starting engine coolant temperature and/or a function of intake air temperature. Engine manufacturers may suspend or delay the diagnostic if the engine is subjected to conditions which could lead to false diagnosis (e.g., engine operation at idle for more than 50 to 75 percent of the warm-up time).*

(B) Malfunction criteria:

Computer-sensed comprehensive components shall be considered malfunctioning when, *at a minimum,* lack of circuit continuity *or engine manufacturer-specified out-of-range values* occur.

(C) Monitoring conditions:

Computer-sensed components shall be monitored continuously for *proper range of values and* circuit continuity. *For rationality monitoring (where applicable), engine manufacturers shall define appropriate operating conditions that are representative of typical in-use operation and will result in the routine execution and completion of all diagnostics in-use. Rationality monitoring shall occur at least once per operating cycle during which the engine manufacturer-defined monitoring conditions are met.*

(D) Malfunction notification and diagnostic trouble code storage:

Upon detecting a malfunction, the diagnostic system shall store a diagnostic trouble code and activate the audio/visual alert device no later than the end of the next operating cycle during which monitoring occurs provided the malfunction is again detected.

(5) Misfire monitoring.

The provisions in this subsection shall be considered voluntary unless otherwise determined by the Executive Officer according to subsection ~~(a)~~(b)(2) above.

(A) Purpose and scope: The diagnostic system shall identify the occurrence of engine misfire that can result in damage to the catalyst system. Identification of the misfiring cylinder is not required, however all patterns of misfire must be identified regardless of whether it occurs in a single or multiple number of cylinders.

(B) Malfunctioning criteria: The diagnostic system shall identify a malfunction when the total number of misfires evaluated in 200 crankshaft-revolution increments for each engine speed and load condition exceeds a percentage (determined by the engine manufacturer to cause damage to the catalyst system) of the total number of firing events in each increment. These threshold percentages shall be provided in the certification documentation. Subject to Executive Officer approval, an interval longer than 200 crankshaft-revolutions may be used. The engine manufacturer shall submit in the certification documentation catalyst temperature data versus percent misfire over the full range of engine speed and load conditions. Alternatively, catalyst temperature data may be submitted for every 500 rpm increment along the Propeller Law curve beginning at engine idle and continuing throughout the "Not to Exceed Zone" for marine propulsion engines with Fixed- and Variable-pitch propellers, as defined in 40 CFR, subpart B, section 94.106, which is incorporated by reference herein. The data shall be obtained from a representative cross section (from small to large displacements) of an engine manufacturer's production. Up to three such engine evaluations shall be documented per engine manufacturer, though an engine manufacturer may submit more data, if desired. An engineering evaluation shall be provided for establishing malfunction criteria for the remainder of engine families in the engine manufacturer's product line. The Executive Officer shall waive the evaluation requirement each year if, in the judgment of the Executive Officer, technological changes do not affect the previously determined malfunction criteria.

(C) Monitoring conditions:

(i) Monitoring for misfire shall be continuous from engine starting under all steady-state positive torque engine speeds and load conditions.

(ii) As an exception to monitoring misfire during all positive torque operating conditions, engine manufacturers may disable misfire monitoring in the engine operating region bound by the positive torque line (i.e., engine load with the transmission in neutral), and the two following engine operating points:

a. an engine speed of 3,000 rpm with the engine load at the positive torque line; and

b. the redline engine speed (defined in section 2441) with the engine's manifold vacuum at four inches of mercury lower than that at the positive torque line.

Misfire detection systems unable to detect all misfire patterns under all required conditions shall be evaluated for compliance by the Executive Officer based on, but not limited to, the following factors:

c. the magnitude of the region(s) in which misfire detection is limited,

d. the degree to which misfire detection is limited in the region(s) (i.e., the probability of detection of misfire events),

e. the frequency with which said region(s) are expected to be encountered in-use,

f. the type of misfire patterns for which misfire detection is troublesome, and

g. demonstration that the monitoring technology employed is not inherently incapable of detecting misfire under required conditions (i.e., compliance can be achieved on other engines).

The evaluation shall be based on the following misfire patterns:

h. equally spaced misfire occurring on randomly selected cylinders,

i. single cylinder continuous misfire; and

j. paired cylinder (cylinders firing at the same crank angle) continuous misfire.

Further, with Executive Officer approval, the engine manufacturer may disable misfire monitoring or employ higher malfunction criteria when misfire cannot be distinguished from other effects (e.g., turbulence causing the propeller to alternately emerge from then re-submerge into the water.) when using the best reasonably available monitoring technology. The engine manufacturer shall present data and/or an engineering evaluation to the Executive Officer to justify the proposed action. Executive Officer approval shall be based on the extent to which monitoring is expected to be disabled in relation to the capabilities of the best available monitoring technologies as applied to other engines. However, any such disablement occurring within the first 5 seconds after engine starting shall not require Executive Officer approval. Additionally, for engines with greater than eight cylinders, the Executive Officer shall waive the requirements of this section provided the engine manufacturer submits data and/or an engineering evaluation which adequately demonstrates that misfire detection throughout the required operating region cannot be achieved when employing proven monitoring technology (i.e., a technology that provides for compliance with these requirements on other engines) and provided misfire is detected to the fullest extent permitted by the technology.

(D) Malfunction notification and diagnostic trouble code storage:

(i) Upon detection of the level of misfire specified in subsection ~~(b)~~(c)(5)(B) above, the following criteria shall apply for audio/visual alert device activation and diagnostic trouble code storage:

a. A temporary diagnostic trouble code shall be stored no later than after the third exceedance of the specified misfire level when operating in the region bound by modes 2 through 5 of the spark-ignition marine engine test cycle and no later than after the first exceedance of the specified misfire level when operating at any other engine speed and load condition during a single operating cycle. If the level of misfire is exceeded again (a single exceedance) during the following operating cycle, or the next operating cycle in which similar conditions are encountered (manufacturer defined conditions), the audio/visual alert device shall activate, a diagnostic trouble code shall be stored, and the audio/visual alert device shall remain continuously activated, even if the misfire ceases. The initial temporary code and stored conditions may be erased if misfire is not detected during the following operating cycle and similar conditions have been encountered without an exceedance of the specified misfire level. The code and conditions may also be erased if similar operating conditions are not encountered during forty operating cycles subsequent to the initial detection of a malfunction.

b. Notwithstanding, in engines that provide fuel shutoff and default fuel control to prevent over fueling during misfire conditions, the audio/visual alert device need not activate provided that the fuel shutoff and default control shall be activated as soon as misfire is detected. Fuel shutoff and default fuel control may be deactivated only to permit fueling outside of the misfire range.

~~(c)~~(d) Additional audio/visual alert device activation and diagnostic trouble code storage protocol.

(1) Audio/visual alert device activation: For all emission-related components/systems, upon final determination of a malfunction, the OBD-M system shall activate an audio or visual alert device.

(A) If so equipped, visual alert devices shall remain activated continuously whenever a malfunction has been identified by the OBD-M system, and may be deactivated only according to the provisions in paragraph (2) below, or with a scan tool after appropriate repairs have been effected.

(B) If so equipped, audio alert devices may remain activated continuously when a malfunction has been identified by the OBD-M system; however, the Executive Officer shall consider alternative strategies in which the audio alert is activated on a discontinuous, but repetitive, basis. To be acceptable, discontinuous audio alert strategies must convey a sense of urgency to vessel operators regarding the presence of OBD-M malfunctions.

Upon fulfillment of the standardization processes referred to in subsection (g) below, a protocol for audio alert device activation shall be specified authorizing only discontinuous activation. A standardized notification format is necessary to facilitate consumer association of the audio alert pattern with the identification of an OBD-M malfunction independent of manufacturer or platform. OBD-M system designers are encouraged to cooperate fully with each other and the ARB early on in this endeavor to minimize the redesigning of OBD-M audio alert activation algorithms once a standardized protocol has been finalized.

(C) The diagnostic system shall store a diagnostic trouble code whenever the audio/visual alert device is activated. The diagnostic system shall activate the audio/visual alert device and shall store a diagnostic trouble code whenever the engine enters a default or "limp home" mode of operation. The diagnostic system shall activate the audio/visual alert device and shall store a diagnostic trouble code whenever the engine control system fails to enter closed-loop operation (if employed) within an engine manufacturer specified minimum time interval.

(2) Audio/visual alert device deactivation:

(A) *Misfire and* Fuel System Malfunctions: For *misfire or* fuel system malfunctions, the audio/visual alert device may be deactivated if the fault does not recur when monitored during three subsequent sequential operating cycles in which conditions are similar to those under which the malfunction was first determined.

(B) All Other Malfunctions: For all other faults, the audio/visual alert device may be deactivated after three subsequent sequential operating cycles during which the monitoring system responsible for activating the audio/visual alert device functions without detecting the malfunction and if no other malfunction has been identified that would independently activate the audio/visual alert device according to the requirements outlined above.

(3) Erasing a diagnostic trouble code: The diagnostic system may erase a diagnostic trouble code if the same fault is not re-registered in at least forty (40) engine warm-up cycles, and the audio/visual alert device is not activated for that diagnostic trouble code.

~~(d)~~(e) Tampering protection: Computer-coded engine operating parameters shall not be changeable without the use of specialized tools and procedures (e.g. soldered or potted computer components or sealed (or soldered) computer enclosures). Subject to Executive Officer approval, engine manufacturers may exempt from this requirement those product lines that are unlikely to require protection. Criteria to be evaluated in making an exemption include, but are not limited to, current availability of performance chips, high performance capability of the engine, and sales volume.

~~(e)~~(f) Certification documentation: The engine manufacturer shall submit the following documentation for each engine family at the time of certification. With Executive Officer approval, one or more of the documentation requirements specified in this section may be waived or altered if the information required would be redundant or unnecessarily burdensome to generate:

(1) A written description of the functional operation of each monitoring strategy within the diagnostic system.

(2) A table providing the following information for each monitored component or system (either computer-sensed or -controlled) of the emission control system:

(A) corresponding diagnostic trouble code

(B) monitoring method or procedure for malfunction detection

(C) primary malfunction detection parameter and its type of output signal

(D) fault criteria limits used to evaluate output signal of primary parameter

(E) other monitored secondary parameters and conditions (in engineering units) necessary for malfunction detection.

(F) monitoring time length and frequency of checks.

(G) criteria for activating the audio/visual alert device

(3) A logic flowchart describing the general method of detecting malfunctions for each monitored emission-related component or system. To the extent possible, abbreviations in SAE J1930 "Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms," May 1998, shall be used. J1930 is incorporated by reference herein. The information required in the chart under (2) above may instead be included in this flow chart, provided all of the information required in (2) is included.

(4) A listing and block diagram of the input parameters used to calculate or determine calculated load values and the input parameters used to calculate or determine fuel trim values.

(5) Any other information determined by the Executive Officer to be necessary to demonstrate compliance with the requirements of this section.

~~(f)~~(g) Confirmatory testing: The ARB may perform confirmatory testing of engine manufacturers' diagnostic systems for compliance with requirements of this section in accordance with malfunction criteria submitted in the engine manufacturer's approved certification documentation. The ARB or its designee may install appropriately deteriorated or malfunctioning components in an otherwise properly functioning test engine (or simulate a deteriorated or malfunctioning component response) in order to test the fuel system, oxygen sensor, catalyst system, and misfire (if applicable) monitors for compliance with the applicable constraints in this section. Diagnostic systems of a representative sample of engines that uniformly fail to meet the requirements of this section may be recalled for correction.

~~(g)~~(h) Standardization: The spark-ignition inboard and sterndrive marine industry, in cooperation with ARB, will develop and adhere to standardized specifications for the implementation of OBD-M, including diagnostics trouble code formats, communication, and scan tool protocols.

~~(h)~~(i) Implementation schedule.

(1) These OBD-M requirements, unless otherwise specified, shall be implemented beginning with the 2007 model year for engines complying with (a)(1) of this section, and with the 2008 model year for engines complying with (a)(2) of this section.

(2) All engine manufacturers shall meet these requirements by the 2009 model year for engines complying with (a)(1) of this section, and the 2010 model year for engines complying with (a)(2) of this section.

(3) The Executive Officer, upon receipt of an application from the engine manufacturer, may certify the engines in question even though said engines may not comply with one or more of the requirements of these subsections. Such certification is contingent upon the extent to which these requirements are satisfied overall on the engine applications in question and a demonstrated good-faith effort to meet these requirements in full by evaluating and considering the best available monitoring technology. Each incident of non-compliance will be recorded as a deficiency.

(A) Engine manufacturers of non-complying systems shall be subject to fines pursuant to section 43016 of the California Health and Safety Code for each deficiency identified subject to the following limitations:

(i) The specified fines shall apply to the third and subsequently identified deficiencies, with the exception that fines shall apply to all monitoring system deficiencies wherein a required monitoring strategy is completely absent from the OBD-M system; and

(ii) Engine manufacturers may not carry over monitoring system deficiencies for more than two model years unless it can be adequately demonstrated that substantial engine hardware modifications and additional lead time beyond two years would be necessary to correct the deficiency, in which case the deficiency may be carried over for three model years.

(B) For the third deficiency and every deficiency thereafter identified in an engine model, the fines shall be in the amount of $25 per deficiency per engine for non-compliance with any of the monitoring requirements specified in this section. Total fines per engine under this section shall not exceed $250 per engine and shall be payable to the State Treasurer for deposit in the Air Pollution Control Fund.

NOTE: Authority cited: Sections 39515, 39600, 39601, 43006, 43013, 43018, 43104, and 44036.2, Health and Safety Code; Sections 27156 and 38395 Engine Code.
Reference: Sections 39002, 39003, 39667, 43000, 43004, 43006, 43008.6, 43013, 43018, 43100, 43101, 43101.5, 43102, 43104, 43105, 43106, 43204, and 44036.2, Health and Safety Code; Sections 27156, 38391, and 38395, Engine Code.

§ 2445.1. Defects Warranty Requirements for Model Year 2001 and Later Spark-Ignition Marine Engines.

(a) Applicability. This section applies to model year 2001 and later spark-ignition personal watercraft and outboard marine engines, and to model year 2003 and later spark-ignition inboard and sterndrive marine engines. The warranty period begins on the date the engine or equipment is delivered to an ultimate purchaser or first placed into service (e.g., a demonstration engine or watercraft).

(b) General Emissions Warranty Coverage. The manufacturer of each spark-ignition marine engine must warrant to the ultimate purchaser and each subsequent purchaser that the engine is:

(1) Designed, built and equipped so as to conform with all applicable regulations adopted by the Air Resources Board pursuant to its authority in Chapters 1 and 2, Part 5, Division 26 of the Health and Safety Code; and

(2) Free from defects in materials and workmanship that cause the failure of a warranted part to be identical in all material respects to that part as described in the engine manufacturer's application for certification.

(c) Warranty Period. In the case of all new, spark-ignition marine engines, the warranty period will be:

(1) For model year 2001 and later spark-ignition personal watercraft and outboard marine engines, a period of 4 years or 250 hours of use, whichever occurs first.

(2) For model year 2003- ~~2008~~2005 spark-ignition inboard and sterndrive marine engines, a period of 2 years.

(3) For model year ~~2009~~2006 and later spark-ignition inboard and sterndrive marine engines~~, a period of 3 years.~~ :

(A) Manufacturers certifying engines according to Option 1 in Section 2442(b)(1) for model years 2006-2008, a period of 2 years.

(B) Manufacturers certifying engines according to Option 2 in Section 2442(b)(1):
1. For model years 2006-2007, a period of 2 years.
2. For model year 2008, a period of 3 years.

(C) Model Year 2009 and Later:
1. Engines 485 kilowatts or less, a period of 3 years.
2. Engines greater than 485 kilowatts:
(i) Electronic/emission-related components, a period of 3 years.
(ii) Mechanical/emission-related components, a period of 1 year or 50 hours (if equipped with an integrated ECM hour-meter).

* * * * *

(g) Exclusions.

(1) The repair or replacement of any warranted part otherwise eligible for warranty coverage under Subsection (d) may be excluded from such warranty coverage if the engine manufacturer demonstrates that the engine has been abused, neglected, or improperly maintained, and that such abuse, neglect, or improper maintenance was the direct cause of the need for repair or replacement of the part.

(2) Engine manufacturers must warrant engines for the yearly warranty period specified in paragraph (c). For Outboard and Personal Watercraft engines, and for inboard/sterndrive engines greater than 485 kilowatts, manufacturers may warrant engines for the hour warranty period if the engines:

(A) are equipped with hour meters; (an ECM-integrated hour meter for inboard/sterndrive engines)

(B) are equipped with devices similar to hour meters that are approved by the Executive Officer; or

(C) are or will be accompanied by other evidence or methods that the Executive Officer determines reliable for determining engine usage in hours.

(3) Except as provided in Subsection (1) above, any adjustment of a component that has a factory installed, and properly operating, adjustment limiting device (such as an idle limiter cap or plug) is eligible for warranty coverage under Subsection (d).

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, 43102 and 43104, Health and Safety Code.
Reference: Sections 43013, 43017, 43018, 43101, 43102, 43104, 43105, 43150-43154, 43205.5 and 43210-43212, Health and Safety Code.

§ 2445.2. Emission Control Warranty Statements.

(a) Each engine manufacturer must provide a verbatim copy of the following statement with each new 2001 model year and later spark-ignition personal watercraft and outboard marine engine and with each new 2003 model year and later spark-ignition inboard and sterndrive marine engine, using those portions of the statement applicable to the engine.

CALIFORNIA EMISSION CONTROL WARRANTY STATEMENT
YOUR WARRANTY RIGHTS AND OBLIGATIONS

The California Air Resources Board (and engine manufacturer's name, optional) is (are) pleased to explain the emission control system warranty on your (model year) (inboard, sterndrive, outboard or personal watercraft) engine. In California, new (inboard, sterndrive, outboard, or personal watercraft) engines must be designed, built and equipped to meet the State's stringent anti-smog standards. (Engine manufacturer's name) must warrant the emission control system on your (inboard, sterndrive, outboard, or personal watercraft) engine for the periods of time listed below provided there has been no abuse, neglect or improper maintenance of your (inboard, sterndrive, outboard, or personal watercraft) engine.

Your emission control system may include parts such as the carburetor or fuel injection system, the ignition system, and catalytic converter. Also included may be hoses, belts, connectors and other emission-related assemblies.

Where a warrantable condition exists, (engine manufacturer's name) will repair your (inboard, sterndrive, outboard, or personal watercraft) engine at no cost to you, including diagnosis, parts and labor.

MANUFACTURER'S WARRANTY COVERAGE:

(For spark-ignition personal watercraft and outboard marine engines:) Select emission control parts from model year 2001 and later (outboard, or personal watercraft) engines are warranted for 4 years, or for 250 hours of use, whichever occurs first.

(For 2003- ~~2008~~2005 spark-ignition inboard and sterndrive marine engines:) Select emission control parts from model year 2003- ~~2008~~2005 (inboard or sterndrive) engines are warranted for 2 years.

(For ~~2009~~2006 and later spark-ignition inboard and sterndrive marine engines:) ~~Select emission control parts from model year 2009 and later (inboard or sterndrive) engines are warranted for 3 years.~~

(1) Manufacturers certifying engines according to Option 1 in Section 2442(b)(1) for model years 2006-2008, a period of 2 years.

(2) Manufacturers certifying engines according to Option 2 in Section 2442(b)(1):

- (A) For model years 2006-2007, a period of 2 years.
- (B) For model year 2008, a period of 3 years.

(3) Model Year 2009 and Later:

- (A) Engines 485 kilowatts or less, a period of 3 years.
- (B) Engines greater than 485 kilowatts:
  - 1. Electronic/emission-related components, a period of 3 years.
  - 2. Mechanical/emission-related components, a period of 1 year or 50 hours (if equipped with an integrated ECM hour-meter).

However, warranty coverage based on the hourly period is only permitted for outboard engines ~~and~~, personal watercraft, and inboard/sterndrive engines greater than 485 kilowatts that are equipped with appropriate hour meters or their equivalent. If any emission-related part on your engine is defective under warranty, the part will be repaired or replaced by (engine manufacturer's name).

OWNER'S WARRANTY RESPONSIBILITIES:

– As the (inboard, sterndrive, outboard, or personal watercraft) engine owner, you are responsible for the performance of the required maintenance listed in your owner's manual. (Engine manufacturer's name) recommends that you retain all receipts covering maintenance on your (inboard, sterndrive, outboard, or personal watercraft) engine, but (engine manufacturer's name) cannot deny warranty solely for the lack of receipts or your failure to ensure the performance of all scheduled maintenance.

– As the (inboard, sterndrive, outboard, or personal watercraft) engine owner, you should however be aware that (engine manufacturer's name) may deny you warranty coverage if your (inboard, sterndrive, outboard, or personal watercraft) engine or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.

– You are responsible for presenting your (inboard, sterndrive, outboard, or personal watercraft) engine to a (engine manufacturer's name) distribution center as soon as a problem exists. The warranty repairs will be completed in a reasonable amount of time, not to exceed 30 days.

If you have any questions regarding your warranty rights and responsibilities, you should contact (Insert chosen contact of engine manufacturer) at 1-XXX-XXX-XXXX.

(b) Commencing with the 2001 model year, each engine manufacturer must also provide with each new engine a warranty statement in accordance with section 2445.1, Title 13, California Code of Regulations, that generally describes the obligations and rights of the engine manufacturer and engine owner under this article. Engine manufacturers must also include in the warranty statement a phone number the consumer may use to obtain their nearest franchised service center.

(c) Each engine manufacturer must submit the documents required by Subsections (a) and (b) with the engine manufacturer's application for new engine certification for approval by the Executive Officer. The Executive Officer may reject or require modifications of the documents to the extent the submitted documents do not satisfy the requirements of Subsections (a) and (b). Approval by the Executive Officer of the documents required by Subsections (a) and (b) is a condition of certification. The Executive Officer will approve or disapprove the documents required by Subsections (a) and (b) within ninety (90) days of the date such documents are received from the engine manufacturer. Any disapproval must be accompanied by a statement of reasons therefore. In the event of disapproval, the engine manufacturer may petition the Board to review the decision of the Executive Officer pursuant to Subchapter 1.25 of Title 17, California Code of Regulations.

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, 43102 and 43104, Health and Safety Code.
Reference: Sections 43013, 43017, 43018, 43101, 43102, 43104, 43105, 43150-43154, 43205.5 and 43210-43212, Health and Safety Code.

§ 2446. 2001 and Later Model Year Production-Line Test Procedures and Selective Enforcement Auditing Regulations for Spark-Ignition Marine Engines.

(a) Applicability. This section applies to 2001 and later spark-ignition personal watercraft and outboard marine engines. The allowable methods of production-line testing are specified in subsections (b) and (c), unless the engine manufacturer can satisfactorily provide an alternate method that shows an equivalent assurance of compliance to that of subsection (b). The engine manufacturer must choose only one method for each model year and submit its method of production-line testing to the Executive Officer for approval no later than 90 days prior to the start of the subject model year production. The 2003 and later spark-ignition inboard and sterndrive marine engines are only subject to the selective enforcement audit requirements specified within subsections (d) and (e) of this section. <u>Inboard and sterndrive engines certified using the provision in Section 2442(d) are exempt from this Section.</u>

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ATTACHMENT B

TEST PROCEDURES

State of California
AIR RESOURCES BOARD

CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR 2001 MODEL YEAR AND LATER SPARK-IGNITION MARINE ENGINES

Adopted: October 21, 1999
Amended: (insert date of amendment)

[Note: The proposed amendments for this rulemaking action are shown in ~~strikethrough~~ to indicate proposed deletions and underline to indicate proposed additions.]

CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR 2001 MODEL YEAR AND LATER SPARK-IGNITION MARINE ENGINES

Part I. Emission Regulations for 2001 and Later New Spark-Ignition Marine Engines, General Provisions.

* * * * *

9. Exhaust Emission Standards for 2001 and Later Spark-Ignition Marine Engines.

(a) Model year 2001 and later model year spark-ignition personal watercraft and outboard marine engines:

* * * * *

(b) Exhaust emissions from new model year 2003 and later spark-ignition inboard and sterndrive marine engines must not exceed the exhaust emission standards listed in Table 2 for the designated emission durability test period. Prior to Model Year 2007 certification, each engine manufacturer must select either Option 1 (OPT 1) or Option 2 (OPT 2) for its entire production for the 2007 and 2008 model years.

Table 2.

~~Inboard and Sterndrive Exhaust Emission Standards (by Implementation Date)~~		
~~Model Year~~	~~$HC+NO_x$ (grams per kilowatt-hour)~~	~~Durability Test Period (hours)~~
~~2003-2008[1]~~	~~16.0[2]~~	~~—~~
~~2007 and Later[3]~~	~~5.0~~	~~480~~

1. ~~Engines with a maximum rated power exceeding 373 kilowatts (500 horsepower) are not required to comply with these standards.~~
2. ~~Compliance with the $HC+NO_x$ standard may be averaged on a sales-weighted basis, across the engine manufacturers' California production, based on projected California sales or the projected California percentage of national sales.~~
3. ~~For model year 2007, engine manufacturers shall certify a minimum of 45% of their California production (projected California sales or projected California~~

~~percentage of national sales) to the standard. For model year 2008, engine manufacturers shall certify a minimum of 75% of their California production (projected California sales or projected California percentage of national sales) to the standard.~~

Inboard/Sterndrive Marine Engine Standards

MODEL YEAR	RATED POWER [kilowatts]	COMPLIANCE OPTION[1]	DURABILITY [hours / years]	EXHAUST STANDARD NMHC[2]+NOx [grams per kilowatt-hour]	EXHAUST STANDARD TYPE	SUPPLEMENTAL MEASURE[3]
2003 - 2006	kW ≤ 373	N/A	N/A	16.0	AVE	None
2007	kW ≤ 373	OPT 1	N/A	16.0 (55%)	AVE	None
			480 / 10	5.0 (45%)	FIXED	
		OPT 2	N/A	14.0	FIXED	Evaporative Low-Permeation Liquid Hoses
2008	kW ≤ 373	OPT 1	N/A	16.0 (25%)	AVE	None
			480 / 10	5.0 (75%)	FIXED	
		OPT 2	480 / 10	5.0	FIXED	Evaporative Low-Permeation Liquid Hoses
2009 and later	kW ≤ 373	N/A	480 / 10	5.0[5]	FIXED	Carryover[6]
	373 < kW ≤ 485		480 / 10	5.0[5]	AVE	
	kW > 485		50[4] / 1	5.0[5]	AVE	

Notes:
1. Once a manufacturer has chosen an option, that option must continue to be used exclusively across product lines
2. The non-methane component of hydrocarbon
3. Supplemental measures may be different than shown, but must provide equal and verifiable emission reductions to those indicated
4. Engine manufacturers may request a shorter durability period for high power engines provided they submit data supporting a shorter period
5. All engines ≤ 373 kW must meet a 5.0 g/kW-hr NMHC+NOx capping standard. For engines > 373 kW, the standard may be met by sales-averaging with engines equal to or less than 373 kW
6. The same or better supplemental emission control hardware used to meet the standard in 2007 must be used every model year thereafter

* * * * *

CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC MEETING TO CONSIDER REVISIONS TO THE CARL MOYER INCENTIVE PROGRAM GUIDELINES AND TO ESTABLISH THE AGRICULTURAL ASSISTANCE PROGRAM

The California Air Resources Board (Board or ARB) will conduct a public meeting at the time and place noted below to consider revisions to existing guidelines for the Carl Moyer Incentive Program and to establish the Agricultural Assistance Program, in response to new legislation.

DATE: November 17, 2005

TIME: 9:00 a.m.

PLACE: California Air Resources Board
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., Thursday, November 17, 2005, and may continue at 8:30 a.m., November 18, 2005. This item may not be considered until November 18, 2005. Please consult the agenda for the meeting, which will be available at least 10 days before November 17, 2005, to determine when 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.

Background:

The Carl Moyer Incentive Program funds voluntary projects to reduce emissions. It is a vital part of California's attainment strategy and assists California in meeting its legal obligations under the federally required State Implementation Plan. Under this program, local air districts disburse funds to grant applicants to cover the incremental cost of lower-emission vehicles, engines, and equipment. The Carl Moyer Program was established in 1999 by sections 44275 through 44299.1 of the California Health and Safety Code (HSC).

The Carl Moyer Program is implemented through guidelines adopted by the ARB. The Board last revised the Carl Moyer Program guidelines in April 2003. New legislation and practical experience in implementing the Carl Moyer Program has made it necessary to revise the existing guidelines. The proposed revisions will affect projects funded in the 2005/06 and later fiscal years.

New Legislation

Assembly Bill 923 (Firebaugh), signed into law last year, substantially amends the Carl Moyer Program. It broadens the categories of emission sources eligible to receive funding and expressly directs ARB to incorporate agricultural sources and vehicle scrappage. It also modifies the program to include reactive organic gases (ROG) and particulate matter (PM) in addition to nitrogen oxides (NOx). Finally, it requires the ARB to update its existing guidelines in response to these changes. Assembly Bill 1394 (Levine) directs the ARB to include heavy-duty fleet modernization projects in Carl Moyer that reduce NOx and/or PM through the replacement of old trucks.

New Funding:

During its first six years, the Carl Moyer Program provided $154 million to reduce emissions from approximately 7,000 diesel engines. A total of 18 tons per day of NOx were achieved during this period at a highly favorable cost-effectiveness of $3,000 per ton. In addition, emissions of toxic PM were reduced by one ton per day.

Legislative and budget actions last year increased Carl Moyer funding up to a maximum of $140 million per year for the next ten years. AB 923 provides $25 million in funding from tire fees to mitigate the air pollution caused by tire wear. AB 923 also authorizes air districts to increase their existing motor vehicle registration fee surcharges up to two dollars per vehicle, providing up to $55 million for four specified purposes: Carl Moyer grants, new school buses, accelerated vehicle retirement or repair, and incentives for previously unregulated agricultural sources. Finally, the state budget adjusted Smog Check fees to provide another $61 million for Carl Moyer and other incentive programs.

Proposed Revisions:

ARB staff is proposing several programmatic and administrative changes to the existing Carl Moyer guidelines. These changes address new and forthcoming regulations; update emission factors; and reflect new legislative direction per AB 923 and AB 1394. The following sections describe the major revisions. ARB staff held several public workshops between November 2004 and August 2005 on the proposed changes. Staff also worked closely with the air districts. The proposed Carl Moyer guidelines are exempt from the Administrative Procedure Act and instead are subject to specific adoption procedures specified in statute. Section 44287(a) of the HSC directs ARB staff to allow the public 45 days to comment on any proposed revisions to the Carl Moyer Program. The staff's proposed revisions were made available to the public on September 30, 2005, opening the required 45-day public comment period.

Cost Effectiveness. AB 923 requires the ARB to establish cost-effectiveness limits for funded projects and to develop appropriate adjustment factors for ROG and PM. Previously, cost-effectiveness was based on NOx only. Accordingly, ARB staff is proposing a new cost-effectiveness calculation to account for NOx, ROG, and PM. Staff also proposes that PM-only and ROG-only projects be allowed. Staff is proposing weighting factors for NOx, ROG and PM based on the relative cost of reducing each pollutant. The weighting factors will enable ARB and districts to compare the relative effectiveness of individual projects across different air pollutants. Finally, to adjust for inflation, staff proposes that the cost-effectiveness limit be adjusted from $13,600 per ton of NOx reduced to $14,300 per ton of NOx plus ROG plus the appropriately weighted amount of combustion PM reduced.

Fleet Modernization. AB 1394 expanded the Carl Moyer Program to account for the benefits of replacing a heavy-duty vehicle with a newer, cleaner model (new HSC section 44297). This is intended to make more alternative fuel and electric technologies eligible for funding. ARB staff is proposing specific project criteria and procedures for the fleet modernization program.

Agricultural Sources. AB 923 extends coverage of the Carl Moyer Program to include previously unregulated stationary and area agricultural sources as defined in HSC section 39011.5. In response, ARB staff is proposing new protocols for agricultural internal combustion engines. Staff also is proposing that the Board direct the Executive Officer to develop and approve project criteria for non-engine agricultural sources when technology is available to ensure the emission reductions are surplus, real, quantifiable and enforceable.

Agricultural Assistance Program. As noted above, AB 923 authorizes local districts to increase their motor vehicle fee surcharges. One allowable use of these funds is the purchase, retrofit, repower, or add-on for previously unregulated agricultural sources of air pollution. ARB staff is proposing that this program be called the Agricultural Assistance Program and is proposing new guidance to address these funds.
AB 923 requires that Agricultural Assistance Program projects follow the Carl Moyer Guidelines with one significant exception: emission reductions do not have to be surplus. Agricultural Assistance Program projects are eligible for funding for at least three years from adoption of an applicable rule or standard, or until the compliance date of that rule or standard, whichever is later (HSC section 41081 and section 44229).

Light-Duty Vehicles. AB 923 added light-duty vehicle scrappage or repair to the Carl Moyer Program (HSC section 44281(a) (5)). Accordingly, staff is proposing revisions to address voluntary accelerated vehicle retirement. ARB staff also proposes that the Board authorize the South Coast Air Quality Management District program to evaluate a remote sensing program to detect gross-polluting vehicles. Staff will continue to assess whether and how to incorporate voluntary vehicle repair and other light-duty vehicle projects before the next scheduled Guideline revision.

Administration. To ensure the best use of public funds and continued public confidence, the Carl Moyer Program must have clearly defined administrative responsibilities, oversight and transparency. The proposed administrative criteria formalize existing practices and policies and establish minimum requirements for ARB and all local air districts. The proposed requirements identify ARB's responsibilities pertaining to program oversight, audits and the recapture of funds. They also identify the minimum requirements that districts must include in their local programs. The districts may establish more stringent requirements in response to local circumstances.

AVAILABILITY OF DOCUMENTS AND AGENCY CONTACT PERSON

The proposed revisions to the Carl Moyer Program Guidelines will be presented by ARB staff at the Board meeting. The Agricultural Assistance Program will also be discussed, along will specific Carl Moyer criteria that will apply to those projects. Copies of the proposed revisions may be obtained from the Board's Public Information Office, 1001 I Street, Sacramento, California 95814, (916) 322-2990, at least 45 days prior to the scheduled meeting. This report will also be available electronically on the ARB's website at www.arb.ca.gov/msprog/moyer/moyer.htm. Further inquiries regarding this matter should be directed to Mr. Robert Nguyen, Air Resources Engineer, at (916) 327-2939 or by e-mail at rnguyen@arb.ca.gov.

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 not physically submitted at the hearing must be received no later than 12:00 noon, November 16, 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: moyer05@listserv.arb.ca.gov and received at the ARB **no later than 12:00 noon, November 16, 2005.**

Facsimile transmissions 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, November 16, 2005.**

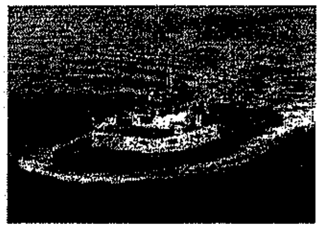
The Board requests but does not require that 30 copies of any written statement be submitted and that all written statements be filed at least 10 days prior to the hearing so that ARB staff and Board Members have time to fully consider each comment. The Board encourages members of the public to bring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

CALIFORNIA AIR RESOURCES BOARD

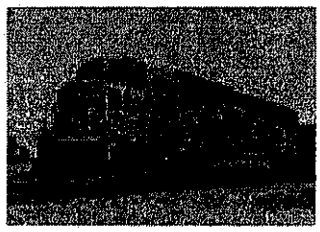
Catherine Witherspoon
Executive Officer

Date: September 28, 2005

THE CARL MOYER PROGRAM GUIDELINES



Proposed Revision 2005



Release Date: September 30, 2005
Meeting Date: November 17, 2005

California Environmental Protection Agency

Air Resources Board

In memory of Dr. Carl Moyer
(1937 - 1997)

This program is named in honor of the late Dr. Carl Moyer, whose extraordinary dedication, hard work, vision and leadership made this program possible. He created and masterminded this program, in a noble effort to unite business and government in the name of public interest to improve California's air quality.

This update was a collaborative effort and has benefited from the valuable contributions of the participating air districts. The ARB appreciates the considerable efforts of district staff both in the development of these guidelines as well as the day-to-day implementation of the Carl Moyer Program.

EXECUTIVE SUMMARY

Air pollution is a serious problem for California. Over 90 percent of Californians live in areas that have unhealthful air at times. Air pollution has been tied to serious health impacts. Studies have linked particulate pollution to premature death in the elderly and other vulnerable populations. Research also shows that children exposed to unhealthful levels of ozone, or smog, suffer decreased lung function growth and increased asthma.

The California Air Resources Board (ARB), together with the 35 local air districts, is responsible for developing and implementing strategies to reduce air pollution and achieve health-based ambient air quality standards. Emission standards on new vehicles and engines help to reduce air pollution as older sources are retired and replaced by newer, cleaner vehicles and engines. However, new emission standards alone will not solve California's air pollution problem. Although older sources of pollution contribute a disproportionate share of emissions, there are technologies available to reduce these emissions. Devices are available that can reduce emissions from in-use vehicles and equipment by up to 85 percent, and new, low-emission engines equipment and vehicles are available that can reduce emissions by 25 to 85 percent. However, reducing emissions from these in-use sources can be difficult. The Carl Moyer Memorial Air Quality Standards Attainment Program (Carl Moyer Program) has proven to be an effective, cost-effective, and popular means of reducing emissions from existing pollution sources.

The Carl Moyer Program is a grant program, implemented by a partnership of ARB and local air districts, that funds the incremental cost of cleaner-than-required engines, equipment, and other sources of pollution. Carl Moyer Program grants provide early or extra emission reductions. It can also accelerate the development and commercialization of advanced emission control technology, accelerate the turnover rate of old equipment to newer and cleaner equipment, and help reduce costs to the regulated community. Projects to reduce emissions from on-road heavy-duty vehicles, idle reduction technologies, off-road diesel equipment, transportation refrigeration units, off-road spark-ignition equipment, marine vessels, locomotives, and agricultural engines have been eligible for grants. Legislative changes enacted in 2004 made projects to reduce emissions from other agricultural sources, light-duty vehicles, and on-road fleet modernization eligible for Carl Moyer Program funding as well. These legislative changes also created a new incentive program aimed at previously unregulated agricultural sources, which ARB staff is proposing to call the Agricultural Assistance Program.

In its first six years, the Carl Moyer Program has provided $154 million in funding to clean up almost 7,000 engines statewide. The Carl Moyer Program has reduced about 18 tons per day of nitrogen oxides (NOx, a smog-forming pollutant), and 1 ton per day of diesel particulate matter. The emission reductions funded through Carl Moyer Program grants are very cost-effective, about $3,000 per ton of NOx, comparing favorably to the cost-effectiveness of other air pollution regulations. The recent legislative changes expand the focus of the Carl Moyer Program to additional pollutants – reactive organic gases (which combine with NOx in the atmosphere to form smog) and particulate matter (which includes toxic diesel particulate matter). This change will allow the Carl Moyer Program to more comprehensively address all of California's air pollution challenges, including the air toxic risk associated with emissions from diesel engines.

The legislative changes enacted in 2004 also provided increased and continued funding for the Carl Moyer Program and other incentive programs – up to $141 million a year statewide through 2015. Emission reductions achieved through the Carl Moyer Program are an important component of the California State Implementation Plan (SIP) – the State's federally-required road map to reducing emissions to meet the health-based ambient air quality standards. All emission reductions funded with Carl Moyer Program funds must be real, surplus, quantifiable, and enforceable in order to be credited toward California's obligations in the SIP. These proposed Guidelines describe project criteria to ensure that projects funded by the Carl Moyer Program achieve SIP-creditable emission reductions. The proposed Guidelines also formalize the administrative requirements for both ARB and the local districts that administer the Carl Moyer Program. Funding criteria for the Agricultural Assistance Program are based on the proposed Carl Moyer Program Guidelines, but the emission reductions under the Agricultural Assistance Program are not required to be surplus to regulatory requirements.

It is important to note that regulations will continue to be the primary means to reduce emissions to improve air quality. The incentives provided by the Carl Moyer Program, and other incentive programs, are intended to complement, not replace, these regulatory requirements. Although incentive programs can help reduce costs to the regulated community, there are simply not enough funds to purchase all the emission reductions needed to achieve healthful air.

The Carl Moyer Program has proven to be immensely popular in its first seven years, with the demand for grants routinely outstripping available funds. The inclusion of additional project categories combined with increased funding will allow the Carl Moyer Program to more fully realize the potential of incentive programs to improve air quality in California. In order to assure that the Carl Moyer Program remains responsive to the challenges facing air pollution control today, ARB staff is committed to improve all aspects of the Program from the technical data to the administrative requirements to customer service. Toward that end, ARB staff will update the technical information, as needed; encourage transparency in Program administration; and continue to explore ways to increase Program accessibility, especially to small businesses.

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PROGRAM OVERVIEW AND ADMINISTRATIVE REQUIREMENTS

Proposed Revision 2005
September 30, 2005

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Chapter One

PROGRAM OVERVIEW

The Carl Moyer Program Air Quality Standards Attainment Program ("Carl Moyer Program") enacted in Health and Safety Code (HSC) section 44275, et seq. is a grant program that funds the incremental cost of cleaner-than-required engines, equipment, and other sources of air pollution. Although air pollution regulations have significantly reduced emissions and improved air quality across the State, many areas of California continue to experience unhealthful air. The Carl Moyer Program complements California's regulatory program by providing incentives to obtain early or extra emission reductions, especially from emission sources in environmental justice communities and areas disproportionately impacted by air pollution.

This document describes proposed revisions to the Carl Moyer Program Guidelines to respond to legislation enacted in 2005, and to update the program to reflect current technical information and regulatory requirements for vehicles, equipment, engines and other pollution sources in California.

I. Background

Since 1998, the Carl Moyer Program has provided grants to encourage the owners of heavy-duty diesel engines to go beyond regulatory requirements by retrofitting, repowering, or replacing their engines with newer and cleaner ones. With the clean-up of about 7,000 old, high-emission engines, resulting in about 18 tons per day of oxides of nitrogen (NOx) emission reductions throughout the State, the Carl Moyer Program is a successful and popular air pollution program. The Carl Moyer Program offers critical emission reductions that are needed to achieve health-based air quality standards and prevent the loss of federal transportation funds throughout California. Although the Program has evolved, it retains its primary objective of obtaining cost-effective and surplus emission reductions to be credited toward California's legally-enforceable obligations in the State Implementation Plan (SIP) – California's roadmap for attaining the health-based national ambient air quality standards. In addition, Carl Moyer Program grants accelerate the turnover rate of old engines to newer and cleaner engines; accelerate the development and commercialization of advanced, reduced-emission technology; and help reduce costs to the regulated community.

On January 1, 2005, new legislation (AB 923, Firebaugh/Pavley) took effect, which expands the Carl Moyer Program to include additional pollutants, as well as additional sources of air pollution (HSC section 44275). The legislation requires the ARB to establish or update grant criteria (HSC section 44283) and guidelines for covered projects, as revised by the bill, by January 1, 2006.

The Carl Moyer Program has been successfully implemented through the cooperative efforts of the Air Resources Board (ARB or "Board") and the local air pollution control and air quality management districts ("air districts" or "districts"). Each year, the ARB makes grant awards to air districts that apply for Carl Moyer Program funds to implement local programs. The air districts, following the Guideline criteria approved by the Board, provide grants to public and private entities for the incremental cost of cleaner-than-required engines and/or equipment. In implementing the Carl Moyer Program, local districts enjoy considerable flexibility. For instance, districts may impose additional or more stringent eligibility requirements for projects in their districts. This flexibility allows air districts to tailor the use of Carl Moyer Program funds to meet local air quality objectives.

Although the Carl Moyer Program is an important component of California's clean air plan, it is important to note that there are simply not sufficient public funds to purchase the emission reductions needed to provide healthful air. The Carl Moyer Program is not an easy path to compliance with regulatory requirements, but the Program can provide financial incentives to those who are able to secure early or extra emission reductions.

II. Legislative Changes

Three key pieces of legislation enacted in 2004 and 2005 provided increased and continued funding, and expanded the Carl Moyer Program. These include Senate Bill 1107, Assembly Bill 923 (Firebaugh/Pavley), and Assembly Bill 1394 (Levine). In addition, on September 6, 2005, Governor Schwarzenegger signed Senate Bill 467 (Lowenthal) which requires the ARB to revise the Carl Moyer Program Guidelines to include projects in which an applicant turns in off-road equipment powered by an internal combustion engines and replaces that equipment with new zero-emission technologies. This legislation will take effect on January 1, 2006. ARB staff will evaluate how to incorporate the requirements of this legislation into the Carl Moyer Program in 2006.

A. Senate Bill 1107 (SB 1107)

As part of the fiscal year 2004-2005 budget, SB 1107 adjusted the Smog Check fee while extending the newer-vehicle Smog Check exemption, securing about $7 million for consumer assistance in the Smog Check program and about $61 million in annual funding to be deposited in the Air Pollution Control Fund to fund the Carl Moyer Program "...to mitigate or remediate the harm caused by the type of motor vehicle on which the fee is imposed" (HSC section 44091.1).

B. Assembly Bill 923 (AB 923)

AB 923 provided two additional sources of funding for the Carl Moyer Program, and expanded the program to include new emission sources and new pollutants.

This legislation adjusted the tire fee that is assessed on purchasers of new tires from $1.00 per tire to $1.75 per tire starting on January 1, 2005. The tire fee is reduced to

$1.50 per tire staring on January 1, 2007 (Public Resources Code section 42885). The adjustments to the tire fee will provide about $25 million for clean air programs like the Carl Moyer Program in fiscal year 2005-2006, decreasing to $16 million a year from 2007 through 2015.

AB 923 also provided air district governing boards with the authority to approve a $2 increase in motor vehicle registration fees ("MV Fees"). The adjustment to the motor vehicle registration fee provides up to $55 million directly to the local air districts for four specific incentive programs, including projects eligible for funding under the Carl Moyer Program, "...that the district determines remediate air pollution harms created by motor vehicles on which the surcharge is imposed". The other three programs that may be funded with the $2 MV Fee are the purchase of new school buses under the Lower Emission School Bus Guidelines [ARB, 2004], light-duty accelerated vehicle retirement or repair programs [ARB, 2001], and a program targeted at previously unregulated agricultural sources – a program that ARB staff is proposing to call the "Agricultural Assistance Program". As directed by AB 923, the funding criteria for the Agricultural Assistance Program are based on the proposed Carl Moyer Program Guidelines and appear in Part III of this document.

AB 923 expanded the Carl Moyer Program to include light-duty vehicle projects and agricultural sources of air pollution as defined in HSC section 39011.5(a). AB 923 also directed ARB to consider emission reductions of reactive organic gases (ROG) and particulate matter (PM10) emissions, as well as NOx, when evaluating eligible projects. The legislation specifically directs ARB to develop a weighted cost-effectiveness to evaluate projects that obtain NOx, ROG and PM10 emission reductions.

C. Assembly Bill 1394 (AB 1394)

AB 1394 (Levine) directed the ARB to broaden the Carl Moyer Program to include heavy-duty fleet modernization projects that reduce NOx and/or PM10 emissions through the replacement of old trucks. ARB staff is proposing new criteria in these Guidelines so districts may select appropriate projects that would qualify for funding under the heavy-duty fleet modernization source category.

III. Summary of Proposed Guideline Revisions

A. Addition of ROG and PM10

With the enactment of AB 923, the Carl Moyer Program has expanded from a NOx-focused incentive program to include projects that also reduce ROG and PM10. This change allows the Carl Moyer Program to more comprehensively address all of California's air pollution challenges, including the air toxic risk associated with emissions from diesel engines.

Reactive organic gases combine in the atmosphere with NOx to form smog. Because different regions of the State require a different combination of ROG and NOx emission reductions to meet ambient air quality standards, the inclusion of ROG in the Carl Moyer Program will allow local regions to tailor the Carl Moyer Program to more closely meet the requirements of their local SIP.

The addition of PM10 allows the Carl Moyer Program to respond to the major air quality challenge of diesel particulate matter. The ARB has identified particulate emissions from diesel-fueled engines as toxic air contaminants (TACs), and reducing diesel particulate emissions is a priority for the ARB. In October 2000, the ARB approved a comprehensive Diesel Risk Reduction Plan [ARB, 2000] to reduce diesel emissions from both new and existing diesel-fueled engines and vehicles. The Plan is a roadmap that identifies the steps that ARB will be taking to develop specific regulations to reduce diesel PM10 emissions. The ability to fund projects that reduce PM10 emissions will help ARB and districts reduce the risk associated with exposure to toxic diesel PM10.

Retrofit technologies to reduce PM10 emissions from diesel engines are becoming more widely available. These retrofit technologies include diesel oxidation catalysts, passive and active diesel particulate filters, flow-through filters, and fuel additives. A number of these retrofits have been verified by the ARB and could be funded using Carl Moyer Program grants. Airborne toxic control measures (ATCMs) already require some diesel-fueled sources to install retrofit devices. Fleets that are subject to these ATCMs may still qualify for Carl Moyer Program funds if they install retrofits earlier than required so that the emission reductions achieved are surplus to regulatory requirements.

B. New Cost-Effectiveness Formula to Include NOx, ROG and PM10 Emission Reductions

As discussed earlier, AB 923 requires the ARB to establish a weighted cost-effectiveness cap for Carl Moyer Program projects that reduce emissions of NOx, ROG and PM10. Cost-effectiveness for the Carl Moyer Program was previously based only on NOx emission reductions.

Cost-effectiveness is a measure of the dollars provided to a project for each ton of covered emission reductions. To calculate Carl Moyer Program cost-effectiveness, the project grant amount is annualized based on the project's life and an appropriate discount rate. This annual cost is then divided by the project's estimated annual emission reductions. In order to consider NOx, ROG and PM10 emission reductions in one calculation, ARB staff proposes to weight the emission reductions to develop a "weighted cost-effectiveness".

For NOx and ROG emission reductions, ARB staff is proposing a weighting factor of one. Oxides of nitrogen and ROG are precursor emissions – that is they combine in the atmosphere with other emissions to form air pollutants such as ozone (smog) or secondary particulate matter. The relative importance of NOx, ROG and other precursor emissions in the formation of smog and PM depends on many factors including location, temperature, geographic features, and the concentration of other pollutants. In order to accurately reflect the actual role of NOx and ROG, the weighting factors would have to be adjusted for each individual air basin. Historically, the ARB has treated NOx and ROG emissions equally. For example, the cost-effectiveness of ARB's regulations is generally provided in dollars per ton of NOx + ROG, with no weighting factors. ARB staff proposes to follow the same approach for the Carl Moyer Program and, thus, NOx and ROG emission reductions would carry a weighting factor of one in the weighted cost-effectiveness formula.

ARB staff believes it is appropriate for emission reductions of combustion PM10 to carry additional weight in the calculation because, for an equivalent weight, these emissions are more harmful to human health. ARB staff is not proposing to include non-combustion PM10 in the weighted cost-effectiveness formula at this time because the staff is not proposing specific project criteria for non-engine projects.

ARB staff considered a range of weighting factors for combustion PM10, ranging from 10 to 30. In Carl Moyer Program Advisory: # 05-001 (December 20, 2004), the staff weighted combustion PM10 emission reductions by 10 on an interim basis based on the cost to control combustion PM10 in the Solid Waste Collection Vehicle ATCM [ARB, 2003a]; that is, a weighting factor of 10 would offset the increased cost of reducing an equal amount of combustion PM10 emissions compared to the emissions of ozone precursors such as NOx. Based on an evaluation of a broader range of diesel ATCMs, staff found that the current cost to control PM10 is about 15 times the cost to control the ozone precursors NOx and ROG.

ARB staff also evaluated the relative health benefits of reducing NOx emissions and reducing PM10 emissions. ARB staff estimated the monetary benefits by considering health endpoints that could be expected from reducing a given amount of combustion PM10 emissions, including premature deaths, asthma related emergency room visits, work loss days, and minor restricted activity days. Staff estimated monetary values for these benefits based on various economic values established for these health endpoints by both the U.S. EPA and the ARB [U.S. EPA, 2000a; U.S. EPA, 2000b; U.S. EPA, 2003; U.S. EPA, 2004; ARB, 2003b]. Based on this evaluation, the health benefits of reducing one ton of PM10 outweighed the health benefits of reducing one ton of NOx by about 30 times.

Based on the staff's evaluation, as well as discussions with stakeholder groups, ARB staff proposes to weight combustion PM10 by 20 times. Staff believes that this weighting factor will balance the objective of the Carl Moyer Program to obtain SIP-creditable emission reductions while also reducing the risk associated with toxic diesel particulate matter.

Thus, the proposed formula for weighted cost-effectiveness is:

$$\frac{\text{Annualized Cost (\$/year)}}{\text{(NOx reductions + ROG reductions + 20 x combustion PM10 reductions) (tons/year)}}$$

Some stakeholders also suggested incorporating exposure, particularly to sensitive receptors such as school children, into the cost-effectiveness calculation. After considering the nature of mobile source projects which travel throughout local air districts, and sometimes the entire state, and the potential difficulties associated with assessing the location, timing, and duration of emissions of each individual Carl Moyer Program project, the ARB staff is proposing not to incorporate exposure into the cost-effectiveness calculation at this time.

Although the proposed weighted cost-effectiveness formula does not incorporate exposure, it should be noted that local districts have the discretion to use project selection criteria that account for exposure. In addition, local districts with a population of over one million must have a method in place to provide for the expenditure of 50 percent of Carl Moyer Program (HSC section 43023.5) funds for projects that operate or are based in environmental justice areas.

C. Administrative Requirements

To ensure the best use of public funds and continued public confidence, the Carl Moyer Program must have clearly defined administrative responsibilities and oversight. The proposed administrative criteria formalize existing practices and policies, and contain minimum requirements that ARB and local air districts must follow to continue implementing a successful statewide Carl Moyer Program based on the requirements of the Health and Safety Code. The proposed requirements identify ARB's responsibilities pertaining to program oversight, audits, and recapture of districts' funds. They also identify the minimum requirements that districts must include in their local programs so ARB can document the districts' success and determine if funds need to be recaptured.

D. Agricultural Sources

The Carl Moyer Program has funded the clean-up of over 2,000 agricultural engines. AB 923 expanded the source categories that are eligible for Carl Moyer Program funding to include agricultural sources of air pollution as defined in HSC section 39011.5(a). This definition includes stationary and area-wide sources of pollution including engines, livestock operations, and other agricultural activities.

The proposed Guidelines respond to the legislative direction by including projects to reduce emissions from internal combustion engines that are agricultural sources. ARB staff also proposes that the Board direct the Executive Officer develop and approve project criteria for non-engine agricultural sources when technology is available to ensure that the emission reductions are real, surplus, quantifiable, and enforceable. However, at this time, the ARB staff is not proposing project criteria for non-engine agricultural projects. If these projects include reductions of non-combustion PM10, the criteria will include a weighting factor for non-combustion PM10 for use in the cost-effectiveness formula.

E. Agricultural Assistance Program

AB 923, in HSC section 44229, also creates an opportunity to provide incentives to fund new purchases, retrofit, repower, or add-on equipment for previously unregulated sources of air pollution. ARB staff is referring to this new program as the "Agricultural Assistance Program". AB 923 allows a portion of the $2 MV Fees to be used to fund this program. One major difference from the Carl Moyer Program is that Agricultural Assistance Program projects are not required to achieve surplus emission reductions. The HSC requires that Agricultural Assistance Program projects comply with the Carl Moyer Program Guidelines. Based on this statutory guidance, ARB staff is proposing to model the Agricultural Assistance Program on the Carl Moyer Program Guidelines. Agricultural Assistance Program projects will be limited to those for which the Board has approved Carl Moyer Program Guidelines. Guidelines for stationary and portable agricultural engines are included in this proposal. Guidelines for non-engine projects, such as dairies, are not included in this proposal, but would be developed by ARB staff, in consultation with interested stakeholders, when technologies for such projects become available.

F. Light-Duty Vehicle Program

AB 923 authorizes the districts and the ARB to fund projects to reduce emissions from light-duty vehicles under the Carl Moyer Program (HSC section 44275). ARB staff is proposing that light-duty vehicle projects will initially be limited to voluntary accelerated vehicle retirement (VAVR) programs that meet the ARB's VAVR regulations. ARB staff is also proposing to include the option of using remote sensing devices (RSD) to identify high emitting vehicles that can be targeted for voluntary early retirement and is taking a two-step approach to integrate RSD into the Carl Moyer Program and the VAVR regulation. As a first step, the ARB would authorize an RSD-based "High-Emitting Vehicle Identification, Repair, and Scrapping Program" to be run by the South Coast Air Quality Management District during 2005 and 2006. The ARB will use the data from this project to revise the VAVR regulation and these guidelines in 2006. After the ARB revises the regulation and the Carl Moyer Program Guidelines to fully incorporate RSD, any district that chooses to would be able to develop and implement RSD-based VAVR programs.

G. On-Road Fleet Modernization Program

AB 1394 expanded the Carl Moyer Program to include on-road fleet modernization (HSC section 44297), which is the replacement of an old, high-polluting, heavy-duty vehicle, which was not likely to be replaced on its own, with a cleaner vehicle. Fleet modernization provides incentive funds to truck owners that typically do not have the financial resources to buy a newer, cleaner vehicle. Incentives offset part of the cost of the newer, lower polluting vehicle. ARB staff is proposing to incorporate a heavy-duty vehicle fleet modernization component into the Carl Moyer Program.

H. Zero-Emission Projects

Zero-emission technology, such as electric equipment, is a key element of California's long-term plan for attaining health-based air quality standards. Zero-emission technology is able to provide major reductions of NOx, ROG, and PM10 emissions, as well as reductions in emissions of TACs and greenhouse gases. In addition, electric equipment will remain emission-free throughout its life. Yet, despite these attributes, and the fact that electric technologies are ideally suited for a number of Carl Moyer Program projects, there have been relatively few zero-emission projects funded through Carl Moyer Program grants. ARB staff is proposing to require districts to encourage zero-emission projects. Each district would choose how to encourage zero-emission projects. Options include, but are not limited to, a funding set-aside, priority processing, or additional outreach. ARB staff has also developed a Zero-Emission Project chapter in these proposed Guidelines to highlight potential projects.

I. Streamlining Program Administration for Small Businesses

ARB staff is committed to work with local air districts to evaluate ways to improve the efficiency of the Carl Moyer Program. Improved program efficiency would benefit all applicants seeking Carl Moyer Program grants, but may be especially beneficial for small businesses.

As part of this effort, ARB staff is proposing to work with the South Coast Air Quality Management District staff to develop a program next year to examine the feasibility of a rebate or voucher program to streamline and expedite fund disbursement. Based on the results of this program, ARB staff would evaluate whether a rebate or voucher program could be implemented statewide. If feasible, ARB staff would develop specific criteria for rebate or voucher programs to be incorporated in the next Carl Moyer Program Guideline revision. Prior to the next Guideline revision, ARB staff could also provide interim guidance to districts on how to implement a rebate or voucher program.

J. Other Proposed Revisions

In addition to the proposed revisions specifically discussed above, the proposed Carl Moyer Program guideline revision also contains other proposed criteria that are specific to each project category. These proposed revisions reflect input from the public and air districts, as well as new statutory requirements.

The proposed Guidelines would adjust the cost-effectiveness cap from $13,600 per ton of NOx to $14,300 per ton of weighted NOx, ROG, and combustion PM10 emissions to account for an approximately 5 percent inflation rate from 2003 to present. This number is based on the California average Consumer Price Index [U.S. BLS, 2005]. ARB staff is also proposing to use 4 percent for the discount rate to calculate the capital recovery factors for use in determining the annualized cost of Carl Moyer Program grants provided for a project. This number is based on the average annual yields for

U.S. Treasury securities, averaged from January 2005 through August 2005, with a 3-year, 5-year, 7-year, and 10-year maturation [U.S. FRB, 2005].

Additionally, the proposed revisions also reflect the current regulatory environment, new technology, and potential projects. These proposed project criteria, along with proposed program administration criteria and updated emission rates are discussed in more detail in each chapter of the Guidelines.

IV. References

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Chapter Two

ADMINISTRATION OF THE CARL MOYER PROGRAM

The Carl Moyer Program has been successfully implemented through the cooperative efforts of the Air Resources Board (ARB) and the local air pollution control and air quality management districts (districts). Health and Safety Code (HSC) section 44286 authorizes ARB to make grant awards to local air districts that apply for funds to implement a local Carl Moyer Program. The ARB has ultimate oversight responsibility for the statewide Carl Moyer Program. The districts implement their local programs in accordance with the guideline criteria approved by ARB. These Guidelines are binding and enforceable. The ARB provides the districts with flexibility in implementing the program, including the authority to implement stricter criteria based on their local air pollution challenges and air quality goals.

The ARB's goal is to administer the Carl Moyer Program stringently enough to ensure emissions benefits are realized, while maintaining enough flexibility to allow for ease in district and applicant participation and maintaining enough transparency for public scrutiny. The ARB has followed the requirements of HSC sections 44287 through 44297 in determining and reporting the success of local districts' programs. For each funding cycle, the districts are currently required to report to ARB three times during the two-year period, in order for ARB staff to track local progress in spending the Carl-Moyer Program funds. With continued funding increasing up to $140 million per year from all funding sources through 2015, it is critical to track funds from the point the district applies for funds from ARB, through the point the local district pays for a project, and during project implementation. This chapter formalizes the minimum requirements that ARB and local air districts must follow to continue implementing a successful statewide Carl Moyer Program. The chapter is designed to outline ARB's responsibility pertaining to program oversight, audits, and recapture of districts' funds. It also provides the minimum requirements that districts must include in their local programs so ARB can document and publicly report the districts' success and failures, and determine if there is a need to recapture Carl Moyer Program funds.

I. Administrative Terminology

Carl Moyer Program Funds. Carl Moyer Program funds include both the state funds awarded by the ARB (as provided by statute) and district matching funds.

Contract. A contract, grant, or other legally binding agreement used by a district to obligate and expend funds for a project funded through the Carl Moyer Program.

II. Funding Sources and Types of Carl Moyer Projects

A. New Carl Moyer Program Funding Sources

Two key pieces of legislation enacted in 2004 have expanded the Carl Moyer Program and brought an increased, continued source of annual funding through 2015. These are Senate Bill 1107and Assembly Bill 923 (Firebaugh/Pavley).

1. Senate Bill 1107 (SB 1107)

As part of the fiscal year 2004-2005 budget, this legislation adjusted the Smog Check fee while extending the newer-vehicle Smog Check exemption, securing about $7 million for consumer assistance in the Smog Check program and about $61 million in annual funding to be deposited in the Air Pollution Control Fund to fund the Carl Moyer Program "... to the extent that the state board or a participating district determines that the moneys are expended to mitigate or remediate the harm caused by the type of motor vehicle on which the fee is imposed" (HSC, section 44091.1).

The adjustment to the Smog Check fee is imposed on vehicles that are subject to biennial smog checks. Vehicles subject to the Smog Check Program include gasoline-powered passenger cars, light-duty trucks, medium-duty trucks, and heavy-duty trucks. These vehicles emit about 620 tons per day (tpd) of NOx, 400 tpd of ROG, and 13 tpd of PM10 emissions. It is the harms caused by these automotive pollutants that the fees will be used to mitigate. Under the Smog Check Program, vehicles are required to be tested every two years to measure the levels of NOx, hydrocarbon (HC), and carbon monoxide (CO) emissions. Vehicles exceeding the allowed emission thresholds are required to be repaired prior to being able to renew their registrations with the Department of Motor Vehicles. Vehicles powered with diesel engines are not subject to the Smog Check Program.

Gasoline engines generally do not produce as many NOx and PM10 emissions as diesel engines. On a per mile driven basis, the ARB's emission inventory shows that heavy-duty diesel trucks emit about 22 times the NOx, 21 times the PM10, and 1.5 times the ROG emissions compared to gasoline-powered vehicles subject to the Smog Check Program (see Table 2-1). In addition to heavy-duty diesel trucks, other heavy-duty diesel engines and pollution sources also contribute significantly to NOx, ROG, and PM10 emissions.

Particulate matter emissions from both gasoline-powered vehicles and heavy-duty diesel vehicles are formed in the combustion process and are dominated by fine PM. Strong links have been demonstrated between elevated fine particulate levels and premature deaths, hospital admissions, emergency room visits, and asthma attacks [ARB, 2002]. In addition, regardless of their origin, whether from light-duty gasoline-powered vehicles or other sources, NOx and ROG emissions react in the atmosphere to form ozone. Ozone is a powerful oxidant that can damage the respiratory tract, causing inflammation and irritation, and induces symptoms such as coughing, chest tightness, shortness of breath, and worsening of asthma symptoms [ARB, 2005]. Recent evidence has, for the first time, linked the onset of asthma to exposure to elevated ozone levels in exercising children [McConnell, 2002]. Light-duty vehicles are one of a multitude of sources that emit both NOx and ROG; a strategy that effectively reduces these emissions, no matter from what source, would reduce the harm caused by motor vehicles and have positive health benefits for the people of California, and particularly for sensitive groups, including young children.

Table 2-1
NOx, ROG, and PM10 Emissions from Vehicles Subject to the Smog Check Program and Heavy-Duty Diesel Trucks for 2005
(grams per mile)

Pollutants	"Smog-Check" Vehicles	Heavy-Duty Diesel Trucks
NOx	0.7	15.2
ROG	0.4	0.7
PM10	0.015	0.32

Source: EMFAC2002_v2.2, April 23, 2003

Gasoline-powered vehicles, particularly light-duty vehicles, in California are already subject to the most stringent emission standards in the nation. It is challenging to obtain additional emission reductions from individual new vehicles over these already extremely low emission levels. In-use emissions from existing gasoline-powered vehicles are significant, especially from older vehicles, due to deterioration and as a result of mal-maintenance. However, in-use emissions already are being addressed through the Smog Check Program as well as the vehicle repair and scrap program being operated by the Bureau of Automotive Repairs (BAR) (HSC, sections 44100-44122, in part).

As discussed earlier, AB 923 expanded the Carl Moyer Program to allow funding for projects to reduce emissions from light-duty vehicles (HSC, section 44275). Thus, ARB staff is proposing criteria for funding light-duty vehicle projects through the voluntary accelerated vehicle retirement program. ARB staff will also participate in a program that is being planned for 2006 in the South Coast Air Basin to evaluate a remote sensing program to detect gross-polluting vehicles. Staff believes that the programs described above, both for the BAR program and the proposed ARB Carl Moyer Program, for light-duty vehicles represent adequate and reasonable efforts to reduce emissions from this class of vehicles. As staff gains more information on the accelerated vehicle retirement and the remote sensing programs, staff plans to revisit this category and will revise the funding criteria for these projects to more fully incorporate them in the Carl Moyer Program.

Based on the discussion presented above, maximum and cost-effective emission benefits to mitigate the harms caused by light-duty vehicles would be obtained if funds from the adjustment to the Smog Check fee, as provided for by SB 1107, are used to reduce emissions from other sources of the same pollutants as automobiles produce. This approach would most expediently and effectively reduce NOx, ROG, and PM10 emissions and would serve the best interests of the people of California. Local air districts have the authority to select projects that would most effectively reduce NOx, ROG, and PM10 emissions in their local area.

2. Assembly Bill 923 (AB 923)

This legislation introduced significant revisions to the Carl Moyer program, including two new funding sources for the Carl Moyer Program – the adjustment to the tire fee and an allowance for an increase to the motor vehicle registration fee.

Increase in Tire Fee. Assembly Bill 923 adjusted the tire fee that is assessed on purchasers of new tires from the current $1.00 per tire to $1.75 per tire starting January 1, 2005. The tire fee is reduced to $1.50 per tire staring on and after January 1, 2007 (Public Resources Code, section 42885). The adjustments to the tire fee translate to about $25 million available for the Carl Moyer Program in 2005-2006, and $16 million from 2007 on.

The legislation requires a portion of the revenues generated by the tire fee to be deposited in the Air Pollution Control Fund for use by the ARB and the air districts. AB 923 also requires the ARB to expend or allocate the portion of the tire fee adjustment that is directed to the Air Pollution Control Fund to fund programs and projects that mitigate or remediate air pollution caused by tires in the state, to the extent that the state board or the applicable district determines that the program or project remediates air pollution harms created by tires upon which the fee described in Section 42885 is imposed" (Public Resources Code, section 42889).

Air pollutants generated through tire wear are particulate matter whose composition is directly related to the constituents and processes used to manufacture the new tire. Tires are manufactured using a mixture of natural rubber; styrene-butadiene synthetic rubber; carbon black; molecular sulfur and sulfur compounds; silicone elastomers; phenolic resin; aromatic, naphthenic, and paraffinic oils; petroleum waxes; zinc oxide, titanium dioxide and other metals; fatty acids and inert materials. Carbon blacks typically contain varying quantities of adsorbed by-products from the production processes, particularly aromatic compounds. Typical classes of chemicals adsorbed onto the carbon black surface are carcinogenic polycyclic aromatic hydrocarbons (PAHs), nitro-derivatives of PAHs and sulfur-containing PAHs. The presence of these compounds can significantly increase the hazards of carbon black exposure. Some of these compounds have been identified by the ARB as TACs.

The legislative intent of the portion of the tire fee as expressed in AB 923 is to reduce PM and TAC emissions to improve air quality for Californians. Elevated PM emissions have been linked to premature deaths and other health ailments, such as asthma attacks. Fine PM, regardless of source, can bypass the body's defense mechanism and can embed deep in the lungs. Ongoing studies have indicated that particulate matter pollution may significantly reduce lung function growth in children [Peters et al. 2001, Avol et. al. 2001, Gauderman et al. 2002] and that exposure to diesel PM could also cause lung cancer [ARB, 2002].

Technologies used to reduce PM emissions from tires generally involve strategies to reduce tire wear. This could be accomplished either through the use of high-mileage tires or by maintaining proper tire pressures. Although high-mileage tires have been available for a number of years, they have been marketed principally for their high-mileage attribute rather than for their potential to reduce PM emissions. Similarly, although tire manufacturers have informed consumers on the benefits of maintaining proper tire pressures in terms of prolonging tire life and improving fuel economy, they have not engaged in presenting the impacts of improper tire inflation on PM emissions.

Existing criteria for funding Carl Moyer projects are based on the net emission benefits of using a low-emission engine or advanced technology compared to a conventional engine or technology. In the case of tires, it is very difficult to accurately quantify the emission benefits of using high-mileage tires versus conventional tires. Although basic information on tire wear is known, factors affecting tire wear PM emissions specific to the types of tires currently available, such as high mileage tires, conventional tires, high performance tires, as well as other specialty tires, have not been developed. Tire wear is also dependent on material and manufacturing process, as well as operational conditions, such as vehicle speed, load, tire pressures, and road conditions.

Because of these factors, the potential emission benefits of high-mileage tires compared to conventional tires, or due to maintaining proper tire inflation, are very difficult to quantify accurately and to enforce. Since the primary objective of the Carl Moyer Program is to obtain surplus emission reductions, and because of the uncertainty in the actual emission benefits of these strategies, criteria for projects that reduce tire wear cannot be developed for this Guideline revision. ARB staff will continue to evaluate the potential for these projects to receive Carl Moyer Program funding as technologies to reduce tire wear emissions continue to be developed so that we can accurately quantify the emission benefits.

Since projects to reduce tire wear cannot be evaluated using traditional Carl Moyer Program criteria, ARB staff is proposing to use the funds associated with the tire fee on projects that remediate the harms caused by PM and TAC emissions generally, since these emissions are caused by tires.

Potential $2 Motor Vehicle Registration Fee Increase ($2 MV Fee). AB 923 amended the HSC to authorize districts in non-attainment areas to increase the motor vehicle registration fee surcharge, currently authorized up to $4 to fund specified air district activities to implement the California Clean Air Act, by up to $2, provided air district governing boards formally approve the increase. Health and Safety Code section 44229 (b) directs the districts to use the $2 MV Fee increase to implement any or all of the following four programs "...that the district determines remediate air pollution harms created by motor vehicles on which the surcharge is imposed":

- Projects eligible for grants under the Carl Moyer Program.

- The new purchase, retrofit, repower, or add-on equipment for previously unregulated agricultural sources of air pollution, for a minimum of three years from the date of adoption of an applicable rule or standard, or until the compliance date of that rule or standard, whichever is later. The ARB proposes to call this program the "Agricultural Assistance Program".

- The new purchase of school buses pursuant to the Lower-Emission School Bus Program.

- An accelerated vehicle retirement or repair program.

If each eligible district chose to use the entire $2 increase to fund the Carl Moyer Program, the adjustment to the motor vehicle registration fee could provide up to $55 million directly to the local air districts for the Carl Moyer Program. Motor vehicles subject to the registration fee surcharge include all on-road vehicles, i.e., light-duty, medium-duty, and heavy-duty vehicles. On-road vehicles are major contributors of NOx, ROG, and PM10 emissions. As shown in Table 2-2, these vehicles emit about 1,518 tons per day of NOx, 772 tons per day of ROG, and 50 tons per day of PM10 in 2005. As discussed in previous sections, strong links have been demonstrated between elevated fine particulate levels and premature deaths, hospital admissions, emergency room visits, and asthma attacks [ARB, 2002]. In addition, NOx and ROG emissions react in the atmosphere to form ozone, a powerful oxidant that can damage the respiratory tract, causing inflammation and irritation, and induces symptoms such as coughing, chest tightness, shortness of breath, and worsening of asthma symptoms [ARB, 2005]. On-road vehicles are one of a multitude of sources that emit the NOx, ROG, and PM10 emissions that cause these harms. In addition to heavy-duty diesel trucks, other heavy-duty diesel engines and pollution sources also contribute significantly to NOx, ROG, and PM10 emissions. As shown in Table 2-2, these other mobile sources emit about 908 tons per day of NOx, 436 tons per day of ROG, and 69 tons per day of PM10 in 2005. A strategy that effectively reduces these emissions, no matter from what sources, would reduce the harms caused by motor vehicles and have positive health benefits for the people of California, particularly for sensitive groups, including young children.

B. Outreach Funds

The ARB sets aside up to two percent of the total Carl Moyer Program annual funding for local air district outreach to implement their local program. These funds are distributed to each district based on the annual allocation of project funds that a district receives. Administrative funds shall be used for direct costs associated with the tasks outlined in this chapter and must be documented by the district. Examples of such costs and the documentation required are:

- Staff time to complete the tasks outlined in this chapter. The staff time shall be documented with time sheets.

- If consultants are used to assist districts in administering their local programs, consultant fees may also qualify. They shall be documented with a contract and invoices.

- Printing, mailing and travel costs directly associated with the implementation of the Carl Moyer Program may also qualify. These costs shall be documented with receipts and/or invoices.

Table 2-2
NOx, ROG, and PM10 Emissions from
On-Road Mobile and Off-Road Mobile Sources for 2005
(tons per day)

Pollutants	On-Road Mobile	Off-Road Mobile
NOx	1518	908
ROG	772	436
PM10	50	69

Source: The California Almanac of Emissions and Air Quality, 2005 Edition

C. Matching Funds

The district matching fund requirement is important because it provides a literal "buy-in" from the districts responsible for the selection, monitoring, and enforcement of the projects. This requirement helps ensure that the most worthwhile projects are selected and that more funds are available for clean air projects.

1. Match Fund Formula

Currently districts participating in the Carl Moyer Program are required to provide $1 in match funding for every $2 of state Carl Moyer Program funding awarded by ARB, with a cap on statewide match funds at a total of $12 million. The formula provided below is used to determine each district's required matching funds.

$$\frac{\text{District's annual allocation} * \$12{,}000{,}000}{[\text{Current annual funding level - (ARB \& district admin./outreach funds + 10\% holdback)}]}$$

The ARB recognizes the fiscal realities, especially for rural districts, which make it a challenge to meet matching fund requirements of the Carl Moyer Program. Currently, a district receiving the minimum grant award of $200,000 may request a waiver of the match fund requirement provided the district can demonstrate appropriate staff commitment for program implementation and administration. The ARB staff works closely with local district staff to determine the proper level of commitment necessary based on previous history of projects funded and performance.

2. Sources of Matching Funds and Allowable Expenditures

Districts have a variety of local funds under their fiduciary control that can be used to meet their match fund requirement. Districts are allowed to meet their matching fund requirement on an overall program basis, rather than a project-by-project basis. This allows the districts the flexibility to fund worthwhile clean air projects from a variety of targeted funding sources.

AB 2766 - $4 Surcharge on Motor Vehicle Registration Fees ($4 MV Fee). Many districts receive funds from a $4 surcharge on motor vehicle registration fees. Funds generated by the $4 MV Fee must be used for projects that reduce emissions from motor vehicles and infrastructure when it serves Carl Moyer Program motor vehicle projects [ARB, 1998]. Table 2-3 below gives a partial list of motor vehicles that are eligible to be funded by the $4 MV Fee. The non-motor vehicles listed below are not eligible project categories for motor vehicle registration fee funds.

Table 2-3
Motor Vehicles vs. Non-Motor Vehicles

Motor Vehicles	Non-Motor Vehicles
Automobiles	Locomotives
Trucks	Aircraft
Buses	Lawn mowers (non-riding)
Vans	Leaf blowers
Road graders	Refrigeration units
Earth movers	Chain saws
Tractors	Auxiliary generators
Golf carts	Welding machines
Motorcycles	Pleasure craft
Self-propelled harvesters	Cranes
Forklifts	Marine vessels
Sweepers	Stationary agricultural engines
Motorized Bicycles	Bicycles

AB 923 – $2 MV Fee. As previously discussed, statewide the $2 MV Fee could generate up to $55 million annually if local governing boards approve the adjustment. As indicated in HSC sections 41081(d), 44225 and 44229(b), districts approving the adjustment must use those funds in one of the four areas previously discussed

If districts use the $2 MV Fee to pay for projects that meet the Carl Moyer Program criteria (including infrastructure in support of a Carl Moyer Program-funded motor vehicle project) or light-duty accelerated vehicle retirement and repair programs that meet the Carl Moyer Program Guidelines, those funds count toward a district's match fund requirement. Emission reductions generated from projects in both categories are considered to be surplus. Note that projects paid for under the Agricultural Assistance Program do not need to meet the criteria that all funded emission reductions must be "surplus" to those reductions required by law, although other Carl Moyer Program criteria, however, must be met. In addition, projects paid for under the Lower Emission School Bus Program also do not have to be surplus nor do they have to meet the cost-effectiveness criteria under the Carl Moyer Program. Hence, only funds from the $2 MV Fee that are used on projects that meet the Carl Moyer Program Criteria may count toward the district's match funding requirement.

Since the Health and Safety Code requires districts to use the $2 MV Fee on projects in four specified areas, it is necessary for ARB to monitor and document that public funds are being spent as intended by law. Hence, all projects funded by the $2 MV Fee will be subject to the same reporting, auditing, and oversight requirements as other Carl Moyer Program projects. After deciding whether to adopt the additional $2 MV Fee and which category(ies) of projects to use the funds for, districts must report projects funded by the extra $2 MV Fee in the Carl Moyer Program database (including non-Carl Moyer Program projects funded with the $2 MV Fee).

Other District Funds. Other funds under the districts' budget authority may be used as match. The eligible expenditures for match with other district funds include:

- Carl Moyer Program Projects. Match funds may be used to pay for any project which meets the Carl Moyer Program requirements of providing cost-effective emission reductions that are real, surplus, enforceable and quantifiable and that meet the other project criteria in these Guidelines.

- Incremental Fuel Cost. Match funds may be used to pay for the incremental cost of liquid or gaseous fuel and electricity, other than standard gasoline or diesel, which is integral to a Carl Moyer Program qualifying project.

- Infrastructure Projects. Match funds may be used for infrastructure projects that serve Carl Moyer Program qualifying projects.

- In-Kind Contributions. Up to 15 percent of a district's match requirement may be fulfilled through in-kind contributions. In-kind contributions are local funds under the district's fiduciary control that are used to pay for administering the local Carl Moyer Program, including but not limited to, staff resources assigned to the Carl Moyer Program, and printing, mailing, transportation and travel cost used by that staff to implement the Carl Moyer Program. Examples of acceptable indirect costs are administrative staff services to the Carl Moyer Program, office space and telephone service. These in-kind contributions must be made in the same time frame as the agreement term for the funds, must be proportional to the time and amount dedicated to Carl Moyer Program activities, and shall not be carried over to other years. The in-kind contributions must be documented and records available for review during ARB or other State monitoring visits and audits. Acceptable documentation includes time sheets, contracts, and invoices.

Districts are entitled to use any funds under their budget authority to cover the in-kind costs to administer the Carl Moyer Program. When using these other district funds for in-kind match, districts must follow any guidelines and other legal requirements for expending those other funds. While the two percent outreach funds that districts receive with each allocation comes under the districts' budget authority, those outreach funds shall not be counted as part of a district's in-kind match contribution

Matching Funds from Outside Sources. HSC section 44287(e) allows port authorities to provide match funding for port projects. Port authorities may participate through projects involving their own equipment, or by soliciting port tenants to apply for project funding. To encourage port authority participation, port authorities are authorized to put up match funding for port projects, to satisfy districts' match funding obligations. Thus, funding provided by a port authority for a qualifying project, or for associated infrastructure, would count toward the district's matching fund requirement. No more than 30 percent of a district's match obligation shall come from a port authority.

Private companies are not allowed to provide match funding to satisfy the districts' match funding obligation. The requirement that districts provide the matching funds facilitates an equitable distribution of funds, by preventing companies with "deep pockets" from tying up the majority of the funds. This requirement also helps ensure that districts independently evaluate the projects they approve for funding.

D. Cost-Effectiveness

Carl Moyer Program funding shall only be used to pay for the incremental cost of a project, minus any other public financial assistance, up to the program cost-effectiveness limit. Public financial assistance includes, but is not limited to, Environmental Quality Incentives Program (EQIP) and Federal Transportation Authority (FTA) funds. Only Carl Moyer Program funding, funding under the district's fiduciary budget authority or funding provided by a port authority (to meet the match fund requirement), is included in the cost-effectiveness calculation. Private funding is not included in the cost-effectiveness calculation. Thus, a project that costs more than the cost-effectiveness limit may be funded, but only if outside funding is used to "buy down" the incremental cost. Funding for infrastructure is not included in the cost-effectiveness calculation. For more details on how to determine the cost-effectiveness of a particular project, see Part II of the Guidelines, Chapters 1-12. A general discussion of the cost-effectiveness calculation methodology is presented in Part IV of the Guidelines, Appendix C.

E. Obligation

Since the inception of the Carl Moyer Program, ARB has required districts to obligate state funds one year from June 30 of the year the district receives its initial Grant Award and Authorization Form. This requirement ensures ARB that state funds will be spent in a timely manner as required by law.

When obligating funds, districts shall do so by contracting with owners to complete selected projects. Funds are considered to be obligated when the district takes one of the following actions:

- The district's governing board approves a project for funding through a resolution, minute order, letter or other written instrument.
- The Air Pollution Control Officer (APCO) or designated district staff, if given the authority by the governing board, approves a contract.
- The contract between the district and the owner is fully executed.

Carl Moyer Program funds shall be obligated by a district one year from June 30th of the year a district received its Grant Award and Authorization Form.

In the event previous years' funds were awarded or obligated to projects that withdraw or are terminated, those funds shall be awarded and/or obligated to other projects along with the current year's funds, following the current year's requirements. However, for tracking purposes, they must be reported with the correct previous year's reports.

F. Expenditures

HSC section 44287(k) requires that Carl Moyer Program funds be expended by a district two years from June 30th of the year a district received its initial Grant Award and Authorization Form. Districts expend funds by paying owners for completing milestones of projects under contract. Prior to paying for a delivered engine/vehicle or making final payment for completed project, the district must receive an invoice from the owner and complete a satisfactory post-inspection.

In the event previous years' funds (that were obligated and invoiced) are returned to a district, those returned funds are to be re-obligated to projects along with the current year's funds, and following the current year's requirements. However, for tracking purposes, they must be reported with the correct previous year's reports.

G. "At-Risk" Districts

In accordance with HSC section 44291(d), ARB shall monitor the districts' implementation of the Carl Moyer Program. The ARB proposes to use the minimum requirements outlined in this chapter as the benchmark for satisfactory implementation of the Carl Moyer Program. The ARB will also evaluate districts' implementation of their local Carl Moyer Program through monitoring and auditing as required. A district will be determined to be "at-risk" if the district fails to demonstrate that it is implementing the local program consistent with this chapter, which includes but is not limited to any of the following:

- Funds not being obligated and/or expended within the required time frames.
- Funds being spent in any way that is not consistent with the requirements of the Carl Moyer Program. For example, not maintaining adequate fiscal and programmatic records.
- Funds being spent in a way that is not consistent with the district's own policies and procedures manual.
- Implementing the local Carl Moyer Program in a way that cannot guarantee the funds are being used for projects that provide real, quantifiable and surplus emissions reductions within the cost-effectiveness limits.

The ARB shall provide technical assistance to districts that are determined to be "at-risk." The repercussions for "at-risk" districts that fail to correct deficiencies are outlined, in Section X-ARB's Oversight.

H. Training and Technical Assistance

The ARB provides training and technical assistance to districts through several means. On a day-to-day basis ARB maintains regular communication with the local districts through ARB's district liaison and the district's Carl Moyer Program contact person. The ARB also provides training and technical assistance when monitoring districts' performance, including review of projects and reports, and making on-site monitoring visits.

After each Guideline revision, ARB provides training and technical assistance on the changes to the Guidelines. This training is mandatory for all participating districts. The ARB, in conjunction with the districts, also provides training and technical assistance at the quarterly Incentive Planning Implementation Team (IPI Team) meetings. All districts must attend at least two IPI Team meetings per year. At-risk districts must attend all IPI Team meetings.

III. ARB's Carl Moyer Program Award Process

The ARB determines the tentative awards for each year in accordance with the formula identified in HSC section 44299.2(a). The formula provides a minimum allocation of $200,000 to all districts. Districts that accept only the minimum allocation may request a waiver from the match requirement. With the exception of the South Coast Air Quality Management District (SCAQMD), awards that exceed the minimum allocation of

$200,000 are calculated based on district population, severity of the air quality problems and the historical funding awards under the Carl Moyer Program. The SCAQMD award is based solely on population. Each year, tentative funding awards are provided in the Carl Moyér Program solicitation package.

Districts may request more than the tentative award. In fact, districts are encouraged to request the maximum funding for which they can commit the required match funds. Even though some districts will opt to accept the minimum award and have the match requirement waived, ARB expects that the total funding requested will exceed the funding available. Each year, all funds will be awarded and ARB will determine the final funding award among the districts. If any district requests less than their tentative award, the remaining funds will be allocated among the districts that requested more than their tentative award following the required formula.

Health and Safety Code section 44286 grants ARB the authority to set aside ten percent of Carl Moyer Program funds for projects to pay for projects that are multi-district in nature. As such, ARB proposes to include an annual ten percent hold-back from project funds to pay for projects that operate a portion of the time or miles outside their primary district of operation (within California). This includes projects that have significant air quality impacts in neighboring districts as a result of air pollution transport. The ARB's ten percent hold-back funds will also focus on areas of statewide importance. In Year 7 (fiscal year 2004-2005), ARB prioritized goods movement projects. Examples of multi-district projects funded in Year 7 include construction equipment, marine vessels, line haul trucks and a locomotive.

IV. ARB's Carl Moyer Program Solicitation

A. Solicitation

The ARB solicits district applications to conduct a local Carl Moyer Program, by sending solicitation packets to the Air Pollution Control Officer (APCO) at each district. The solicitation packet is also made available electronically on the Carl Moyer Program website. The application packet includes all of the following:

- A cover letter with instructions for completing and submitting the application.
- An application with match requirement information and documentation requirements.
- A match waiver request form.
- A list of the tentative awards.

B. Districts' Carl Moyer Program Applications

Districts interested in participating in the Carl Moyer Program must submit a completed application packet with all documentation by the posted deadline, which is 60 days from the date of the solicitation. The completed application packet must include the documents described below.

1. Completed Application

The ARB application must be completed and originally signed. All information requested must be provided or the application will be considered incomplete.

2. Documentation for Match Commitment

Any district may elect to request the minimum allocation of $200,000 per year and request a match waiver. Districts that request a match commitment waiver shall document the request by submitting the match commitment waiver request form which commits the district to provide sufficient resources to implement the local Carl Moyer Program. The match waiver must be originally signed by the APCO. Districts requesting the monetary match waiver are not eligible to receive reallocated Carl Moyer Program funds.

Districts receiving an award that exceeds the $200,000 minimum allocation must provide documentation of monetary match of district funds that has or will be spent on eligible projects. Projects that have been completed shall be documented by entering the project data into the Carl Moyer Program database. Future projects shall be proposed by listing the type of monetary match on the application and identifying the source of funds that the district will be using. The ARB staff will verify that the listed amount and source of funds are available for the district to use under the Carl Moyer Program. Districts may also meet up to 15 percent of their match requirement with in-kind contributions.

3. Local District Board Resolution

The application must include a resolution of the district governing board that authorizes the district to participate in the Carl Moyer Program and accept funds from ARB. Districts may want to include language and funding amounts in the resolution that provide the districts with the opportunity to accept additional funds, should additional funds become available. For districts with a match requirement, the board resolution shall authorize the APCO to apply sufficient funding to meet the match requirement. Since Carl Moyer Program funding is now authorized until 2015, districts may include a board resolution, which authorizes the district to implement the Carl Moyer Program for multiple years. Each year the district would document the resolution as still being in effect by simply including a copy of the resolution with the signed application.

4. Local Carl Moyer Program Implementation Plan

The district shall include a Carl Moyer Program implementation plan for obligating the grant award, including, but not limited to, how the district will complete the tasks of outreach, solicitation, application processing, obligation and invoicing of funds, reporting and monitoring. The plan must include a timeline for completing milestones for the identified tasks. Districts that have already submitted their implementation plan in previous years may submit just their timetable for implementation of the milestones and, if appropriate, changes the district is making to the local implementation of the Carl Moyer Program.

5. Documentation of Obligation and Expenditure of Previous Grant Awards

Districts that have previously been awarded Carl Moyer Program funds, must have submitted, or submit with the application, documentation of the status (obligation/expenditure) of all previous years' Carl Moyer Program funds for which no final report has been submitted. The details of this status report are described under section IV.F.1., below. ARB reviews the documentation to evaluate each district's status of obligating and expending previous years' funds before approving additional allocations. This evaluation ensures funds are expended within the time frames required by the HSC section 44287(k).

C. Review and Approval of Carl Moyer Program Applications

The ARB receives the applications and determines if each application is complete. If the application is incomplete, ARB shall provide the district with a written explanation of what is missing from the application within 10 working days of receipt of the application. Once the district application is complete, ARB shall verify all commitments of monetary match and, complete a review of all previous years' Carl Moyer Program funding.

While districts may apply for funding each year, beginning with Year 9 (fiscal year 2006-2007), ARB proposes minimum requirements regarding the amount of funds that each district must obligate from previous awards in order to receive a grant award in the new funding cycle. The proposed requirements are as follows:

- Any district receiving the minimum award of $200,000 that has not obligated at least 50 percent of their funds from the previous year shall not be eligible to receive funds for the current fiscal year.

- Any district receiving more than the minimum award of $200,000 that has not obligated 70 percent of their funds from the previous year shall only be eligible to apply for the minimum award of $200,000 and shall not be eligible to accept additional funds, should they become available.

- Districts may elect to return unobligated funds from previous years to obtain their full current year award.

- "At-risk" districts are only eligible to apply for funds once corrective action has been taken and the "at-risk" determination has been removed.

Complete applications, which fulfill all criteria, shall be approved no later than 60 days after receipt. On a case-by-case basis, ARB may elect to approve an application that is missing a particular item and make the submittal of that item a stipulation of the Grant Agreement. For example, sometimes district staff is unable to obtain a board resolution before the application deadline. In such a case, ARB may allow a board resolution to be submitted with the signed Grant Agreement or prior to the district's initial disbursement.

D. Final Grant Awards

Once all of the districts' applications have been approved, ARB will determine the final awards. Final awards are incorporated into the Grant Award and Authorization with the districts. The Grant Award and Authorization Form shall specify the amount of each districts' award that are from the smog check fee, the tire fee and for outreach. The ARB prepares and submits two original copies of the Grant Award and Authorization Forms to qualifying districts. The districts review and have the authorized person (usually the APCO) originally sign both copies of the agreement. The districts retain one fully executed copy of the agreement for their files and return one original copy of the fully executed agreement to the ARB. April 30th of each year is the deadline for acceptance of a grant award. From June 30th following the full execution of the agreement, the districts have 12 months (one year) to obligate and 24 months (two years) to expend the grant award.

E. Disbursement Requests to Districts

1. Initial Disbursements

In order to receive a disbursement, each district must submit a Grant Disbursement Request to ARB. The Grant Disbursement Request form must be signed by a district board-authorized party. If there are stipulations on the Grant Award and Authorization form, all stipulations must be met prior to submitting the initial disbursement request. For the initial disbursement, districts may request up to ten percent of their allocation or $100,000, whichever is greater. If a district submits a request that documents the need for more than ten percent or $100,000, to the satisfaction of ARB, a larger disbursement may be made. In addition, districts may request half of their administrative funds. Districts will receive one check for both administration and project funds. However, districts must account for the administration and project funds separately.

Prior to receiving the initial disbursement, districts must submit documentation of the obligation and expenditure of previous years' Carl Moyer Program and required matching funds as follows:

- Obligation and expenditure of 100 percent of all Carl Moyer Program funds and required district match from allocations awarded two or more years previous.

- Obligation of at least 90 percent of the previous year's Carl Moyer Program and required match funds.

2. Additional Disbursements

For additional disbursements of Carl Moyer Program funds, districts must submit a Grant Disbursement Request and provide documentation of obligation of previous and current years' funds as follows:

- Obligation of 100 percent of all previous years' funds, documented by entering the projects' information into the database and the submission of a copy of pertinent pages (initial page, signature page and page describing the project) of the executed contracts for the same projects.

- Obligation of 50 percent of the initial disbursement, documented by entering the projects' information into the database and submitting a copy of approval by board resolution, minute order, or board letter; APCO approved contracts; or, fully executed contracts. On a case-by-case basis, ARB may accept other documentation of the commitment to obligate current year's funds.

Districts may request the other half of their administrative funds when 50 percent of their Carl Moyer Program funds have been obligated. Districts will again receive one check for both administration and project funds and must account for the administration and project funds separately.

3. Earned Interest

Any Carl Moyer Program funds provided by the State that are deposited in interest bearing accounts must be reported to ARB. The interest income must be used to fund projects that meet the current Carl Moyer Program Guidelines. Projects funded by interest earned shall be entered into the database and included in the final report of the year from which the interest accrued.

F. District Reporting Requirements

Districts are required to report on the status of each year of Carl Moyer Program funding three times. The required reports - the initial, annual and final reports - are described below. Districts that fail to submit a satisfactory annual report on a timely basis shall be deemed "at-risk." Districts that fail to submit satisfactory initial and final reports may also be deemed "at-risk."

1. Status Report

Each district shall submit their status report to ARB in mid-November at the time Carl Moyer Program district applications are due. If a district is not applying for the next year's Carl Moyer Program, the district shall submit the status report, by itself, by

November 15th. The report shall use the ARB prescribed format to indicate the district's progress in meeting its projected milestones from its current year's Carl Moyer Program funds. Funds that have been obligated to projects shall be documented by updating the project data in the Carl Moyer Program database. While not being termed "at-risk," any district that has not met the minimum obligation requirement of their funds (50 percent of funds obligated for districts receiving the minimum allocation or less and 70 percent of funds obligated for districts receiving more than the minimum allocation), at this time, shall be monitored more closely by ARB and may be provided extra training and technical assistance. In addition, any district not meeting the minimum obligation requirement shall either not be eligible for funding or only be eligible for the minimum award as specified in Section IV.C. of this chapter.

If a district has not already done so, the district shall submit their written policies and procedures manual for the implementation of the Carl Moyer Program as part of the status report. If all funds have been obligated, the database updated, and the policies and procedures manual submitted to ARB by the November 15th deadline, the status report will (with ARB approval) satisfy the requirement for the annual report.

2. Annual Report

Districts shall submit an annual report by or before June 30 of the year following their allocation. At a minimum, districts shall submit a brief narrative report on their implementation of the Carl Moyer Program and update all of their project information in the database to assure data is current and accurate. The brief narrative shall specifically include information on:

- Total applications received.
- Efforts to meet environmental justice mandates, if required.
- Efforts to outreach to potential zero-emission and small business projects.
- Monitoring and auditing efforts and results.
- Enforcement actions and recaptured funds, if any.
- Outstanding features and accomplishments.
- Challenges in implementation.
- For Year 8 only, information on the average and median time to obligate funds (from receipt of application to execution of contract).

The update of the project information shall include the following:

- Carl Moyer Program projects, including those funded by state funds (specified by smog check or tire fee), interest accrued on state funds, and local matching funds.
- Other projects funded by AB 923 (Light Duty Vehicle, School Bus and Agricultural Assistance Programs).
- Copies of executed contracts for all Carl Moyer Program projects and AB 923 funded projects. Districts may make and submit one complete copy of their standard contract format and then submit only the pertinent pages (initial page, signature page and page describing the project) of the agreements to ARB. Districts are required to submit only one copy of each agreement or the pertinent pages of each agreement.

If a district has previously submitted a satisfactory annual report, all funds have been expended and the database updated, the district may complete a combined annual and final report brief narrative, which will (with ARB approval) satisfy the requirement for the final report.

3. Final Report

Districts shall submit a final report no later than June 30 of the second year following their award or after all Carl Moyer Program funds and local match commitment have been expended. At a minimum, districts shall submit a brief narrative report on their implementation of the Carl Moyer Program and update all of their required project information already entered into the database and any new project information. The brief narrative shall specifically include information on:

- Results of environmental justice efforts, if required.
- Results of outreach efforts to zero emissions and small business projects.
- Monitoring and auditing efforts and results.
- Enforcement actions and recaptured funds, if any.
- Outstanding features and accomplishments.
- Challenges in implementation.
- For Year 8 only, information on the average and median time to expend funds (from contract execution to invoice payment)

The update will ensure that the data in the database is current and accurate. The update shall include all of the following:

- Modifications to Carl Moyer Program projects, including both state funds, interest accrued on state funds, and local matching funds.

- Modifications to AB 923 funds obligated for projects not meeting Carl Moyer Program requirements.
- Copies of executed contracts, as listed in item 2 above, that obligate Carl Moyer Program and local match funds to projects, which were not previously submitted.
- Copies of invoices that document the amount Carl Moyer Program funds and local district match expended for each project.

G. Policies and Procedures Manual

Each District shall maintain a current policies and procedures manual, which is in conformance with or more stringent than these guidelines. The policies and procedures manual must, at a minimum, include the overall plan and day-to-day process for the districts' implementation of the following tasks as outlined in this chapter:

- District solicitation and project acceptance.
- Project selection.
- Obligation of funds to projects.
- Contract development and boilerplate language.
- Monitoring of projects.
- Expending the funds.
- Auditing of projects, and when necessary recapturing funds
- Reporting to ARB.
- Requesting disbursements from ARB.

The policies and procedures manual shall be submitted to ARB for approval with the Year 8 status report by November 15, 2006 or with the next year's Carl Moyer Program application in November 2006, and with any substantive revision thereafter.

H. Timeline for Each Year of Funds

Mid-September	ARB solicits applications from the districts based on tentative awards
Mid-November	ARB receives applications from the districts including districts' status report from the previous year

Early January	ARB notifies districts of final awards
April 30	District deadline to accept or decline funds
June 30 following year	Districts' annual report to ARB – funds must be obligated
June 30 of second year	Districts' final report to ARB – projects invoiced and paid for, funds expended

V. District Solicitation and Project Acceptance

Each district must maintain and follow written policies and procedures for soliciting and accepting projects. ARB encourages districts to provide clear and detailed information to the owner regarding the reporting requirements and consequences for failure to demonstrate achievement of emissions reductions.

A. Outreach

Outreach prior to and during the time frame of the solicitation is critical for the success of a local program. The districts shall focus their outreach in a way that encourages applications from all sectors, including environmental justice communities, small businesses and zero-emission projects. Below are brief descriptions of the types of practices that should be included as part of a district's outreach activities.

1. List of Interested Parties

Districts should maintain a list of interested parties throughout the year and mail a notification to the parties on the list when funds are available. This list should also include prior applicants, public agencies (e.g. public works departments, sanitation departments, school districts), engine dealers/distributors, and where appropriate, port authorities, and farm bureaus.

2. Local Newspaper Announcement

Districts are encouraged to put an announcement in local newspapers, in locally based trade newsletters including the local farm bureau and in the trade journals of organizations representing zero-emission technologies such as the Clean Cities Coalition and West Start-CALSTART.

3. Web Site Notification

If the district has a website, the Carl Moyer Program solicitation should be advertised on the district's website. Similarly, if the district has a newsletter, the Carl Moyer Program solicitation should be advertised in the district's newsletter.

4. Prior Participants

Districts should solicit additional projects from prior participants with successfully implemented projects, especially during monitoring visits.

5. Small Business

Districts are encouraged to expand the participation of small business by advertising to targeted industries, offering workshops to the engine dealer network, and offering to assist small business owners with the completion of the application. For example, many urban districts have found the construction industry to be a viable source of projects, when the districts provide outreach, training and technical assistance to the many small businesses that own qualifying equipment.

6. Agricultural Community

Districts with agricultural communities are encouraged to contact the local agricultural department and request that a flyer is posted that will be visible to farmers when they come in to get their pesticide use permits.

7. Advertising

Districts may consider requiring their grantees to place a logo or decal on the new engine(s) advertising that the engine was funded by the district and ARB with Carl Moyer Program funds.

B. Environmental Justice

It is important that projects funded under the Carl Moyer Program benefit all Californians especially those in communities disproportionately impacted by air pollution. As such, ARB encourages all districts to incorporate an environmental justice component in their local Carl Moyer Programs. Districts with a population greater than 1 million inhabitants are required to provide funding to projects that benefit environmental justice areas (HSC section 43023.5). This will continue to be a requirement and an important component of the Carl Moyer Program for these districts. These districts are encouraged to continue updating current written policies and procedures, where necessary, to define the environmental justice areas within district boundaries. They must market the Carl Moyer Program to owners that operate or are based in environmental justice areas. These districts must select from their applicant pool in a way that ensures that 50 percent or more of their Carl Moyer Program funds (including the smog check fee, and adjustment to the tire fee) are expended on projects that are located and/or operate in environmental justice areas. The ARB also recommends these districts expend 50 percent or more of their $2 MV Fee funds on projects that are located and/or operate in environmental justice areas.

C. Project Solicitation

Below are brief descriptions of the options districts typically use for accepting applications.

1. Over the Counter

The over the counter method is also referred to as a first-come first-served application process, where the district announces the first day project applications will be accepted. Applications are accepted until all of the funds are obligated. This method provides districts with smaller populations a greater opportunity to garner Carl Moyer Program eligible projects. This method may also maximize flexibility for applicants by allowing them to apply at any time, up until the funds run out.

2. Notice of Funds Available (NOFA)

The NOFA method is also referred to as Request for Proposals (RFP), or Call for Projects. Districts following this method announce an application deadline for all proposals to be submitted. This method allows proposals to be accepted from the date of the solicitation to a specified date and time. This method provides districts with a high demand for Carl Moyer Program funds with the opportunity to select the most cost-effective projects that meet local criteria through a competitive rating and ranking process.

D. Project Applications

For consistency throughout the Carl Moyer Program, to assist applicants statewide and to limit confusion, ARB encourages all districts to use the same application form for the Carl Moyer Program. The application is available on the Carl Moyer Program web site at http://www.arb.ca.gov/msprog/moyer/moyer.htm. Districts that use their own application form shall ensure it includes all the information the ARB application includes, as listed in each source category chapter. A few districts run their local Carl Moyer Program concurrently with other local heavy-duty incentive programs, which use one combined and unique application form. In these cases districts will have unique application forms.

No matter what forms are used, districts' applications must include a disclosure statement that the owner (or the owner's designee) must initial/sign. The disclosure statement certifies that the owner has not submitted and shall not submit an application for Carl Moyer Program funds to any other district and/or the ARB. In addition, owners are required to disclose the value of any current financial incentive that directly reduces the project price, including tax credits or deductions, grants, or other public financial assistance, for the same engine. The incremental cost of the project shall be reduced by the amount of the current financial incentive. Any owner or owner's designee who is found to have submitted multiple applications for the same engine and/or not disclosed any current financial incentive shall, at a minimum, be disqualified from funding for that engine from all sources and may also be banned from submitting future applications to any and all Carl Moyer Program solicitations. In addition, as a violation of law, including but not limited to the Business and Professional Code, ARB and the districts may levee fines and/or seek criminal charges.

Third party applications are not allowed. The owner of the engine must sign and agree to the application. However, a third party (e.g. engine dealer or distributor) may complete an application or part of an application on an owner's behalf. Applications must include a signature section for third parties. The third party signature section must include signature and date lines, and blanks for the third party to list how much they are being paid, if anything, to complete the application and what source of funds are being used to pay them. To make the Carl Moyer Program accessible to all potential applicants, including applicants that cannot afford to hire third party assistance, districts are encouraged to provide technical assistance to applicants in completing the application.

1. Completeness of Application

In accordance with HSC section 44288(a), districts must review all applications for completeness upon receipt and notify the applicants in writing if their application is not complete within five working days of receipt of the application. The notification must clearly state what is required to make the application complete. A copy of the notification must be maintained with the application. This written notification must be accomplished using one of the options below:

- A letter, sent through the U.S. mail.
- An email message.
- A boiler plate form with check-offs.

No matter what method is selected, the notification must be copied, with the original handed or sent to the owner and the copy must be placed in the applicant file along with a copy of the incomplete application. Districts are encouraged to assist applicants, especially small business applicants, complete their application. Districts may determine that an application is not in good faith, credible or in compliance with the Carl Moyer Program and its objectives.

2. Eligibility of Projects

All complete applications that are in good faith, credible and in compliance with the Carl Moyer Program and its objectives, must be reviewed by the district for eligibility. This process must include all of the following:

- Entering the data from the application into the database or the database calculator to ensure it meets the emission reductions and cost-effectiveness criteria of the Carl Moyer Program.

- Checking to ensure the project meets all of the minimum requirements outlined in the chapter for the appropriate category.

- Maintaining a record of the eligibility verification in the applicant file.

E. Application Tracking

Districts must have a system for tracking applications. Districts may use the database to track applications. At a minimum, the tracking system shall include the name and address of the owner, the category, and type of baseline engine. The district shall also maintain a copy of each application and a file for each selected project. A district may use a solely electronic file system only after the district satisfactorily demonstrates to ARB that all documentation is maintained and can be easily accessed on demand.

VI. Project Selection

Once a district has checked the eligibility of projects, the district must follow its policies and procedures manual in selecting projects to fund. The record of each project's rating and ranking, receipt date or other project selection criteria must be maintained with the application. Districts may choose to disqualify an application if the applicant defaulted or otherwise violated the terms of a previous Carl Moyer Program contract or other incentive program contract. Districts must ensure that projects do not involve sources subject to adopted regulations.

At this time, the project information shall be entered into the database to ensure the project meets the emission reduction requirements and cost-effectiveness criteria of the Carl Moyer Program. No project shall be funded unless the database indicates the emission reduction requirements and cost-effectiveness criteria of the Carl Moyer Program have been met. If the database indicates the project does not meet either the emission reduction requirements or the cost-effectiveness criteria of the Carl Moyer Program, and the district representative thinks the project should actually qualify, the district representative may contact their ARB liaison to determine if the project is, in fact, eligible.

Once a project is selected, a flag shall be set in the database indicating that the project has been selected for funding. The project shall be assigned a Carl Moyer Program project number by the ARB database. Districts may continue to use their own numbering system within their district. All exchanges between ARB and the districts shall utilize the standardized project grant numbering system, and may also use the district's number system upon request.

Districts shall make every effort to process an application and grant an award rapidly. The district shall provide ARB with information on the average and median time frames to award grants as part of the districts' Year 8 annual report. A file shall be created for all projects selected for funding. Grant award notification shall be in writing, and a copy of the grant award notification letter must be maintained in the applicant file.

VII. Obligation of Funds to Projects

Districts shall obligate their allocation of Carl Moyer Program funds consistent with other sections of this chapter. In addition, districts that have a match requirement must obligate their match funds in a way that meets all of the Carl Moyer Program criteria. Districts must document their in-kind support with fiscal records of resource allocations to the Carl Moyer Program. Districts may meet up to 15 percent of their match funding requirement with in-kind contributions.

For ease of financial tracking of funds, and to the maximum extent practical, projects should be paid entirely through either ARB funds or district match funds. If ARB funds and district match funds must be mixed, it shall be for only one project and, if the project is for more than one engine, for only one engine. If funds from two years or phases of the programs are used for a project, the funds must be either ARB funds or district match funds but not both.

VIII. Minimum Contract Requirements

When paying for projects using Carl Moyer Program funds, districts must enter into a contract with the applicant. The contract must be signed and the project milestones (i.e. engine delivery, engine installation, final inspection, and acceptance) shown in the contract must be met before Carl Moyer Program funds are given to an applicant. The equipment must be operating before the final payment is issued. In order to provide consistency in contract requirements throughout the Carl Moyer Program, staff has conducted an extensive review of contracts used by many local districts participating in the Carl Moyer Program. Staff also conducted several working group meetings to determine the minimum content for contracts used by districts under the Carl Moyer Program. Based on this research and input from districts, ARB staff is proposing to require that all districts participating in the Carl Moyer Program incorporate the following minimum requirements in contracts entered into with applicants that have been selected to receive funds under the Carl Moyer Program. Samples of contract terms from existing districts' contracts are provided to districts upon request. Actual language in each district's contracts shall be established by the district in consultation with the district's legal staff.

A. Party Names and Date

All contracts shall state the name of the district and the owner as parties to the contract. All contracts shall also state that, in addition to enforcement by the district, the ARB reserves the right to audit and enforce the terms of the contract at any time during the contract term.

B. Contract Term

All contracts shall provide the term of the contract. The term of the contract must extend to the end of the project life and shall include both the project completion and project implementation time frames. The contract term shall include both the project completion and project implementation/life periods to ensure that the district and ARB can fully enforce the contract terms during the life of the Carl Moyer Program-funded project.

1. Project Completion.

Project completion is the time frame starting with the date of execution of the contract to when the project is complete i.e., becomes operational. This includes the time period when an engine or vehicle is ordered, delivered and installed. Districts may require periodic reporting during this time frame. The contract shall include a specified time frame in which project completion shall occur, so that the funds are expended within the two-year required timeframe. The contract shall also require that no work may begin on the project until the contract is fully executed.

2. Project Implementation/Life

The project implementation time frame equals the project life. Project life is the number of years that a Carl Moyer Program project obtains or is claimed to obtain surplus emission reductions while operating in California. Surplus emission reductions are reductions that are early or extra. That is, the reductions occur prior to a rule compliance date or the reductions exceed the requirements of a rule or regulation.

The contract shall specify that the project implementation equals the period of time during which the owner is required to operate and maintain their Carl Moyer Program-funded engine/vehicle according to the terms of the contract. The contract shall specify that by executing the contract, the owner understands and agrees to operate the engine/vehicle according to the terms of the contract and to cooperate with the district and ARB implementation, monitoring, enforcement and other efforts to assure the emissions benefits are real, quantifiable, surplus and enforceable. The minimum project implementation time frame shall be three years, unless otherwise approved in advance by the ARB. The maximum project implementation is defined in the following chapters under each specific source category. The project implementation time frame includes the district monitoring and ARB auditing phases which may run concurrently or sequentially:

- During all or a part of the project implementation term, the district is responsible for monitoring the project to assure the project is operational and emissions reductions are realized. The contract shall require the owner to report at least annually to the district on the operation of the vehicles or equipment during this district monitoring phase. The contract shall inform the owner that noncompliance with the reporting requirements shall require on-site monitoring. The district monitoring phase shall match the project life when the project life is less than five years. When the project life is more than five years, the district monitoring phase shall be for a minimum of five years.

- The district shall also include language in the contract that clearly states the owner understands and agrees that the ARB has the authority and reserves the right to monitor and enforce the terms of the contract at any time during the project life to ensure emission reductions are obtained for a minimum of 75 percent operation within California, including the period between five years and the end of the project life for those projects with project lives that are more than five years. The contract shall also inform the owner that ARB will seek whatever legal, equitable and other remedies are available under State law for the owner's failure to comply with the Carl Moyer Program requirements and failure to fully perform under the contract.

The contract term may also outline other timing requirements. For example, districts may include a requirement that the owner sign and return the contract by a certain date or the Board's obligation of funds to the project is nullified.

C. Payment

In order to ensure that the district and ARB are paying only for the incremental cost of eligible items, paying only once for each engine, and the equipment being paid for is operating, all contracts must include the following payment terms.

1. Maximum Contract Amount

The maximum contract amount (which is the incremental cost, partial incremental cost, or funding cap), must meet the required minimum cost-effectiveness limit. The maximum contract amount may never exceed the incremental cost. If a district desires to have their maximum contract amounts in round numbers, the district is only allowed to round down.

2. Itemized Invoices

Payment terms must require itemized invoices from the engine supplier for repowers or paid invoices from the vehicle owner for new vehicles and satisfactory post-inspection by the district prior to payment of the owner's invoice. Partial payments may be made only if the payment process and requirements have been reviewed and approved by the district. Payments shall be made directly to the project applicant only if the invoice has been paid and the payment is a reimbursement. Payments may be made to the engine dealer or distributor only if such payment arrangements are specified in the contract.

3. Disclosure of Funds

A disclosure statement the owner (or owner's designee) must initial/sign. The disclosure statement certifies that once the owner (or the owner's designee) signs this contract for this project, the owner (or designee) shall not submit another application or sign another contract for the same specific engine(s) with any other source of funds, including but not limited to, other districts or to ARB for a multi-district solicitation. Any owner or owner's designee who is found to have submitted multiple applications or signed multiple contracts for the same engine(s) shall, at a minimum, be disqualified from funding for that engine(s) from all sources and may also be banned from submitting future applications to any and all Carl Moyer Program solicitations. In addition, as a violation of law, including but not limited to the Business and Professional Code, ARB and the districts may levee fines and/or seek criminal charges.

4. Non-Compliance Terms

Districts shall include terms to cancel contracts or withhold payment for non-compliance with or not meeting the obligations of the contract, and may include a term that cancels the contract if it is not executed by the owner in a timely manner.

D. Carl Moyer Program Criteria

All contracts shall include basic Carl Moyer Program Guidelines. Contracts must contain either a general statement of compliance with all Carl Moyer Program Guidelines and/or outline those requirements, as follows:

- The project shall not be required by any local, state and/or federal rule, regulation or MOU currently in effect.

- The low emissions technology must be certified or verified (as outlined in the following source category chapters) and meet the current NOx, PM and/or ROG requirements. If the low emissions technology is not certified or verified it may be approved based on an ARB case-by-case evaluation. When approved by an ARB case-by-case evaluation, the method for emissions verification must be included as part of the contract.

- Rights to the emission reductions must not be claimed by any participant as emission reduction credits or in an Average Banking and Trading Program.

- The new engine/equipment/vehicle must not have been purchased prior to the effective date of the contract.

- The existing (old) engine must be destroyed and rendered useless. There must be no cannibalization of parts from the old engine. Destruction methods for the fleet modification and light duty categories are further described in those chapters. Engines must have a complete and fully visible and legible engine serial number in order to be eligible for an engine repower. The destruction of the engine must be documented by the district seeing the destroyed engine or the receipt from the qualified vehicle salvage yard (see appendix for definition). Engines without a visible and legible serial number may be repowered if district staff stamp the engine block with the Carl Moyer Program project number and the district staff is present to personally verify engine removal from the project vehicle or equipment and the subsequent engine destruction. ARB will consider alternatives to stamping the engine block on a district-by-district basis.

- The new engine/vehicle/equipment must remain in service for the project life; operate in California as per the source category requirements specified in the following chapters; and, operate a specified amount. The district may specify minimum operating requirements within air district or air basin boundaries.

E. Maintenance of the Engine/Vehicle

All contracts shall require the owner to maintain the engine/vehicle according to the manufacturer's specifications for the life of the project. This includes a requirement for no tampering. The owner is also responsible for maintaining a working hour meter, or other approved usage measuring device, for projects that document hours of operation as a means of calculating emissions reductions and cost-effectiveness. If the hour meter/usage device fails, the owner remains responsible for validating any hours not recorded by the hour meter/usage device. The owner must either repair or replace the non-operating meter/device or provide other documentation of equipment operating hours acceptable to the district.

F. Project Specifications and Performance Expectations

All contracts shall include detailed information on the baseline engine. This detailed information shall include at a minimum, the make, model, model year, horsepower and serial number of the baseline engine. All contracts shall also include the same detailed information on the new engine. This requirement may be met by including the project application as an attachment to the contract. An engine, which meets or exceeds the certification of the proposed engine, may be substituted with prior approval of the district. All contracts shall specify the amount the engine is to operate based on hours, miles or fuel usage within California (or the district) each year. Due to fluctuations in weather and other unforeseen circumstances, districts may average multiple years' usage to determine annual usage.

G. Repercussions for Nonperformance

The contract must outline the repercussions to the owner for nonperformance and for not meeting any of the obligations of the contract. The contract must also inform the owner that ARB and the district have the authority to fine the owner or seek other remedies available under the law for noncompliance with Carl Moyer Program requirements and nonperformance with the contract. Districts may consider unforeseen circumstances beyond the owners' control in determining repercussions for nonperformance.

H. On-Site Inspections

All contracts shall include language that allows the district, ARB or their designee(s) to inspect the engine(s) and/or records relating to the engine during the term of the contract.

I. Auditing

All contracts shall include language that allows for fiscal auditing by the district, ARB or a third party designee during the life of the project.

J. Records and Records Retention

All contracts shall include language requiring the owner to maintain records and retain the records for at least three years after the term of the contract.

K. Reporting

All contracts must include a provision for owners to submit, at a minimum, annual reports commencing one year after project completion and annually thereafter for the term of the contract. The district shall include the dates the annual report is due. The owner shall also submit a copy of evidence of the appropriate insurance. If the district monitoring phase of the contract term exceeds five years, the owner's reporting responsibility may be reduced to once every other year after the initial five years of reporting. If the project is a zero-emission technology, reporting may be reduced to biennially for the first six years, and no annual reports are required thereafter.

L. Insurance

All contracts shall require owners to carry and (as required by annual reports or requested during monitoring and auditing) provide proof of insurance covering the new engines throughout the term of the agreement. A district may require more or additional insurance.

M. Notices

All contracts shall include contact information for both parties to the contract, and how to send and receive notices.

N. Signature Blocks

All contracts must include signature blocks with an area for the dates that the contract is signed.

O. Optional Contract Terms

All districts have the option to include other terms and conditions in their agreements. Below, are contract terms that are used by some districts. Even though they are not required, all districts have the option of including the following additional contract terms:

1. Severability

If any part of agreement is found invalid by a court of law, the severability contract term maintains the enforceability of the remainder of the contract.

2. Tax Implications and Information

Each district should consult with their tax attorney regarding potential tax implications for the owners and what, if any, actions the district will take as a result of the attorney's assessment.

3. Non-Allocation of Funds

If funds are not available from ARB, this contract term provides the district the ability to cancel the contract

4. Decals

Districts may want to add a contract term to require a decal to be affixed on the new engine. This is one method for outreach.

5. Electronic Monitoring Unit

Some categories (marine, locomotive and fleet modernization) require the installation of an Electronic Monitoring Unit (EMU). Contracts for those categories must include a contract term for EMUs. Districts may require the installation of an EMU with each new engine for other categories as well. The EMU is a Carl Moyer Program eligible expense and may be added to the incentive amount as long as the project still meets the cost-effectiveness cap. Districts may allow projects with EMUs to complete all reporting through the electronic data system.

6. Incorporate the Application

In order to assure the baseline engine in the application is the one being replaced, districts may want to incorporate the application by reference.

IX. Districts' Monitoring Requirements

A. Pre-Inspection

Once an application is deemed eligible and before funds are obligated to a project, a pre-inspection shall be completed by the district. The one exception is for public agencies (e.g. public works departments, transit organizations and school districts). Districts may choose to allow public agencies to provide documentation of the engine and its use.

The pre-inspection shall, at a minimum, include collecting the serial number of the baseline engine, verifying the information in the application about the baseline engine (make, model, model year, horsepower). The pre-inspection shall also verify the engine is operational (with a start up) and that the engine is working as described in the application (document function and use). A photo shall be taken for the file. The photo must include the applicant's name, the date and the serial number of the engine.

A pre-monitoring form shall be used to document the pre-inspection. The required elements for a pre-inspection form include all of the following:

- Owner's name, address and telephone number.
- Location of the engine.
- Verification of the baseline engine information (make, model, model year, horsepower and serial number) as described in the application.
- Space for the inspector to record whether the engine is in running condition, make comments and attach pictures.

A hard copy of the completed pre-inspection form shall be maintained in the project file. Districts may utilize paraprofessional staff, with training, to complete pre-inspections. Districts may also complete the Carl Moyer Program pre-inspections in combination with permit inspections.

B. Post-Inspection

Post-inspections shall be completed on all projects funded under the Carl Moyer Program. The post-inspection shall occur after the district receives an invoice from the owner for an engine, but prior to the district paying for that engine (or making final payment for the engine). For public fleets, such as transit organizations, where more than 20 of the vehicles in the fleet are included in the project, the district may choose to inspect a random sample of the fleet. The sample size must be statistically significant.

The district's post-inspection must verify that the engine listed in the contract was installed. The inspector shall record the information from the plate (serial number, make, model, model year and horsepower) on the inspection form and verify it with the information listed in the contract. The engine must be operational in the equipment or vehicle as stated in the contract. The inspector must visually witness all engines start up and mobile projects run. The vehicle or engine information must be documented with pictures.

Where applicable, the post-inspection shall also verify that the baseline engine or vehicle is destroyed and rendered useless and there is no evidence of cannibalization of parts from the old engine. Depending on the method of destruction selected, the inspector must see the destroyed engine, witness the engine destruction, and take photos of the destroyed engine. The photos shall include the name of the owner and date of the inspection. For engines with a complete, fully visible and legible engine serial number, the district must see the destroyed engine or the receipt from the qualified vehicle salvage yard (see appendix for definition). For engines without a complete, visible and legible serial numbers, the district staff must stamp the engine block with the Carl Moyer Program project number and be present to personally verify engine removal from the project vehicle or equipment and the subsequent engine destruction. The district must follow all additional requirements for the methods of destruction for fleet modernization and light-duty categories as further described in those chapters.

A post-inspection form shall be used to document the post-inspection. The required elements for a post inspection form include all of the following:

- Owner's name, address and telephone.
- Location of the engine.
- Baseline engine information (make, model, model year, horsepower and serial number) as written in the application and/or contract.
- Space for the inspector to record whether the engine was scrapped or destroyed.
- New engine information (make, model, model year, horsepower and serial number).
- Space for the inspector to record whether the engine is in running condition, make comments.

Photos shall be maintained with the hard copy file or electronically and made available upon ARB request. The completed form shall be maintained in the project file. Final payment shall only be made to an owner once a satisfactory post-inspection has been completed.

C. Annual Reports

Districts shall require all owners to submit annual reports commencing one year after project completion and annually thereafter for the term of the contract. The annual report shall be in a format prescribed by the district and shall contain all of the following information:

- Owner's name, address and telephone.
- Location of the engine.
- Engine information (make, model, model year, horsepower and serial number).
- Condition of the engine, including current working condition and any major maintenance of the engine that significantly effected the annual usage of the engine.
- Any conditions (e.g. weather, permits) that significantly effected the annual usage of the engine.
- Readings of the usage meter (hour meter, odometer, EMU, etc.).
- A copy of evidence of the appropriate insurance

The districts shall review the annual report for completeness, accuracy and usage. A hard copy of the annual report and record of its review shall be maintained in the project file. If the project performed 30 percent above or below the usage specified in the contract the district shall flag the project. Any project that has been flagged for performance shall be evaluated over a multiyear basis. If the project's usage does not average out to within 30 percent of the usage specified in the contract over at least a three year period, the district shall take appropriate action to ensure the contracted emissions reductions are realized. Appropriate actions include, but are not limited to, recapturing funds from the project in proportion to the loss in emissions reductions.

There are a few situations whereby the district may reduce annual reporting requirement. If the district's monitoring phase of the contract term exceeds five years, the owner's reporting responsibility may be reduced to once every other year after an initial five years of satisfactory reporting. If the project involves a zero-emission technology, reporting may be reduced to biennially for the first six years and no annual reports are required thereafter. If the project has an EMU, the annual report may be collected through the electronic data system.

If an annual report is incomplete, inaccurate or not received from an owner on schedule the district shall make a reasonable attempt to obtain the complete and accurate report from the owner. If the district is unable to obtain the report, all of the engines in that project shall be audited by the district. Owners with outstanding reports shall not be granted any additional Carl Moyer Program funds until all reports are satisfactorily submitted. Districts may bar an owner from applying for any additional Carl Moyer Program funds, if that owner has a history of not submitting satisfactory annual reports.

D. Audits

Districts shall audit at least ten percent (or a statistically significant number of projects) of the projects that have more than a three-year project life that are within two years of contract expiration. District audits shall include all of the projects whose owners fail to report annually. The audit shall be completed by district staff and shall include verification that the engines paid for are still operational in the same equipment and meet the mileage, fuel usage, or hours of operation indicated on the executed contract. This shall be completed by checking the serial number of the engine; witnessing the engine operate; and checking the odometer, hour meter/usage device, fuel receipts or EMU.

Districts shall also randomly audit at least 5 percent (or a statistically significant number of the engines) at the end of the contract term. Districts shall also include those projects whose owners failed to report annually and those projects that were found to be below the level of use during the audit two years prior to the end of the contract. The audit shall be completed by district staff and shall, at a minimum, include verifying that the engines paid for are still operational in the same equipment and meet the mileage, fuel usage, or hours of operation indicated on the executed contract. This shall be completed by checking the serial number of the engine; witnessing the engine operate; and checking the odometer, hour meter/usage device, fuel receipts or EMU.

If the project is more than 30 percent below or above an annual average of the level of use outlined in the contract, the district shall take appropriate action to assure the emissions benefits are realized and captured during the term of the contract. In addition, the district shall audit all of the other engines owned by the same participant and included in the same Carl Moyer Program funded project.

X. Expenditure Requirements

The final payment for a project shall only be made after a post-inspection is satisfactorily completed (see post-inspection section, above) and all invoices have been received and approved. The district shall review the itemized receipts and only pay for eligible expenses. Eligible expenses are limited to those mechanical items that are necessary to complete the installation of the new engine or retrofit. At the discretion of the district the labor and sales tax directly associated with that installation may be included. The district shall maintain copies of all invoices and documentation of payment in the project file. For all on-road projects, if a compliance check was not previously completed, the district shall verify with ARB that there are no outstanding violations prior to payment.

Districts may make progress payments to owners provided the progress payments are based on a predetermined schedule that is set forth in the contract between the district and the owner. Those progress payments shall only be made after the owner provides the district with sufficient evidence of completing predetermined milestones (e.g. delivery of an engine). The district must maintain a clear record of progress payments in the file and in the administration/fiscal unit of the district.

XI. ARB's Oversight

The ARB's oversight responsibilities for the Carl Moyer Program are multifaceted. The ARB must ensure that the emission reductions claimed by the Carl Moyer Program are real, surplus, enforceable and quantifiable. The ARB is responsible for ensuring the funds are expended on projects that meet and follow the Health and Safety Code and Carl Moyer Program Guidelines. The ARB is also responsible for reviewing districts' progress obligating and expending statewide funds, ultimately determining, when necessary, the need to reallocate funds within a funding cycle. The ARB may contract with an independent third party to ensure the structure of the Carl Moyer Program ensures the integrity of the program. The ARB staff shall report to the Board annually on the progress of the Carl Moyer Program. In carrying out these responsibilities, ARB maintains a close working relationship with the districts.

A. Monitoring and Auditing of District Programs

Monitoring is an ongoing process that is designed to provide training and technical assistance, as well as oversight, to the districts. Throughout the implementation of the Carl Moyer Program, ARB completes desk reviews of district programs, on-site monitoring and audits. Desk reviews include reviewing project data to assure emissions reductions and cost-effectiveness meet Carl Moyer Program Guidelines, and are real, surplus, enforceable and quantifiable. At a minimum, the project data review shall occur when a district obligates funds on June 30th one year after the award of funds, and on June 30th two years after the award of funds. The ARB also reviews all districts' Carl Moyer Program policy and procedures manuals to assure they are consistent with Carl Moyer Program rules, guidelines and advisories. This review shall be completed at the time of the initial report, and when determined necessary by ARB.

The ARB shall complete on-site monitoring on at least five percent of district projects, that were funded in the last completed funding cycle, for at least four districts per year. Due to statistical significance in random sampling, ARB may monitor up to 100 percent of the projects of a district, if the district funds 20 or less projects per year. During the on-site monitoring, ARB shall review and verify that project data, emission reductions and cost-effectiveness meet Carl Moyer Program Guidelines and advisories, and all emission reductions are real, quantifiable and surplus. The ARB's on-site monitoring includes randomly selecting a sample of at least 5 percent of the projects funded in one funding cycle, completing an on-site file review and project field review for each sampled project. The on-site monitoring also includes reviewing the implementation of the district's local program for consistency with Carl Moyer Program Guidelines, advisories and district policies and procedures manuals. This includes reviewing administrative (e.g. fiscal) controls.

Auditing is a periodic formal process designed to assess the districts' implementation of the Carl Moyer Program and that its implementation is consistent with all applicable rules, regulations and guidelines, including with the district's own policies and procedures manuals. Audits may be fiscal, programmatic or both. A district may be audited with or without a previous monitoring or auditing. For example, the State Bureau of Audits may audit a district whether or not ARB has previously monitored or audited the same district. An audit may include all components of both desk and on-site reviews. The ARB may include an audit of the Carl Moyer Program with any other scheduled ARB audit of a district. The ARB may also designate a third party auditor to perform the audit.

At the conclusion of monitoring and/or auditing, ARB shall provide the district with a written report. This written review shall include, if applicable, any deficiencies in the district's program that require correction. The district will have 30 calendar days, from the date of the written report, to correct the deficiencies and respond in writing to the report. The ARB staff will provide the district with the opportunity for training and technical assistance to develop and implement a corrective action plan. If ARB determines the district has not taken adequate corrective action within the allotted 30 days the district will be deemed "at-risk"; the district shall not be eligible to apply for future funding, and; ARB shall hold at least one public meeting to consider public comments prior to recapturing all Carl Moyer Program funds that have not been obligated by the district. When recapturing project funds, ARB may also recapture administrative funds associated with the project funds. The ARB shall reallocate those funds to districts that are eligible to receive additional funds based on applications for the same fiscal year.

B. ARB Administrative Action

The administrative actions described in this section are the procedures ARB shall follow to recapture funds. The HSC section 44287(k), requires any funds not expended by a district by June 30th of the second calendar year following the date of the reservation, to revert back to the ARB as of that June 30th. Those funds shall be recaptured and reallocated to another district or districts based on applications for the same fiscal year. The HSC section 44287(k), also requires that any district whose allocation has been recaptured, remain eligible to reserve funds for local administration of the Carl Moyer Program.

1. "At-Risk" Districts

Any and all districts that have not provided an annual report documenting the obligation of all of their funding by June 30th of the year following their award are defined as an "at-risk" district. Any district that has been identified as "at-risk" by ARB will receive a letter from ARB by July 30th of the year following the district's award (or as soon thereafter as practically possible) stating the reason the district has been identified as "at-risk." The ARB notification letter will also require the district to develop and submit an acceptable remedial plan within 30 calendar days from the date the district receives notification (sent certified mail) from ARB.

2. Submittal of a Remedial Plan

The remedial plan shall include all of the following:

- An outline of milestones the district will follow to fully obligate the remainder of their allocation by December 30th.
- An outline of milestones to completely expend the funds by the second June 30th following their award.
- An annual report documenting the amount of match and Carl Moyer Program funds the district has obligated to date.

Upon receipt of the remedial plan, ARB will review and approve or disapprove the plan as acceptable. If a district does not submit an acceptable plan within 30 calendar days, the ARB shall begin administrative action to recapture the funds from that district. When recapturing project funds, ARB may also recapture administrative funds associated with the project funds. The ARB will reallocate those funds to districts that are eligible to receive additional funds based on applications for the same fiscal year.

3. ARB Assistance to Meet Acceptable Remedial Plan

Once an acceptable remedial action plan is submitted by an "at-risk" district, ARB will provide the district with technical assistance to and monitor the district's progress in, meeting the milestones in the remedial plan. This will require the "at-risk" district to update and submit reports on progress in meeting their milestones as required by ARB. If the "at-risk" district falls 30 or more days behind its remedial plan ARB will take administrative action to recapture the remaining unobligated Carl Moyer Program funds from that district. Those funds will be reallocated to districts that are eligible to receive additional funds based on applications for the same fiscal year.

4. Obligation and Expenditure of Match Funds

If a district has obligated funds from an allocation, and any of the allocation has been recaptured by the ARB, the district remains responsible for obligating and expending all of the required match for the obligated amount of the allocation. No further disbursements from any allocation will be made to a district that has an outstanding match requirement from any previous allocation.

C. ARB Allocation of Recaptured District Funds

When ARB recaptures funds in any fiscal year, ARB will only consider the districts that have applied for and have sufficient match to accept additional funding for the same year and type of (district or multi-district) allocation. The ARB will not consider any districts that are "at-risk" at the time of this allocation. The ARB is not able to reallocate funds to any district receiving the minimum award of $200,000 unless that district is able to provide match funds for the minimum award of $200,000 plus any additional funds applied for.

Once ARB has a list of districts with sufficient match and that are not "at-risk," ARB will use the following steps to allocate the recaptured funds to the district(s) that are eligible to receive an additional award.

- The ARB will first try to allocate funds to districts that are located in the same air basin as the district from which the funds have been recaptured.
- If there are no districts in the air basin that have sufficient match and are in good standing, then ARB will allocate the funds to districts that have projects that travel through the same air basin as the district from which the funds were recaptured.
- If there are no districts that have projects that travel through the same air basin, ARB will allocate the recaptured funds to the districts that have already obligated all of their allocation of that same FY funds; and, are the first, or among the first, to propose a Carl Moyer Program eligible and viable project, which will be completed (funds obligated and expended) within two years of the original allocation of the reallocated funds.

The new allocated funds must be spent in the same category (district or multi-district) from which they came. These funds may or may not include the administration funds originally associated with them.

D. Report to the Board

The Carl Moyer Program staff shall report to the Board annually on the progress in implementing the Carl Moyer Program. This report will provide the general public with another opportunity to be advised of the results of the program. This report shall include the following topic areas:

- Total applications received for current year's funds.
- Efforts and results of outreach to potential environmental justice, zero-emission and small business project owners.
- The status of the obligation and expenditure of the current year's funds statewide and by district.
- The status of the obligation and expenditure of previous years' funds statewide and by district.

- District and ARB monitoring and auditing efforts and results, including any audits completed by independent third parties.

- The status of emissions reductions by projects in the implementation phase of their contracts, including reasons for and solutions to shortfalls for projects that do not perform as projected.

- Outstanding features and accomplishments of the Districts and ARB.

- Challenges for the districts and ARB in implementing the Carl Moyer Program.

The ARB encourages the districts to report to their governing boards in a similar fashion.

XII. References

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THE CARL MOYER PROGRAM GUIDELINES

PART II of IV

PROJECT CRITERIA

Proposed Revision 2005
September 30, 2005

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Chapter One

ON-ROAD HEAVY-DUTY VEHICLES

This chapter addresses the project criteria for on-road heavy-duty vehicles (HDVs). It also contains a brief overview of the HDV emission inventory, current engine emission standards and regulations impacting HDVs, available control technologies, potential projects eligible for funding, and cost-effectiveness calculations. Since the 2003 Guidelines, the Air Resources Board (ARB or Board) has adopted many regulations that affect existing heavy-duty vehicles. The proposed project criteria in this chapter have been updated to reflect these new regulatory requirements. The Carl Moyer Program provides financial incentives to pay for the incremental cost of cleaner-than-required HDVs, new purchases, repowers, and retrofits.

I. Introduction

On-road HDVs encompass a large variety of vehicles such as buses, solid waste collection vehicles, street sweepers, delivery trucks and more. These vehicles are typically categorized by weight. Vehicles greater than 8,501 pounds (lbs) gross vehicle weight rating (GVWR) are considered to be HDVs which can also be subcategorized as light heavy duty (LHD), medium heavy-duty (MHD) and heavy heavy-duty (HHD) vehicles (see Table 1-1).

Table 1-1
Heavy-Duty Vehicle Classifications

Vehicle Classification	GVWR
Light Heavy-duty (LHD)	8,501 ≤ 14,000 lbs
Medium Heavy-Duty (MHD)	14,001 ≤ 33,000 lbs
Heavy Heavy-Duty (HHD)	33,001 or more lbs

HDVs can also be further categorized by use and fuel type. Regulations traditionally refer to the vehicle usage type such as solid waste collection vehicles (SWCV), urban buses, and street sweepers. Section III of this chapter provides information on regulations that currently impact these vehicles.

Fuel types for HDVs include diesel, alternative diesel fuels, compressed natural gas (CNG), liquefied natural gas (LNG), liquefied propane gas (LPG), gasoline and electricity. The majority of HDVs are powered by compression-ignition engines typically fueled with diesel fuel. This preference for diesel engines presents an air quality challenge since diesel emissions of oxides of nitrogen (NOx) and particulate matter (PM) have not been able to be controlled to the extent that gasoline-fueled vehicle emissions have, particularly for light and medium-duty vehicles. Furthermore, HDVs involved in the transport of goods typically accrue higher annual mileage than other vehicles. Consequently, the share of total emissions from HDVs is disproportionately higher than their population would suggest.

II. Emissions

Even though the population of all HDVs, including urban buses, account for approximately one percent of all on-road vehicles, they emit about 55 percent of the on-road statewide NOx emissions, 14 percent of the statewide reactive organic gases (ROG) emissions and 35 percent of the statewide PM10 emissions. As shown in Table 1-2, the NOx, ROG and PM10 annual emissions from HDVs will decrease through 2010. However, it is important to note that emissions from other on-road motor vehicle categories will also decrease, and by 2010, HDVs will contribute an even larger share of the emissions from motor vehicles. In addition, daily vehicle miles traveled (VMT) by HDVs are projected to increase by about 11 percent from 2005 to 2010. Clearly, emissions from heavy-duty vehicles have to be reduced further if California is to achieve its air quality goals.

Table 1-2
Heavy-Duty Vehicle Annual Emissions*
Vehicles Greater than 8,500 Pounds

	VMT	NOx tpd	ROG tpd	PM10 tpd
2005	61,446,000	839	107	18
2010	69,112,000	654	84	15

* 2005 Almanac

III. Regulatory Requirements

All HDVs sold in California have engines that have been certified to specific standards. Those standards are, in general, consistent nationwide and are discussed below. Urban transit buses are an exception, having more stringent requirements than other HDVs. All new purchases funded by the Carl Moyer Program must be surplus to these minimum requirements.

In addition, the ARB has developed, or is in the process of developing, additional regulations which will overlay these new engine standards for specific categories. These categories, discussed below, include transit vehicles, solid waste collection vehicles, school bus, public fleets and private fleets. Any Carl Moyer Program project must be surplus to these regulations.

A. Emission Standards

Engine emission standards have progressively and substantially reduced NOx and PM emissions from HDVs. Table 1-3 lists the existing and future NOx and PM emission standards for heavy-duty engines as found in Title 13, California Code of Regulations

(CCR), section 1956.8 [ARB, 2002a]. Urban buses have a separate set of standards and are shown in Table 1-4 as found in Title 13, CCR, section 1956.1 [ARB, 2002b].

Table 1-3
Emission Standards for Heavy-Duty Diesel Engines
(grams per brake horsepower-hour (g/bhp-hr))

	Heavy-Duty Vehicles		Heavy-Duty Optional Standard [(4)]	
Model Year	**NOx**	**PM**	**NOx + NMHC**	**PM**
2004 - 2006	2.4[(1)] or 2.5[(2)]	0.1	1.8 - 0.3	0.03 - 0.01
2007	1.2[(3)]	0.01	-	-
2010	0.2	0.01	-	-

(1) NOx plus NMHC
(2) NOx plus NMHC with 0.5 g/bhp-hr NMHC cap
(3) Between 2007-2009, 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.
(4) Optional Standard sunsets on December 31, 2006

Table 1-4
Emission Standards for Urban Buses
(g/bhp-hr)

	Diesel Urban Bus		Alt Fuel Urban Bus		Alt Fuel Urban Bus Optional Standard [(4)]	
Model Year	**NOx**	**PM**	**NOx**	**PM**	**NOx + NMHC**	**PM**
2004 - 2006	0.5[(1)]	0.01	2.4[(2)] or 2.5[(3)]	0.01	1.8 - 0.3	0.03 - 0.01
2007	0.2	0.01	0.2	0.01	-	-
2010	0.2	0.01	0.2	0.01	-	-

(1) Standard applies to urban bus equipped with diesel-fuel, dual fuel, or bi-fuel engines.
(2) NOx plus NMHC
(3) NOx plus NMHC with 0.5 g/bhp-hr NMHC cap
(4) Standard sunsets on December 31, 2006

B. Fleet Regulation for Transit Agencies

1. Transit Fleet Vehicles

The fleet regulation for transit agencies was amended by the Board on February 24, 2005 [ARB, 2005]. This regulation impacts vehicles owned or operated by a transit agency. The specific transit fleet vehicles impacted are on-road vehicles 8,501 pounds GVWR or greater powered by a heavy-duty engine fueled by diesel or alternative fuel that are not urban buses. Transit agencies operating only gasoline-powered vehicles are not subject to this regulation.

The regulation establishes a fleet average NOx standard and PM emission reduction requirement for transit fleet vehicles phased-in between 2007 and 2010. Transit fleet vehicles are subject to the heavy-duty diesel engine emission standards and not the urban bus engine exhaust emission standards.

A transit agency must meet NOx emission averages of 3.2 g/bhp-hr by December 31, 2007, and 2.5 g/bhp-hr by December 31, 2010, from its transit fleet vehicles. A transit agency must also reduce diesel PM emissions of its transit fleet vehicles by 40 percent as of December 31, 2007, and 80 percent as of December 31, 2010, compared to the agency's baseline emissions as of January 1, 2005.

2. Urban Bus

An urban transit bus is a passenger-carrying vehicle powered by a heavy heavy-duty diesel engine with a load capacity of fifteen or more passengers and intended primarily for short rides and frequent stops. Urban transit buses statewide are subject to ARB's Public Transit Agency Vehicle regulation amended in 2005. The regulation required transit agencies that own, operate or lease urban buses to choose a diesel fuel or alternative fuel path and follow the requirements as described for each fuel path.

Agencies on the alternative fuel path are required to:

- Purchase or lease alternative fuel buses that meet the current standards for 85 percent of the annual purchases made by the agency, through 2015.
- Only purchase new buses with an engine certified to an optional PM standard of 0.03 g/bhp-hr or lower.
- Agencies established before January 1, 2005 that are on the alternative-fuel path shall not operate an active fleet of urban buses with:
  - Average NOx emissions in excess of 4.8 g/bhp-hr, based on the engine certification standards of the engines in the active fleet.
  - Diesel PM emission totals exceeding:
    (1) 60 percent of the agency's January 1, 2002 diesel PM average through December 31, 2006.
    (2) 40 percent of the agency's January 1, 2002 diesel PM average beginning January 1, 2007.

Agencies on the diesel fuel path are required to:

- Purchase a diesel-fueled, dual-fueled or bi-fueled bus with 2004-2006 MY engines certified to 0.5 g/bhp-hr of NOx and 0.01 g/bhp-hr of PM or an alternative fuel bus with an engine certified to an optional PM standard of 0.03 g/bhp-hr or lower.
- Agencies established before January 1, 2005 that are on the diesel fuel path shall not operate an active fleet of urban buses with:
  - Average NOx emissions in excess of 4.8 g/bhp-hr, based on the engine certification standards of the engines in the active fleet.
  - Diesel PM emission totals exceeding:

(1) 40 percent of the agency's January 1, 2002 diesel PM average through December 31, 2006.
(2) 15 percent of the agency's January 1, 2002 diesel PM average or equal to 0.01 g/bhp-hr times the total number of current diesel-fueled active fleet buses whichever is greater beginning January 1, 2007.

Agencies established after January 1, 2005, regardless of which path they choose, shall not operate an active fleet of urban buses with:

- Average NOx emissions in excess of 4.0 g/bhp-hr, or the NOx average of the active fleet of the transit agency from which it was formed whichever is lower, or in the case of a merger of two or more transit agencies or parts of two or more transit agencies, the average of the NOx fleet averages, whichever is lower.
- Diesel PM exhaust emissions exceeding the following values:
  (1) Through December 31, 2009, 0.05 g/bhp-hr times the total number of diesel-fueled buses in the active fleet.
  (2) As of January 1, 2010, 0.01 g/bhp-hr times the total number of diesel-fueled buses in the active fleet.

C. Solid Waste Collection Vehicles

SWCVs are on-road heavy-duty vehicles with a GVWR of 14,000 pounds or more and are used for the purpose of collecting residential and commercial solid waste. SWCV are subject to a statewide diesel PM control measure adopted by the Board on September 23, 2003 [ARB, 2004]. The regulation requires each owner to use one of the best available control technologies (BACT) as described in the regulation on each engine or collection vehicle in the fleet.

BACT, as defined by the regulation, can be summarized as an engine or power system certified to the optional 0.01 g/bhp-hr PM standard; an engine or power system certified to the 0.1 g/bhp-hr PM emission standard, used in conjunction with the highest level diesel emission control system (DECS); an alternative fuel or heavy-duty pilot ignition engine, model year 2004 – 2006 certified to the optional standard; or the highest level diesel emission control strategy that is verified.

BACT compliance deadlines are phased in, and are based on a group of engine model years as listed in Table 1-5. It is important to note that Group 2 requirements apply to specific model years (MY) based on the fleet size. Compliance deadlines begin in 2004 and continue through 2010.

Table 1-5
Implementation Schedule for Solid Waste Collection Vehicles, Model Years 1960 to 2006

Group	Engine Model Years	Percentage of Group to Use Best Available Control Technology	Compliance Deadline
1	1988 – 2002	10 25 50 100	December 31, 2004 December 31, 2005 December 31, 2006 December 31, 2007
2a	1960 – 1987 (Total fleet ≥ 15 collection vehicles)	15 40 60 80 100	December 31, 2005 December 31, 2006 December 31, 2007 December 31, 2008 December 31, 2009
2b	1960 – 1987 (Total fleet < 15 collection vehicles)	25 50 75 100	December 31, 2007 December 31, 2008 December 31, 2009 December 31, 2010
3	2003 – 2006 (Includes dual-fuel and bi-fuel engines)	50 100	December 31, 2009 December 31, 2010

D. Upcoming Regulations

Municipal or utility-owned on-road heavy-duty diesel-fueled vehicles, such as dump trucks, street sweepers, and aerial lift trucks are not currently regulated by a fleet rule. The Board will consider a proposed in-use diesel particulate control measure for public and utility fleets in December 2005 which may impact the project criteria for these projects. Due to low mileage, these projects are generally only eligible for small grant amounts.

Private on-road heavy-duty diesel-fueled vehicle fleets such as in-use heavy-duty trucks are not currently regulated. The Board will also hear a proposed diesel particulate control measure for private fleets in 2006 which may impact the project criteria for these projects.

IV. Potential Project Types

The Carl Moyer Program can achieve emission reductions from heavy-duty vehicles operating in California. The project criteria are designed to ensure that the emission reductions expected through the deployment of low-emission engines or retrofit technologies under this program are surplus, real, quantifiable, and enforceable.

There are four main types of HDV projects: new purchases, repowers, retrofit, and alternative fuels. Each of these are discussed below.

Commercially available low-emission HDVs are considered suitable Carl Moyer Program projects, either as new engine/vehicle purchases or new engine purchases for vehicle repowers. Recent statutory changes now allow for the potential to fund LHD projects. Due to the uncertainty of future requests, LHD projects will be considered initially on a case-by-case basis. If an appreciable number of applications are received for LHD projects, ARB will develop specific guidance.

Diesel engines, due to their high efficiency and long life, dominate the HDV markets. However, their typical lean-burn, high-compression, high-temperature operation has resulted in technical limitations for achieving significant NOx emission reductions. Alternative fuel engines, especially those fueled by CNG and LNG, have been able to achieve NOx emissions of about half of a conventional diesel engine. Alternative fuel engines, including LPG engines, are available for MHD truck applications and HHD engines used in trash truck applications.

In 2010, both the alternative-fuel and diesel fuel standards will align at 0.2 g/bhp-hr NOx. As a result, engine manufacturers have invested significant resources for the development of reduced-emission diesel engines and progress has been made, especially with the integration of advanced electronics, the use of exhaust gas recirculation, and after treatment devices. Today's generation of HD diesel engines are nearly as clean as some of the alternative-fuel engines produced prior to 2003. Nevertheless, it is likely that only alternative-fuel engines will meet the lower NOx emission standard requirements for Carl Moyer Program funding for new purchases at this time.

The variety of alternative fuel engines available and the number sold in California has increased significantly. However, due to increasingly stringent emission standards, the number of available alternative fuel engines being certified each year has decreased. As engine technology matures, the number and variety of engines certified to the emission standards will expand. Alternative fuel vehicles have had the most success in the urban bus market. Presently, approximately 50 percent of all bus sales in California are alternative fuel vehicles and a significant number of transit agencies have focused exclusively on alternative fuel buses for new purchases.

A. New Vehicle Purchase

New vehicle purchases of LNG and CNG HDVs are expected to continue to be the most common type of project for on-road heavy-duty vehicles under the Carl Moyer Program, although LPG vehicles continue to be an option. The ARB certifies engines destined for sale in California and provides the engine manufacturers with an Executive Order (EO) for each certified engine family which is used to determine eligibility for new vehicle purchases and engine repowers. To be eligible, the new vehicle/engine must be certified to one of the ARB's current optional NOx emission standards of

1.8 g/bhp-hr NOx through 2006, regardless of fuel type or engine design. Beginning in January 2007, the optional standards will sunset, and projects for new vehicle/engine must be certified to 0.2 g/bhp-hr of NOx.

The Heavy-Duty Diesel-Engine and Vehicle Standard will continue to be used as the baseline for determining eligibility for on-road new purchases except urban buses. Engines and vehicles certified to the Heavy-Duty Otto-Cycle Engine Standard may also be eligible for funding if certified to a level equivalent to the current optional diesel standard or 30 percent less than the current diesel standard. Since new engines are certified throughout the year, districts are encouraged to contact ARB for the most current list of eligible engines.

Purchases of new vehicles must also be beyond the requirements of ARB's regulations. Thus, applicants must submit evidence of compliance with the regulations or documentation to support that Carl Moyer Program funds will not be used to meet regulatory requirements.

Heavy-duty hybrid electric vehicle purchases are another new vehicle purchase project type eligible for Carl Moyer funding. Heavy-duty hybrid-electric propulsion systems combine two motive power sources: an energy storage system such as batteries or ultra-capacitors, and an internal combustion engine, turbine, or fuel cell functioning as an auxiliary power unit. An electric motor provides partial or complete power to the wheels. In addition, energy otherwise lost as heat during braking is captured through regenerative braking to charge the energy storage system.

In order to qualify for the Carl Moyer Program, the hybrid-electric drive system must be certified using the "California Interim Certification Procedures for 2004 and Subsequent Model Hybrid-Electric Vehicles, in the Urban Bus and Heavy-Duty Vehicle Classes." These test procedures provide a method to quantify the emission benefits of a hybrid-electric drive system which is not possible through engine certification methods. At this time, one gasoline hybrid-electric drive system for use in urban buses is certified to the optional NOx standards at 0.6 g/bhp-hr and is classified as an alternative fuel bus.

Average Banking and Trading (ABT) engines (i.e., all Family Emission Limit (FEL)-certified engines) are not eligible to participate in the Carl Moyer Program for new vehicle purchase projects since emission benefits from an engine certified to an FEL level are not surplus emissions.

B. Repower

Vehicle repower refers to the replacement of an existing engine with a newer engine certified to lower emission standards. For the Carl Moyer Program, existing HDV engines, regardless of model year, must be repowered with an ARB certified engine, Model Year 1991 or newer. Engine repowers are allowed only when the highest available ARB verified retrofit is installed as part of the repower project. All other eligibility criteria must also be met. Under the Carl Moyer Program, funding is not available for projects in which spark-ignition engines (i.e., natural gas or gasoline, etc.) are replaced with new diesel engines.

Replacement of an old mechanical engine with a newer mechanical engine that is certified to a lower NOx emission standard may be cost-effective. (Mechanical engines are those having mechanically-controlled injection timing. These engines are common in pre-1991 models). Some air districts have also expressed interest in mechanical-to-electronic engine repowers for on-road heavy-duty engines. Although substantial NOx emission reductions may occur in these types of projects, installation of an electronically controlled engine into a mechanical engine platform is difficult due to the significant differences in fuel and electrical systems. Thus, mechanical-to-electronic engine repower projects will be considered on a case-by-case basis.

Another possible repower option is the use of an engine that was certified to a FEL level as the replacement engine. FEL engines can be funded for vehicle repower projects only if they are certified to a level that is below the required emission standard. Due to the possibility of emission credits being generated from FEL engine averaging, specific guidelines must be followed when calculating emission reductions. These Guidelines are explained in the repower portion of the Project Criteria section below.

C. Retrofit

Retrofit involves modifications to an engine and/or fuel system such that the retrofitted engine does not have the same specifications as the original engine. Retrofit projects are allowed for all engine model years, regardless of mechanical or electronic control. The most straightforward retrofit projects are add-on after treatments. ARB has approved formal verification procedures for several retrofit kits and diesel emission control strategies. The verification process is ongoing, and districts are encouraged to contact ARB to obtain the most current list of eligible retrofits. Retrofits may also include engine and/or fuel system component upgrades that could be done at the time of an engine rebuild, resulting in a lower emission configuration. See Appendix F for more detailed information regarding retrofits.

D. Alternative Fuel

Districts have the option to fund the cost difference between conventional diesel fuel and an alternative fuel such as alternative-diesel fuel, CNG, LNG, and LPG with matching funds. The fuel purchase must be an integral part of an engine purchase, repower, or retrofit.

V. Proposed Project Criteria

Reduced-emission on-road heavy-duty vehicle projects which include new vehicle purchase, vehicle engine replacement (repower), and engine retrofit, can be considered for incentive funding. The project criteria listed below for on-road heavy-duty vehicles provide districts, fleet operators, transit agencies, and applicants with the minimum qualifications for the Carl Moyer Program. The primary criteria for selection are: emission reductions, cost-effectiveness, and ability for the project to be completed within the timeframe of the program. Sample calculations that illustrate the methodology for determining emission reductions and cost-effectiveness are included in Appendices C and D.

Participating districts retain the authority to impose additional requirements in order to address local concerns.

A. General

- Emission reductions obtained through Carl Moyer Program projects must not be required by any federal, state or local regulation, memorandum of agreement/understanding with a regulatory agency, settlement agreement, mitigation requirement, or other legal mandate.

- Projects must meet a cost-effectiveness of $14,300 per weighed ton of NOx + ROG + PM10 reduced calculated in accordance with the cost-effectiveness methodology discussed in this chapter.

- No emission reductions generated by the Carl Moyer Program shall be used as marketable emission reduction credits, or to offset any emission reduction obligation of any person or entity.

- No project funded by the Carl Moyer Program shall be used for credit under any federal or state emission averaging banking and trading program.

- Projects must have a minimum project life of three years. ARB may approve a shorter project life on a case-by-case basis. Projects with shorter lives may be subject to additional funding restrictions, such as a lower cost-effectiveness limit or a project cost cap.

- The contract term must extend to the end of the project life.

- Funded projects must have at least 75 percent of the vehicle's annual miles traveled in California.

- Potential projects that fall outside of these criteria may be considered on a case-by-case basis if evidence provided to the air district suggests potential surplus, real, quantifiable and enforceable emission reduction benefits.

- Vehicles operating under a compliance extension granted by the ARB, a local district, or the U.S. EPA are not eligible for funding.

- Default project life for on-road projects are as follows:

School buses ≥ 33,000 GVWR - New	20 years
Buses ≥ 33,000 GVWR - New	12 years
Other On-road - New	10 years
Repowers + Retrofits	5 years
Retrofits	5 years

  Applicants must provide documentation to justify a longer project life. The default project life does not consider upcoming regulatory requirements. Project life may be shorter due to regulatory requirements.

- On-road heavy-duty diesel vehicles with a gross vehicle weight rating between 8,501 and 14,000 pounds may be considered for Carl Moyer Program funding for new, repower and retrofit projects on a case-by-case basis.

- All engines in new purchases and repower projects must be certified by the ARB for sale in California and must comply with durability and warranty requirements.

- All aftermarket emission controls (retrofits) must be verified by ARB.

- Air districts must consult with ARB staff to determine eligibility of all projects considered for funding on case-by-case basis. All projects considered on a case-by-case basis must receive ARB approval prior to receiving program funding.

B. Compliance Check

After the district qualifies on-road repower and retrofit projects for funding but before the district APCO signs an agreement for funding a project, the district must submit information regarding the project to ARB to check for outstanding violations. The process for completing the compliance check is as follows:

- The district shall email their ARB district liaison the contact name, organization or business name and vehicle identification number for the project.

- The liaison will forward that information electronically to the responsible parties at ARB. The liaison will email the district the results of the compliance check within seven working days.

- If the compliance check indicates there is an outstanding violation the district shall inform the engine owner in writing that no disbursement may be made until the owner provides proof that the violation has been corrected and the fines have been paid.

- If the outstanding violation is based on problems with the baseline engine (e.g., gross polluter) the new engine must be installed (instead of fixing the old engine), the vehicle must be operational, the engine owner must pay the violation and submit documentation of the violation being corrected with, or before submitting, the invoice.

- During inspections, districts must also check for a sticker verifying engines subject to the software upgrades for diesel trucks (i.e., chip reflash) have completed the upgrade before receiving funding.

C. New Purchase

The following criteria apply to all on-road new vehicle purchases

- Projects must provide at least a 30 percent NOx emission reduction compared to baseline NOx emission factors for the specific vehicle type.
- Fleets/agencies affected by upcoming fleet regulations may use Carl Moyer Program funding to purchase a new vehicle if the project life expires prior to the final compliance date for the reductions in the regulation. For example, if a project with a 3-year project life is funded in December 2006, the emission reductions must be surplus to any emission reductions that are required by any regulations that apply through December 2009.
- Fleets/agencies purchasing vehicles that will be affected by upcoming emission standards may use Carl Moyer funding to purchase a new vehicle up to the compliance date of the new standard.
- The Heavy-Duty Diesel-Engine and Vehicle Standard will be used as the baseline for determining eligibility for on-road new purchases. Engines and vehicles certified to the Heavy-Duty Otto-Cycle Engine Standard may be eligible if certified to a level equivalent to the current optional diesel standard or 30 percent less than the current diesel standard.
- Through 2006, new vehicles eligible for the Carl Moyer Program must have engines certified to an optional, low-emission standard of 1.8 g/bhp-hr NOx + NMHC or less.
- From 2007 to 2009, new vehicle engines eligible for the Carl Moyer Program must be certified to a 0.2 g/bhp-hr NOx emission limit.
- Engines used in any ABT program are not eligible for funding.

D. Repower

The following criteria apply to all on-road repower (engine replacement) projects.

- Repower replacement engines must be an ARB certified engine with a Model Year of 1991 or newer.

- On-road engine repowers are allowed only when the highest available ARB retrofit is installed as part of the repower project.

- If a repower project does not meet the weighted cost-effective limit due to a retrofit, then the project is only eligible for the cost up to the weighted cost-effective limit.

- If during data logging the retrofit is proven not to be technically feasible for the replacement engine of the repower project then other retrofits must be examined for usability. If no retrofit is shown to be technically feasible to the district and ARB, the retrofit is not required. However, at any time during the project life, if a retrofit that is compatible with the engine and the vehicle duty cycle has been verified by ARB it must be installed.

- Repower projects that reduce NOx emissions must be certified by ARB to a NOx reduction level of at least 15 percent from the baseline engine.

- Fleets/agencies affected by upcoming fleet regulations may use Carl Moyer funding for repower projects if the project life expires prior to the final compliance date for the reductions in the regulation. For example, if a project with a 3-year project life is funded in December 2006, the emission reductions must be surplus to any emission reductions that are required by any regulations that apply through December 2009.

- Funding requests for other related repowering equipment, such as the vehicle transmission, will be considered on a case-by-case basis, based upon whether it is a necessary expense, and is at the discretion of the district.

- The full cost of a retrofit kit included in a repower project may be funded subject to the $14,300 weighted cost-effectiveness limit.

- The replacement engine used in vehicle repower projects may be a new, rebuilt, or remanufactured engine. Eligible rebuilt or remanufactured engines are those offered by the original engine manufacturer (OEM) or by a non-OEM rebuilder who demonstrates to the ARB that the rebuilt engine and parts are functionally equivalent from an emissions and durability standpoint to the OEM engine and components being replaced. Rebuild and remanufactured engines that are not re-certified to new emission standards, shall use the emission standards associated with the original engine block.

- For repowers, replacement engines manufactured after September 30, 2002, that are not certified to at least the 2.4 g/bhp-hr NOx + NMHC, or 2.5 g/bhp-hr NOx + NMHC with a 0.5 g/bhp-hr NMHC cap, are ineligible to participate in the Carl Moyer Program.

- Engines that are certified to a FEL NOx or NOx + NMHC level that is lower than the required emission standard are eligible for use in vehicle repower projects.

However, the emission level that can be used in cost-effectiveness calculations for these engines would be the applicable emission standards and not the FEL levels.

- Replacement engines subject to the software upgrades for diesel trucks (i.e., chip reflash) must complete the software upgrade process before being installed in a vehicle. The cost of the software upgrade, if any, is not an eligible Carl Moyer Program expense.

- Mechanical-to-electronic engine repower projects will be considered on a case-by-case basis.

- Funding is not available for projects to replace spark-ignition engines (i.e., natural gas or gasoline, etc.) with diesel engines.

E. Retrofit

The following criteria apply to all on-road retrofit projects:

- Only ARB-verified retrofits are eligible for funding.

- Retrofit projects that reduce NOx emissions must be verified by ARB to a NOx reduction level of at least 15 percent from the baseline engine.

- Retrofit projects that control PM must use the highest level cost-effective technology available for the equipment being retrofitted. The following are the diesel PM reductions for each ARB verified level: Level 1 (25 percent reduction), Level 2 (50 percent reduction), or Level 3 (85 percent reduction).

- Fleets/agencies affected by upcoming fleet regulations may use Carl Moyer funding for retrofit projects if the project life expires prior to the final compliance date for the reductions in the regulation. For example, if a project with a 3-year project life is funded in December 2006, the emission reductions must be surplus to any emission reductions that are required by any regulations that apply through December 2009.

- If the retrofit device reduces both NOx and PM emissions and is being installed to comply with a PM requirement, only the cost of the NOx reductions are eligible for Carl Moyer Program funding.

- The cost of the retrofit, and all filters needed during the project life, may be paid for with Carl Moyer Program funding provided it meets the weighted cost-effectiveness limit.

F. Scrap

- Scrap requirements are described in the Administrative Chapter of these Guidelines

G. Fuel

- Carl Moyer funds can not be used for fuel projects, however funds under a district's budgetary authority or fiduciary control (i.e. match funds) may be used to pay for the incremental cost of liquid or gaseous fuel, other than standard gasoline or diesel, which is integral to a covered emission reducing technology that is part of a project receiving grant funding under the Program. If all Carl Moyer Program criteria are met and the project is not a "fuel-only" project, the incremental cost of alternative fuel can be considered a qualified matching contribution from a district.

H. Glider Kits

- An engine repower for a glider kit (replacement cab and chassis) is eligible for funding. The replacement engine must be newer than the glider kit and meet the general program criteria above.

- Glider kits are not an eligible expense under the Carl Moyer Program.

I. Heavy-Duty Trucks

Currently, most in-use heavy-duty trucks, or heavy-duty vehicles designed to carry an entire load such as long-haul, short-haul, delivery, and construction trucks, are not subject to any fleet rules. The ARB is developing a fleet rule for private heavy-duty vehicles that is tentatively scheduled to be presented to the Board in 2006. If approved, it may affect the project criteria for these projects. Eligible heavy-duty truck projects including new vehicle purchases, repowers, and retrofits are subject to the general criteria cited above.

- Heavy-duty trucks are eligible for funding if they meet the general program criteria above.

- Hybrid electric vehicle (HEV) new purchases will be considered on a case-by-case basis if the HEV is certified to the current NOx and PM standards.

J. Private Fleets

Private on-road heavy-duty diesel vehicle fleets are not currently regulated by a fleet regulation. The Board is tentatively scheduled to consider a proposed diesel particulate control measure for these fleets in 2006 which may affect the project criteria for these projects.

- Private fleet vehicles are eligible for funding if they meet the general program criteria above.

K. Public and Utility Fleets

Municipal and utility-owned on-road heavy-duty diesel-fueled vehicles are not currently regulated by a fleet regulation. The ARB will consider a proposed diesel particulate control measure for these fleets in December 2005 which may affect the project criteria for these projects. Due to low mileage, these projects are generally only eligible for small grant amounts.

- Public and utility fleet vehicles are eligible for funding if they meet the general program criteria listed above.

L. School Buses

School buses are vehicles used for the express purpose of transporting students through grade 12 from home to school, school to home and to any school sponsored activities.

- School buses are eligible for Carl Moyer Program funding if they meet the general program criteria above; however, their relatively low annual miles traveled usually allows for minimum grant amounts.

M. Solid Waste Collection Vehicles

SWCVs are on-road heavy-duty vehicles with a GVWR of 14,000 pounds or more that are used for the purpose of collecting residential and commercial solid waste. SWCVs are subject to a statewide in-use diesel particulate matter airborne toxic control measure (ATCM). Projects that meet the following criteria provide emission reductions that are surplus to the regulatory requirements and may be funded:

- Projects are subject to the general program criteria listed above.

- Projects will be considered on a case-by-case basis. All SWCV projects must submit evidence of compliance with the SWCV rule or documentation to show that the funds will not be used to meet the rule's requirements. Documentation must include the name of the company, address, and fleet terminal(s) names and locations. Documentation must also include company records identifying the vehicles in their total fleet including: listing them by the terminals out of which they operate, model years of vehicles and engines in the fleet, vehicle identification number, serial numbers, engine families, series, status as active or backup vehicle. The companies must also identify out of which terminal the vehicles potentially receiving Carl Moyer Program funds operate.

- New purchase, repower, and retrofit projects for group 2a (MY 1960-1987 with a total fleet of ≥ 15 collection vehicles) are eligible for funding through December 31, 2006 if the following are met:

  - 100 percent of the vehicles in group 2a must be in compliance with the SWCV ATCM and in operation by December 31, 2006.

  - 25 percent of the vehicles in group 2a would be eligible for the incremental cost of the new purchase, repower or retrofit project up to the weighted cost-effectiveness limit.

  - The maximum project life for these projects is three years.

- New purchase, repower, and retrofit projects for group 2b (MY 1960-1987 with a total fleet of < 15 collection vehicles) are eligible for funding through December 31, 2007 if one of the following options are met:

  - If 100 percent of the vehicles in group 2b are in compliance with the SWCV ATCM and in operation by December 31, 2006, 50 percent of the vehicles in group 2b would be eligible for the incremental cost of the new purchase, repower or retrofit project up to the weighted cost-effectiveness limit. The project life for 25 percent of the vehicles is three years and the remaining 25 percent is four years.

  - If 100 percent of the vehicles in group 2b are in compliance with the SWCV ATCM and in operation by December 31, 2007, 25 percent of the vehicles in group 2b would be eligible for the incremental cost of the new purchase, repower or retrofit project up to the weighted cost-effectiveness limit. The project life for these vehicles is three years.

- New purchase, repower, and retrofit projects for group 3 (MY 2003-2006) are eligible for funding through December 31, 2007 if one of the following options are met:
  - If 100 percent of the vehicles in group 3 are in compliance with the SWCV ATCM and in operation by December 31, 2006, 100 percent of the vehicles in group 3 would be eligible for the incremental cost of the new purchase, repower or retrofit project up to the weighted cost-effectiveness limit. The project life for 50 percent of the vehicles is three years and the remaining 50 percent is four years.

  - If 100 percent of the vehicles in group 3 are in compliance with the SWCV ATCM and in operation by December 31, 2007, 50 percent of the vehicles in group 3 would be eligible for the incremental cost of the new purchase, repower or retrofit project up to the weighted cost-effectiveness limit. The project life for these vehicles is three years.

- During 2007-2009, new vehicle purchases throughout the state must meet the new vehicle purchase requirements above and must be certified to 0.2 g/bhp-hr for NOx.

- Surplus NOx reductions from retrofit projects are eligible for funding as described in the retrofit criteria above.

N. Street Sweepers and Other Stop-and-Go Vehicles

Stop-and-go vehicles, such as street sweepers, may be included in the public fleet rule scheduled to be considered by the Board in December 2005. This may affect the project criteria for these projects.

- Street sweeper projects that are surplus to regulations are eligible for funding for new purchase, repower, and retrofit projects. See the general program criteria listed above.

O. Transit Fleet Vehicles (Non-Urban Buses and Transit Vehicles)

Transit fleets include commuter service buses and or transit fleet vehicles that are not urban buses. These fleets are subject to a statewide in-use fleet rule that impacts vehicles with a GVWR of 8,501 pounds or greater and are powered by a heavy-duty engine fueled by diesel or alternative fuel that are owned or operated by a transit agency.

- Projects are subject to the general program criteria listed above.

- Projects will be considered on a case-by-case basis. All project applicants must submit evidence of compliance with the Transit Fleet Rule or documentation to show that the funds will not be used to meet the rule's requirements. Documentation must include the transit agency's Transportation Implementation Plan and annual ARB updates. If data included in the Transportation Implementation Plan is not sufficient, districts and/or ARB may require additional documentation.

- Through 2006, new vehicle purchases by transit agencies are eligible for Carl Moyer Program funding if the engine is certified to the optional standard of 1.8 g/bhp-hr NOx + NMHC.

- From 2007 to 2009, new vehicle purchases must be certified to 0.2 g/bhp-hr NOx to be eligible for Carl Moyer Program funding.

- Transit agency fleets established before January 1, 2007 are eligible for Carl Moyer Program funds for repower and retrofit projects if documentation is provided that shows:
  1. The whole fleet has met the 2.4 g/bhp-hr NOx fleet average, and

2. PM reductions of 80 percent compared to January 1, 2005 PM levels or equal to 0.01 g/bhp-hr times the total number of transit fleet vehicles in the current fleet whichever is greater.

- Transit agency fleets established after January 1, 2007 are eligible for Carl Moyer Program funds for repower and retrofit projects through December 31, 2007 if documentation is provided that shows:
  1. The whole fleet has met the 2.4 g/bhp-hr NOx fleet average, and
  2. PM reductions of 50 percent compared to the fleet's baseline when established.

- Transit agency fleets established after January 1, 2007 are eligible for Carl Moyer Program funds for repower and retrofit projects beginning January 1, 2008 if documentation is provided that shows:
  1. The whole fleet has met the 2.4 g/bhp-hr NOx fleet average, and
  2. PM reductions of 80 percent compared to the fleet's baseline when established.

P. Urban Transit Buses

An urban transit bus is a passenger-carrying vehicle powered by a heavy heavy-duty diesel engine with a load capacity of fifteen or more passengers and intended primarily for intra-city operation, short rides and frequent stops. Urban transit buses statewide are subject to an in-use and new purchase regulation that requires transit agencies that own, operate or lease urban buses to choose a diesel-fuel or alternative-fuel path and follow the requirements as described for each fuel path.

- Projects are subject to the general program criteria listed above.

- Projects will be considered on a case-by-case basis. All urban bus projects must submit evidence of compliance with the Public Transit Agency Vehicle Rule or documentation to show that the funds will not be used to meet the rule's requirements. Documentation must include the transit agency's Transportation Implementation Plan and annual ARB updates. If data included in the Transportation Implementation Plan is not sufficient, district and/or ARB may require additional documentation.

- For urban bus new vehicle projects, only the portion not funded by the Federal Transit Administration (FTA) is eligible for Carl Moyer Program funding. Proper documentation must be provided. The full incremental cost for an urban transit bus that is not funded by FTA may be granted under the Carl Moyer Program. Operation and maintenance costs are not eligible for Carl Moyer Program funding.

- Through 2006, alternative fuel buses are eligible for Carl Moyer Program funds for new bus purchases if the engine is certified to at least the optional standard of 1.8 g/bhp-hr for NOx + NMHC.

- Through 2006, diesel fuel buses are eligible for Carl Moyer Program funds for new bus purchases if the engine is certified to 0.2 g/bhp-hr for NOx.

- Urban bus fleets established before January 1, 2005 that are on the diesel fuel-path are eligible for Carl Moyer Program funds for repower and retrofit projects if documentation is provided that shows:
  1. The whole fleet has met the 4.8 g/bhp-hr NOx average, and
  2. PM reductions of 85 percent compared to January 1, 2002 PM levels or equal to 0.01 g/bhp-hr times the total number of current diesel-fueled active fleet buses whichever is greater.

- Urban bus fleets established before January 1, 2005 that are on the alternative fuel-path are eligible for Carl Moyer Program funds for repower and retrofit projects if documentation is provided that shows:
  1. The whole fleet has met the 4.8 g/bhp-hr NOx average, and
  2. PM reductions of 60 percent compared to January 1, 2002 PM levels.

- Urban bus fleets established after January 1, 2005 are eligible for Carl Moyer Program funds for repower and retrofit projects if documentation is provided that shows:
  1. The whole fleet has met the 4.0 g/bhp-hr NOx average, and
  2. May not have a diesel PM emission total exceeding 0.01 g/bhp-hr (exhaust emission value) times the total number of diesel-fueled buses in the active fleet.

- Hybrid electric bus (HEB) new purchases will be considered on a case-by-case basis, if the HEB is certified to the current NOx and PM standards.

VI. Cost-Effectiveness Calculations

To receive Carl Moyer Program funding, each project must meet the maximum cost-effective threshold of $14,300 per weighted ton of covered pollutants reduced. Only funds provided by the Carl Moyer Program and local district matching funds are to be used in determining cost-effectiveness.

The emission factors in the tables of Appendix B reflect preliminary data developed by ARB staff as part of a comprehensive effort to update the emissions models used for on-road motor vehicles and off-road mobile sources. These draft data were made available on ARB's website in early 2005, but are subject to change as staff completes its analyses and the associated model development. Appropriate emission factors as a function of vehicle type and model year are illustrated in Appendix B. ARB staff will issue Carl Moyer Program Advisories to update the tables as necessary.

The converted emission standards used in the calculations are the standards described in the emission standard section of this chapter that have been adjusted using the fuel correction factors and NOx fraction factors in Appendix B. It is important to note that urban buses have different standards than other heavy-duty vehicles.

Examples

On-road project calculations are generally mileage based. However, some projects such as stop-and-go vehicles can use fuel-based calculations.

For new purchase projects, the baseline will be an engine certified to the current standard. The reduced technology will be an engine certified to the current optional standard or 30 percent less than the current standard. For repower projects, the baseline will be the model year of the existing engine that would have been rebuilt. The reduced technology will be the engine certified to at least 5.0 g/bhp-hr of NOx that will be installed instead of the rebuilt engine. The baseline for a retrofit project is the existing engine. The reduced technology is the verified level of emission reductions for the retrofit.

A detailed description of how to calculate cost-effectiveness can be found in Appendices C and D.

VII. Minimum Project Application Requirements

A. Application

The applicant must provide the minimum information listed in Table 1-6.

A disclosure must also be included stating that the proposed project has not been funded and is not being considered for funding by another air district, ARB, or any other public agency. Any applicant who is found to have submitted multiple applications for the same project may be banned from submitting future applications to any and all Carl Moyer Program solicitations and may be subject to criminal sanctions. A project funded cooperatively by multiple air districts is eligible for funding if the project parameters are coordinated amongst the participating districts and the project meets all applicable Carl Moyer Program criteria. Applicants are allowed to re-apply for project funding if a previous application has been rejected and is no longer being considered for funding.

Third party applications are not allowed. The owner of the engine must sign and agree to the application. However, a third party (e.g. engine dealer or distributor) may complete an application or part of an application on an owner's behalf. Applications must include a signature section for third parties. The third party signature section must include signature and date lines, and blanks for the third party to list how much they are being paid, if anything, to complete the application and what source of funds are being used to pay them. To make the Carl Moyer Program accessible to all potential applicants, including applicants that cannot afford to hire third party assistance, districts are encouraged to provide technical assistance to applicants in completing the application.

Table 1-6
Minimum Application Requirements for On-Road Heavy-Duty Vehicle Projects

Air District Applicant Demographics Company Name: Business Type: Contact Name and Title: Mailing Address: Location Address: Contact Number: Project Description Project Name Project Location VIN or Serial Number Vehicle Function Vehicle Class GVWR(lbs): Annual Miles Traveled or Annual Fuel Usage Percent Operated in California Project Life (years) Application Type: (Repower, Retrofit or New) Existing Engine Information Serial number Engine Make Engine Model Engine Year Fuel Type	Replacement/New Engine Information Serial number Engine Make Engine Model Engine Year Fuel Type Certification Executive Order Retrofit Technology Product Name Executive Order Reference Cost-Effectiveness Analysis Basis (choose one) Annual Mileage Annual Gallons Incremental Cost Repower Cost ($) of the existing engine (rebuild cost) Cost ($) of certified replacement engine New Purchase Cost ($) of the required certified engine Cost ($) of certified lower emission engine Retrofit Cost ($) of retrofit kit Dollar amount of additional financial incentives District Incentive Amount Requested

B. Reporting and Monitoring

Reporting and monitoring requirements for districts are described in the Administrative Chapter of these Guidelines.

Fleet operators and transit agencies participating in the Carl Moyer Program are required to keep appropriate records during the life of the funded project as determined by the district and ARB. Records must contain, at a minimum, total miles traveled in and outside of California, fuel usage, and maintenance and repair information. Records must be retained and updated throughout the project life and made available at the request of the district or ARB.

VIII. References

ARB, 2002a. Air Resources Board. December 12, 2002. California Exhaust Emission Standards and Test Procedures for 1985 through 2003 Model Heavy-Duty Diesel Engines and Vehicles. http://www.arb.ca.gov/msprog/onroadhd/85-03hddtps_levhdg02_clean_11-14.doc

ARB, 2002b. Air Resources Board. December 12, 2002. California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles.
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ARB, 2004. Air Resources Board. June 4, 2004. Diesel Particulate Matter Control Measure for On-road Heavy-duty Diesel-fueled Residential and Commercial Sold Waste Collection Vehicles. http://www.arb.ca.gov/regact/dieselswcv/fro2.doc

ARB, 2005. Air Resources Board. January 7, 2005. Staff Report: Proposed Modifications to the Fleet Rule for the Transit Agencies and New Requirements for Transit Fleet Vehicles. http://www.arb.ca.gov/regact/bus04/isor.pdf

Chapter Two

HEAVY-DUTY ON-ROAD FLEET MODERNIZATION

This chapter adds a fleet modernization source category to the Carl Moyer Program. Fleet modernization provides incentives to replace old high-polluting heavy-duty vehicles with newer, lower emission replacement vehicles. The fleet modernization source category provides real emission benefits by retiring the high polluting vehicle earlier than would have been expected through normal attrition. Carl Moyer Program funds for fleet modernization projects are used to offset part of the cost of the replacement vehicle. Project funds also pay for a diesel particulate emission reduction device to further reduce emissions and an electronic monitoring unit to verify miles traveled in California and the district. An additional vehicle replacement strategy included in fleet modernization is the tiered transaction. A tiered transaction project combines the purchase of a new vehicle certified to the optional NOx standard by one owner with the replacement of an old vehicle by a second owner.

I. Introduction

Heavy-duty diesel trucks are durable and stay in operation for an average of 18.5 years. Old trucks contribute disproportionately to the state's NOx, ROG, and PM10 emissions. Pre-1990 heavy-duty trucks emit one and a half times as much NOx and two and a half times as much PM10 as a truck that meets current standards. These old trucks tend to be driven by relatively low-income operators and are concentrated in specific industrial sectors. Generally, the income generated from the old trucks operating in low paid vocations does not justify the purchase of a newer truck, even with the improved fuel economy, reduced maintenance costs, and fewer downtime expenses of a newer truck. These old trucks continue operating until they deteriorate to a point that it does not make economic sense to repair them.

The Carl Moyer Program for on-road vehicles was designed to pay for the incremental purchase cost of a new vehicle that is cleaner than the required emission standards. However, the owners of the oldest trucks cannot afford to buy a new vehicle that qualifies for incentive funds. It is unlikely that the old truck owners would be willing to invest in a newer truck since the old truck is still operating. In addition, operators of old trucks do not have an incentive to sell their trucks since the market price for the old trucks is undervalued relative to its utility to the truck owner. Traditional scrap programs, which provide incentives to scrap a vehicle, may not lower emissions from the old, heavy-duty sector because the old, scrapped truck is likely to be replaced with another affordable old truck.

Recognizing that resources were not available to get old, high polluting vehicles off the road, AB 1394 was passed in 2004 directing ARB to consider fleet modernization as a potential project under the Carl Moyer Program. As such, the Air Resources Board (ARB or Board) is proposing a source category that provides incentive funds to replace old vehicles that were unlikely to be removed from operation with newer, cleaner vehicles. The incentives provided by the Carl Moyer Program change the economics of vehicle replacement, making it economically feasible for owners who could not previously justify the expense.

II. Emissions

According to ARB's motor vehicle inventory, 1990 and older vehicles account for 33 percent of California's heavy-duty fleet. This equates to about 58,800 pre-1991 and older heavy-duty vehicles traveling over four million miles per day statewide. In 2005, these vehicles will emit about 107 tons of NOx and three tons of PM10 per day, as reflected in Table 2-1. The number of these old trucks will decrease to slightly over 32,000 by 2010, but this gradual decline is not sufficient if California is to achieve its air quality goals. This is of particular concern because emissions from older trucks often occur in environmental justice areas, such as ports, which are heavily impacted by high volumes of truck traffic.

Table 2-1
Statewide Calendar Year 2005
Contribution of Pollutants by On-Road Heavy-Duty Vehicles
1990 Model Year and Older*

	Population	NOx	ROG	PM10
2005	58,775	107	6	3
2010	32,155	43	3	1

*EMFAC2002 v2.2 (April 03)

Using data from the United States Census Bureau 2002 Economic Census - Vehicles and Use Survey [U.S. Census Use Survey], ARB staff determined that in California there are specific industrial sectors that have the highest concentration of old vehicles. Most significant to the fleet modernization category are the vocations with the highest numbers of 1990 and older trucks in service. Approximately 60 percent of the mining fleet is 1990 and older; 55 percent of the trucks engaged in agriculture and forestry are 1990 and older; and, 43 percent of the construction fleet is 1990 and older. In addition to these fleets, it is widely recognized that haulers moving goods from California's ports and rail yards utilize the oldest trucks in the fleet.

The concentration of old trucks in specific vocations generally occurs through a series of sales of the individual trucks. Trends in the industry show that fleets which normally utilize new trucks turn over their trucks in three to five years. The vehicles are then sold to operators that drive high mileage in a well-paid vocation. After several years of use, the vehicle is sold again, moved into a low-paid, low-mileage sector and driven until it deteriorates to the point where it does not make economic sense to repair it. The owners of the oldest vehicles tend to buy another old vehicle to replace the truck that has deteriorated, and do not normally purchase a new or newer vehicle. Data from the U.S. Census Use Survey supports this claim: four out of five newer trucks (<5 years old) are purchased as new vehicles, while four out of five old trucks (>15 years old) are purchased as used vehicles.

III. Regulatory Requirements

To help meet California's air quality goals, the ARB has adopted engine emission standards and several mobile source fleet regulations that apply to on-road trucks. In addition, ARB is currently drafting regulations that will be considered by the Board in late 2005 and 2006. Recently adopted regulations demonstrate the Board's increased commitment to reduce emissions from the in-use fleet. The standards and regulations, which may impact eligibility for all heavy-duty, on-road projects, including fleet modernization, are included in Chapter One. All Carl Moyer Program project emission reductions must be surplus to regulatory requirements. Applicants from fleet categories must be especially cognizant of the impact of recently adopted and upcoming requirements, such as solid waste collection vehicles and public and utility fleets.

Public and private, on-road, heavy-duty, diesel-fueled vehicle fleets, such as in-use heavy-duty trucks, are not currently regulated. The Board will hear a proposed diesel particulate control measure for private fleets in 2006, which may further impact the project criteria for these projects.

Fleet modernization incentives may be used for the purchase of a new vehicle. For standard fleet modernization projects that replace an old vehicle with a new vehicle, the new vehicle must be certified to more stringent emission standards than the vehicle being replaced. With tiered transaction projects, the new vehicle must be certified to ARB's current optional NOx emission standards of 1.8 grams per brake horsepower-hour (g/bhp-hr) of NOx through 2006, regardless of fuel type or engine design. Beginning in 2007, the optional standards will sunset and projects for new vehicle/engine must be certified to 0.2 g/bhp-hr of NOx. Since new engines are certified throughout the year, districts are encouraged to contact ARB for the most current list of eligible engines.

IV. Development of the Fleet Modernization Source Category

The ARB has long recognized the need to reduce emissions from the oldest trucks in the heavy-duty diesel truck sector. In 1994, the ARB proposed a concept for retiring heavy-duty vehicles in its State Implementation Plan for Ozone as Measure M-7. The measure envisioned the program could be self-sustaining through the sale of the old trucks for export to overseas markets. However, the M-7 measure was eventually withdrawn because of concern regarding the lack of funding and analyses showing that the old, high emitting trucks removed from the fleet were likely to be replaced with similar aged trucks from outside the area.

In 2001, the Sacramento Metropolitan Air Quality Management District (SMAQMD) received ARB's approval to establish a fleet modernization pilot program, which was funded by the Sacramento Emergency Clean Air Transportation program in partnership with the Sacramento Area Council of Governments (SACOG). The Sacramento program was designed to replace the oldest trucks in a fleet by scrapping the trucks and providing a monetary incentive to purchase newer trucks with fewer emissions. The

SMAQMD developed the concept as an alternative to on-road repower projects. Also in 2001, the Gateway Cities Coalition of Governments, located in the area surrounding the Port of Long Beach, initiated a fleet modernization program that mirrored the Sacramento program. To ensure that incentives were changing the normal purchase practices of operators with the oldest trucks, both pilot programs required the destruction of the old truck and a commitment to keep the replacement vehicle in the same location doing the same type of work. These requirements aimed to resolve the concerns raised in response to the original M-7 measure.

A. Sacramento Metropolitan Air Quality Management District Program

The SMAQMD in partnership with SACOG administers a fleet modernization program for the Sacramento and surrounding air districts. This region includes El Dorado, Placer, Sacramento, Solano and Yolo counties. The SMAQMD pilot program was implemented in 2002 with the expectation that data would be gathered on the replacement vehicles for five years. To date, the SMAQMD program has appropriated approximately $10 million to replace 300 trucks. The average incentive award for the program is $35,000 with a cost-effectiveness of $8,000/ton of NOx reduced. It is estimated that the SMAQMD program has reduced 200 tons of NOx and 30 tons of PM10 per year. The replaced vehicles come primarily from construction and heavy-hauling vocations.

B. Gateway Cities Council of Governments Program

The Gateway Cities Council of Governments (COG) administers a program in the region surrounding the Port of Long Beach and the Port of Los Angeles. The COG is a joint powers authority whose members are the 27 cities in southeast Los Angeles County and the Port of Long Beach. The COG program has expended approximately $7.6 million on the replacement of 350 trucks. The average incentive award for the program is $25,000 with a cost-effectiveness of $8,400/ton of NOx reduced. It is estimated that the COG program has reduced 193 tons of NOx and 42 tons of PM10 per year. The replacement vehicles are owned primarily by independent operators working in port related vocations. The Gateway vehicles tend to be older and have lower mileage than the Sacramento program. Approximately 85 percent of the program participants are non-English speaking. The Gateway Cities program has received funding from multiple sources including the ARB, the United States Environmental Protection Agency (U.S. EPA), the Mobile Source Air Pollution Reduction Review Committee, and the Port of Los Angeles.

C. Lessons Learned

In developing the proposed criteria for the heavy-duty fleet modernization source category, ARB staff, in collaboration with a multi-agency workgroup, established parameters based on the legislative guidance and mandates, data from existing federal and state emission inventories, and data and expertise gathered from the pilot programs. This information has been instrumental in the development of project criteria for a robust, statewide program. To insure real emission reductions, the proposed criteria includes requirements that assure the newly-funded truck will have the same configuration as the old truck, that it will stay in the same vocation and not move to a new location, and that the greatest emission reductions are realized through the use of diesel emission reduction devices. Staff is also proposing rigorous qualifying criteria to assure that the replaced vehicle would have been operating for the project life and that the heavy-duty fleet modernization participants would have been unlikely to have replaced their old truck with a newer truck without incentive funds. The fulfillment of contract obligations is addressed through the use of electronic monitoring devices and monitoring and reporting requirements.

V. Key Components of the Fleet Modernization Source Category

Ensuring that the emission reductions from an incentive program are real, quantifiable, enforceable, and surplus, is critical to the success of the Carl Moyer Program. Given the new niche that fleet modernization must serve, new and rigorous criteria have been proposed to protect the integrity of the program. The major proposed criteria include: eligibility of the old vehicle, vocations, model years, project life, weight class, salvage requirements, electronic monitoring units, funding caps, subtracting the cost of repairs, tiered transactions, and administrative tools.

A. Eligibility of the Old Vehicle and Replacement Vehicle

To receive funding for fleet modernization projects, participants must show that the old vehicle meets the following requirements: it must be a model year 1990 or older; it must have California registration for the last three years; the participant must show proof of ownership, vocation, operation, and documentation to verify actual mileage; and the old vehicle must be turned over to an approved salvage yard for destruction, this includes requiring the engine be destroyed and the frame rails cut. The replacement vehicle must be model year 1999 or newer and it must be identical to the old vehicle including axle configuration and body type to prevent a change in vocation during the life of the project. New vehicles participating in tiered transaction projects are required to meet the optional NOx standard.

B. Vocations

One of the goals of the fleet modernization is to ensure that participants continue to do the same type of work and do not drift to other vocations once they have acquired a newer vehicle that is capable of traveling long distances with greater reliability. This restriction is necessary because the movement of a fleet modernization truck to a new vocation would result in another old truck backfilling the original vocation. The program requires participants to show proof of vocation for the previous three years and maintain that vocation for the life of the project.

Vocation is further emphasized by providing greater incentives to vehicles operating in vocations known to have the highest number of old trucks in service. Targeted vocations include vehicles operating in agricultural, construction, mining, forestry vocations, and vehicles that move goods in and out of ports and rail yards. Participants from the targeted vocation are eligible for a five year project life, rather than the standard three year project life available for other types of vocations.

C. Model Years

To be eligible for the fleet modernization source category, the old vehicle must be a model year 1990 or older. This model year was selected for several reasons. The emission factors for the 1990 and older vehicle make it a high emitting vehicle at 21.2 grams of NOx/mile and 1.32 grams of PM/mile. The EMFAC 2002 inventory shows that there are approximately 58,000 of these old vehicles on the road today. Reducing the number of these high emitting vehicles will improve air quality. The SMAQMD pilot program originally allowed only 1983 and older vehicles to participate in its program. The district then modified its pilot program to allow 1986 and older vehicles. Recently, the district moved the eligible model year to 1990 and older vehicles because it has exhausted the number of available applicants with 1986 and older vehicles. Districts should consider a similar strategy when establishing a fleet modernization category- initially targeting the very oldest trucks and then moving up the allowable age as the program progresses.

Under fleet modernization, the replacement vehicle must be model year 1999 or newer. A 1999 model year was selected due to reduced emission factors, concern with consent decree engines, and affordability to participants. Dual-calibration engines manufactured from 1993-1998 are bound by ARB and U.S. EPA consent degrees and are not eligible for Carl Moyer Program funding. Districts will need to verify the engine model year for 1999 model year vehicles because 1998 model year engines may have been installed and are not eligible for funding. Experience with the Gateway COG pilot program shows that a majority of their fleet modernization participants purchased 1999 model year replacement trucks. 1999 is a popular choice because it is generally the least expensive model qualified for fleet modernization funding. Selecting a newer, more expensive model year would make the fleet modernization inaccessible to program participants that are from low-paid vocations.

D. Project Life

The project life for fleet modernization projects, with the exception of target vocations, is three-years. A three-year project life was selected because inventory data show the life expectancy of a 1990 on-road, heavy-duty vehicle that is still on the road is an additional 5.5 years. This means that 50 percent of the heavy-duty fleet 15 years and older would remain on the road for another 5.5 years on average, while the other 50 percent would retire through attrition. It is expected that the old trucks volunteered for a fleet modernization project will be those with less remaining life. To be protective of air quality and ensure that real emission reductions are achieved, staff is proposing three years as an acceptable project life. This approach follows what has already been established in the existing regulations for the Voluntary Accelerated Light-Duty Vehicle Retirement Program. The light-duty program is designed to retire very old light-duty vehicles. In that program the life expectancy was reduced by 50 percent to determine the credit value.

Targeted vocations are allowed a five-year project life because they are known to keep the oldest vehicles in service for more years and would be less likely to replace their trucks with a newer truck than the average old truck owner. Data indicate that in these very limited target vocations, the normal practice for purchasing vehicles is to purchase vehicles of the same age or older. Staff proposes that for these vocations, the data justifies allowing a five-year project life.

E. Weight Class

The focus of the fleet modernization pilot programs has been the replacement of heavy heavy-duty trucks with all analysis conducted on the heaviest class of vehicles. Fleet modernization projects will continue to focus on vehicles having a gross vehicle weight rating of 33,000 pounds and greater. However, some districts have expressed an interest in including vehicles in the medium heavy-duty class. Districts may request inclusion of medium heavy-duty vehicles with a weight class rating of 19,501-33,000 pounds on a case-by-case basis.

F. Salvage Requirements

Fleet modernization requires that the old truck be scrapped. To ensure that the vehicle will not be used again, the criteria specify that a qualified salvage yard must drill a hole in the engine block and cut the frame rails of the old vehicle. This requirement has been established to ensure that emission reductions are real. It prevents the old trucks from being moved into another locale to continue emitting high levels of pollutants.

G. Electronic Monitoring Units

All fleet modernization replacement vehicles must be equipped with an electronic monitoring unit (EMU). The EMU electronically reports vehicle miles traveled and the number of miles a vehicle has operated within California and district boundaries. This requirement has been established to verify that the replacement vehicle continues to operate in the same location as the old, scrapped vehicle. The ARB is developing a state services master agreement to assist local air districts and to streamline the local contracting process for EMUs.

H. Funding Caps

The fleet modernization criteria sets a maximum funding amount of 72 percent of the value of a used, replacement vehicle and 80 percent of the invoice price of a new vehicle. These caps are based on the maximum loan value available through lending institutions.

I. Subtracting the Cost of Repairs

Fleet modernization projects are required to subtract the cost of repairs needed for the old vehicle from the incremental cost of the project. The cost of repairs is subtracted because it is assumed that repair costs are a normal business expense that would have been incurred by the participant had the vehicle stayed in service. The repair costs are identified during the inspection verifying the operating condition of the old vehicle.

J. Tiered Transactions

Tiered transactions are an additional vehicle replacement strategy available through fleet modernization. A tiered transaction combines the emission reductions achieved from the purchase of a new vehicle meeting the optional NOx standard with a basic fleet modernization project. Combining both transactions provides additional incentives to offset the cost of purchasing the vehicle meeting the optional standard. However, linking the purchase of the new vehicle by one owner, with the retirement of an old truck and purchase of a replacement truck by a second participant, presents complexities that are not found in the basic fleet modernization transaction. Tiered transactions are a new concept enacted by legislation and have not been included in the pilot programs. Local air districts may develop and implement tiered transactions as part of their fleet modernization component. ARB must approve a district's proposed tiered transaction component prior to implementation.

K. Administrative Tools

The ARB must review and approve local air district fleet modernization guidelines prior to the district funding fleet modernization projects. This requirement has been established because both pilot programs show there are many administrative tools needed to implement fleet modernization. These include: contracts with the applicant, dealers and scrap yards; performance requirements; reimbursement procedures; pre- and post-inspections; and, monitoring and enforcement considerations. This requirement will help achieve ARB's goal of establishing a robust, verifiable, enforceable fleet modernization component that reaches previously non-eligible sectors. As with all Carl Moyer Program components, districts are provided with outreach funds, which are approximately two percent of the Carl Moyer Program grant. In addition, there are a number of funding sources districts may use to cover in-kind costs. When using these other funding sources, districts must follow the guidelines for expending those other funds.

VI. Potential Projects

As discussed, there are two types of potential projects available under the fleet modernization category. The first is the replacement of an old vehicle (1990 or older) with the new or newer vehicle (1999 or newer). The second type of project is a tiered transaction, which links the emission reductions achieved from the purchase of a new vehicle meeting the optional NOx standard with the retirement of an old vehicle (1990 and older). Under the tiered transaction project, two transactions take place:

- A participant proposes the purchase of a new vehicle meeting the optional NOx standard and estimates the cost of this transaction based on a new, heavy duty vehicle purchase (as discussed in Chapter One, Section V-C).

- This same owner identifies a standard fleet modernization project that meets the fleet modernization criteria and estimates the cost-effectiveness of the project.

- The combined cost-effectiveness of both transactions is used to determine cost-effectiveness.

Tiered transactions could potentially be utilized by one party that purchases new equipment meeting the optional standard and contributes replacement vehicles to a fleet that has old vehicles.

In addition to replacing an old, high-emitting vehicle with a newer, cleaner vehicle, fleet modernization requires the use of diesel emission control strategy (DECS) on all projects. An ARB-verified DECS is required on all fleet modernization vehicles. In selecting the appropriate DECS for the project, preference is given to the device providing the highest level of emission reductions. Examples of DECS include diesel particulate filters, diesel oxidation catalysts, and flow through filters. Incentive funds may be used to cover the cost of DECS maintenance and filters needed for the duration of the project life.

The requirement for a DECS may be waived. The waiver must be based upon the specifics of individual projects including cost, vehicle duty cycle restrictions, availability, and other factors. Additional details regarding the DECS requirement, including funding and data logging options, are included in Section VII-C.

VII. Proposed Project Criteria

Fleet modernization projects, which include scrapping an old, high-emitting vehicle and replacing it with a newer, cleaner vehicle, are eligible for incentive funding. The proposed project criteria listed below provide the minimum qualifications for the Carl Moyer Program. Sample calculations that illustrate the methodology for determining emission reductions and cost-effectiveness are included in Appendix D.

Participating districts retain the authority to impose additional requirements in order to address local concerns.

A. General Criteria

- Emission reductions obtained through Carl Moyer Program projects must not be required by any federal, state or local regulation, memorandum of agreement/understanding with a regulatory agency, settlement agreement, mitigation requirement, or other legal mandate.

- Projects must meet a cost-effectiveness of $14,300 per weighed ton of NOx + ROG + combustion PM10 reduced calculated in accordance with the cost-effectiveness methodology discussed in this chapter.

- No emission reductions generated by the Carl Moyer Program shall be used as marketable emission reduction credits or to offset any emission reduction obligation of any person or entity.

- No project funded by the Carl Moyer Program shall be used for credit under any federal or state emission averaging banking and trading program.

- In funding fleet modernization projects, the replacement vehicle must reduce NOx emissions by at least 15 percent from the old vehicle emissions.

- Carl Moyer Program grants can be no greater than a project's incremental cost. The incremental cost is the cost of the project minus the baseline cost. The incremental cost shall be reduced by the value of any current financial incentive that reduces the project price, including tax credits or deductions, grants, or other public financial assistance.

- Fleet modernization projects have a minimum project life of three years. Project life is the number of years that a Carl Moyer Program project must operate in California under the conditions specified in the grant funding agreement.

- The default project life does not consider upcoming regulatory requirements. Project life may be shorter due to regulatory requirements.

- Fleet operators with vehicles in open vocation categories are eligible to receive funding for a maximum of five vehicles. There is no restriction on the number of vehicles per fleet that can be funded in targeted vocation categories.

- Fleet modernization project life must be equal to the project contract life.

- Vehicles equipped with glider kits are not eligible to participate in the fleet modernization category; this includes both old and replacement vehicles. Glider kits are replacement chassis and cab for on-road heavy-duty vehicles. Glider kits are identified with a vehicle identification number (VIN) starting with the letters "GL".

- Potential projects that fall outside of these criteria may be considered on a case-by-case basis if evidence provided to the air district suggests potential surplus, real, quantifiable and enforceable emission reduction benefits.

- Air districts must consult with ARB staff to determine eligibility of all projects considered for funding on a case-by-case basis. All projects considered on a case-by-case basis must receive ARB approval prior to receiving program funding.

B. Participant Requirements

The following categories of vehicles are eligible for Carl Moyer Program funding:

- **Open Category**: Vehicles from any vocation or fleet size are eligible for funding provided the participant submits conclusive documentation of annual mileage and vehicle usage in California. The maximum project life is three years.

- **Targeted Vocation Category**: Vehicles operating in agricultural, construction, mining, port hauling, and forestry vocations, or vehicles that move goods in and out of ports and rail yards may apply as a targeted vocation. The participant is required to submit conclusive documentation of annual mileage and vehicle usage in California. The maximum project life is five years.

- The old vehicle must have both engine and chassis of model year 1990 or older.

- The old vehicle must have been registered in California for the previous three years.

- The old vehicle must be in operational condition to qualify for funding. Operating condition must be determined through a California Highway Patrol's Biennial Inspection of Terminals (CHP BIT) or equivalent inspection. The inspection must identify any needed repairs and the estimated cost of the repairs. The district will also verify the operating condition of the truck by a visual and operational inspection. If the district cannot conduct a pre-inspection, the ARB may approve one of the following methods on a case-by-case basis:

  - The motor carrier company may submit a completed CHP 90-Day Safety Inspection Form documenting their inspection and the estimated cost of any repairs.

  - A participating dealership or motor company may conduct the inspection of the old vehicle and provide pictures verifying the vehicle condition. The dealer must provide a completed CHP 90-Day Safety Inspection Form and documentation of any necessary repairs. The participant will pay the cost of the inspection.

  - Other methods as approved by ARB.

- The participant must currently own and operate the old vehicle. If it is unclear whether a vehicle is owned or leased by a participant, the district will determine whether the vehicle is eligible.

- Participants must submit documentation of annual miles traveled for the previous three years to determine cost-effectiveness. Examples of documentation include: logbooks; fuel records; and/or maintenance records.

- The participant must maintain replacement value insurance coverage for the project life.

- The participant must be in compliance with air quality laws; all outstanding citations must be paid up.

C. Replacement Vehicle Requirements

All replacement vehicles must meet the following conditions before funding is awarded to the participant.

- Model Year: The replacement vehicle must have both an engine and chassis model year of 1999 and newer.

- The replacement vehicle must operate in the same vocation for the project life. The participant must stay in the contracted vocation for a minimum of 85 percent of the miles, as specified in the application. If a change of vocation is required to stay in operation, a written explanation must be provided to the district and approved by the ARB.

- The annual mileage of the replacement vehicle must not exceed 150 percent of the baseline project mileage, except as approved by the district and ARB.

- Engine Horsepower Requirements: The horsepower rating for the replacement vehicle engine must not be greater than 120 percent of the original manufacturer rated horsepower (baseline horsepower) for the old vehicle engine. This is necessary because engine horsepower is related to the emissions produced by heavy-duty diesel engines. Auditing of the replacement vehicle's horsepower may occur throughout the length of the agreement.

  - Participants must use the horsepower rating listed on the old engine tag. If the engine tag is not legible, a dynamometer test can be used to determine the horsepower rating. The results of a dynamometer test will take into account a 15 percent loss in actual horsepower, based on transmission loss. The participant must pay the cost of dynamometer testing.

  - In the event the replacement engine horsepower is more than 20 percent greater than the old vehicle, it must be derated (reduced) to not exceed the 20 percent allowable increase. The 20 percent allowable increase in horsepower is calculated as follows:

    (Old Engine Horsepower) x (1.20) = Maximum New Engine Horsepower
    (Example: 300 HP x 1.20 = 360 HP)

  - In limited situations, the district may approve a greater than 20 percent increase in horsepower.

- Weight Class: Eligible vehicles must have a California heavy-heavy gross vehicle weight rating of 33,000 pounds. Vehicles having a California medium heavy-duty weight rating of 19,501-33,000 pounds may be eligible upon the request of the district on a case-by-case basis. The replacement vehicle must be in the same weight rating as the old vehicle.

- Body and Axle Configuration: The replacement vehicle must have the same axle and body configuration as the old vehicle. The district may allow slight changes based on the latest technology. Changes must be requested and approved prior to the purchase of the replacement vehicle.

- Warranty Requirements: All participants must purchase a minimum of a one-year or 100,000-mile major component engine warranty for the replacement vehicle. The warranty must cover parts and labor. It is recommended that the highest grade warranty be purchased in order to avoid expensive repairs in the future. No Carl Moyer funds will be issued for maintenance or repairs related to the operation of the vehicle. The participant takes sole responsibility for ensuring that the vehicle is in operational condition throughout the agreement period.

- ARB Verified Diesel Emission Control System (DECS): An ARB-verified DECS is required on all replacement vehicles.

  - In selecting the appropriate DECS for the project, preference shall be given to the DECS providing the highest level of NOx and PM10reductions.

  - The DECS must be installed prior to vehicle delivery to the participant and must stay in operation on the replacement vehicle for the project life.

  - The cost of the device, and all filters and maintenance of the filters needed during the project life, may be paid for with incentive funding provided it meets the cost-effectiveness limit.

  - Upon approval of the ARB, the district may waive the requirement for installation of the DECS. The waiver must be based upon the specifics of individual projects, including cost, vehicle duty cycle restrictions, availability, and other factors.

  - Data-logging may be conducted on the old vehicle to determine the proper DECS device needed for the replacement vehicle. Data-logging, which is the collection of exhaust temperatures, must be conducted while a vehicle is in service. The information gathered from the old vehicle is applied to the replacement vehicle. Data-logging may be paid for with incentive funding, if it meets the cost-effectiveness limit.

  - The participant must maintain the DECS as specified by the manufacturer's warranty requirements. The participant must provide maintenance reports to the district as required.

  - If an ARB-approved DECS is not available at the time the replacement vehicle is purchased, a DECS will be installed when a DECS compatible with the engine and the vehicle duty cycle has been verified by ARB, unless otherwise stipulated at the time of purchase by the district.

- Vehicles outfitted with dual exhaust will be addressed on a case-by-case basis. The district will determine if no DECS is required, or if a DECS shall be installed on both exhaust tailpipes, or if the exhaust shall be converted to a single pipe with a DECS.

- Additional information on retrofit systems is included in Appendix F - Retrofit Emission Control Systems.

- Electronic Monitoring Unit (EMU): The EMU electronically reports vehicle miles traveled and the number of miles a vehicle has operated within the California and district boundaries. An EMU is required on all replacement vehicles.

  - Installation and maintenance of the EMU may be included in the cost of the project.

  - If an affordable and suitable EMU is not available at the time the replacement vehicle is ready for delivery, the vehicle may be delivered to the applicant. The owner will be required to return the vehicle to the dealer when an EMU is available for installation. Verification of the installation must be submitted to the district following installation.

  - EMU data must be reported to the district for the project life.

  - If the EMU is not functioning properly as indicted by the district, the participant will submit mileage reports as specified the district.

  - Upon approval of the ARB, the district may waive the requirement for installation of an EMU.

- Engine and Emission Control Modifications: Emission controls on the replacement vehicle engine cannot be modified in any manner. Unauthorized modification to engine performance (including changes in horsepower), emission characteristics, engine emission components (not including repairs with like-original equipment manufacturers replacement parts), or any other modifications to the engine's emission control function or the EMU are not allowed.

D. Tiered Transactions

Districts may establish a tiered transaction component within their fleet modernization source category. Tiered transactions were added to the Carl Moyer Program with the enactment of AB 1394 in January 2005, but were not included in the fleet modernization pilot programs. As a result, there is no experience or model to guide districts in implementing a tiered transaction component. ARB must approve district plans for implementing a tiered transaction component prior to funding projects in this unmapped territory.

A tiered transaction combines the emission reductions achieved from the purchase of a new vehicle meeting the optional NOx standard with the replacement of a 1990 or older vehicle. In the tiered transaction, the purchaser of a new vehicle meeting the optional standard identifies a standard fleet modernization project that meets the fleet modernization criteria, including the participation of a 1999 or newer replacement vehicle. A second participant acquires the replacement vehicle and scraps a 1990 or older vehicle. Tiered transaction programs should include the following elements; however, districts may request that ARB consider alternative components.

- In determining the grant award for the purchaser of the new vehicle, the emission benefits and cost-effectiveness of the project must include two transactions:
  - Emission reductions from the currently applicable standard to the new vehicle meeting the optional standard.
  - Emission reductions from the old vehicle to the replacement vehicle.
- The baseline cost for the new vehicle purchase is the cost of a new vehicle that meets the current emission standards. The incremental cost eligible for funding is the cost of the vehicle meeting the optional standard minus cost of the vehicle meeting the existing standards. This is the standard method used for new, on-road Moyer projects.
  - Emission reductions from the old vehicle are based on the annual mileage traveled by the old vehicle.
  - The participant scrapping the old vehicle is subject to all fleet modernization project criteria. The participant purchasing the new vehicle is subject to all on-road, heavy-duty project criteria.
  - The participant purchasing the new vehicle is not eligible for emission reductions from scrapping an old vehicle within his/her own fleet.

VIII. Emission Reduction and Cost-Effectiveness Calculations

To receive weighted Carl Moyer Program funding, each fleet modernization project must meet the maximum cost-effectiveness threshold of $14,300 per weighted ton of NOx + ROG + PM10 reduced. State and local funds used to pay for a fleet modernization project are to be used in determining cost-effectiveness. Any federal incentives must be discounted from the overall grant award. Appropriate emission factors as a function of vehicle type and model year are illustrated in Tables B-5 in Appendix B. Sample calculations for the fleet modernization category are provided in Appendix D.

IX. Minimum Project Application Requirements

All fleet modernization applicants must provide the minimum information listed in the following table (Table 2-2).

Table 2-2
Minimum Application Requirements for Fleet Modernization

1. Air District

2. Applicant Information
   Company Name:
   Business Type:
   Contact Name and Title:
   Mailing Address:
   Location Address:
   Telephone Number:

3. Project Description
   Project Type: Fleet Modernization
   Applicant Name:
   Project Vocation
   Project Location:
   Vehicle Function:

4. Old Vehicle Information
   Engine Make:
   Engine Model:
   Engine Year:
   Horsepower Rating:
   Vehicle Class: GVWR (lbs):
   Annual Miles Traveled or
   Annual Fuel Usage:
   Fuel Type:
   Percent Operated in California:
   Project Life (years):

5. Replacement Vehicle Information
   VIN or Serial Number:
   Vehicle Make:
   Vehicle Model:
   Engine Make:
   Engine Model:
   Engine Year:
   Horsepower Rating:
   Vehicle Class: GVWR (lbs):
   Fuel Type:

6. For Tiered Transactions Only-
   New Optional Standard Vehicle
   VIN or Serial Number:
   Vehicle Make:
   Vehicle Model:
   Engine Make:
   Engine Model:
   Engine Year:
   Horsepower Rating:
   Vehicle Class: GVWR (lbs):
   Fuel Type:

7. Diesel Emission Control System Information
   Equipment Make:
   Equipment Model:
   Model Year:
   Level:
   Percent Reduction of NOx:
   Percent Reduction of PM:
   Verification Executive Order:

8. NOx Emissions Reductions
   Baseline NOx Emission Factor:
   NOx Conversion Factors Used:
   Reduced NOx Emissions Factor:
   Estimated Annual NOx Emissions Reductions:
9. *Projected Annual Mileage or Fuel Usage:*
10. Estimated Lifetime NOx Emissions Reductions:

11. PM10 Emissions Reductions
    Baseline PM10Emissions Factor:
    PM10Conversion Factors Used:
    Reduced PM10Emissions Factor:
    Estimated Annual PM10Emissions Reductions:

12. Estimated Lifetime PM10 Emissions Reductions:

13. ROG Emissions Reductions
    Baseline ROG Emissions Factor:
    ROG Conversion Factors Used:
    Reduced ROG Emissions Factor:
    Estimated Annual ROG Emission Reductions:

14. Estimated Lifetime NOx, ROG, and PM10 Emission Reductions:

15. Cost ($) of the Base Vehicle

16. Cost ($) of Replacement Vehicle

17. Cost ($) of DECS, includes data logging, installation and maintenance

18. Cost ($) of Electronic Monitoring Unit

19. Incremental Cost-Effectiveness
    Analysis Basis: (Mileage/Fuel/Hours of Operation)

20. District Incentive Amount Requested

A disclosure must also be included stating that the proposed project has not been funded and is not being considered for funding by another air district, ARB, or any other public agency. Any applicant who is found to have submitted multiple applications for the same project may be banned from submitting future applications to any and all Carl Moyer Program solicitations and may be subject to criminal sanctions. A project funded cooperatively by multiple air districts is eligible for funding if the project parameters are coordinated amongst the participating districts and the project meets all applicable Carl Moyer Program criteria. Applicants are allowed to re-apply for project funding if a previous application has been rejected and is no longer being considered for funding.

Third party applications are not allowed. The owner of the engine must sign and agree to the application. However, a third party (e.g. engine dealer or distributor) may complete an application or part of an application on an owner's behalf. Applications must include a signature section for third parties. The third party signature section must include signature and date lines, and blanks for the third party to list how much they are being paid, if anything, to complete the application and what source of funds are being used to pay them. To make the Carl Moyer Program accessible to all potential applicants, including applicants that cannot afford to hire third party assistance, districts are encouraged to provide technical assistance to applicants in completing the application.

In addition, the following items must accompany the completed application at the time of submittal:

- A copy of the old vehicle title.
- Copies of California Motor Carrier Permits and permit applications for the last three years. If the participant does not have a Motor Carrier Permit, submit copies of the Department of Motor Vehicle registration and proof of insurance for the old vehicle for the last three years.
- The participant must provide mileage verification for the previous three years.
- Proof of vehicle vocation for the last three years.
- The participant may be required to provide either:
  - Copies of the participant's United States Internal Revenue Service Form 2290 (Heavy Highway Vehicle Use Tax Return) for the previous three years.
  - United States Internal Revenue Service Schedule C.
- If the old vehicle engine tag is missing, the participant may be required to provide a dynamometer printout of the engine horsepower from a participating engine

dealership, or another means of obtaining the required information approved by the ARB.

- The district may request any additional information.

X. Administrative Requirements

Districts must establish fleet modernization policies and guidelines before they can fund fleet modernization projects. Many administrative tools are needed to manage a reliable fleet modernization source category. This includes agreements with local dealerships and salvage yards, reimbursement procedures, the development of contracts, etc. The ARB must approve district fleet modernization policies and guidelines prior to district implementation of a fleet modernization category. The ARB will provide examples for district use. The district's fleet modernization guidelines must address all of the above criteria as well as the items discussed in the following sections.

A. Determining Awards

Grant award determinations must be made with the following considerations:

- Funding awards are based on the average miles per year driven during the previous three years. Fleet averages can not be used. Participants must submit conclusive documentation of mileage including logbooks, fuel records, and maintenance records maintained for individual vehicles.

- The incentive amount available for the purchase of the vehicle will be based upon three criteria: cost-effectiveness of the project based upon the weighted NOx + ROG + combustion PM10 emission benefits as calculated by the district; the value of the used vehicle based upon the National Automotive Dealership Association (N.A.D.A.) adjusted loan value or new vehicle invoice price; and, less any costs associated with repairs noted during the vehicle inspection.

- The maximum reimbursement for all awards will be the N.A.D.A. adjusted loan value of the replacement truck or the maximum calculated incentive -- whichever is less. The funding amount of a used, replacement vehicle shall not exceed the value of the vehicle given by the N.A.D.A. commercial vehicle guide adjusted loan value. The funding amount of a new replacement vehicle shall not exceed 80 percent of the invoice price.

- If suitable equipment is available and deemed cost-effective by the district, supplemental incentive funding will be provided to cover installation of a DECS and/or an EMU.

- Incentive funding can only be used to pay for items essential to the operation of the vehicle. Optional items, such as cigar lighters and custom mud flaps, must be paid for at the owners expense.

- The participant may obtain financing to assist in the purchase of a replacement vehicle.

B. Dealer Requirements

Districts are encouraged to establish contracts with dealers that are selling replacement vehicles to fleet modernization participants. Experience with the pilot programs has shown that dealers have provided participants with needed assistance in the application process. Vehicle dealers are encouraged to help in the application process as much as possible. If districts use vehicle dealers in implementing the fleet modernization category, reimbursement cannot be issued until <u>all</u> forms are submitted and approved by the district.

Participants may purchase the replacement vehicles from a private party, provided all required documentation is submitted. This includes warranty requirements and all other fleet modernization requirements.

Vehicle dealers are expected to do the following:

- Provide basic information about the fleet modernization category. Districts will provide liaison training to dealership staff.

- Inform participants of rights and responsibilities as outlined in the district and ARB guidelines.

- Help the participants complete the application. The vehicle dealers will ensure that the participant correctly completes the application. It is important to make sure that all information is filled out correctly and that the participant understands the meaning of the program and the contract. The district will provide all forms and certificates as appendices to the application. Once complete, the dealer will submit the application package to the district.

To ensure that an application package is complete, the dealer will make sure that all the following items are complete and included in the participant's submission to the district. The following must be completed before reimbursement can be made:

- Submit a signed and complete application.

- Provide documentation showing that the old vehicle is roadworthy. This includes documentation showing that the old vehicle has passed a CHP BIT inspection old vehicle in the past 90 days or conduct an equivalent vehicle inspection and sign as appropriate. The district reserves the right to audit the dealer's record of inspection.

- Provide invoices of all work performed on the replacement vehicle. The invoices must include all engine, transmission, body and other work performed on the replacement vehicle. Invoices must include the installation of all equipment required by this program: EMU (at the discretion of the district), diesel emission control system (at the discretion of the district), and engine horsepower derated, if necessary.

- Submit digital photographs of the old vehicle and the replacement vehicle to the district. The district will specify the required digital format. Reimbursement will not be processed until all photographs are received and verified by the district. Before submitting photographs to the district, dealers must verify that photographs are clear. All VIN and engine serial numbers must be legible.

  Photographs of the old vehicle must include the following views:

  - Right Side - hood down.
  - Front - hood down.
  - Left Side - hood down.
  - VIN Tag - inside vehicle or on frame rail.
  - Engine - left side.
  - Engine - right side.
  - Engine Serial Number - either tag or stamp on block.
  - License plate.
  - Rear.

  Photographs of the replacement vehicle must include the following views:

  - Right Side - hood down.
  - Front - hood down.
  - Left Side - hood down.
  - VIN Tag - inside vehicle.
  - VIN Tag - on frame rail.
  - Engine - left side.
  - Engine - right side.
  - Engine Serial Number and Engine Information – tag.
  - License plate.
  - Rear.
  - Electronic Monitoring Unit (in working condition).
  - Diesel Emission Control Device (if available).
  - Odometer Reading.
  - Additional modifications (if applicable).

- Provide certification that the old vehicle will be delivered to a qualified salvage yard. The certification must state that the dealer will deliver the vehicle to the salvage yard within 30 days of receipt of the old truck. The contract must include the make, model, year, VIN, engine make, engine serial number, and the date the vehicle is expected to be delivered. It is the dealer's responsibility to ensure that the salvage actually occurs, to obtain the completed Certificate of Vehicle Destruction, and to ensure that the Certificate of Vehicle Destruction has been filed with the district. The district will not cover the salvage costs.

- Provide documentation of replacement vehicle warranty and registration.

- Provide proof of replacement vehicle financing. The financing package will enable the district to determine the reimbursement costs that may be accrued in case the participant defaults on the contracted performance requirements.

Prior to releasing the replacement vehicle to the participant, the dealer must have documentation of a district pre-inspection of the old vehicle and a post-inspection of the replaced vehicle. Upon request of the district, ARB may waive inspection requirements.

After the application and all required documentation have been approved by the district, the dealer must provide the district with proof of sale of the replacement vehicle.

C. Salvage Requirements

Destruction of the old vehicle chassis and engine permanently removes the old, high emitting vehicles from service. The old vehicle must be driven to a qualified vehicle salvage yard for destruction. Vehicle salvage yards are required to enter into an agreement with the district to qualify for participation. Qualified vehicle salvage yards are required to be licensed by the Department of Motor Vehicles (DMV) as an auto-dismantler; have a current, valid California Environmental Protection Agency (Cal/EPA) Hazardous Materials Generators Permit; and be in compliance with all local, state and federal laws and regulations.

Funding is not available for the salvage of any old vehicle. The vehicle salvage value will be negotiated between the participant, the dealership and the salvage yard. The salvage yard operator must do the following:

- Dismantle the old vehicle within 60 days of receipt. The destruction must be done in accordance with program guidelines.

- Drill a hole in the engine block of the old vehicle to ensure that block will not be used again.

- Cut the frame rails of the old vehicle to ensure that the vehicle will not be used again.

- Take photographs of the hole in the engine block and the cut frame rails. Photographs of the destroyed engine block and cut frame rails must be provided to the district within ten business days of salvaging the vehicle. The following picture views must be taken:

  - Front of vehicle with hood down.
  - Right side of vehicle with hood down.
  - Left side of vehicle with hood down.
  - Serial number printed either on the tag inside in the cab or on the frame rail.

- Engine side view.
- Engine serial number either stamped on the block or on the tag.
- Hole in the engine block either in-frame or out of frame.
- Cut frame rails.

- File a "Non-Repairable Vehicle Certificate" with the DMV.

- Upon request of the district, ARB may approve an alternative disposition for the old vehicle.

D. Pre- and Post-Inspections

To protect the integrity of the fleet modernization source category, districts must conduct a pre-inspection of the old vehicle and a post-inspection of the replacement vehicle. Districts are encouraged to design rigorous pre- and post-inspection procedures. At a minimum, the inspection of the old vehicle must be conducted to establish that it has been in service, that it meets the described weight class and configuration, and that costs associated with needed repairs have been identified and deducted from the incentive award. The cost of repairs needed for the old vehicle will be subtracted from the incremental cost of the grant award.

Post-inspection of the replacement vehicle must be conducted to verify that the vehicle meets the contract description, including class and configuration descriptions, DECS and EMU installation, and any other items deemed necessary to confirm the authenticity project. Upon the request of the district, the ARB may approve an alternative method of ascertaining the authenticity of the old and replacement vehicle.

E. Minimum Reporting Requirements

Fleet modernization reporting requirements have been established to verify that project participants meet contract requirements and to quantify the emission reductions achieved through the Carl Moyer Program. Fleet modernization projects are subject to the following minimum reporting requirements:

- If the participant has a California Motor Carrier Permit, a current copy must be submitted to the district annually. If the participant does not have a California Motor Carrier Permit, the participant must provide registration and proof of insurance to the district annually.

- The participant must provide annual reports for the life of the project. The report on the replacement truck will include information such as the number of hours of operation, miles driven in the district and California, the amount of fuel consumed in the twelve months preceding the report date, details regarding maintenance and servicing, and any other items specified by the district.

- Participants from targeted vocation categories must provide documentation of vocation on an annual basis.

- If the replacement vehicle is involved in an accident, the participant must report the accident to district staff within 14 days. The participant will be required to provide a police report of the accident, a letter from the insurance company regarding the accident and any additional information requested by the district. The participant is required to repair the vehicle and return it to operation, if possible. Down time due to an accident will be credited toward the performance requirements as along as the information is reported as requested and the repairs are made as soon as possible. If the vehicle is totaled, the participant and the district staff must come to an agreement regarding any requirements that still need to be met.

F. Compliance Checks

After the district qualifies fleet modernization projects for funding, but before the district APCO signs an agreement for funding a project, the district must submit the project to ARB to check for outstanding violations. The process for completing the compliance check is as follows:

- The district shall email their ARB district liaison the contact name, organization or business name and VIN for the project.

- The liaison shall then forward that information electronically to the responsible parties at ARB. The liaison will email the district the results of the compliance check within five working days.

- If the compliance check indicates there is an outstanding violation the district shall inform the applicant in writing that no disbursement may be made until the owner provides proof that the fines have been paid.

- Clearance of the citation requires proof of repair or a "Statement of Facts" documenting that the old truck will be scrapped. The "Statement of Facts" can be written by the dealer or the participant explaining the old truck will be scrapped as required by the Carl Moyer fleet modernization program. The statement and a copy of the fleet modernization contract should be provided along with the penalty payment. Include the citation number on all documents.

G. Recovery of Incentive Funds

The district must establish a mechanism to assure the participant fulfills all contractual obligations. This includes owning and operating the replacement vehicle for the project life, and staying in the agreed upon vocation for the duration of the contract. Participants must meet an 80 percent minimum baseline mileage requirement for the life of the project and agree to repay a pro-rated portion of the incentive funding for failure to fulfill the minimum performance requirements. The district will determine the method of notice and achieving fund recovery. Options may include:

- List the district as co-lien holder on the title of the replacement vehicle for the term of the agreement. The participant must submit a completed Uniform Commercial Code-1 Financing Statement Form to the California Secretary of State, with a copy sent to the district, within 30 days of the purchase of the replacement vehicle. The financing statement must have the district as the secured party and the vehicle should be listed as collateral.

- The participant must be the registered owner of the replacement vehicle for the project life. If the replacement vehicle is sold within the project life, the new owner must assume the obligations under the participant's contract with the district and comply with the terms and conditions of the contract. The district must approve the change in ownership prior to the sale.

XI. References

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Chapter Three

REDUCING IDLING EMISSIONS FROM HEAVY-DUTY VEHICLES

This chapter addresses the project criteria for idling reduction technologies that may be installed on on-road heavy-duty vehicles. Projects that meet the criteria may be considered for Carl Moyer Program funding. This chapter contains a brief overview of the engine idling practices of truck operators, emission inventories, available control technology, emission reductions and cost effectiveness calculations. This chapter expands eligible idling reduction techniques to electrification projects. Information specific to electric auxiliary power units (APU) and other zero-emission technologies is provided in Chapter 12: Zero-Emission Technologies.

I. Introduction

Heavy-duty vehicles are employed in line-haul service carrying goods across the state and throughout the nation. The majority of heavy-duty vehicles are powered by diesel engines. Heavy-duty vehicles employed in line-haul service are typically greater than 33,000 pounds gross vehicle weight rating (GVWR), are grouped under a Class 8 truck classification, and often accrue very high annual mileage. It is not uncommon for a line-haul truck to accrue 100,000 miles or more annually. These heavy-duty vehicles (HDV) idle at low engine speeds for a significant amount of time for various operational reasons. The low engine efficiency at these idle speeds results in significant increases in fuel consumption and emissions.

Truck idling practices vary among different fleets, operators, and geographical locations. Two main purposes of idling are to keep the engine and fuel warm, especially in cold weather, and to heat or cool the truck's cab/sleeper compartment. Although technologies for reducing idling emissions from heavy-duty trucks are commercially available, relatively high initial costs have prevented these idling reduction strategies from being more widely utilized.

The average power demand for an APU operating under extreme climate conditions is estimated to be approximately 2.3 kilowatts (kW) for winter conditions and 3.1 kW for summer conditions [Wallace, 2003; Lutsey, 2003]. Staff assumed that the diesel-fueled APU would provide an average of 2.7 kW power to provide sleeper berth comfort and electrical power for accessories.

The Carl Moyer Program can provide incentives to reduce emissions from truck idling by encouraging the purchase and installation of alternative idling reduction technologies. These technologies not only reduce idling emissions from heavy-duty trucks, but can also result in fuel savings and reduced maintenance costs to truck operators.

II. Emissions

According to the Air Resources Board's (ARB or "Board") emission inventory, idling emissions from heavy heavy duty diesel (HHD) trucks account for approximately 29 tons per day (tpd) of nitrogen oxides (NOx), 1.6 tpd of reactive organic gases (ROG) and 0.7 tpd of particulate matter (PM10). This represents about 7 percent of the total NOx, ROG and PM10 emissions from this sector of vehicles in California. Idling emissions from individual trucks are significant and the idling emission rate for HHD diesel trucks is large. For example, a single HHD truck that idles an average of 1,500 hours per year emits approximately: 564 pounds/year of NOx, 114 pounds/year of ROG and 7.6 pounds/year of PM10 from idling.

III. Regulatory Requirements

A. School Bus Idling

An airborne toxic control measure (ATCM) became effective on July 16, 2003, that restricts idling by school buses and other special classes of vehicles at schools. The regulation also limited the idling of these buses and vehicles to no more than five minutes when within 100 feet of a school. [ARB, 2003]

B. Heavy-Duty Vehicle Idling

On February 1, 2005, an ATCM became effective that extended idling limitations beyond school buses to include diesel APUs, and heavy-duty diesel trucks over 10,000 GVWR. The ATCM specifically limits idling of the main engine or the operation of diesel-fueled APU systems when health, safety or operational concerns are not an issue. This regulation limits the idling of HDVs to no more than five minutes if the truck is within 100 feet of a school or home. These requirements apply to both California and non-California trucks.

In addition to statewide restrictions on idling, some local government and municipalities have ordinances restricting idling time for some types of vehicles. Carl Moyer Program funding for projects must be surplus to the requirements of both the ATCM and local ordinances.

C. Proposed Idling Restrictions

In October 2005, the Board will consider a proposal that would remove the exemption for idling of heavy duty trucks equipped with sleeper berths. This proposal would prohibit heavy duty trucks with sleeper berths from idling more than five minutes unless certain conditions are met. Beginning in 2008, model year 2006 and older trucks may operate certified diesel APUs. Model year 2007 and newer trucks may only operate an APU for longer than 5 minutes if the exhaust of the APU is equipped with a Level 3 PM retrofit device or is routed through the main engine exhaust with a Level 3 PM retrofit device; however, the truck must not be within 100 feet of a restricted area such as a school or residential area. In addition, 2008 and subsequent model year heavy-duty trucks may idle longer than five minutes in a non-restricted area if the main engine meets a low NOx standard of 30 g/hr. [ARB, 2004]

If the Board approves the staff recommendations, the baseline for calculating the benefits of truck idle reduction projects would be a certified diesel APU. Zero-emission technologies would be eligible for funding using the lower emission baseline.

IV. Potential Projects

A. Auxiliary Power Units

APUs are usually installed on the truck chassis outside the truck cab to provide power for the truck's accessory loads and to keep the engine warm when the truck is parked. This allows the operator to refrain from idling the truck's main engine. The extent of labor involved in the installation of an APU on the truck depends on the configuration of the truck engine and chassis and the plumbing of its heating/cooling system. Heating and cooling of the cab compartment are accomplished through either dedicated equipment supplied with the APU or through the truck's existing heating and cooling system. APUs are commercially available and meet most of the power needs of truck operators. Some APUs are available with an electric option for a few hundred dollars more.

B. Truck Stop Electrification

Another strategy for reducing truck idling is the retrofit of trucks with components such as engine block heaters, fuel heaters, electric heaters and air conditioning for cab/sleeper areas. This strategy requires the installation of charging infrastructure at truck stops and rest areas. Specific information and project criteria pertaining to truck stop electrification is provided in the Zero-Emission Technologies Chapter.

C. Advanced Travel Center Electrification

An alternative to truck stop electrification that does not require truck modification has been introduced by IdleAire Technologies. Specific information and project criteria are provided in the Zero-Emission Technologies Chapter.

D. Direct-Fired Heaters and Thermal Storage

Direct-fired heaters for truck heating applications are devices that use the combustion heat of a small internal combustion engine to provide heat directly to the truck's cab/sleeper area through the use of a small heat exchanger. Because it is designed to provide heat directly from a combustion flame, the heating efficiency of these units is higher than that obtained through the truck's engine due to reduced mechanical losses and fuel consumption. Two primary limitations of direct-fired heaters for this application are that they cannot provide cooling and that they draw on the truck's battery power during operation. Direct-fired heater technologies continue to evolve, but they have not gained widespread commercial acceptance.

Thermal storage systems provide both heating and cooling for the cab/sleeper area. This technology uses the heat of transformation associated with material phase change to provide heating and cooling to the cab/sleeper area. However, the technology cannot provide cooling at night unless the truck's air conditioner was used in the daytime.

V. Proposed Project Criteria

The project criteria for eligible idling reduction strategies for heavy-duty vehicles provide districts and fleet operators with the minimum requirements for participation in the Carl Moyer Program. The criteria have been developed specifically for idling reduction technologies that will be installed on a heavy-duty truck to reduce the truck's idling emissions. The ARB may develop additional project criteria for idling reduction strategies if additional technologies enter the market.

Idling reduction technologies provide a cost-effective means to reduce idling emissions from heavy-duty diesel trucks. Carl Moyer Program funds can be used to pay for a portion of the capital cost of idling reduction equipment as well as the installation costs.

A. General Criteria

- Emission reductions obtained through Carl Moyer Program projects must not be required by any federal, state or local regulation, memorandum of agreement/understanding, settlement agreement, mitigation requirement, or other legally binding document.

- Projects must meet a cost-effectiveness of $14,300 per weighed ton of NOx + ROG + combustion PM10, reduced calculated in accordance with the cost-effectiveness methodology discussed in this section.

- No emission reductions generated with funding from the Carl Moyer Program shall be used as marketable emission reduction credits, or to satisfy any emission reduction obligation of any person or entity.

- No emission reductions from a project funded by the Carl Moyer Program shall be used for credit under any federal or state emission averaging, banking and trading program

- Carl Moyer Program grants shall be no greater than a project's incremental cost. The incremental cost is the cost of the project minus the baseline cost. The incremental cost shall be reduced by the value of any current financial incentive that reduces the project price, including but not limited to tax credits or deductions, grants, or other public financial assistance.

- Projects must have a minimum project life of three years. The ARB may approve shorter project life in writing for good cause on a case-by-case basis. Projects with shorter lives may be subject to additional funding restrictions, such as a lower cost-effectiveness limit or a project cost cap.

- The contract term must extend to the end of the project life.

- The default project life does not consider upcoming regulatory requirements. Project life may be shorter due to regulatory requirements.

- Air districts must consult with ARB staff to determine eligibility of all projects considered for funding on case-by-case basis. All projects considered on a case-by-case basis must receive ARB approval prior to receiving program funding.

- Repower projects must provide at least a 15 percent NOx emission benefit compared to baseline idling NOx emissions.

- 75 percent of the APU usage must be in California. The ARB may approve exceptions on a case by case basis.

- Air districts are encouraged to co-fund projects that will produce emission reductions in more than one air district.

- Potential projects that fall outside of these criteria may be considered on a case-by-case basis is evidence provided to the air district suggests potential surplus, real, quantifiable and enforceable emission reduction benefits.

- Air districts must consult with ARB staff to determine eligibility of all projects considered for funding on a case-by-case basis. All projects considered on a case-by-case basis must receive ARB approval prior to receiving program funding.

B. APUs and Alternative Technologies

- The engine used in an APU must meet current emission standards, be certified by the ARB for sale in California, and comply with all applicable durability and warranty requirements.

- If an internal combustion engine APU is available with an electric option, the ARB strongly recommends installation of the electric option.

- An hour-meter or other means to measure usage must be installed with an APU to track operation. The participant shall provide this information to ARB or the district upon request during the life of the project.

- The default load factor for the engine used in an APU shall be the maximum power rating of the engine, unless another load factor is proposed by the participant and supported by proper documentation as determined by the ARB.

- Emission benefits must be based on the vehicle's idling time that occurs in California. At least 75 percent of the idling time must be in California. ARB may approve exceptions on a case-by-case basis.

- The actual capital cost, up to $5,500, of an APU may be eligible for funding.

- The installation cost of an APU, including installation of an hour-meter, up to a maximum of $1,700 per diesel APU and a maximum of $3,400 per alternative fuel, electric motor, or fuel cell APU, may be funded.

- The full cost of a PM retrofit device may be funded provided that the cost-effectiveness for the overall project does not exceed $14,300.

C. Scrap

- A baseline engine in a repower project must be destroyed by scrapping or drilling a hole in the engine block rendering it inoperable unless prior approval for alternate disposition has been granted by ARB staff. At the discretion of the district, core charges are eligible for funding and, if included, must be part of the cost-effectiveness calculation.

VI. Minimum Project Requirements

A. Application

In order to qualify for incentive funds, districts make applications available and solicit proposals for reduced-emission projects from HDV operators. The applicant must provide at least the following information listed in Table 3-2.

A disclosure must also be included stating that the proposed project has not been funded and is not being considered for funding by another air district, ARB, or any other public agency. Any applicant who is found to have submitted multiple applications for the same project may be banned from submitting future applications to any and all Carl Moyer Program solicitations and may be subject to criminal sanctions. A project funded cooperatively by multiple air districts is eligible for funding if the project parameters are coordinated amongst the participating districts and the project meets all applicable Carl Moyer Program criteria. Applicants are allowed to re-apply for project funding if a previous application has been rejected and is no longer being considered for funding.

Third party applications are not allowed. The owner of the engine must sign and agree to the application. However, a third party (e.g. engine dealer or distributor) may complete an application or part of an application on an owner's behalf. Applications must include a signature section for third parties. The third party signature section must include signature and date lines, and blanks for the third party to list how much they are being paid, if anything, to complete the application and what source of funds are being used to pay them. To make the Carl Moyer Program accessible to all potential applicants, including applicants that cannot afford to hire third party assistance, districts are encouraged to provide technical assistance to applicants in completing the application.

Table 3-2 Minimum Application Information Auxiliary Power Unit Projects

1. Air District 2. Project Funding Source: 3. Applicant Demographics Company Name: Business Type: Mailing Address: Location Address: Contact Number: 4. Project Description Project Name: Project Type: Vehicle Function: Vehicle Class: GVWR(lbs): 5. NOx, ROG and PM10 Reduction Incremental Cost-effectiveness Analysis Basis: (Mileage/Fuel/Hours of Operation) 6. VIN or Serial Number: 7. Application: (Repower, Retrofit , Idling, or New) 8. Percent Operated in California: 9. APU Engine Information Horsepower Rating: Engine Make: Engine Model: Engine Year: Fuel Type:	10. NOx, ROG and PM10 Emission Reductions Baseline NOx, PM10 and ROG Emissions Level (g/hr): NOx+HC+PM10 Emissions Standard (g/kW-hr): Estimated Annual NOx, PM10 and ROG Emissions Reductions: Estimated Lifetime NOx, PM10 and ROG Emissions Reductions: 11. Cost ($) of Certified APU or Alternate Technology: 12. Installation Cost ($) of APU or Alternate Technology: 13. Annual Diesel Gallons Used: 14. Annual Hours Idled (Must be documented or justified): 15. APU Load Factor (Must be documented or use default value of 100 percent): 16. Project Life (years): 17. Existing Truck Engine Information Truck Horsepower Rating: Truck Engine Make: Truck Engine Model: Truck Engine Year: 18. District Incentive Grant Amount Requested: 19. Project Contact:

B. Reporting and Monitoring

The district has the authority to conduct periodic checks or solicit operating records from the applicant that has received Carl Moyer Program funds for emission reduction projects. This is to ensure that the APU is operated as stated in the program application. Fleet operators participating in the Carl Moyer Program are required to keep appropriate records during the life of the project. Records must contain, at a minimum, total California hours idled. Records must be retained and updated throughout the project life and made available at the request of the district.

VII. References

ARB, 2003. Final Regulation Order: Airborne Toxic Control Measure to Limit School Bus Idling And Idling At Schools. July 16, 2003.

ARB, 2004. Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Airborne Toxic Control Measure for Idling Reduction. September 1, 2005.

Lutsey, Nicholas. Fuel Cells For Auxiliary Power in Trucks: Requirements, Benefits, and Marketability. Institute of Transportation Studies, University of California, Davis. UCD-ITS-RR-03-04. July 2003.

Wallace, John Paul. Modeling of Line-Haul Truck Auxiliary Power Units in ADVISOR 2002. Institute of Transportation Studies, University of California, Davis. UCD-ITS-RR-03-07. August 2003

Chapter Four

TRANSPORT REFRIGERATION UNITS

This chapter is a new source category and presents the project criteria for transport refrigeration units (TRU) and transport refrigeration generator sets. This chapter also contains a brief overview of the engine operating characteristics of transport refrigeration units, emission inventory, available control technology, potential projects eligible for funding, and emission reduction and cost-effectiveness calculation methodologies. Information is also provided for potential consideration of other alternative technologies or strategies that may offer real emission reduction of transport refrigeration unit operations from transport refrigeration unit diesel engines. For more information about zero-emission technology, consult Chapter 12: Zero-Emission Technologies.

I. Introduction

TRUs are employed in service carrying perishable goods throughout the world. TRUs use an internal combustion engine to run the compressor of the refrigeration system. TRUs and TRU generator sets operating in the United States are generally powered by diesel engines, typically between 9 and 36 horsepower. TRUs may be installed on trucks, trailers, shipping containers, and railcars to refrigerate perishable contents. When a refrigerated trailer becomes disconnected from the tractor, the trailer TRU will continue to maintain temperature. When the tractor is parked at a rest stop or shut down, the TRU engine continues to cycle. TRU generator sets are also attached to ocean-going shipping containers when they are on land, to provide electric power to the shipping container's refrigeration system between the port and cold storage warehouse or distribution center.

II. Emissions

There are currently about 31,000 TRUs and TRU generator sets based in California, and another 7,500 out-of-state refrigerated trailers and 1,700 railcar TRUs operating in California at any given time. The Air Resources Board (ARB or "Board") estimates that emissions of diesel particulate emissions from TRUs and TRU generator sets were almost two tons per day or 2.6 percent of the total statewide diesel particulate matter emissions in 2000. Estimated NOx emissions in 2000 were about 20 tons per day. Based on emission projections, the diesel PM10 emissions from TRUs will decrease to about 1.6 tons per day in 2010 and decrease again to about 0.3 tons per day in 2020, because of the cumulative effects of new emission standards and ARB's in-use TRU Airborne Toxic Control Measure (ATCM).

III. Regulatory Requirements

In February 2004, the Board approved an ATCM for TRUs that set in-use performance standards for PM10 emissions beginning in 2008. Compliance is phased in over the next 12 years.

The TRU ATCM In-Use Performance Standards and compliance dates must be considered when determining whether emission reductions are surplus. Table 4-1 gives the TRU and TRU Generator Set In-Use Performance Standards and Table 4-2 provides a graphical representation of the implementation schedule. The region in Table 4-2 labeled Potential Surplus Reductions shows a window of opportunity where projects can achieve emissions reductions prior to the compliance date of the TRU ATCM [ARB, 2003].

Table 4-1
TRU and TRU Generator Set In-Use Performance Standards

Horsepower Category	Engine Certification Value PM10 Emissions Standard (grams/horsepower-hour)	Options for Meeting Performance Standard
Low Emission Performance Standards		
less than 25	0.30 g/hp-hr	▪ Use an engine that meets the Engine Certification Value ▪ Retrofit with at least Level 2 DECS* (≥50% PM10 reduction) ▪ Use an Alternative Technology
25 or greater	0.22 g/hp-hr	▪ Use an engine that meets the Engine Certification Value ▪ Retrofit with at least Level 2 DECS ▪ Use an Alternative Technology
Ultra-Low Emission Performance Standard		
less than 25	N/A	▪ Retrofit with Level 3 DECS (≥85% PM10 reduction) ▪ Use an Alternative Technology
25 or greater	0.02 g/hp-hr	▪ Use an engine that meets the Engine Certification Value ▪ Retrofit with Level 3 DECS ▪ Use an Alternative Technology

* Diesel Emission Control System

• Table 4-2
≥ 25 hp TRU and TRU Generator Set Engines In-Use Compliance Dates
(Compliance date is December 31 of applicable year)

MY	In-Use Compliance Year													
	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20
'01 & Older									U	U	U	U	U	U
'02										U	U	U	U	U
'03				U	U	U	U	U	U	U	U	U	U	U
'04	Potential				U	U	U	U	U	U	U	U	U	U
'05	Surplus					U	U	U	U	U	U	U	U	U
'06	Emissions						U	U	U	U	U	U	U	U
'07								U	U	U	U	U	U	U
'08									U	U	U	U	U	U
'09										U	U	U	U	U
'10											U	U	U	U
'11												U	U	U
'12													U	U
'13														

< 25 Hp 2013 and subsequent MY must meet ULETRU 7 years after MY
L = Low-Emission TRU, U = Ultra Low-Emission TRU

IV. Potential Projects

TRU owners can apply for Carl Moyer Program grant funds for projects that achieve surplus emission reductions by repowering with cleaner certified engines, installing verified retrofit diesel emission control strategies, or using alternative technologies to reduce or eliminate NOx, ROG, and PM10 emissions. Many of the technologies discussed below have not yet been verified. However, they are included in this discussion since they could provide real emission reductions and could potentially be verified during the time frame covered by the Guidelines.

A. New Purchase

Purchase of a new TRU is eligible for Carl Moyer Program funding if the new TRU is cleaner than what would have normally been purchased – a diesel engine. Thus the incremental cost of the new purchase of alternative technologies may be eligible for Carl Moyer Program grants.

B. Repower

Repowering TRUs with cleaner certified diesel engines is one type of potential project. However, there may be some compatibility issues with some engines due to spatial and electronic control differences (e.g., the new engine is too big to fit in the available space or the electronic controls are incompatible). Those compatibility issues must be resolved prior to submitting a grant application.

C. Retrofit with a Diesel Emission Control Strategy

Retrofit with a diesel emission control strategy is another potential project if the retrofit is not required by the TRU ATCM or any other regulation. Diesel retrofit systems must be verified by ARB in order to qualify for Carl Moyer Program funding. Potential retrofits include diesel oxidation catalysts, diesel particulate filters, flow though filters and fuel additives.

D. Alternative Technologies to Reduce or Eliminate NOx, ROG, and PM Emissions

Alternative technologies are defined under the TRU ATCM as electric standby, cryogenic temperature control systems, alternative fuels, alternative diesel fuels, fuel cells, and other systems that reduce or eliminate diesel engine operation. Brief descriptions of each of these potential project types follow.

1. Electric Standby

Electric standby equipped TRUs allow the TRU engine to be shut off when a compatible electric power supply is available at a facility so TRU diesel engine emissions are eliminated while the TRU is plugged in at the facility. See the Zero-Emission Technology Chapter for more information.

2. Hybrid Electric TRU

Hybrid electric TRUs have been available in Europe for several years. The diesel engine drives a generator that, in turn, powers an electric semi-hermetic refrigeration compressor and electrically driven fans, all controlled by an advanced microprocessor. This hybrid electric TRU is easily adaptable to run on electric grid power when at a facility, so that diesel engine operation is eliminated. The cost is higher than a traditional TRU, but costs less than it would to retrofit a traditional TRU with an electric standby system. One big advantage is that the hybrid design provides full refrigeration capacity for the initial chill-down. The hybrid design is also very likely to be adaptable for future use with fuel cell technology

3. Cryogenic Temperature Control Systems

Cryogenic temperature control systems heat and cool using a cryogen, such as liquid carbon dioxide or liquid nitrogen that is routed through an evaporator coil that cools air blown over the coil. Since there is no diesel engine, diesel PM10 emissions are eliminated. Capital costs for these types of systems are ten percent higher than a diesel TRU, but the facility infrastructure costs for cryogenic "fuel" storage and dispensing add to the capital cost.

4. Alternative Fuels

Conventional diesel engines are internal combustion, compression-ignition engines. In contrast, engines that operate on an alternative fuel, such as compressed natural gas (CNG), liquefied natural gas (LNG), and liquid propane gas (LPG), are usually spark-ignited. Engines certified to operate on alternative fuels produce substantially lower PM10 and NOx emissions than diesel-fueled engines that are not equipped with exhaust after-treatment.

5. Alternative Diesel Fuels

Before any alternative diesel fuel can be used to comply with a diesel PM10 control measure or used in a Carl Moyer Program project, it must be verified through ARB's Verification Procedure, which includes a special section that deals specifically with alternative diesel fuels.

The Carl Moyer Program does not fund fuel-only projects however, districts may use matching funds to pay for the incremental cost of alternative diesel fuels if they are part of a Carl Moyer Program project. Recordkeeping and reporting must provide assurance that the emission reductions are real, quantifiable, surplus and enforceable.

6. Fuel Cells

Compared to a conventional diesel-powered TRU, fuel cell TRUs would offer zero or near-zero emissions of criteria pollutants and lower greenhouse gas emissions. At this time, there are no fuel cells appropriately sized for use on a TRU, but electrically-driven TRUs could be powered by fuel cells on or off the road (e.g., at a facility).

V. Proposed Project Criteria

Participating districts retain the authority to impose additional more stringent requirements in order to address local issues.

A. General Criteria

- Emission reductions obtained through Carl Moyer Program projects must not be required by any federal, state or local regulation, memorandum of agreement/understanding, settlement agreement, mitigation requirement, or other legally binding document.

- Projects must meet a cost-effectiveness of $14,300 per weighed ton of NOx + ROG + combustion PM10 reduced calculated in accordance with the cost-effectiveness methodology discussed in this chapter.

- No emission reductions generated by the Carl Moyer Program shall be used as marketable emission reduction credits, or to satisfy any emission reduction obligation of any person or entity.

- No project funded by the Carl Moyer Program shall be used for credit under any federal or state emission averaging, banking, and trading program.

- Carl Moyer Program grants shall be no greater than a project's incremental cost. The incremental cost is the cost of the project minus the baseline cost. The incremental cost shall be reduced by the value of any current financial incentive that reduces the project price, including but not limited to tax credits or deductions, grants, or other public financial assistance.

- Projects must have a minimum project life of three years. ARB may approve shorter project life in writing for good cause on a case-by-case basis. Projects with shorter lives may be subject to additional funding restrictions, such as a lower cost-effectiveness limit or a project cost cap.

- The contract term must extend to the end of the project life.

- The default project life does not consider upcoming regulatory requirements. Project life may be shorter due to regulatory requirements.

- Air districts must consult with ARB staff to determine eligibility of all projects considered for funding on case-by-case basis. All projects considered on a case-by-case basis must receive ARB approval prior to receiving program funding.

- Projects with more than a 5 year project life must have a contract term of at least 5 years.

- Emission benefits must be based on the TRU operations that occur in California. 75 percent of TRU operations must be in California. The ARB may approve exceptions in writing on a case-by-case basis.

- Air districts are encouraged to co-fund projects that will produce emission reductions in more than one air district. (Most TRU projects will provide multi-district emission reductions.)

B. Repowers

- For repower projects, Carl Moyer Program funds shall only be used to pay for the incremental costs of an eligible engine and the cost to install that engine in the TRU equipment.

- The replacement engine for repower projects used in the TRU must meet current emission standards and be certified by the ARB for sale in California. Compliance with all applicable durability and warranty requirements is required.

- Repower projects must provide at least 15 percent NOx emission benefit compared to baseline NOx emission level.

- The participant shall install an hour-meter or other means to measure usage on the TRU to track operating hours, and shall provide this information to ARB or the district upon request.

- Potential projects that fall outside of these criteria may be considered on a case-by-case basis is evidence provided to the air district suggests potential surplus, real, quantifiable and enforceable emission reduction benefits.

- Air districts must consult with ARB staff to determine eligibility of all projects considered for funding on a case-by-case basis. All projects considered on a case-by-case basis must receive ARB approval prior to receiving program funding.

C. Retrofits

- For retrofit projects, diesel emission control strategies used on TRUs must be verified by ARB for sale in California. Compliance with all applicable durability and warranty requirements is required.

- Alternative Technologies such as electric standby and pure cryogenic systems are not required to be verified, but ARB must review and approve such systems in writing on a case-by-case basis. The district shall require recordkeeping and reporting to assure that estimated emission reductions are achieved.

`D. Scrap

- A baseline engine in a repower project must be destroyed by scrapping or drilling a hole in the engine block rendering it inoperable unless prior approval for alternate disposition has been granted by ARB staff. At the discretion of the district, core charges are eligible for funding and, if including, must be part of the cost-effectiveness calculation.

VI. Cost-Effectiveness

In general, the emission reduction benefit represents the difference in the emission level of a baseline engine and reduced-emission engine, retrofit, or use of alternative technology. TRU engine annual emissions are calculated by multiplying the emission factor in grams per horsepower-hour for each pollutant by the rated hp, load factor, and activity (annual engine hours of operation).

VII. Minimum Project Requirements

A. Application

In order to qualify for incentive funds, districts make applications available and solicit proposals for reduced-emission projects from distribution centers and TRU owners. The applicant must provide at least the following information listed in Table 4-4.

A disclosure must also be included stating that the proposed project has not been funded and is not being considered for funding by another air district, ARB, or any other public agency. Any applicant who is found to have submitted multiple applications for the same project may be banned from submitting future applications to any and all Carl Moyer Program solicitations and may be subject to criminal sanctions. A project funded cooperatively by multiple air districts is eligible for funding if the project parameters are coordinated amongst the participating districts and the project meets all applicable Carl Moyer Program criteria. Applicants are allowed to re-apply for project funding if a previous application has been rejected and is no longer being considered for funding.

Third party applications are not allowed. The owner of the engine must sign and agree to the application. However, a third party (e.g. engine dealer or distributor) may complete an application or part of an application on an owner's behalf. Applications must include a signature section for third parties. The third party signature section must include signature and date lines, and blanks for the third party to list how much they are being paid, if anything, to complete the application and what source of funds are being used to pay them. To make the Carl Moyer Program accessible to all potential applicants, including applicants that cannot afford to hire third party assistance, districts are encouraged to provide technical assistance to applicants in completing the application.

B. Reporting and Monitoring

The district has the authority to conduct periodic checks or solicit operating records from the applicant that has received Carl Moyer Program funds for emission reduction projects. This is to ensure that the TRU is operated as stated in the program application. Fleet operators participating in the Carl Moyer Program are required to keep appropriate records during the life of the project. Records must contain, at a minimum, total California hours idled. Records must be retained and updated throughout the project life and made available at the request of the district.

Table 4-4
Minimum Application Information Transport Refrigeration Unit Projects

1. Air District 2. Project Funding Source: 3. Applicant Demographics Company Name: Business Type: Mailing Address: Location Address: Contact Number (email & phone): 4. Project Description Project Name: Project Type: 5. Truck, Trailer, Shipping Container, or Railcar I.D. Number (e.g., VIN, railcar recording mark and car number, container number, company I.D. number, or serial number): 6. Application: (Repower, Retrofit , or Alternative Technology) 7. Percent Operated in California: 8. Baseline TRU Engine Information TRU or Gen Set Make TRU or Gen Set Model Horsepower Rating Engine Make Engine Model Engine Model Year Fuel Type NOx emission factor PM10 emission factor Activity (annual hours of operation) Load Factor	9. Project Emission Reductions New Equipment Information TRU or Gen Set Make TRU or Gen Set Model Horsepower Rating Engine Make Engine Model Engine Model Year Fuel Type NOx Certification Value PM Certification Value Activity (annual hours of operation) Retrofit Emission Reduction Percentage NOx: ROG: PM10: Retrofit Verification Executive Order # Estimated Annual NOx Emissions Reductions: Estimated Lifetime NOx Emissions Reductions: Estimated Annual ROG Emission Reductions Estimated Lifetime ROG Emission Reductions Estimated Annual PM10 Emission Reductions Estimated Lifetime PM10 Emission Reductions 10. Project Incremental Capital Cost ($) (above normal) 11. Installation cost ($) 12. Project Life (years): 13. District Incentive Grant Amount Requested: 14. Project Contact:

VIII. References

ARB, 2003. ARB, 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, Stationary Source Division, Emissions Assessment Branch, October 28, 2003.

Chapter Five

COMPRESSION-IGNITION OFF-ROAD EQUIPMENT

This chapter presents the project criteria for off-road compression-ignition (CI) equipment projects under the Carl Moyer Program. It also contains a brief overview of the current regulations, incentive projects eligible for funding, project criteria, cost effectiveness calculations, and minimum application requirements for off-road CI equipment. Proposed updates to the project criteria in this chapter since the 2003 Guidelines include: 1) lowering the minimum engine horsepower (hp) to 25 hp, and 2) prioritizing Tier 2 or Tier 3 repowers.

I. Introduction

Off-road CI equipment eligible for Carl Moyer Program funding includes equipment 25 hp (19 kilowatt) or greater such as construction and agricultural equipment. This also includes auxiliary engines found on off-road equipment, marine vessels, and on-road vehicles. Excluded from this discussion are engines that propel or are used on locomotives, marine vessel propulsion, and most forklifts (except for class 7 forklifts) which are discussed in other chapters of these Guidelines. Aircraft engines are excluded from the Carl Moyer Program. In addition, the Carl Moyer Program does not apply to off-road engines used for underground mining operations, which are regulated by the Mining Safety and Health Administration.

II. Emissions

Off-road CI engines are used in a wide array of applications including agricultural tractors, backhoes, excavators, trenchers, and motor graders. Off-road equipment can be categorized broadly into equipment less than 175 hp and equipment equal to or greater than 175 hp.

Table 5-1 displays statewide population and emission estimates for off-road CI engines.

Table 5-1
Statewide Emissions from Off-Road Compression-Ignition Engines*
(tons per day)

	Population	NOx	ROG	PM10
2005	350,420	453	54	30
2010	354,175	354	24	39

*Includes agricultural, construction, dredging, drilling, industrial, and logging equipment.

III. Regulatory Requirements

A. Off-Road Compression Engine Regulations

The Air Resources Board (ARB or "Board") is preempted from regulating new farm and construction equipment less than 175 hp. The U.S. Environmental Protection Agency (U.S. EPA) has sole authority to regulate this type of equipment. ARB has the authority to regulate new off-road equipment equal to or greater than 175 hp and non-preempted off-road equipment less than 175 hp. ARB and U.S. EPA have worked closely to harmonize the off-road CI standards. ARB is not preempted from regulating in-use equipment; a discussion of these regulations may be found in Section III. B of this chapter.

Current off-road engine regulations contain exhaust emission standards that engines are not to exceed under steady state and transient conditions [ARB, 2000 and ARB, 2004b]. In addition, the regulations include provisions that assist engine manufacturers in complying with emission standards through: 1) flexibility provisions for equipment manufacturers, 2) Averaging, Banking, and Trading (ABT) programs, and 3) the Tier 4 Early Introduction Incentive for engine manufacturers. Since the objective of the Carl Moyer Program is the deployment of cleaner-than-required low-emission engines to achieve maximum emission reduction benefits, it is important to understand the regulatory provisions that allow for the sale of engines not meeting the current applicable emission standards.

1. Emission Standards

Emissions from off-road equipment between 175 and 750 horsepower were uncontrolled prior to 1996. Estimates of NOx emission rates from uncontrolled off-road engines range from 8.2 g/bhp-hr to 14 g/bhp-hr. In January 1992, the Board adopted exhaust emission standards for off-road diesel-cycle engines 175 hp and greater, effective beginning with 1996 model year engines.

In August 1996, the U.S. EPA, ARB, and off-road diesel engine manufacturers signed a Statement of Principles which called for harmonization of ARB and U.S. EPA off-road diesel engine regulations, as appropriate, in exchange for an accelerated introduction of progressively more stringent standards. The U.S. EPA adopted emission standards in 1998 and again in 2004 that provided for new NOx + non-methane hydrocarbons (NMHC), PM, and carbon monoxide (CO) emission standards for engines within different power categories in a tiered approach, commonly referred to as "Tier" standards. These standards are defined in Title 13, California Code of Regulations (CCR), sections 2423(b)(1). ARB has since amended the California exhaust emission standards for off-road diesel engines to harmonize with the federal requirements. Table 5-2 summarizes the existing and future emission standards for these engines.

Table 5-2
ARB and U.S. EPA Exhaust Emission Standards for New Off-Road Diesel Engines ≥ 25 hp (g/bhp-hr)

Maximum Rated Power (hp)	Tier	Model Year	NOx	HC	NOx+NMHC	CO	PM
25=<50	Tier 1	2000-2003	—	—	7.1	4.1	0.60
	Tier 2	2004-2007	—	—	5.6	4.1	0.45
	Tier 4 Interim	2008-2012	—	—	5.6	4.1	0.22
	Tier 4	2013 and later	—	—	3.5	4.1	0.02
50=<75	Tier 1	2000-2003[a]	6.9	—	—	—	—
	Tier 2	2004-2007	—	—	5.6	3.7	0.30
	Tier 3[b]	2008-2011	—	—	3.5	3.7	0.30
	Tier 4 Interim	2008-2012	—	—	3.5	3.7	0.22
	Tier 4	2013 and later	—	—	3.5	3.7	0.02
75=<100	Tier 1	2000-2003[a]	6.9	—	—	—	—
	Tier 2	2004-2007	—	—	5.6	3.7	0.30
	Tier 3	2008-2011	—	—	3.5	3.7	0.30
	Tier 4 Interim[c]	2012-2014	2.5	0.14	—	3.7	0.15
	Tier 4	2015 and later	0.3	0.14	—	3.7	0.15
100=<175	Tier 1	2000-2002[a]	6.9	—	—	—	—
	Tier 2	2003-2006	—	—	4.9	3.7	0.22
	Tier 3	2007-2011	—	—	3.0	2.6	0.22
	Tier 4 Interim[c]	2012-2014	2.5	0.14	—	3.7	0.15
	Tier 4	2015 and later	0.3	0.14	—	3.7	0.15
175=<300	Tier 1	1996-2002	6.9	1.0	—	8.5	0.40
	Tier 2	2003-2005	—	—	4.9	2.6	0.15
	Tier 3[d]	2006-2010	—	—	3.0	2.6	0.15
	Tier 4 Interim[c]	2011-2013	1.5	0.14	—	2.6	0.15
	Tier 4	2013 and later	0.3	0.14	—	2.2	0.15
300=<600	Tier 1	1996-2000	6.9	1.0	—	8.5	0.40
	Tier 2	2001-2004	—	—	4.8	2.6	0.15
	Tier 3[d]	2006-2010	—	—	3.0	2.6	0.15
	Tier 4 Interim[c]	2011-2013	1.5	0.14	—	2.6	0.15
	Tier 4	2013 and later	0.3	0.14	—	2.2	0.15
600=<750	Tier 1	1996-2001	6.9	1.0	—	8.5	0.40
	Tier 2	2002-2004	—	—	4.8	2.6	0.15
	Tier 3[d]	2006-2010	—	—	3.0	2.6	0.15
	Tier 4 Interim[c]	2011-2013	1.5	0.14	—	2.6	0.15
	Tier 4	2013 and later	0.3	0.14	—	2.2	0.15
≥750	Tier 1	2000-2005	6.9	1.0	—	8.5	0.4
	Tier 2	2006-2010	—	—	4.8	2.6	0.15
	Tier 4 Interim	2011-2014	2.6	0.30	—	2.6	0.07
	Tier 4	2015 and later	2.6	0.14	—	2.6	0.03

[a] ARB model years, U.S. EPA model years for Tier 1 start at 1998 for 50=<75 hp and 75=<100 hp, and 1997 for 100=<175 hp.

[b] Engine families in this power category may meet the Tier 3 PM standard instead of the Tier 4 interim PM standard in exchange for introducing the final Tier 4 PM standard in 2012.

[c] The implementation schedule shown is the three-year alternate NOx approach. Other schedules are available.

[d] Caterpillar, Cummins, Detroit Diesel Corporation, and Volvo Truck Corporation have agreed to comply with these standards by 2005.

2. Flexibility Provisions for Equipment Manufacturers

Current regulations for off-road heavy-duty CI engines contain a flexibility provision that allows original equipment manufacturers (OEMs) to use engines not meeting current applicable emission standards in their existing product line for new equipment. Thus, engines that are certified under the flexibility provisions do not comply with current applicable emission standards, and are not eligible for the Carl Moyer Program. The flexibility provision took effect with the introduction of Tier 2 engines (Tier 1 for power categories less than 50 hp) and applies separately for each engine power category. Engine families certified under the flexibility provision must have previously been certified to a prior engine standard, for example Tier 1.

There are four main elements to the flexibility program: 1) a percent-of-production allowance, 2) a small-volume allowance, 3) continuance of the Tier 1 allowance to use up existing inventories of engines, and 4) availability of hardship relief. The adoption of the Tier 4 emission standards added several additional components to the program including technical hardship allowances, retroactive use of flexibilities, delayed implementation, an economic hardship allowance, an early introduction incentive, and a labeling requirement. The percent-of-production allowance is the largest component of the program and allows each equipment manufacturer to use flexibility engines in their new product line over a seven-year period in cumulative quantities that sum up to 80 percent of a single year's national production at the end of the seven years.

Except for engines used in flexibility allowances prior to January 1, 2007, flexibility engines will be labeled according to the requirements of Title 13, CCR, sections 2423(d) and 2424(c). In addition, the Executive Order (EO) for engines certified under this program state that the engines were certified in compliance with Title 13, CCR, section 2423(d).

3. Averaging, Banking, and Trading

Off-road engine manufacturers are allowed the flexibility to participate in an ABT program in lieu of only producing engines that comply with the current emission standards. The emission benefits from an engine certified to a lower Family Emission Limit (FEL) may be used to offset the emissions from engines certified to a higher FEL levels within the engine manufacturer's ABT program. As a result, ABT emission credits are generated from the lower FEL level engine since it is certified lower than the required emission standards. These engines are only eligible for Carl Moyer Program funding as part of repower projects. In these cases, the emission standard, not the certified FEL level, will be used in emission calculations. The FEL emission level is identified on the EO and is located under the emission standard.

4. Tier 4 Early Introduction Incentives for Engine Manufacturers ("Engine Offsets")

Engine manufacturers may voluntarily certify engines to the Tier 4 standards prior to 2011 in exchange for making fewer Tier 4 engines after 2011. These early introduction Tier 4 engines are not eligible for Carl Moyer Program funding. These engines are first offered to OEMs to use as part of the flexibility program (see Section III. A. 2 above). Should the OEM decline the engine, the engine manufacturer may use it as part of the "Tier 4 Early Introduction Incentive for Engine Manufacturers" created by Title 13, CCR, section 2423(b)(6).

Engines used as part of the "Tier 4 Early Introduction Incentive for Engine Manufacturers" must be in production by September 1 of the year prior to the first model year when the standards would otherwise be applicable, where the model year means the manufacturer's annual production period which includes January 1 of a calendar year or, if the manufacturer has no annual production period, the calendar year. Engines sold during the transitional "phase-in" model years (years where the Tier 4 interim standards are in effect) are not considered "early" introduction engines.

These engines will meet all federal labeling requirements but will add the following statement: "This engine meets U.S. EPA emission standards under 40 CFR 1039.104(a)" and an additional statement of "meeting ARB requirements under 13 CCR section 2423(b)(6)". In addition, the EO for engines certified under this program will reference that the engines were certified in compliance with 13 CCR section 2423(b)(6).

B. Upcoming Regulations

The ARB is developing a cargo handling equipment regulation that is scheduled for Board consideration in December 2005. This regulation would apply to diesel-fueled cargo handling equipment at California's ports and intermodal railyards. Cargo handling equipment is used to transfer goods and includes equipment such as yard tractors (hostlers), rubber tire gantry cranes, top handlers, side handlers, forklifts, loaders, and mobile cranes. Specific Carl Moyer Program project criteria will be identified for this equipment after the regulation is approved.

The ARB is also developing a control measure to reduce diesel particulate matter emissions from in-use, off-road, diesel-fueled, mobile equipment greater than or equal to 25 horsepower. This includes, but is not limited to, construction equipment, mining equipment, airport ground support equipment, and industrial equipment such as forklifts. The proposal will not cover equipment used in agricultural operations, cargo handling at ports and intermodal rail facilities, or equipment already covered by an in-use rule or agreement. This item is scheduled to be heard by the Board in 2006. If approved, it may affect project criteria for off-road projects.

IV. Potential Projects

The Carl Moyer Program can achieve significant emission reductions from off-road diesel engines and equipment operating in California. All eligible projects must use certified technology or technology that has been verified by the ARB for real and quantifiable emission reductions that go beyond any regulatory requirement. The project criteria included in this chapter are designed to ensure that emission reductions achieved by the deployment of reduced-emission engines or retrofit technologies are surplus, real, quantifiable, and enforceable.

Off-road projects fall into three distinct categories: 1) new purchase of an emission certified engine, 2) repower with an emission certified engine, and 3) retrofit with a verified diesel emission control strategy (DECS). Based on past experience, most projects will likely fall under the repower category for off-road projects. Emerging reduced-emission technologies, such as engine retrofit or new engine technologies, will become eligible for program participation after ARB grants verification or certification for sale in California. Districts have the option to fund the cost difference between conventional diesel fuel and an alternative fuel such as alternative-diesel fuel, CNG, LNG, and LPG with matching funds. The fuel purchase must be an integral part of an engine purchase, repower, or retrofit.

Auxiliary engines on mobile equipment are considered portable engines and are regulated by the ARB's Portable Equipment Air Toxics Control Measure (ATCM). Auxiliary engines that are an integral part of the vehicle's or vessel's main function, and are not covered under any district rule may be eligible for Carl Moyer funding. Because the ATCM requires that all portable engines be certified engines by January 1, 2010, projects must begin by January 1, 2007 to meet the minimum three year project life requirement [ARB, 2004a].

Class 7 diesel forklifts are the only diesel forklifts eligible for Carl Moyer Program funding and are subject to all off-road project criteria. The district must obtain and verify documentation of the classification of the forklift prior to funding. Class 7 forklifts typically have a lift capacity of over 6,000 pounds, pneumatic tires, and internal combustion, compression ignition engines powered almost exclusively by diesel. Many of the characteristics of these forklifts, including pneumatic tires for rough terrain, make them exclusively for outdoor use.

A. New Purchase

For most engine categories, the current standard is Tier 2 or Tier 3 with an optional Blue Sky Standard that applies through Tier 3. However, at this time, no engines have been certified to the Blue Sky standard. New equipment having an engine that was certified to any FEL level is not eligible for new purchase in the Carl Moyer Program. This is because the emission level from an eligible FEL engine in the new equipment would be considered to be at the level of the required emission standard for that engine, through the averaging provision of the ABT program discussed previously. Therefore, the emissions from an FEL engine in the new equipment would not be surplus when compared to the emissions from a new engine meeting the required emission standards.

For some off-road equipment such as yard tractors, it may be possible to purchase new equipment with a new on-road engine certified to ARB's optional NOx emission credit standard instead of a new off-road engine. Where this is the case, emission benefits relative to the baseline engine are calculated based on on-road engine emission factors. If an applicant provides ARB with documentation showing that in past practice, the fleet has been powered by off-road engines, then the baseline emission may be calculated using the off-road engine emission factors.

B. Repower

Replacement of the in-use engine (i.e., repower) with an emission-certified engine instead of rebuilding the existing engine to its original uncontrolled specifications is the most common type of off-road project. Although this is commonly a diesel-to-diesel repower, significant NOx and PM benefits are achieved due to the high emission levels of the uncontrolled engine being replaced. Eligible engines are those that are certified to the current applicable emission standard or to an optional credit emission standard. For off-road equipment with similar modes of operation to on-road vehicles, other possible options include the replacement of an older uncontrolled diesel off-road engine with a new or rebuilt on-road engine certified to an emission standard equal to or lower than the Tier 2 off-road emission standard or a newer emission-certified alternative fuel engine.

ARB staff proposes that the Carl Moyer Program Guidelines require repower with a newer engine meeting current applicable emission standards (i.e., Tier 2 or Tier 3). If this is not a technical or practical option, as determined by the engine manufacturer, a newer emission-certified engine that meets the Tier 1 standards may be used. Off-road CI engines have undergone major design changes to meet new and more stringent emission regulations. Off-road engine manufacturers have made significant hardware modifications in order to meet the Tier 2 emission standards for engines with horsepower rating of 100 hp and greater. The incorporation of air-to-air aftercoolers and other auxiliary systems have resulted in Tier 2 engines for some applications that are physically different than the earlier Tier 1 engines. As a result, some existing equipment cannot accept Tier 2 engines without extensive modifications. This may involve cutting the equipment frame to gain adequate space for the Tier 2 engine. In these situations, technical, cost, and safety considerations make a new Tier 2 engine repower infeasible. Thus, the use of a newer emission-certified engine meeting the earlier Tier 1 emission standard may be justified. Specific information on the eligibility of these projects is further described in the project criteria.

In addition, ARB staff is proposing to require that all repower projects funded by the Carl Moyer Program install a retrofit device if one is available. ARB staff is proposing to require that the highest level ARB-verified retrofit device be installed for retrofit projects if the project meets the cost effectiveness limit of $14,300 per weighted ton. If a Level 3 device is not feasible or does not meet the cost-effectiveness limit, a Level 2 device must be installed; if no Level 3 or Level 2 devices are feasible a Level 1 device must be installed. Due to limited current availability of retrofit devices for off-road engines it is likely that a retrofit will not be available in the near term. Repower projects would not be disqualified from participation in the Carl Moyer Program if retrofit devices are not feasible or if the cost of the available retrofit places the project over cost-effectiveness limit.

Funding is not available for projects where a spark-ignition engine (i.e., natural gas, gasoline, etc.) is replaced with a diesel engine.

C. Retrofit

Retrofit refers to modifications made to an engine and/or fuel system such that the specifications of the retrofitted engine are not the same as the original engine, please refer to Appendix F for more detailed information. The most straightforward retrofit projects are add-on after treatments. Other retrofits include upgrades of components that can be accomplished at the time of engine rebuild and result in a lower emission configuration. To qualify for Carl Moyer Program funding, the retrofit technology must be verified for sale in California and must comply with established durability and warranty requirements. Retrofits are verified for diesel PM reductions of: Level 1 - 25 percent, Level 2 - 50 percent, and Level 3 - 85 percent. Although retrofit technology options for off-road diesel engines are limited, it is possible that retrofit technologies that have been used to reduce NOx and PM emissions from on-road heavy-duty diesel engines may be used to control off-road engine emissions in some applications. More information on DECS, including a list of currently verified DECS, may be found at http://www.arb.ca.gov/diesel/verdev/verdev.htm.

V. Proposed Project Criteria

Participating districts retain the authority to impose more stringent additional requirements in order to address local concerns.

A. General

- Emission reductions obtained through Carl Moyer Program projects must not be required by any federal, state or local regulation, memorandum of agreement/understanding with a regulatory agency, settlement agreement, mitigation requirement, or other legal mandate.

- Projects must meet a cost-effectiveness of $14,300 per weighed ton of NOx + ROG + PM10 reduced, calculated in accordance with the cost-effectiveness methodology discussed in this chapter.

- No emission reductions generated by the Carl Moyer Program shall be used as marketable emission reduction credits, or to satisfy any emission reduction obligation of any person or entity.

- No project funded by the Carl Moyer Program shall be used for credit under any federal or state emission averaging, banking, and trading program.

- Carl Moyer Program grants can be no greater than a project's incremental cost. The incremental cost is the cost of the project minus the baseline cost. The incremental cost shall be reduced by the value of any current financial incentive that reduces the project price, including, but not limited to, tax credits or deductions, grants, or other public financial assistance.

- Projects must have a minimum project life of three years. ARB may approve shorter project life in writing for good cause on a case-by-case basis. Projects with shorter lives may be subject to additional funding restrictions, such as a lower cost-effectiveness limit or a project cost cap.

- The contract term must extend to the end of the project life.

- Potential projects that fall outside of these criteria may be considered on a case-by-case basis if evidence provided to the air district suggests potential surplus, real, quantifiable and enforceable emission reduction benefits.

- Air districts must consult with ARB staff to determine eligibility of all projects considered for funding on case-by-case basis. All projects considered on a case-by-case basis must receive ARB approval prior to receiving program funding.

- The certification emission standard and Tier designation for the engine must be determined from the Executive Order issued for that engine, not by the engine model year.

- Reduced-emission engines or retrofits must be certified/verified for sale in California and must comply with durability and warranty requirements. These may include new ARB certified engines, ARB certified after-market part engine/control devices, and verified diesel emission control strategies.

- Engines participating in the ABT program that are certified to FELs higher than the applicable emission standards, as designated on the Executive Order, are ineligible to participate in the Carl Moyer Program.

- Equipment manufactured under the "Flexibility Provisions for Equipment Manufacturers", as detailed in Title 13, CCR, section 2423(d), are ineligible for Carl Moyer funding.

- Engines that are participating in the "Tier 4 Early Introduction Incentive for Engine Manufacturers" program, as detailed in Title 13, CCR, section 2423(b)(6), are ineligible for Carl Moyer funding.

- Auxiliary engines on mobile equipment are eligible for Carl Moyer funding through January 1, 2007 if they are an integral part of the vehicle's or vessel's main function and are not covered by any district rule.

- Class 7 diesel forklifts are the only diesel forklifts eligible for Carl Moyer funding and are subject to all off-road project criteria. The district must obtain and verify documentation of the classification of the forklift prior to funding.

- Funded projects must operate at least 75 percent of total equipment operation hours in California.

- Default project life

Off-road new purchase	10 years
Off-road repower	7 years
Off-road repower and retrofit	5 years
Retrofit	5 years

Applicants must provide documentation to justify a longer project life.

B. New Purchase

- Engines must be certified to an ARB optional NOx or NOx+NMHC emission credit standard for off-road diesel engines that is at least 30 percent lower than current applicable emission standards or for some equipment, such as yard tractors, an on-road engine certified to ARB's optional NOx emission credit standard

- Engines that are certified to FEL levels are not eligible for funding in new equipment purchase projects.

C. Repower

- For repower projects that replace uncontrolled engines in existing equipment, the replacement engine must be certified to either: 1) the current applicable emission standard except as noted below, 2) to a FEL NOx or NOx+NMHC level that is lower than the required emission standard, or 3) to an optional credit emission standard as applicable for the horsepower rating.

- For equipment repower projects that replace emission-certified engines in existing equipment, the replacement engine must be certified to a NOx emission standard that is at least 15 percent lower than the emission standard(s) applicable to the existing engine.

- Engines used in equipment repower projects may be new, emission-certified rebuilt, or emission-certified remanufactured units. Eligible rebuilt or remanufactured engines are those offered by the original equipment manufacturer (OEM) or by a non-OEM rebuilder who demonstrates to the ARB that the rebuilt engine and parts are functionally equivalent from an emissions and durability standpoint to the OEM engine and components being replaced. Rebuilt and remanufactured engines that are not re-certified to new emission standards shall use the emission standards associated with the original engine block.

- ARB strongly recommends that districts give priority to Tier 2 or Tier 3 repowers. However, ARB recognizes that in some cases repower with the current applicable standard is not possible. In these cases a Tier 1 repower may be allowed if the conditions below are met and the project meets a project cost-effectiveness cap of $6,000 per weighted ton of emission reductions for the repower portion of the project. Tier 1 repowers of specialty equipment not meeting the project cost-effectiveness cap may be allowed on a case-by-case basis.

- If repower with an engine meeting the current applicable standard is technically infeasible, unsafe, or cost prohibitive, the replacement must meet the most current practicable previously applicable emission standard. The district shall determine eligibility of a Tier 1 engine repower project on a case-by-case basis by obtaining a Tier 2/Tier 3 repower exemption using one of the two following methods:

    1. The Carl Moyer Program application may include a written statement of reason(s) from the engine manufacturer verifying that a particular piece of equipment cannot accommodate an engine meeting current standards without major modifications, safety risks, or exorbitant cost. The letter must include information on the equipment being repowered, the engine being replaced, the reason why an engine meeting the currently applicable standard cannot be used (including details on required equipment modifications with pictures of the equipment, engineering drawings as necessary, and cost for the Tier 2/Tier 3 engine), and the proposed Tier 1 replacement engine. Districts must submit the written statement of reason(s) to ARB as an attachment to the annual report.

    2. The engine manufacturer may provide ARB with sufficient information on engine and/or equipment models for which Tier 2/Tier 3 repowers are available, and engine and/or equipment models for which Tier 2/Tier 3 repowers are not feasible. Engine manufacturers who are interested in pursuing this option should contact ARB. ARB staff will maintain a list of such engines and/or equipment models and make that list available to district staff.

- If an ARB-verified diesel emission control strategy is available for the replacement engine, ARB requires installation of the retrofit verified to the highest level which still meets the cost-effectiveness limit of $14,300 as discussed in the retrofit section of these project criteria.

- For repowers of equipment with baseline engines manufactured under the flexibility provision, as detailed in Title 13, CCR, section 2423(d), baseline emission rates shall be determined by using the latest applicable Tier emission standard for that engine model year and horsepower rating. Alternative emission rates will be allowed with documentation of the actual emission rates from the manufacturer based on the engine serial number. Districts must submit all documentation to ARB as an attachment to the annual report.

- Replacement of an uncontrolled diesel off-road engine with a new or rebuilt on-road engine certified to an emission standard equal to or lower than the Tier 2 off-road emission standard or a newer emission-certified alternative-fuel engine is eligible for funding in off-road equipment with similar modes of operation to on-road vehicles. Other equipment may be eligible for funding on a case-by-case basis. These repowers must meet all other applicable project criteria.

D. Retrofit

- Only ARB-verified retrofits are eligible for funding. Emerging engine retrofits will become eligible for Program participation once ARB grants verification for sale in California. Non-verified technologies may be considered on a case by case basis if: 1) an application for verification of the retrofit or add-on equipment on the proposed engine category is pending or 2) for highly specialized equipment where it is unlikely that a retrofit would be verified.

- Retrofit projects that control PM must use the highest level ARB-verified technology available for the equipment being retrofitted. The following are the diesel PM reductions for each verified level:
  - Level 1 - 25 percent;
  - Level 2 - 50 percent; and
  - Level 3 - 85 percent.

- Retrofit projects that control NOx must reduce NOx emissions from uncontrolled engines to the current applicable emission standard. If this is not feasible, the project must reduce NOx to at least the applicable Tier 1 NOx emission level (6.9 g/bhp-hr or lower). For emission-certified engines, the retrofit technology must be able to reduce NOx emissions by at least 15 percent.

- The cost of the retrofit, filters, and maintenance of the retrofit device needed during the project life may be paid for with incentive funding provided it meets the cost-effectiveness limit.

E. Scrap

- A baseline engine in a repower project must be destroyed by scrapping or drilling a hole in the engine block rendering it inoperable unless prior approval for alternate disposition has been granted by ARB staff. At the discretion of the district, core charges are eligible for funding and, if including, must be part of the cost-effectiveness calculation.

VI. Cost-Effectiveness

Emission reduction benefits represent the difference in the emission levels of the existing baseline technology relative to the newer, reduced-emission technology. Baseline and reduced engine emission factors are listed in Table B-12 in Appendix B. These factors reflect preliminary emission data based on model input values to the OFFROAD emission inventory model for engines greater than or equal to 25 hp.

A detailed description of how to calculate cost-effectiveness can be found in Appendix C. Off-road emission reduction calculations will use either the fuel or hour based formula as discussed Appendix C. The equipment activity level must be based on actual hours reading from an hour-meter or other similarly appropriate documentation provided by the applicant (i.e. fuel receipts). Future annual hours of equipment operation for determining emission reductions must be based only on readings from an installed and fully operational hour-meter. A properly functioning hour-meter is required to support equipment activity information included in the application for Carl Moyer Program funding. See the Administrative Part of the Guidelines for additional information on this topic. In addition, specific cost-effectiveness criteria and sample calculations for off-road projects may be found in Section V of Appendix D.

VII. Minimum Project Requirements

These are minimum project application requirements; the district has full authority to require additional application, reporting, monitoring, and scrapping requirements.

A. Application

Districts solicit bids for reduced-emission projects from off-road diesel equipment operators. The applicant must provide the minimum information illustrated in Table 5-3 below.

A disclosure must also be included stating that the proposed project has not been funded and is not being considered for funding by another air district, ARB, or any other public agency. Any applicant who is found to have submitted multiple applications for the same project may be banned from submitting future applications to any and all Carl Moyer Program solicitations and may be subject to criminal sanctions. A project funded cooperatively by multiple air districts is eligible for funding if the project parameters are coordinated amongst the participating districts and the project meets all applicable Carl Moyer Program criteria. Applicants are allowed to re-apply for project funding if a previous application has been rejected and is no longer being considered for funding.

Table 5-3
Minimum Application Information for Off-road CI Projects

Air District Applicant Demographics Company Name Business Type Mailing Address Location Address Contact Number Project Description Project Name Project Type Equipment Function Application: (Repower, Retrofit or New Purchase) Retrofit Technology Product name Executive Order reference Percent PM reduction Percent NOx reduction Percent Operated in California: Project Life (years) Existing Engine Information Serial number Horsepower rating Engine make Engine model Engine year Tier (if applicable) Fuel type	Replacement Engine Information Serial number Horsepower rating Engine make Engine model Engine year Tier (engine standard) Fuel type Executive Order reference Cost Effectiveness Analysis Basis: (choose one) Annual Diesel Gallons Used Annual Hours of Operation (must have hour meter installed) Incremental Cost: Repower: Cost ($) of the existing engine (rebuild cost) Cost ($) of certified replacement engine New Purchase: Cost ($) of the required certified emission equipment Cost ($) of the certified lower emission equipment Retrofit: Cost ($) of retrofit kit Dollar amount of additional financial incentives District Incentive Amount Requested

Third party applications are not allowed. The owner of the engine must sign and agree to the application. However, a third party (e.g. engine dealer or distributor) may complete an application or part of an application on an owner's behalf. Applications must include a signature section for third parties. The third party signature section must include signature and date lines, and blanks for the third party to list how much they are being paid, if anything, to complete the application and what source of funds are being used to pay them. To make the Carl Moyer Program accessible to all potential applicants, including applicants that cannot afford to hire third party assistance, districts are encouraged to provide technical assistance to applicants in completing the application.

B. Reporting and Monitoring

Districts must abide by all reporting and monitoring requirements described in Part I-Program Administration. Monitoring of project progress ensures that the vehicle or engine is operated as stated in the program application. Fleet operators and transit agencies participating in the Carl Moyer Program are required to keep appropriate records during the life of the funded project. Records must be retained and updated for the duration of the project life and made available at the request of the district or ARB.

IV. References

ARB, 2000. Staff Report: Initial Statement of Reasons. Public Hearing to Consider Amendments to Off-road Compression-ignition Engine Regulations: 2000 and Later Emissions Standards, Compliance Requirements and Test Procedures. http://www.arb.ca.gov/regact/ciengine/isor.pdf

ARB, 2004a. Staff Report: Initial Statement of Reasons. Proposed Amendments to the regulation for Statewide Portable Equipment Registration Program. http://www.arb.ca.gov/regact/portreg/isor.pdf

ARB, 2004b. Staff Report: Initial Statement of Reasons. Public Hearing to Consider Amendments to the California Off-road Emissions Regulations for Compression-ignition Engines and Equipment. http://www.arb.ca.gov/regact/offrdcie/isor.pdf

Chapter Six

LARGE SPARK-IGNITION OFF-ROAD EQUIPMENT

Due to the upcoming regulations for large spark-ignition (LSI) equipment that include forklifts, this chapter has been added to replace the Forklift Chapter in the 2003 Guidelines. This revision of the Guidelines expands funding opportunities from only forklifts to all LSI equipment types. The chapter provides an overview of off-road LSI equipment and discusses the emissions from LSI equipment, the State and federal emission standards, and potential types of projects eligible for funding.

The Carl Moyer Program funds projects that provide emission reductions that are surplus to any regulation. Because proposed regulations for LSI equipment are scheduled for consideration by the Board, staff will provide specific criteria to districts through a technical advisory approved by the Executive Officer once the Board has approved the proposed regulations.

In the interim, districts may continue to use the 2003 Carl Moyer Program Guidelines to fund projects or request consideration of other projects on a case-by-case basis.

I. Introduction

LSI engines are typically derived from automobile engines and are most commonly fueled by gasoline or liquefied petroleum gas. A small number are fueled by compressed natural gas (CNG), and some have dual fuel capability. Off-road LSI equipment includes the following types of equipment: large turf care equipment, scrubber/sweepers, airport service vehicles, and a variety of other agricultural, construction, and general industrial equipment. The largest group of LSI equipment in California is forklifts, representing almost half of the LSI inventory.

The U.S. Environmental Protection Agency (U.S. EPA) has sole authority to regulate new farm and construction equipment less than 175 hp. However, the Air Resources Board (ARB) has authority to regulate off-road equipment equal to or greater than 175 hp, and all in-use off-road equipment and non-preempted off-road equipment less than 175 hp.

II. Emissions

Uncontrolled LSI engines can emit more than 12 grams per brake horsepower-hour (g/bhp-hr) of oxides of nitrogen plus hydrocarbons (NOx + HC). Statewide, the NOx + HC emissions from LSI equipment are approximately 70 tons per day.

The equipment categories shown in Table 6-1 represent the largest contribution to the overall off-road LSI inventory and are the focus of the proposed LSI regulation. Although these three categories account for only 60 percent of the off-road LSI equipment population in 2004, they account for more than 80 percent of the NOx + HC off-road LSI emission inventory. As shown in Table 6-1, most of those emissions are from forklifts, 80 percent of which are in large fleets.

Table 6-1
Statewide Emissions from Off-Road LSI Equipment
(tons per day)

Equipment Category	2004		2010		2020	
	NOx	ROG	NOx	ROG	NOx	ROG
Industrial Forklifts	40.4	11.8	19.9	5.3	15.6	3.4
Airport Ground Support Equipment	3.3	0.6	1.5	0.3	1.0	0.2
Sweeper/Scrubbers	0.8	0.2	0.3	0.1	0.2	0.1
Total	44.5	12.6	21.7	5.7	16.8	3.7

III. Regulatory Requirements

A. Emission Standards

In 1998, the ARB adopted LSI regulations that addressed the State's obligations under the 1994 State Implementation Plan (SIP). The SIP is California's federally required plan describing how the State will reduce emissions and meet federal clean air standards.

That regulation required all new LSI engines over 25 horsepower sold in California to be certified to a standard of 3.0 g/bhp-hr of NOx + HC. This was to be phased in from 2001 to 2004. In 2002, U.S. EPA adopted a more stringent standard requiring that new LSI engines meet a 2.0 standard of g/bhp-hr of NOx + HC beginning in 2007.

B. Proposed Regulation

In order to achieve California's clean air goals, the 2003 SIP calls for further reductions from new and in-use LSI engines.

1. Emission Standards

The ARB staff has developed a proposal that would provide more low emission options for equipment purchases. Staff is proposing to require 2007 model year engines to meet a 2.0 g/bhp-hr standard and 2010 and subsequent model year engines to meet a 0.6 g/bhp-hr standard. ARB staff is also proposing NOx + HC optional standards so that new 2007 engines can be certified to 0.1, 0.2, 0.4, 0.6, 1.0, and 1.5 g/bhp-hr. For model years 2010 and beyond, new engines could be certified to 0.1, 0.2, and 0.4 g/bhp-hr.

2. Fleet Rules

As part of the staff proposal, equipment fleets would have to meet average emission requirements. Large and mid-size fleets of forklifts, airport ground support equipment (GSE), sweeper/scrubbers (with a displacement greater than one liter), and non-GSE industrial tow tractors would have specific emission averages to meet.

Table 6-2 lists the proposed standards required of manufacturers as well as proposed compliance dates for fleets. The proposed averages that fleets would be required to meet would be based on the total number of pieces of equipment in the fleet. Equipment with hour-meters documenting usage of less than 251 hours per year would be exempt from the fleet average emission level requirements.

Table 6-2
Current and Proposed Emission Standards and Fleet Average Requirements
(g/bhp-hr of NOx + HC)

LSI Fleet Type	2005	2006	2007	2008	2009	2010	2011	2012	2013	2016
current standards (CA and U.S. EPA)	3.0		2.0							
proposed standards	3.0		2.0			0.6				
proposed optional standards	0.1, 0.2, 0.4, 0.6, 1.0 and 1.5					0.1, 0.2, and 0.4				
proposed fleet average large fleet forklift					2.4	2.4	1.7	1.7	1.1	1.1
proposed fleet average mid-size fleet forklift					2.6	2.6	2.0	2.0	1.4	1.4
proposed fleet average non-forklift					3.0	3.0	2.7	2.7	2.5	2.5
proposed fleet average small fleet							3.0			
proposed fleet average ground support equipment					3.0					
proposed agricultural crop preparation services fleets		12	11.1	10.2	9.3	8.4	7.5	6.6	5.7	3

IV. Potential Projects

The ARB encourages replacement of LSI equipment with zero-emission equipment where feasible. Information about zero-emission strategies is provided in Chapter 12. Below are brief descriptions of potential projects. Off-road projects fall into three categories: 1) new purchase of an emission certified engine, 2) repower with an emission certified engine, and 3) retrofit with ARB-verified technology.

A. New Purchase

New or expanding facilities purchasing LSI equipment with engines that are certified to 30 percent below the current standard may qualify for funding if the emission reductions are shown to go beyond any regulatory requirement and the any LSI regulating that are adopted by the Board. This could be accomplished by purchasing equipment that is electric or certified to an optional low emission standard.

These projects are eligible for Carl Moyer Program funding if the project exceeds regulatory requirements. Since replacing an older electric forklift with a newer electric model would not reduce emissions, projects with "electric to electric" replacements are excluded. Purchase of new CNG LSI equipment may also be eligible if it is certified to meet optional low emission standards.

B. Repower

Repower refers to the replacement of an existing engine with a newer engine certified to lower emission standards. This is an alternative to rebuilding an existing engine to the original higher emitting specifications the existing engine. The certified engine must include all the emission controls components as stated in the Executive Order for that engine. There may be some limits to repowering of LSI equipment because installing a newer engine design into existing equipment may not always be feasible. The baseline emissions for these projects would be the emission rate of the existing engine. The baseline cost would be the cost to rebuild. Repower projects may qualify for funding if the emission reductions are shown to go beyond any regulatory requirement and the LSI regulation adopted by the Board. Repowers of certified engines must provide at least a 15 percent emission reduction from the baseline engine and repowers of uncontrolled engines must meet the current emission standard.

C. Retrofit

Retrofit refers to modifications or additions made to an engine and/or fuel system such that the specifications of the retrofitted engine are not the same as the original engine. Data has shown that existing LSI engines retrofitted with closed loop, catalyst-based emission systems could achieve emission reductions similar to those achieved from new engines designed with catalysts. Retrofits for LSI equipment will likely incorporate advanced automotive-inspired emission control technologies that dramatically reduce emissions while meeting operational requirements. (See Appendix F for more discussion on retrofits.) This technology has been in use for about 10 years nationwide on a variety of LSI equipment. Usually a retrofit would be installed at the time of engine rebuild or a regularly scheduled maintenance. To qualify for Carl Moyer Program funding, the retrofit technology must be verified for sale in California. The ARB has an interim verification procedure for manufacturers of retrofit systems for LSI equipment.

To be eligible to receive Carl Moyer Program funds, emission reductions must go beyond any legally-binding requirement and the LSI regulation adopted by the Board.

Typically under the Carl Moyer Program, retrofit projects are allowed if they provide at least 15 percent reductions in emissions. However, under the proposed LSI regulations only retrofits that reduce emissions by 25 percent or more will be verified. Hence, only retrofits that reduce emissions on uncontrolled LSI engines by 25 percent would be for Carl Moyer Program funding. Retrofit systems for installation on emission-certified engines must by verified to no more than 2.0 g/bhp-hr of NOx+HC. The eligible cost would be the kit and installation costs.

Since nearly half of the LSI equipment in California is forklifts, some information on forklift classes is presented below. The Industrial Truck Association (ITA) has defined seven classes of forklifts. These classes are defined by the type of engine, work environment (indoors, outdoors, narrow aisle, smooth or rough surfaces), operator positions (sit down or standing), and equipment characteristics (type of tire, maximum grade, etc.). Several classes are further divided by operating characteristics. Classifications are described in Table 6-3.

Table 6-3
Forklift Classes

Class	Lift Code	Engine Type	Type/Use
1	1	Electric	Counterbalanced rider, stand up
1	4		Three-wheel, sit down
1	5		Counterbalanced rider, sit down
1	6		Counterbalanced rider, sit down
2			Narrow aisle truck
3			Hand or hand/rider truck
4		Internal Combustion	Rider, sit down, generally suitable for indoor use on hard surfaces
5			Rider, sit down, typically used outdoors, on rough surfaces or steep inclines
6		Internal combustion and Electric	Ride on unit with the ability to tow at least 1,000 pounds; designed to tow cargo rather than lift it (e.g. an airport tug)
7		Internal combustion (primarily diesel)	Rough terrain forklift truck for outdoor use; almost exclusively powered by diesel engines

Class 1 forklifts (lift codes 5 and 6) can be used in many of the same work applications as the class 4 or 5 forklifts because they are similar in design and specification. Increasing the use of class 1 forklifts relative to class 4 and 5 forklifts would reduce NOx emissions of the fleets.

Class 6 trucks are ride-on vehicles designed to tow at least 1,000 pounds. Airport tugs are an example of a Class 6 truck. See Chapter 7 for a description of GSE and additional information about the South Coast Ground Support Equipment Memorandum of Understanding that may limit project eligibility for LSI equipment used in airport ground support fleets.

Class 7 consists of rough terrain forklifts for outdoor use. See Chapter 5 for project funding criteria for Class 7 forklifts which are usually powered by diesel engines.

V. Proposed Project Criteria

Since all Carl Moyer Program projects must be surplus to any regulations, specific project criteria that define project eligibility for the LSI source category must be based on LSI regulations that are adopted by the Board. After Board approval of the LSI regulation, staff will develop criteria for those projects that provide emission reductions beyond the approved regulatory requirements. Staff recommends that the Board grant the Executive Officer the authority to approve LSI project criteria in a technical advisory. In the interim, forklift purchases and retrofits would be allowed as approved under the 2003 Carl Moyer Program Guidelines. Staff is proposing that until the Board adopts the LSI regulation, districts may continue to use the 2003 Guidelines in evaluating projects. During this interim period additional LSI projects may be considered on a case-by-case basis.

On September 6, 2005, Governor Schwarzenegger signed Senate Bill 467 (Lowenthal) which requires the ARB to revise the Carl Moyer Program Guidelines to include projects in which an applicant turns in off-road equipment powered by an internal combustion engines and replaces that equipment with new zero-emission technologies. This legislation will take effect on January 1, 2006. ARB staff will evaluate how to incorporate the requirements of this legislation into the Carl Moyer Program in 2006.

Chapter Seven

AIRPORT GROUND SUPPORT EQUIPMENT

This chapter describes the airport ground support equipment (GSE) category under the Carl Moyer Program. It also gives a brief overview of the requirements for fleets. It discusses different types of equipment, current emission standards, available control technology, and potential incentive projects eligible for funding.

All Carl Moyer Program projects must be surplus to any regulation. Because regulations for GSE equipment with spark-ignition engines are currently scheduled for consideration by the Board in late 2005, this chapter does not present criteria districts would use in selecting a project to fund. Staff proposes to present specific criteria to districts through a technical advisory approved by the Executive Officer once the Board has approved the proposed regulations for large spark ignited (LSI) equipment. In the interim, projects would be allowed as approved under the 2003 guidelines.

I. Introduction

Airport vehicles and ground support equipment are used to transport passengers as well as baggage and freight, to support maintenance and repair functions, and to provide power to various service functions. Airport GSE includes aircraft pushback tugs, baggage and cargo tugs, carts, forklifts and lifts, ground power units, air conditioning units, belt loaders, and other equipment. Vehicles and equipment at airports fall into two broad categories. Land-side vehicles and equipment are used on the passenger/entry side of the airport. Air-side vehicles are used principally (at least half of the time) on the tarmac. For the purposes of the Carl Moyer Program, this airport GSE chapter is only to be used to evaluate air-side equipment. Land-side vehicles and equipment may be considered under the on-road vehicles (Chapter 1) and off-road vehicles and equipment (Chapters 5 and 6) project criteria of the Carl Moyer Program.

Airport GSE is typically powered by gasoline, diesel or propane. Airport GSE can also be powered by electric motors having zero exhaust emissions. Electric GSE is commercially available from a number of manufacturers, and interest in the use of electric equipment is increasing. Currently, there are no federal or California regulations that require the use of electric GSE. There are airports throughout the United States, however, with a very high percentage of electric GSE. For example, Denver International Airport was designed for all electric GSE. Also, Logan International Airport in Boston has made considerable progress in switching to electric GSE equipment.

Airport GSE are used from the moment an aircraft lands until it takes off. GSE perform a variety of functions such as towing, powering, and servicing aircrafts. There is great diversity in the type of equipment used, as well as in the variety of engines that power GSE. Table 7.1 below lists the commonly used types of GSE. Airport GSE can be owned by airlines, airports, cargo handlers, mail and parcel companies or management companies. Most airlines own or maintain the GSE they use, or have full service leasing from equipment management companies. Airports usually own the buildings and other stationary infrastructure on site and lease them to the airlines. The installation and cost of improvements, including electric equipment and vehicle infrastructure, are usually subject to the approval of the airport's property management. Costs can either be borne by the airport or passed on to the airlines. There is also a growing trend for airports to own the ground power units and charge the airlines for the time of usage.

Table 7-1
Types of Airport GSE

Baggage Tug
Belt Loader
Forklifts, lifts & cargo loaders
Ground Power Unit
Aircraft Tug (narrow & wide body)
Airstart Unit
Air Conditioner
Deicer
Cart & Lavatory Cart
Fuel Trucks
Utility Trucks (lavatory, maintenance, water & service)
Bobtail

II. Regulatory Requirements

The United States Environmental Protection Agency (U.S. EPA) and ARB have adopted emission standards that will be phased in for new GSE equipment powered by off-road internal combustion (IC) engines. Internal combustion engines used in GSE can be powered by either compression-ignition (CI or "diesel") engines or by spark-ignition (SI) engines using gasoline, compressed natural gas (CNG), or propane fuel. GSE is regulated under ARB and U.S. EPA's emission standards for off-road equipment.

ARB has the authority to regulate new off-road CI equipment equal to or greater than 175 hp and non-preempted off-road CI less than 175 horsepower. In January 1992, the Board adopted exhaust emission standards for off-road diesel engines 175 hp and greater, effective beginning with 1996 model year engines.

In August 1996, the U.S. EPA, ARB, and off-road diesel engine manufacturers signed a Statement of Principles, which established a progressive set of emission standards and called for harmonization of ARB and U.S. EPA off-road diesel engine regulations. The U.S. EPA adopted emission standards in 1998 and again in 2004 that provided for new oxides of nitrogen (NOx) + non-methane hydrocarbons (NMHC), PM, and carbon monoxide (CO) emission standards for engines within different power categories to be effective in a tiered approach, commonly referred to as Tier standards. ARB has since amended the California exhaust emission standards for off-road diesel engines (originally adopted in 1992) to include non-preempt engines below 175 horsepower and to harmonize with the federal requirements. Please refer to Chapter 5 of the Guidelines (Compression-Ignition Off-Road Equipment) for more discussion on these requirements.

In 1998, the ARB adopted regulations for off-road LSI engines sold in California. The regulations require new LSI engines 25 horsepower and greater to be certified to an emission standard of 3.0 g/bhp-hr of NOx+HC. This standard was phased in between 2001 and 2004. The U.S. EPA followed in 2002, adopting the same NOx+HC standard beginning in 2004. At the same time, the U.S. EPA also adopted a standard of 2.0 g/bhp-hr NOx+HC, beginning in 2007. ARB is currently developing a proposal that includes new emission standards and fleet requirements for LSI engines and equipment. This proposal is scheduled for Board consideration in late 2005 and would govern the development of project criteria for GSE. Please refer to Chapter 6 of the Guidelines (Off-Road Large Spark Ignition Equipment) for more discussion on the off-road LSI equipment category and emission requirements.

In 2002, the ARB and several airlines entered into a Memorandum of Understanding (MOU) aimed at introducing cleaner GSE, with an emphasis on electric GSE, into the South Coast Air Basin. Under the agreement, all major airlines operating at five airports in the South Coast Air Basin (LAX, Ontario, Orange County, Burbank, and Long Beach) would begin to incorporate lower-emission GSE into their fleets. GSE projects that are surplus to the emission reductions required under the MOU are eligible for funding under the Carl Moyer Program.

III. Potential Projects

A cost-effective strategy to reduce emissions involves the purchase of electric GSE, which has no exhaust emissions. Electric GSE is commercially available for a number of equipment types, including belt loaders, baggage tractors, aircraft tugs, lifts, and ground power units. Several airlines and airports have conducted electric GSE demonstration programs and fleet conversion programs. Further discussion of electric GSE experiences can be found in Chapter 12 of the Guidelines and a report by Arcadis, Geraghty & Miller [ARB, 1999].

Airport GSE emissions can also be decreased by retrofitting the equipment with a PM filter, diesel oxidation catalyst or a three-way catalyst. For instance, catalysts have been added to SI GSE to meet the current LSI emission standards. In addition, to reduce emissions GSE can be repowered with a new, cleaner IC engines.

The Carl Moyer Program will fund the purchase of electric GSE, as well as GSE repower and retrofit projects if this equipment is not subject to any existing or planned regulations, funded through another incentive program, or used to generate credits of any type. In addition, projects that are surplus to the emission reductions required under the South Coast MOU are eligible for funding. The most promising categories are those where electric equipment has been used and demonstrated and are readily available from commercial vendors. This includes electric baggage tugs, belt loaders, and aircraft tugs. These equipment categories also represent a significant portion of the statewide GSE population and have some of the highest average annual hours of usage. Purchase of electric GSE instead of IC-engine GSE would yield significant emission benefits. Therefore, the Carl Moyer Program guidelines would continue to target these categories. Other promising projects include lifts and cargo loaders. Carts, lavatory carts and air-start units each represent a smaller fraction of the GSE equipment inventory. Fuel, utility, water, and service trucks are not covered under the current airport GSE guidelines, but may be considered under the on-road vehicle category (Chapter 1).

IV. Proposed Project Criteria

Since potential GSE projects could involve either CI or SI engines, eligibility criteria for GSE would be dependent on the base engine of the GSE and any regulatory requirements, including fleet requirements, applicable to the GSE category. For projects involving CI GSE, please refer to Chapter 5. Note that in addition to meeting the project criteria for off-road CI equipment, GSE projects applied for by the participating airlines in the GSE MOU must also be surplus to the MOU. For LSI GSE, specific project criteria will be developed based on the outcome of the proposed regulation for LSI engines and equipment currently scheduled for Board's consideration in late 2005. Staff recommends that the Board grant the Executive Officer authority to approve GSE project criteria in a Carl Moyer Program advisory. Staff proposes that until the Board adopts the upcoming LSI regulation, districts may continue to fund GSE projects using the 2003 Carl Moyer Program Guidelines. In addition, airport GSE used at non-commercial airports would be eligible for funding. During this interim period, additional GSE projects may be considered on a case-by-case basis.

Airport GSE projects funded by the Carl Moyer Program must meet a cost-effectiveness of $14,300 per weighed ton of NOx + ROG + combustion PM10 reduced calculated in accordance with the cost-effectiveness methodology discussed in the Guidelines.

On September 6, 2005, Governor Schwarzenegger signed Senate Bill 467 (Lowenthal) which requires the ARB to revise the Carl Moyer Program Guidelines to include projects in which an applicant turns in off-road equipment powered by an internal combustion engines and replaces that equipment with new zero-emission technologies. This legislation will take effect on January 1, 2006. ARB staff will evaluate how to incorporate the requirements of this legislation into the Carl Moyer Program in 2006.

V. References

ARB, 1999. Assessment of Airport Ground Support Equipment Using Electric Power or Low-Emitting Fuels (Final Report), Final Report to Air Resources Board. Arcadis Geraghty & Miller, July 20, 1999.

Chapter Eight

LOCOMOTIVES

This chapter presents program criteria for locomotive projects, and provides an overview of the locomotive industry, locomotive emissions, current emission control requirements, and types of incentive projects eligible for funding. The chapter also sets requirements for installation of an idle-limiting device (ILD) on project locomotives, defines criteria for hybrid and multiple engine technology switcher projects.

I. Introduction

Locomotives move more than 40 percent of the freight in the United States, on a ton-miles basis [Association of American Railroads, 2004]. Most locomotives operating today are diesel-electric, using a diesel engine to drive a generator, which in turn drives the locomotive wheels. Locomotive engines have very long useful lives, with the capability of being rebuilt numerous times.

Locomotives provide line-haul, short-haul, switcher, and passenger service. Each of these locomotive types has discrete functions and characteristics:

- Line Haul - Line-haul locomotives typically transport goods between major urban centers, sometimes up to 3,000 miles apart. Line-haul locomotives operate at higher speeds than other locomotives and generally utilize engines with 3,000 or greater horsepower. Because reliability is important for line-haul operators, these locomotives tend to be newer and well-maintained.

- Short-Haul - Short-haul locomotives perform a combination of line-haul and railyard service. Typically, they use 2,000 to 3,800 horsepower engines, and move freight regionally or locally. For the purposes of the Carl Moyer Program, short-haul locomotives are treated the same as line-haul locomotives.

- Switcher - Switch locomotives separate and move railcars from track to track or transfer cars to and from regional carriers. Typically, they use 1,500 to 2,300 horsepower diesel engines, travel short distances at low speeds, make numerous stops, and idle frequently for long periods of time. Switcher locomotives are generally remanufactured from aging line-haul locomotives. Switchers are typically the oldest and most poorly maintained locomotives.

- Passenger - Passenger locomotives haul passengers rather than freight, and are typically used in high speed, line-haul type operations. The average passenger train is about 10 years old and has a 3,000 to 3,600 horsepower engine.

II. Emissions

Locomotives are a significant source of oxides of nitrogen (NOx) and particulate matter (PM) emissions. Line haul and short-haul locomotives emit over 90 percent of locomotive Nox and PM emissions in California, while switchers and passenger locomotives are responsible for about six and two percent of locomotive emissions, respectively. Although switch locomotives generate less overall emissions than line-haul locomotives, their emissions tend to be concentrated at and around railyards, and can pose greater health concerns for nearby communities.

About 25 percent of the State's locomotive Nox and PM emissions occur in the Mojave Desert Air Basin (See Table 8-1, below). The bulk of these emissions are generated by the hauling of freight from the Ports of Los Angeles and Long Beach through Barstow to points east. Barstow is home to the second largest rail yard west of the Mississippi River; the largest is the Roseville Rail Yard in the Sacramento Valley. Locomotives in the South Coast Air Basin contribute about 20 percent of statewide emissions, while the locomotives in the San Joaquin Valley and Sacramento Valley each account for about 15 percent.

Table 8-1
Locomotive Emission Inventory
(Annual average tons per day in 2005)

Region	Nox	PM
Mojave Desert Air Basin	39	1.3
South Coast Air Basin	33	1.0
San Joaquin Valley	24	0.7
Sacramento Valley	23	0.7
Bay Area	11	0.3
Rest of the State	32	1.1
Total	**162**	**5.1**

Based on ARB's CCOS Emissions Inventory (Version 2.12)

III. Regulatory Requirements

The U.S. Environmental Protection Agency (U.S. EPA), with its sole authority to set emission standards for new and remanufactured locomotives, has adopted phased-in locomotive emission standards [Federal Register, April 16, 1998]. Federal locomotive emission standards contain two primary provisions: 1) remanufacture emission limits applicable to railroads whenever they remanufacture or rebuild their locomotive engines, and 2) emission standards for new locomotives applicable to locomotive manufacturers.

A. Locomotive Remanufacture Emission Standards

Regulation of remanufactured locomotives is critical because locomotives are generally remanufactured five to ten times during their service lives. U.S. EPA's locomotive remanufacture emission standards therefore provide a mechanism to reduce emissions from the existing fleet. Federal locomotive remanufacture emission standards require locomotives originally manufactured in 1973 or later to meet the emission limits listed in Table 8-2 whenever they are rebuilt or remanufactured. Locomotives originally manufactured before 1973 are exempt from the federal locomotive remanufacture requirements.

Table 8-2
Federal Exhaust Emission Standards for Locomotives for New Engines and at Time of Remanufacture
(g/bhp-hr)

Duty-cycle	Gaseous and Particulate Emissions			
	HC	CO	NOx	PM
	Tier 0 (1973 – 2001 model years)			
Line-haul/ Passenger	1.00	5.0	9.5	0.60
Switcher	2.10	8.0	14.0	0.72
	Tier 1 (2002 – 2004 model years)			
Line-haul/ Passenger	0.55	2.2	7.4	0.45
Switcher	1.20	2.5	11.0	0.54
	Tier 2 (2005 and later model years)			
Line-haul/ Passenger	0.30	1.5	5.5	0.20
Switcher	0.60	2.4	8.1	0.24

U.S. EPA locomotive remanufacture requirements also include an exemption for small railroads -- line-haul railroads with fewer than 1,500 employees, and switch railroads with fewer than 500 employees. Surface Transportation Board (STB) freight railroad classifications, based on annual revenues, provide an equivalent mechanism for distinguishing between large and small railroads in California. STB freight and other railroad classifications, and the applicable U.S. EPA remanufacture requirements are as follows:

- Class I Railroads - Class I freight railroads are carriers with annual revenues greater than or equal to $266.7 million. Locomotives owned and operated by Class I railroads in California must meet the U.S. EPA remanufacture emission limits in Table 8-2. The Union Pacific Railroad (UP) and the Burlington Northern & Santa Fe Railroad (BNSF) are the only Class I freight railroad companies operating in California.

- Class II Railroads - Class II railroads are carriers with annual revenues between \$21.3 and \$266.7 million. Class II railroads are exempt from federal locomotive remanufacture requirements. Currently, there are no Class II railroads headquartered in California. For the purposes of the Carl Moyer Program, a Class II railroad locomotive must meet the same project criteria as a Class III railroad locomotive.

- Class III Railroads - Class III railroads are carriers with annual revenues less than \$21.3 million. Class III railroads in California are largely exempt from federal locomotive engine remanufacture requirements. As a result, many older, unregulated locomotives continue to operate at Class III railroads.

- Military and Industrial Railroads – Over 100 military and industrial locomotives owned by non-railroad companies operate in California. These locomotives are generally much smaller in size and horsepower than locomotives used by larger rail yards, are confined to small yards or industrial plants, and are typically 40 to 60 years old. Military and industrial locomotives are largely exempt from federal locomotive remanufacture requirements. For the purposes of the Carl Moyer Program, military and industrial locomotives must meet the same project criteria as a Class III railroad locomotive.

- Passenger Service Railroads – Amtrak is California's only passenger locomotive operator not considered a small railroad by federal regulations. Amtrak is therefore the state's only passenger railroad subject to federal locomotive remanufacture requirements. Amtrak locomotives are currently required to meet all Tier 1 and Tier 2 emission limits, but are not subject to Tier 0 remanufacture requirements for their 1973 through 2001 model year locomotives until 2007.

The practical impact of the federal small railroad exemption from locomotive remanufacture requirements is that UP, BNSF, and Amtrak locomotives must meet federal remanufacture emission limits, while other railroads can remanufacture to uncontrolled emission levels.

B. Emission Standards for New Locomotives

The second component of federal locomotive standards took effect in 2000, applies to locomotive manufacturers, and requires all new locomotives to meet the tiered emission standards in Table 8-2. Because these standards apply to locomotive manufacturers, all railroads, regardless of size, must purchase locomotives meeting Tier 2 emission limits when purchasing a new locomotive. In practice, however, only Class I railroads purchase new locomotives, while Class III railroads typically purchase existing in-use locomotives.

C. Upcoming Regulations

In May 2004, U.S. EPA issued an Advanced Notice of Proposed Rulemaking, signaling its intent to pursue more stringent standards for new and existing locomotives [U.S. EPA, 2004]. The standards are likely to be modeled after 2007 and 2010 on-road and off-road diesel engine standards, and to be based on the application of catalytic after-treatment technology. The new locomotive standards could be phased in beginning as early as 2011.

D. South Coast Locomotive Memorandum of Understanding

The Air Resources Board (ARB or "Board") and U.S. EPA have signed an enforceable Memorandum of Understanding (MOU) with UP and BNSF railroads to implement a locomotive fleet average emissions program in the South Coast Air Basin (SCAB). The purpose of the South Coast MOU is to expedite the introduction of new, lower-emitting locomotive engines in the SCAB. The agreement commits UP and BNSF railroads to achieve a 5.5 g/bhp-hr locomotive fleet average NOx emission rate in the SCAB by 2010. The railroads can also get credit towards their 2010 fleet average target by exceeding the fleet average emissions targets between 2005 and 2009.

In order to ensure Carl Moyer Program funding achieves surplus emission reductions, railroads subject to the South Coast MOU must meet the following minimum project criteria:

- Locomotive projects in the SCAB may not be included in the MOU fleet average emission rate compliance demonstration.
- The project baseline emission rate for all locomotives in the SCAB subject to the South Coast MOU shall be equivalent to the Tier 2 emission rates identified for line-haul and switch locomotives in Table B-16.
- Locomotive projects in all air districts must have a minimum project life of ten years.

This last requirement helps ensure that a cleaner locomotive funded in another air district cannot be exchanged for a dirtier locomotive in the SCAB at the completion of the project life to demonstrate compliance with the South Coast MOU. Allowing such an exchange, even at the end of the project life, could result in higher overall emissions since the locomotive exchanged into the participating air district could be dirtier than the original project locomotive.

E. Statewide Locomotive Memorandum of Understanding

In June 2005, ARB signed a Statewide MOU with UP and BNSF railroads. The MOU requires UP and BNSF to install an ILD on over 99 percent of their intrastate locomotives between June 30, 2006 and June 30, 2008. The Statewide MOU also requires 80 percent of the diesel fuel dispensed to UP and BNSF locomotives in California to be low-sulfur diesel by the end of 2006. This agreement complements an ARB intrastate locomotive fuels regulation, adopted in November 2004, which requires all intrastate diesel locomotives to use California reformulated low-sulfur diesel fuel by January 1, 2007. The Statewide MOU also requires that railroads conduct health risk assessments at California's rail yards and consider additional long-term strategies to reduce idling PM emissions and health risks. Because the Statewide MOU requires virtually all UP and BNSF locomotives have ILDs, ILD projects for UP and BNSF locomotives are not eligible for Carl Moyer Program funding. (*The Board will consider the Statewide Locomotive MOU at a October 27, 2005 Board meeting. ARB may update Carl Moyer Program criteria for Class I railroad ILD installation, if necessary, based upon this meeting*).

IV. Potential Projects

Projects eligible for Carl Moyer Program incentive funding include repower or retrofit of an existing locomotive engine, purchase of a new reduced-emission engine or locomotive, or installation of an ILD. Hybrid and multiple engine switch locomotive projects have also received Carl Moyer Program funding in recent years and are eligible for funding. Other technologies that offer real emission reductions may also be considered on a case-by-case basis. Funding for projects considered on a case-by-case basis shall be contingent on a clear demonstration that the project shall achieve surplus, real, quantifiable, and enforceable emission reductions.

A. Repower

Repowering involves replacing an existing locomotive engine with a newer, lower-emitting engine. Locomotive repower projects must achieve at least a 15 percent NOx reduction beyond existing emissions levels. Repower projects for 1973 and later year Class III locomotives must achieve at least Tier 0-equivalent emission rates if a remanufacture kit certified by U.S. EPA to meet Tier 0 or lower emission levels is available. Baseline emissions for locomotive repower projects reflect federal emission requirements for engine remanufacture (e.g. Tier 0 through Tier 2 emission rates for Class I locomotives, and uncontrolled emissions for pre-1973 locomotives and Class III locomotives). Baseline costs for repower projects reflect the cost to remanufacture the project engine or $50,000, whichever is greater.

B. Retrofits

Retrofits involve hardware modifications to the engine or exhaust system to reduce emissions. Potential retrofit projects involve the addition of an ARB-verified retrofit device, or installation of a U.S. EPA-certified remanufacture emission kit. For most Carl Moyer Program categories, a retrofit device must be ARB-verified in order to be considered for funding. To date, however, very few retrofit technologies have been verified to reduce emissions from a locomotive. Retrofit technologies generally develop first for on-road sources, and are refined for use on off-road engines. Because of the lack of retrofit devices verified for use on a locomotive engine, ARB will consider funding a locomotive retrofit device which is not yet ARB-verified for use on locomotives on a case-by-case basis. Applicants for funding on a case-by-case basis must meet the applicable project criteria identified in Section V of this chapter.

In recent years, engine manufacturers have developed U.S. EPA-certified engine retrofit kits for use on locomotives. To be eligible for Carl Moyer Program funding, retrofit emission kits must be U.S. EPA certified to achieve at least Tier 0 locomotive emission standards on the project locomotive engine. Remanufacture emission kit projects must also achieve at least 15 percent NOx reductions from the project locomotive if taking credit for NOx emission reductions. Kits which utilize fuel injection timing retard must be clearly demonstrated to not increase in-use PM or HC emissions to be eligible for funding. Individual engine parts or other locomotive components are not eligible for funding except as part of a complete U.S. EPA certified engine retrofit kit.

C. Idle-Limiting Devices

Locomotive operators idle their engines to maintain battery charge, warmth of the engine coolant, fuel, oil, and water, and comfortable temperatures inside the operator cabs. Locomotives also idle to ensure the engine is readily available (avoiding unnecessary starting and shutting-down), and because of habitual practice. Installation of an ILD can significantly reduce emissions from locomotives, which typically spend 40 to 60 percent of their operating time in the idle duty cycle.

The ILD technologies on the market today vary in operational requirements and predictability of idling reductions. An automatic engine start-stop (AESS) typically uses a central computer to monitor vital engine parameters, such as battery charge, water temperature, and brake pressure, and automatically shuts off the engine after a set time. The AESS provides an automatic, fully integrated mechanism to reduce idling and does not rely upon a locomotive operator or require additional engines or infrastructure. This technology is generally applicable to more locomotive types and operating conditions than other ILD devices.

Other ILDs include diesel driven heating systems (DDHS), stationary power plug-in units, and locomotive auxiliary power units (APU). These ILD technologies can reduce locomotive idling time under certain conditions. For example, a DDHS is particularly effective in colder climates, while a stationary power plug-in unit is feasible only for site-specific locomotives where plug-in technology can be permanently located. Costs for these ILDs range from $4,000 to $12,000 for a shore power plug-in unit, $8,000 to $15,000 for an AESS, and $25,000 to $35,000 for an DHSS or APU.

Because an AESS unit can provide significant and predictable air quality benefits at a relatively low cost, all locomotive projects without a functioning ILD must install an AESS, if feasible, to receive program funding. The Carl Moyer Program shall pay actual equipment costs up to a maximum of $8,000 for the AESS and actual installation costs of the AESS up to $3,400. The award cap reflects the fact that AESS installation significantly reduces locomotive operating costs and has a typical capital payback period of one to three years. Other ILD technologies may be considered for program funding on a case-by-case basis if an AESS device cannot be installed on the project locomotive.

D. Alternative Technology Switch Locomotives

In recent years, several diesel-electric hybrid switch locomotives have been funded through the Carl Moyer Program. Hybrid switch locomotives significantly reduce PM and NOx emissions, idling time, and fuel use compared to conventional switchers. These locomotives use the same basic concept as a gas-electric hybrid automobile -- a battery pack powers the locomotive, while a small diesel engine runs as needed to keep the batteries charged. Hybrid locomotives typically utilize an aging locomotive frame and replace the existing large diesel engine, generator, and analog controls with a small diesel generator, battery pack, and computerized control module. The batteries can provide up to 90 percent of the locomotive horsepower at full load, while the remaining power comes from a 300 to 800 horsepower diesel engine. In addition to driving the locomotive, the added weight of the battery pack provides additional traction to propel the locomotive.

Switch locomotive projects which involve replacing the main engine with multiple heavy-duty truck or off-road engines have also become more commonplace. Multi-engine locomotive projects also typically involve significantly refurbishing an existing locomotive frame with new batteries, electronics, and controls. The replacement engines typically have a much lower horsepower rating and lower emissions than the engine they replace. For the purposes of the Carl Moyer Program, hybrid and multiple engine switchers, as described above, are defined as alternative technology switchers.

Switch locomotive purchase practices are unique. Few new locomotives are manufactured and purchased by the railroads for use in switcher service. Instead, as line-haul locomotives get older and less reliable, they are remanufactured for switching service and moved to a rail yard. In many cases, Class III railroads will purchase older switchers when they are retired by Class I railroads. Because railroads do not typically purchase newly manufactured switcher locomotives, an alternative technology switcher is considered a new locomotive purchase for the purpose of the Carl Moyer Program.

Baseline project emissions and costs for alternative technology switchers also reflect differing Class I and Class III regulatory requirements and purchase practices. Since Class I railroads are required to meet federal locomotive remanufacture emission standards for 1973 and newer locomotives, a new Class I switcher would typically emit at Tier 0 emission rates. Class III railroads -- which are not subject to federal requirements and typically purchase older, in-use locomotives -- typically remanufacture to uncontrolled emission levels. Baseline emissions for hybrid and multiple engine switcher projects at Class I and Class III railroads therefore reflect Tier 0 and uncontrolled emission rates, respectively.

The Carl Moyer Program may fund up to 60 percent and 80 percent of the total cost of an alternative technology switcher for Class I and Class III railroads, respectively.

Project funding caps reflect the differential cost of a typical switcher purchased by Class I and Class III railroads, as described above. Funding caps have also been set in recognition that an alternative technology switcher achieves significant fuel cost savings over its lifetime relative to a traditional switch locomotive.

V. Proposed Project Criteria

These criteria provide the minimum requirements for all Carl Moyer Program locomotive projects. Participating districts retain the authority to impose additional requirements in order to address local concerns.

A. General

- Emission reductions obtained through Carl Moyer Program projects must not be required by or used to comply with any federal, state or local regulation, memorandum of agreement/understanding with a regulatory agency, settlement agreement, mitigation requirement, or other legally binding document. Inclusion in a rail yard or port emission reduction plan, lease agreement, or other voluntarily adopted strategy does not exclude a locomotive project from funding eligibility, if such a project is not otherwise required.

- No emission reductions generated by the Carl Moyer Program shall be used as marketable emission reduction credits, or to offset any emission reduction obligation of any person or entity.

- No project funded by the Carl Moyer Program shall be used for credit under any federal or state emission averaging banking and trading program.

- Locomotive operators utilizing an alternative emission control plan (AECP) to comply with California's locomotive low-sulfur diesel fuel requirements shall not be eligible for Carl Moyer Program funds.

- Beginning January 1, 2007, all diesel locomotive projects must use ARB low-sulfur diesel fuel. Emission reductions and costs associated with use of ARB low-sulfur diesel shall not be included in project cost-effectiveness calculations.

- Projects must meet a cost-effectiveness of $14,300 per weighed ton of NOx + ROG + combustion PM10 reduced calculated in accordance with the cost-effectiveness methodology discussed in this chapter.

- Carl Moyer Program grants can be no greater than a project's incremental cost. The incremental cost is the cost of the project minus the baseline cost. The incremental cost shall be reduced by the value of any current financial incentive that reduces the project price, including tax credits or deductions, grants, or other public financial assistance.

- The contract term for all locomotive projects must be equivalent to the project life. The project life is defined as the number of years used to evaluate project cost-effectiveness.

- Class I freight locomotive projects must have a minimum project life of ten years. All other locomotive projects have a minimum project life of three years. ARB may approve a shorter project life on a case by case basis. Projects with shorter lives may be subject to additional funding restrictions, such as a lower cost-effectiveness limit or a project cost cap.

- The maximum project life for a locomotive project is 20 years.

- Because of uncertainty in locomotive load factors, locomotive project activity must be based upon fuel consumption.

- Seventy-five percent of estimated annual miles traveled and annual fuel consumption must occur in California.

- The energy consumption rate for a locomotive engine is 20.8 bhp-hr per gallon. The energy consumption factor for an on- or off-road engine used in a locomotive application is 18.5 bhp-hr per gallon.

- Carl Moyer Program funds cannot be use to pay for labor or parts used during routine maintenance.

- Class I locomotives subject to the South Coast MOU are eligible for Carl Moyer Program funding only if such locomotives are excluded from the fleet average emission rate calculations which demonstrate compliance with the MOU provisions. The baseline emission rates used to determine emission reductions and cost-effectiveness for these locomotive projects reflect the Tier 2 emission rates for line-haul and switch locomotives identified in Table B-16. Locomotives subject to the South Coast MOU which receive Carl Moyer Program funding are ineligible to receive fleet average emission credits.

- Military and industrial locomotives and locomotives owned or operated by Class II railroads use the same Carl Moyer Program criteria as Class III railroad locomotives.

- Locomotive engine emissions must be determined following the most current and approved U.S. EPA emission testing procedures for locomotives.

- All locomotive new purchase or repower projects must include an electronic monitoring unit (EMU) to track activity and geographic location. Eligible EMUs include a geographic positioning system (GPS) unit, transponding device, automated vehicle locator (AVLs), or other similar device. The EMU must be capable of providing complete digital information regarding total activity both within the air district and the State of California; this information shall be reported to air districts annually for the project life. The full purchase and installation cost of the EMU is eligible for Carl Moyer Program funding, and may be included when calculating project cost-effectiveness. The grantee is responsible for assuring the locomotive is equipped with a working EMU for the full project life.

- An EMU must be used to electronically monitor activity and fuel consumption by fuel type for all liquefied natural gas-diesel or other dual fuel locomotive projects. This information must be provided to the air district annually for the life of the project.

- Potential projects which fall outside of these criteria may be considered on a case-by-case basis if evidence provided by the air district suggests potential surplus, real, quantifiable, and enforceable emission reduction benefits.

- Air districts must consult with ARB staff to determine eligibility of all projects considered for funding on case-by-case basis. All projects considered on a case-by-case basis must receive ARB approval prior to receiving program funding.

B. New Purchase

- Purchase of a new locomotive must achieve federal Tier 2 locomotive emission standards for PM and hydrocarbon emissions, and a NOx emission rate at least 30 percent below Tier 2 locomotive emission standards.

- For the purposes of the Carl Moyer Program, an alternative technology switcher is defined as a hybrid (e.g., Green Goat) or multiple engine switcher in which an existing locomotive chassis is significantly refurbished with a new engine, brakes, electronic controls, and/or other equipment. An alternative technology switcher project is considered a new locomotive purchase and must meet all emission criteria for a new locomotive purchase as described above. Other switch locomotives may be considered for funding as an alternative technology switcher on a case-by-case basis.

- Baseline emissions for an alternative technology switcher project reflect Tier 0 emission rates for Class I locomotives and uncontrolled emission rates for Class III locomotives. The cost of an alternative technology switcher eligible for Carl Moyer Program funding shall not exceed 60 percent of the total cost of the new switcher for Class I railroad switchers, and 80 percent of the total cost of the new switcher for Class III railroad switchers.

- Baseline emissions and costs for a new locomotive purchase project which is not an alternative technology switcher reflect Tier 2 emission rates and the cost of a new Tier 2 locomotive, respectively.

C. Repower

- Locomotive repower projects must achieve at least a 15 percent NOx reduction beyond existing emission levels.

- Baseline emissions for a locomotive engine repower are based upon federal emission requirements for engine remanufacture (see Section III of this chapter) and the corresponding emission rates in Table B-16. Baseline costs for a locomotive engine repower equal the actual remanufacture cost or $50,000, whichever is greater.

- 1973 and later model year Class III locomotives must achieve at least Tier 0 emission levels, if Tier 0 remanufacture kits are available.

- Alternative-fueled engines must be ARB- or U.S. EPA-certified to achieve a reduced emission level in a locomotive application. Alternative-fueled engines not certified to achieve a reduced emission limit in a locomotive application may be eligible for funding on a case by case basis.

D. Retrofit

- A retrofit device must be ARB-verified to reduce emissions from the project engine in order to be eligible for funding. Non-verified technologies may be considered on a case by case basis if: 1) an application for verification of the retrofit or add-on equipment on the proposed engine category is pending, 2) the retrofit or add-on equipment has been verified or certified by ARB or U.S. EPA for use on a similar engine category, or 3) project emission benefit, durability, and applicability have been or shall be demonstrated through in-situ testing.

- Retrofits considered for funding on a case-by-case basis must be clearly demonstrated to achieve the expected emission reductions for the full project life, function properly under the project locomotive engine duty cycle, and to not harm the locomotive engine.

- Remanufacture emission kits must achieve at least a 15 percent NOx reduction and be U.S. EPA certified to achieve at least Tier 0 locomotive emission standards on the project locomotive engine. Emission kits must be demonstrated not to increase in-use emissions of NOx, ROG, or PM emissions. Individual engine parts or other locomotive components are not eligible for funding except as part of a complete U.S. EPA certified engine retrofit kit.

E. Idle-Limiting Device

- All locomotive purchase and repower projects (except alternative technology switchers) must include purchase and installation of an AESS ILD to reduce unnecessary engine idling if the locomotive is not already equipped with such a device and AESS installation is technically feasible.

- If not already required by a rule, regulation, MOU, or other legal mandate, the purchase and installation cost of an AESS is eligible for Carl Moyer Program funding, subject to the following limitations:

  - The Carl Moyer Program may provide actual equipment costs up to a maximum of $8,000 for a locomotive-specific AESS.
  - The Carl Moyer Program may provide the lower amount of actual installation costs of the AESS, up to a maximum of $3,400.
  - AESS emission reductions are calculated by applying the ILD emission reduction factors in Table B-17 to the reduced engine emissions.
  - All ILDs must comply with applicable durability and warranty requirements.

F. Scrap

- A baseline engine in a repower project must be destroyed by scrapping or drilling a hole in the engine block rendering it inoperable unless prior approval for alternate disposition has been granted by ARB staff. At the discretion of the district, core charges are eligible for funding and, if included, must be part of the cost-effectiveness calculation.

I. Cost-Effectiveness

Emission reduction benefits represent the difference in the emission levels of the existing baseline technology relative to the newer, reduced-emission technology. Baseline and reduced engine emission factors are listed in Table B-16 in Appendix B. These factors represent U.S. EPA emission factors from *U.S. EPA Technical Highlights – Emission Factors for Locomotives* [December 1997], with fuel correction factors applied.

As mentioned earlier, an AESS ILD is required for all locomotive projects if feasible. An Idle-Limiting Device Emission Reduction Factor, identified in Table B-17, is used to account for the air quality benefits of reduced idling.

Hydrocarbon (HC) emissions or emission limits for diesel locomotive technologies must be converted to ROG emissions based upon the following formula:

$$HC = ROG * 0.98$$

A detailed description and examples of how to calculate cost-effectiveness can be found in Appendix D. Locomotive emission reduction calculations will use either the fuel- or hour-based formula as discussed in Appendix C.

II. Minimum Project Application Requirements

The minimum application requirements for locomotive projects are described below. Air districts have full authority to require additional application, reporting, and monitoring requirements.

A. Application

Districts solicit bids for reduced-emission projects for locomotives. The applicant must provide the minimum information listed in Table 8-3. A disclosure must also be included stating that the proposed project has not been funded and is not being considered for funding by another air district, ARB, or any other public agency. Any applicant who is found to have submitted multiple applications for the same project may be banned from submitting future applications to any and all Carl Moyer Program solicitations and may be subject to criminal sanctions. A project funded cooperatively by multiple air districts is eligible for funding if the project parameters are coordinated amongst the participating districts and the project meets all applicable Carl Moyer Program criteria. Applicants are allowed to re-apply for project funding if a previous application has been rejected and is no longer being considered for funding.

Third party applications are not allowed. The owner of the engine must sign and agree to the application. However, a third party (e.g. engine dealer or distributor) may complete an application or part of an application on an owner's behalf. Applications must include a signature section for third parties. The third party signature section must include signature and date lines, and blanks for the third party to list how much they are being paid, if anything, to complete the application and what source of funds are being used to pay them. To make the Carl Moyer Program accessible to all potential applicants, including applicants that cannot afford to hire third party assistance, districts are encouraged to provide technical assistance to applicants in completing the application.

Table 8-3
Minimum Application Requirements for Locomotive Projects

Air District: Applicant Demographics Company Name: Mailing Address: Physical Address: Contact Number: Contact Name/Title: Contact Phone Number: Project Description Project Name: Locomotive Function (Line-haul, Switch, Passenger): Project Location (Street address): Type of Equipment Application: (New purchase, Repower, or Retrofit) FOR LOCOMOTIVE REPOWER OR NEW PURCHASE 1. Existing and new engine make: 2. Existing and new engine model: 3. Locomotive model year: 4. Existing and new engine horsepower: 5. Existing engine serial number: 6. Percent operated in California: 7. Annual fuel consumption: 8. Cost to rebuild existing engine (parts + labor): 9. Cost of new engine: 10. Cost to install new engine: 11. New engine vendor: 12. New engine installed by:	FOR LOCOMOTIVE RETROFITS 1. Engine make, model, model year, and serial number: 2. Locomotive model year: 3. Percent operated in California 4. Annual fuel consumption: 5. Retrofit equipment manufacturer and name: 6. Retrofit or add-on equipment is warrantied by manufacturer (y/n): 7. Retrofit or add-on equipment is verified or certified by ARB or U.S. EPA (y/n): 8. Cost of retrofit or add-on equipment: 9. Cost of installation: FOR IDLE-LIMITING DEVICE 1. Engine make, model, year, and serial number: 2. Locomotive make, model and year: 3. ILD make, model, year, and serial number: 4. Percent operated in California: 5. Annual fuel consumption: 6. Cost of ILD: 7. Cost of installation:

B. Reporting and Monitoring

Air districts must abide by all reporting and monitoring requirements described in Chapter 1 – Program Administration. Monitoring of project progress ensures that the vehicle or engine is operated as stated in the program application. Records must be retained and updated for the duration of the project life and made available at the request of the air district or ARB.

III. References

Association of American Railroads, 2004. Association of American Railroads, 2004, Overview of U.S. Freight Railroads.

Federal Register, April 16, 1998. Federal Register, Part II - Environmental Protection Agency, Emission Standards for Locomotives and Locomotive Engines Final Rule; 40 CFR Parts 85, 89 and 92; April 16, 1998.

U.S. EPA, 2004. U.S. EPA Advanced Notice of Proposed Rulemaking on the Control of Emissions of Air Pollution from New Locomotive Engines and New Marine Compression-Ignition Engines Less Than 30 Liters Per Cylinder;
Docket OAR-2003-0190.

Chapter Nine

MARINE VESSELS

This chapter presents program criteria for marine vessel projects, and provides an overview of types of marine vessels, current emission control requirements, and available emission reduction technologies. The chapter also expands eligibility for Carl Moyer Program marine vessel projects to marine vessels with wet exhaust systems, and utilizes a single set of emission factors for propulsion and auxiliary engines, consistent with federal emission standards.

I. Introduction

Marine vessels eligible for Carl Moyer Program funding include harbor craft and oceangoing ships, but exclude recreational vessels such as personal watercraft. Historically, harbor craft have received the vast majority of Carl Moyer Program funding for marine vessels. However, oceangoing vessels remain eligible for funding if they operate in California Coastal Waters enough to generate cost-effective emission reductions and the proposed project meets all applicable Carl Moyer Program criteria. A map of California Coastal Waters can be found in Figure 9-1.

A. Harbor Craft

Harbor craft include tugboats, fishing vessels, work boats, crew boats, ferries, Coast Guard vessels, and some military vessels. These vessels generally stay within California Coastal Waters and often leave and return to the same port. Tugboats generally have the most powerful engines, averaging about 1,300 horsepower. Commercial fishing and work boats, at the other end of the spectrum, average a little over 200 horsepower [ARB, 2003]. Beginning on January 1, 2007, all fuel sold to harbor craft statewide will be required to meet Air Resources Board (ARB or "Board") low-sulfur diesel fuel standards. This ARB requirement goes into effect on January 1, 2006 in the South Coast Air Basin.

B. Oceangoing Ships

Oceangoing ships usually travel internationally and include container ships, bulk carriers, general cargo ships, tankers, military ships, auto carriers, cruise ships and ocean-going tugboats. Oceangoing ships generally run on one or more 750 or greater horsepower engines. Most oceangoing ships run their main propulsion engines on a mixture of residual and distillate fuel (heavy fuel oil). Diesel gas turbine propulsion engines and auxiliary engines on ocean-going ships often run on cleaner marine gas oil (MGO).

C. Propulsion Engines

Both propulsion and auxiliary marine vessel engines are eligible for Carl Moyer Program funding. For the purpose of the Carl Moyer Program, a propulsion engine is defined as an engine that powers the vessel through the water or directs the movement of the vessel. About two-thirds of harbor craft in California have one propulsion engine, while the remaining vessels have two or more engines [ARB, 2003]. Unlike most recreational vessel engines, harbor craft engines typically push the vessel through the water rather than hydroplaning, endure heavy use, and operate up to 6,000 hours a year. Harbor craft propulsion engines are therefore designed for prolonged operation at high loads.

Ocean-going vessels may be propelled by diesel piston engines, steam turbines, or diesel-fueled gas turbines. In addition, diesel piston or turbine engines on oceangoing vessels may be used to drive generators to create electric power for propulsion.

D. Auxiliary Engines

Auxiliary engines are used to power on-board equipment such as electrical lights, refrigeration units, and radios. For the purposes of the Carl Moyer Program, an auxiliary engine is defined as a marine vessel engine that is not the propulsion engine whose fuel, cooling, or exhaust systems are an integral part of the vessel or require special mounting hardware. All other auxiliary engines are considered portable and may be eligible for funding under the Off-Road Compression Ignition project criteria (See Chapter 5).

About 40 percent of harbor craft in California have auxiliary engines; almost half of these vessels are equipped with more than one engine [ARB, 2003]. Harbor craft auxiliary engines range from 4 to 400 horsepower, with ferries, tug boats, and commercial work boats having the highest horsepower auxiliary engines.

II. Emissions

Marine vessels are a significant source of airborne particulate matter (PM) and oxides of nitrogen (NOx), particularly at and around the State's major maritime ports. The Ports of Los Angeles and Long Beach are among the busiest in the world, and emissions from marine vessels serving the ports are recognized to impact air quality in surrounding communities and the South Coast Air Basin. At the Port of Los Angeles, for example, marine vessels are responsible for about two-thirds of port-related NOx emissions and over 80 percent of port-related PM emissions -- locomotives, heavy-duty trucks, and cargo-handling equipment contribute the bulk of remaining emissions [Port of Los Angeles Air Quality Task Force, 2005]. As trade with the Pacific Rim countries continues to grow, marine vessel emissions are projected to increase significantly.

As shown in Table 9-1, emissions from ocean-going ships are far greater than emissions from harbor craft. The majority of California's commercial marine vessel NOx and PM emissions (excluding emissions in the outer continental shelf) occur in the

South Coast Air Basin. The San Francisco Bay Area, home to the Port of Oakland, is responsible for another 20 percent of the State's total marine vessel emissions.

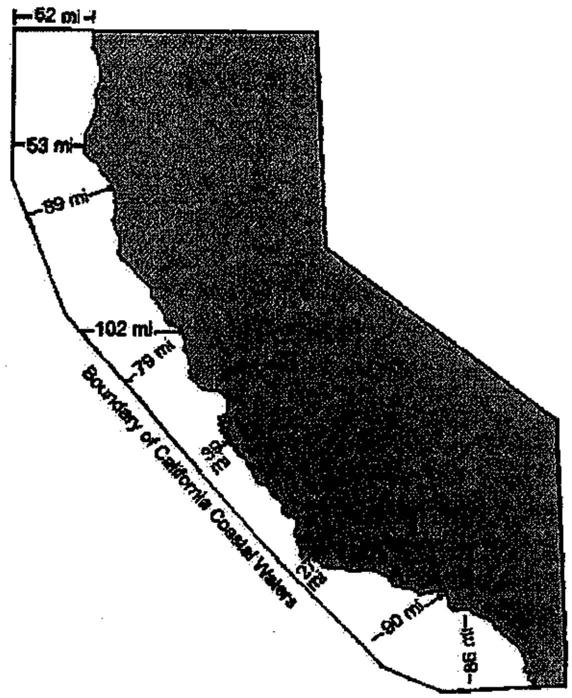
Table 9-1
Marine Vessel Emissions
(Statewide, Annual Average, tpd)

Pollutant by Vessel Type	2005	2010	2015	2020
NOx				
Harbor Craft	24	25	25	25
Ocean-going Ships	119	132	156	181
Total	143	157	181	206
PM				
Harbor Craft	1.3	1.3	1.3	1.4
Ocean-going Ships	10.3	11.3	13.0	14.9
Total	11.6	12.6	14.4	16.2
ROG				
Harbor Craft	3	3	3	3
Ocean-going Ships	6	7	8	10
Total	9	10	11	13

Based on the 2005 ARB Emission Inventory Almanac. Numbers may not total due to rounding.

PM tends to be a localized pollutant, having the greatest impact in proximity to where it is emitted. PM emissions from vessels which spend much of their time further off-shore, such as fishing vessels, may therefore have less of a human health impact than emissions from vessels which operate closer to shore. At this time, however, PM emission standards for marine vessel engines do not differentiate by vessel type based upon the potential for human exposure. ARB staff will evaluate whether PM emissions from certain vessels should be discounted based on exposure potential in future Carl Moyer Program Guideline revisions.

Figure 9-1
California Coastal Water Boundaries



III. Regulatory Requirements

Most marine vessels in operation today have uncontrolled engines, since marine vessel emission standards have only recently begun being phased-in. Harbor craft began being subject to U.S. Environmental Protection Agency (U.S. EPA) emission standards beginning in 2004, while new oceangoing vessels have recently become subject to federal and international emission standards.

A. Harbor Craft Emission Standards

Unlike other Carl Moyer Program categories, marine vessel propulsion and auxiliary engine emission standards are based upon cylinder displacement rather than horsepower. Basing standards on displacement rather than horsepower is intended to help ensure that each engine is not subject to multiple standards, since marine engines can be tuned for different power output.

U.S. EPA harbor craft emission standards, adopted in 1999, apply to new diesel-powered engines with a displacement of up to 30 liters per cylinder. The standards apply to both propulsion and auxiliary engines and take effect between 2004 and 2007, depending upon the engine size [Federal Register, 1999]. Table 9-2 provides more information regarding federal harbor craft engine standards.

Table 9-2
U.S. EPA Marine Propulsion and Auxiliary Engine Emission Standards (g/kW-hr)*

Displacement (liter/cyl)	Starting Date	NOx+THC**	PM
D < 0.9	2005	7.5	0.40
0.9 ≤ D < 1.2	2004	7.2	0.30
1.2 ≤ D < 2.5	2004	7.2	0.20
2.5 ≤ D < 5.0	2007	7.2	0.20
5 ≤ D < 15	2007	5.8	0.20
15 ≤ D < 20 (P < 3300 kW)	2007	7.8	0.27
15 ≤ D < 20 (P ≥ 3300 kW)	2007	8.7	0.50
20 ≤ D < 25	2007	9.8	0.50
25 ≤ D < 30	2007	11.0	0.50

* grams per kilowatt-hour.
** NOx plus total hydrocarbon emissions.

In May 2004, U.S. EPA issued an Advanced Notice of Proposed Rulemaking, signaling its intent to pursue more stringent standards for new and existing harbor craft engines [U.S. EPA, 2004]. The standards are likely to be modeled after 2007 diesel off-road and 2010 heavy-duty diesel on-road engine standards, and be based on the application of catalytic after-treatment technology. The new standards could be phased in as early as 2011 and require a 90 percent reduction from previous limits.

ARB staff is also developing a rule that may require the Best Available Control Technology (BACT), such as after-treatment devices or accelerated turnover, to reduce emissions from existing harbor craft fleets. The rule is scheduled to be considered for adoption by the Board in mid- to late-2006. If the rule is adopted, ARB shall publish an advisory describing how the rule impacts Carl Moyer Program funding eligibility.

B. Oceangoing Vessel Emission Standards

International oceangoing vessels fall under the regulatory jurisdiction of the International Maritime Organization (IMO). In 1997, the IMO established NOx emission standards for diesel-powered propulsion and auxiliary engines over 130 kW (174 hp) on new ocean-going ships. The IMO standards have been ratified by the requisite number of nations and became enforceable in May 2004. Engine manufacturers have generally produced IMO-compliant engines since January 1, 2001, however, since the standards were retroactive to that date upon ratification.

Table 9-3
International Maritime Organization NOx Emission Standards

Engine Speed (rpm)	NOx (g/kW-hr)	NOx (g/bhr-hr)
n < 130	17.0	12.7
130 ≤ n < 2000	$45n^{(-0.2)}$	(convert from g/kW-hr)
n ≥ 2000	9.8	7.3

n = IMO rated engine speed (crankshaft revolutions per minute).

U.S. EPA also adopted NOx emission standards for new oceangoing vessel engines in 2003 [U.S. EPA, 2003]. The federal standards are virtually equivalent to the IMO standards but apply only to vessels flagged or registered in the United States beginning in 2004. U.S. EPA has also committed to adopt more stringent standards for oceangoing vessel engines by April 2007. The IMO and U.S. EPA standards do not include PM or reactive organic gas (ROG) emission limits, leaving marine vessels largely unregulated for these pollutants.

An ARB rule requiring oceangoing vessel auxiliary engines run on MGO or marine diesel oil (MDO) while at dock or in California Coastal Waters is also under development. Use of MGO or MDO in place of dirtier heavy fuel oil can achieve up to 80 percent emission reductions from oceangoing vessel auxiliary engines. The draft rule is scheduled to be considered by the Board in December 2005 and could require implementation beginning in mid-2006.

Finally, ARB staff is developing a rule to require ships that visit California frequently to implement emission reduction strategies. The rule will be considered for adoption by the Board sometime in 2006. ARB will publish an advisory once these rules are adopted describing how each rule impacts Carl Moyer Program funding eligibility.

C. Voluntary Emission Standards—The Blue Sky Series Program

In order to provide engine manufacturers with an incentive to produce engines that are cleaner than those required by regulations, the federal government developed the Blue Sky Series Program. U.S. EPA's voluntary Blue Sky Series Program permits manufacturers to certify their engines to more stringent emission standards than required. New marine vessel purchase projects must meet the federal Blue Sky Standards to qualify for Carl Moyer Program funding. To date, no marine vessel propulsion engines have been certified to meet the Blue Sky standards, and no marine vessel new purchase projects have been funded through the Carl Moyer Program.

Table 9-4
"Blue Sky Series" Voluntary Emission Standards
(g/kW-hr)

Cylinder Displacement (D, dm^3)	NOx+THC	PM
Power ≥ 37 kW & D < 0.9	4.0	0.24
0.9 ≤ D < 1.2	4.0	0.18
1.2 ≤ D < 2.5	4.0	0.12
2.5 ≤ D < 5.0	5.0	0.12
5.0 ≤ D <15	5.0	0.16
15 ≤ D < 20 & Power < 3300 kW	5.2	0.30
15 ≤ D < 20 & Power < 3300 kW	5.9	0.30
20 ≤ D < 25	5.9	0.30
25 ≤ D < 30	6.6	0.30

IV. Potential Projects

The vast majority of Carl Moyer Program marine vessel projects thus far involve harbor craft, rather than oceangoing vessels. Harbor craft projects have been more common due to several factors – their emissions tend to occur solely within California Coastal Waters, vessel activity is more predictable, and engine replacement is extremely cost-effective.

Marine vessel projects that could potentially qualify for incentive funding under the Carl Moyer Program for marine vessels include the purchase of a new reduced emission marine vessel, a marine vessel repower, or a marine vessel retrofit. Shore power projects to reduce marine vessel auxiliary engine emissions may also be eligible for Carl Moyer Program funding and are discussed in Chapter 12. Projects to replace gasoline-fueled engines with diesel engines are not eligible for funding.

A. New Purchase

New marine vessels with propulsion engines certified to U.S. EPA's Blue Sky Series emission limits are eligible for Carl Moyer Program funding. While no marine vessel propulsion engines currently meet the Blue Sky Standards, engines meeting certification emission limits may become commercially available as engine technologies continue to advance.

B. Repower

To date, most Carl Moyer Program marine vessel projects have involved replacing or "repowering" an old harbor craft engine with a newer, cleaner engine. Most of these projects have involved replacing an older mechanical engine with a newer electronically controlled engine. For all Carl Moyer Program engine repowers, the replacement engine certified emission rate must provide at least a 15 percent NOx reduction relative to the baseline engine. If the replacement engine is significantly modified or reconfigured in any way during the project life, emissions testing must be conducted to determine its new emission rates.

Engine repowers for marine vessels equipped with wet exhaust system are eligible for Carl Moyer Program funding. Since a wet exhaust system reduces air emissions from both the baseline and the newer, cleaner engine, repower projects on marine vessels with these systems may result in slightly fewer emission reductions compared to repowers of vessels with dry exhaust. An analysis of emissions data from California harbor craft indicates wet exhaust systems reduce PM and NOx emissions from propulsion and auxiliary engines by 1 to 19 percent. In order to ensure emission reductions projects on vessels with wet exhaust systems are not overstated, a conservative 20 percent NOx and PM emission reduction factor must be applied to both the baseline and reduced emission engine (See marine vessel example calculation 3 in Appendix D for more information). The Carl Moyer Program does not provide funding to repair or replace any component of the wet exhaust system itself.

C. Retrofits

Potential marine vessel retrofit projects involve the addition of an ARB-verified diesel particulate filter, diesel oxidation catalyst, or selective catalytic reduction technology. A retrofit device must typically be verified by ARB in order to be considered for funding. To date, however, very few retrofit technologies have been verified to reduce emissions from marine vessels. Retrofit technologies generally develop first for on-road sources, and are refined for use on off-road engines. Because of the lack of retrofit devices verified for use on a marine vessel engine, a marine vessel retrofit device which is not yet verified may be considered for funding on a case-by-case basis. Applicants for funding on a case-by-case basis must meet the applicable project criteria described in Section V of this chapter.

In recent years, engine manufacturers have also developed engine remanufacture retrofit kits certified by the IMO to meet IMO NOx emission standards. To be eligible for Carl Moyer Program funding, a remanufacture retrofit kit must be certified by the ARB, U.S. EPA, or the IMO to reduce emissions from the project vessel engine. NOx emissions must be reduced by at least 15 percent to take credit for NOx emission reductions. Remanufacture kits which employ fuel injection timing retard are only eligible for funding if it is demonstrated that PM emissions from the project vessel shall not increase. If the retrofit kit certification does not specify a specific percent reduction or emission rate for NOx, PM, or ROG, emissions testing must be conducted annually for the life of the project to ensure the retrofit does not increase emissions from these individual pollutants. Individual engine parts or other vessel components are not eligible for funding unless as part of a complete certified engine remanufacture retrofit kit.

D. On-Board Testing

Because of the high variability in marine engine emission rates, districts may utilize on-board testing to determine baseline marine vessel emission rates for the purposes of

Carl Moyer Program cost-effectiveness calculations, if testing follows approved test procedures. Constant speed propulsion engines should be tested on the International Organization for Standardization's (ISO) 8178- E2 test cycle and constant speed auxiliary engines on the ISO 8178-D2 test cycle. Variable speed auxiliary engines and variable speed propulsion engines used with variable-pitch propellers (or electrically coupled propellers) should be tested on the ISO 8178-C1 duty cycle. All other engines, including those used with fixed-pitch propellers, should be tested on the ISO 8178-E3 Marine Propeller Law Heavy Duty operating cycle. When on-board testing is conducted in accordance with approved procedures, these results must be used when calculating emission reductions. The maximum acceptable values of baseline NOx, ROG, and PM emission factors derived from in-situ source testing are 20 g/bhp-hr, 2.0 g/bhp-hr, and 1.0 g/bhp-hr, respectively. If emission testing is not feasible, the applicant can use the default baseline emission factors presented in Appendix B.

V. Proposed Project Criteria

These criteria provide the minimum requirements for all Carl Moyer Program marine vessel projects. Participating districts retain the authority to impose additional requirements in order to address local concerns.

A. General

- Emission reductions obtained through Carl Moyer Program projects must not be required by any federal, state or local regulation, memorandum of agreement/understanding with air quality regulators, settlement agreement, mitigation requirement, or other legal mandate. Inclusion in a port emission reduction plan, lease agreement, or other voluntarily adopted strategy does not exclude a marine vessel project from Carl Moyer Program funding eligibility, if such project is not otherwise required.

- No emission reductions generated by the Carl Moyer Program shall be used as marketable emission reduction credits, or to offset any emission reduction obligation of any person or entity.

- No project funded by the Carl Moyer Program shall be used for credit under any federal or state emission averaging banking and trading program.

- Marine vessels and engines utilizing an alternative compliance plan to comply with a rule, requirement, or other mandate shall not be eligible for Carl Moyer Program funds.

- A marine vessel receiving any type of emission reduction credit or offset is ineligible for Carl Moyer Program funding.

- Beginning January 1, 2007, all harbor craft with diesel engines must use ARB low-sulfur diesel fuel to be eligible for Carl Moyer Program funding. Emission reductions and costs associated with use of ARB diesel shall not be included in project cost-effectiveness calculations.

- Only marine vessel engines with a United States Coast Guard Documentation Number are eligible for Carl Moyer Program funding. This information must be included in the project application.

- Projects must meet a cost-effectiveness of $14,300 per weighed ton of NOx + ROG + combustion PM10 reduced calculated in accordance with the cost-effectiveness methodology discussed in this chapter.

- Carl Moyer Program grants can be no greater than a project's incremental cost. The incremental cost is the cost of the project minus the baseline cost. The incremental cost shall be reduced by the value of any current financial incentive that reduces the project price, including tax credits or deductions, grants, or other public financial assistance.

- The contract term for all marine vessel projects must be equivalent to the project life. The project life is defined as the number of years used to evaluate project cost-effectiveness.

- Projects must have a minimum project life of three years. ARB may approve shorter project life on a case by case basis. Projects with shorter lives may be subject to additional funding restrictions, such as a lower cost-effectiveness limit or a project cost cap.

- The maximum project life for marine vessel projects (equivalent to the average engine life reported by U.S. EPA) is as follows:

	Maximum Project Life
Engine displacement ≤5.0 liter/cyl.	16 years
Engine displacement >5.0 liter/cyl.	23 years
Auxiliary engines	17 years

- Only marine vessel activity in California waters may be used to determine project emission reductions. For the purposes of the Carl Moyer Program, California water boundaries are based upon each air districts' emission inventory boundary. If a local district has not established an emission inventory boundary, the ARB and district staff will determine an appropriate boundary for use in project evaluation.

- Non-captive California fleets and vessels may be considered for funding on case-by-case basis if their operation in California coastal waters can be properly documented.

- Marine vessels which are not self-propelled (e.g. barges) are not eligible for Carl Moyer Program funding.

- Project marine vessels must be equipped with a functioning tamper proof electronic monitoring unit (EMU) to track activity and geographic location. The EMU must be turned on and functional when the project engine is running for the life of the project, to record all vessel trips and activity. If the EMU is battery powered, the battery life must be long enough to ensure the EMU is charged and functional each time the project vessel is operated. Electronic information from the EMU regarding total and percent of activity (fuel use or hours of operation) within the air district coastal boundary and California Coastal Waters must be reported to air district annually for the project life. The cost of a new unit may be included in the Carl Moyer Program grant and in the project cost-effectiveness calculations if not required by any rule, statute, MOU, or other mandate. The grantee is responsible for assuring a working EMU is on the project vessel for the full project life.

- Carl Moyer Program funds cannot be expended on costs for labor or parts used during routine maintenance.

- Funding is not available for projects where spark-ignition engines (i.e. natural gas or gasoline, etc.) are replaced with new diesel engines.

- Engines on marine vessels with wet exhaust systems are eligible for Carl Moyer Program funding if the project vessel meets all other applicable program requirements. The wet exhaust systems themselves are not eligible for Carl Moyer Program funding. A wet exhaust factor of 0.80 must be applied to the baseline and reduced emission propulsion and auxiliary engine emission calculations for all projects on vessels with wet exhaust systems.

- Potential projects which fall outside of these criteria may be considered on a case by-case basis if evidence provided by the air district suggests potential surplus, real, quantifiable, and enforceable emission reduction benefits.

- Air districts must consult with ARB staff to determine eligibility of all projects considered for funding on a case-by-case basis. All projects considered for funding on a case-by-case basis must receive ARB approval prior to receiving program funding.

B. New Purchase

- A new marine vessel must meet the U.S. EPA Blue Sky Series Standards identified in Table 9-4 to be eligible for funding. All propulsion and auxiliary engines on new marine vessel purchase projects must also achieve at least a 30 percent NOx emission reduction from baseline levels.

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C. Repower

- A replacement engine or retrofit must provide a 15 percent minimum NOx emission reduction relative to the baseline engine.

D. Retrofit

- A retrofit device must be ARB-verified to reduce emissions from the project engine in order to be eligible for funding. Non-verified technologies may be considered on a case by case basis if: 1) an application for verification of the retrofit or add-on equipment on the proposed engine category is pending, 2) the retrofit or add-on equipment has been verified or certified by ARB for use on a similar engine category, or 3) project emission benefit, durability, and applicability have been or shall be demonstrated through in-situ testing.

- Retrofits considered for funding on a case-by-case basis must be clearly demonstrated to achieve the expected emission reductions for the full project life, function properly under the project vessel engine duty cycle, and to not harm the vessel engine.

- To be eligible for Carl Moyer Program funding, a retrofit emission kit must be certified by the ARB, U.S. EPA, or the IMO to reduce emissions from the project vessel engine. NOx emissions must be reduced by at least 15 percent to take credit for NOx emission reductions. Engine retrofit kits must also not increase NOx, PM, or ROG emissions from the project vessel. If the engine certification does not specify a specific percent reduction or emission rate for NOx, PM, or ROG, emissions testing must be conducted annually for the life of the project to ensure the retrofit does not increase emissions from these individual pollutants. Individual engine parts or other vessel components are not eligible for funding unless as part of a complete certified engine retrofit kit.

E. Scrap

- A baseline engine in a repower project must be destroyed by scrapping or drilling a hole in the engine block rendering it inoperable unless prior approval for alternate disposition has been granted by ARB staff. At the discretion of the district, core charges are eligible for funding and, if including, must be part of the cost-effectiveness calculation.

VI Cost-Effectiveness Calculations

Emission reduction benefits represent the difference in the emission levels of the existing baseline technology relative to the newer, reduced-emission technology. Baseline and reduced engine emission factors are listed in Table B-18 in Appendix B. Harbor craft emission factors represent off-road engine emission factors for uncontrolled engines, and harbor craft emission standards for controlled engines. Fuel correction factors have been applied to all emission factors.

A detailed description of how to calculate cost-effectiveness can be found in Appendix B. Marine vessel emission reduction calculations will use either the fuel- or hour-based formula as discussed in Appendix B. Examples of cost-effectiveness calculations can also be found in Appendix B.

VII. Minimum Project Application Requirements

These are minimum project application requirements. Air districts have full authority to require additional application, reporting, and monitoring requirements.

A. Application

Districts solicit bids for reduced-emission projects for marine vessels. The applicant must provide the minimum information illustrated in Table 9-5.

A disclosure must also be included stating that the proposed project has not been funded and is not being considered for funding by another air district, ARB, or any other public agency. Any applicant who is found to have submitted multiple applications for the same project may be banned from submitting future applications to any and all Carl Moyer Program solicitations and may be subject to criminal sanctions. A project funded cooperatively by multiple air districts is eligible for funding if the project parameters are coordinated amongst the participating districts and the project meets all applicable Carl Moyer Program criteria. Applicants are allowed to re-apply for project funding if a previous application has been rejected and is no longer being considered for funding.

Third party applications are not allowed. The owner of the engine must sign and agree to the application. However, a third party (e.g. engine dealer or distributor) may complete an application or part of an application on an owner's behalf. Applications must include a signature section for third parties. The third party signature section must include signature and date lines, and blanks for the third party to list how much they are being paid, if anything, to complete the application and what source of funds are being used to pay them. To make the Carl Moyer Program accessible to all potential applicants, including applicants that cannot afford to hire third party assistance, districts are encouraged to provide technical assistance to applicants in completing the application.

Table 9-5
Minimum Application Requirements for Marine Vessel Projects

Air District: Applicant Demographics • Company Name: • Mailing Address: • Physical Address: • Contact Number: • Contact Name/Title: • Contact Phone Number: Project Description • Vessel Name: • Vessel U.S. Coast Guard Doc. No. (or IMO/Lloyd's No., if foreign flagged): • Vessel function (Fishing vessel, tugboat, work boat, etc...): • Vessel berth location: • Does vessel remain with the port only (y/n): • Propulsion or auxiliary engine project: • Hours project engine operates or project engine fuel consumption within California Coastal Waters: Type of Equipment Application: (Repower or Retrofit) FOR MARINE VESSEL REPOWERS 1. Existing and new engine make: 2. Existing and new engine model: 3. Vessel model year:	FOR MARINE VESSEL REPOWERS (Cont.) 4. Existing and new engine horsepower: 5. New engine cylinder displacement 6. Existing engine serial number: 7. Cost to rebuild existing engine (parts + labor): 8. Cost of new engine: 9. Cost to install new engine: 10. New engine vendor: 11. New engine installer: FOR MARINE VESSEL RETROFITS 1. Engine make, model, model year, and serial number: 2. Vessel model year: 3. Retrofit equipment manufacturer and name: 4. Retrofit or add-on equipment is warrantied by manufacturer (y/n): 5. Retrofit or add-on equipment is verified or certified by ARB or U.S. EPA (y/n): 6. Cost of retrofit or add-on equipment: 7. Cost of installation:

B. Reporting and Monitoring

Air districts must abide by all reporting and monitoring requirements described in Chapter 1 – Program Administration. Monitoring of project progress ensures that the vessel or engine is operated as stated in the program application. Records must be retained and updated for the duration of the project life and made available at the request of the air district or ARB.

VIII. References

ARB, 2003. California Air Resources Board 2003 Harbor Craft Survey.

Federal Register, 1999. *Federal Register - Environmental Protection Agency, Control of Emissions of Air Pollution From New Marine Compression-Ignition Engines at or Above 37 kW,* December 29, 1999 (Volume 64, Number 249).

Port of Los Angeles Air Quality Task Force, 2005. Port of Los Angeles Air Quality Task Force, *Port of Los Angeles No Net Increase in Air Emissions Final Report*, June 24, 2005.

U.S. EPA, 2003. U.S. EPA, Control of Emissions From New Marine Compression-Ignition Engines at or Above 30 Liters Per Cylinder, Federal Register 9745-9789, 28 Feb 2003.

U.S. EPA, 2004. United States Environmental Protection Agency, *U.S. EPA Advanced Notice of Proposed Rulemaking on the Control of Emissions of Air Pollution from New Locomotive Engines and New Marine Compression-Ignition Engines Less Than 30 Liters Per Cylinder* (Docket OAR-2003-0190).

Chapter Ten

AGRICULTURAL SOURCES

This chapter presents the project criteria under the Carl Moyer Program for stationary and portable agricultural engines and for non-engine agricultural projects (e.g. dairies). Previous versions of the Carl Moyer Program Guidelines only allowed funding for stationary agricultural irrigation pump engines; eligible projects now include other non-mobile agricultural engines and non-engine sources. Information about mobile agricultural use equipment (e.g. tractors) can be found in Chapter 5: Compression Ignition Off-Road Equipment. This chapter also contains an overview of agricultural sources of air pollution, current regulations, potential project types, and application requirements. For information about electric-powered agricultural equipment, please consult Chapter 12: Zero-Emission Technologies.

I. Introduction

The agricultural industry contributes greatly to the economy and identity of California. Approximately 78,500 farming operations within California produce 13 percent of the nation's gross farming receipts, while representing only four percent of the total farms in the nation. Agricultural marketings from California's farmers and ranchers reached $27.8 billion in 2003 [CASS, 2003].

Until the enactment of Senate Bill 700 (SB 700, Florez) in 2003, the agricultural industry in California was largely exempt from air pollution regulations. Local air districts are currently adopting regulations to reduce air pollution from agricultural engines as well as other agricultural sources.

Since 1998, the Carl Moyer Program has provided significant funding for repowers or retrofits of internal combustion engines powering irrigation pumps, and for engine replacement of self-propelled farm equipment. Recent legislative changes extended the Carl Moyer Program to additional agricultural sources of air pollution.

II. Emissions

Emissions attributed to agricultural use off-road vehicles are included in the emissions estimates found in the Chapter 5: Compression Ignition Off-Road Equipment. Currently available estimates for other agricultural sources are discussed below.

As part of the airborne toxic control measure (ATCM) for stationary diesel engines, ARB staff worked with the local districts and the agricultural community to create an estimate of emissions from stationary diesel-fueled engines used in agricultural operations [ARB, 2003]. ARB staff was unable to project the emissions for future years with any degree of certainty because of the limited data available. The emissions estimates for stationary agricultural use diesel engines are shown in Table 10-1.

Table 10-1
Statewide Emissions from Agricultural Use Stationary Diesel Engines for 2001
(prime engines, tons per day)

Population	NOx	ROG	PM10
5,338	21.1	4.3	1.5

No emissions estimates for stationary spark-ignited (SI) agricultural use engines are available because the population of stationary SI engines in agricultural operations is not known.

Emission estimates for livestock operations were developed for the recent regulatory process for creating a definition for large confined animal facility (CAF) [ARB, 2005]. The emission estimates (found in Table 10-2) are based on current best available data as of March 2005. The emission factors used to develop livestock emission estimates will be refined as additional research studies are completed.

Table 10-2
Statewide ROG and PM10 Emissions from Livestock for 2004
(tons per day)

	ROG	PM10
Dairies	35.7	8.3
Other livestock	10.1	11

III. Statutory and Regulatory Requirements

A. SB 700

In 2003, SB 700 amended and added air pollution control requirements in the California Health and Safety Code (sections 39011.5, 39023.3, 40724, 40724.5, 40724.6, 40724.7, 40731, 42301.16, 42301.17, 42301.18, 42310, and 44559.9) to include requirements for agricultural sources of air pollution. Some of the key requirements of this legislation are listed below:

- The legislation defined "agricultural source of air pollution" as a source or group of sources used in the production of crops or raising of fowl or animals located on contiguous property and under common ownership or control. Four categories of emission sources are identified as part of this definition:
  - Large CAFs.
  - Internal combustion engines, including portable and off-road engines, unless used to propel instruments of husbandry.
  - Sources subject to requirements of Title V, the federal operating permitting program for major stationary sources.
  - Sources of emissions otherwise subject to district regulation.

- The legislation removed language exempting agricultural sources from air quality permits in the Health and Safety Code in its entirety. As a result, agricultural operations may be required to obtain air permits from local districts.

- The legislation established specific agricultural source permitting and exemption requirements for local districts.

- The legislation required certain districts to adopt by regulation a set of measures to reduce emissions from agricultural sources in federal particulate matter non-attainment areas.

- The legislation required the ARB to establish a definition for a "large" CAF, and required certain districts to adopt rules requiring large CAFs to obtain permits and implement emission mitigation measures.

B. Stationary Diesel Engine ATCM

In February 2004, the Board adopted an ATCM for stationary compression ignition (CI) engines greater than 50 horsepower. The Board amended the ATCM in May 2005. The control measure requires new CI engines for agricultural operations, including those used to repower agricultural equipment, to meet ARB and federal new off-road engine PM certification standards for engines of the same horsepower and model year. The only exception to this requirement is for the installation of Tier 2 engines through January 1, 2008 purchased with Carl Moyer Program funds.

ARB staff is currently working on the development of in-use stationary diesel agricultural engine requirements to be considered by the Board in early 2006.

C. Large Confined Animal Facility Definition

In response to the requirements of SB 700, the Board approved a definition for large CAF on June 23, 2005. The definition (shown in Table 10-3) is based on headcount of livestock categories and takes into consideration the federal ozone attainment status of districts as well as livestock population and operational practices of facilities. A recordkeeping component requires the owner or operator of a large CAF to keep a daily record of animals at the facility and to submit the information to the local air district consistent with applicable local rules.

Table 10-3
Large Confined Animal Facility Definition by Livestock Category
(facilities at or exceeding threshold are considered large)

Livestock Category	Non-Attainment Areas*	Attainment Areas*
Dairy	1,000 milk producing cows	2,000 milk producing cows
Beef feedlots	2,500 beef cattle	5,000 beef cattle
Other Cattle Operations	7,500 calves, heifers, or other cattle	15,000 calves, heifers, or other cattle
Chickens – Broilers	650,000	1,300,000
Chickens – Egg Layers	650,000	1,300,000
Turkeys	100,000	200,000
Swine	3,000	6,000
Sheep and Goats	15,000	30,000
Horses	2,500	5,000
Ducks	650,000	1,300,000
Rabbits, Pheasants, Llamas, Others	30,000	60,000

*Federal 1-hour ozone designation as of January 1, 2004

By July 1, 2006, air districts in federal ozone non-attainment areas must adopt rules requiring large CAFs to submit a mitigation plan to reduce air contaminants to the extent feasible. Each air district in a federal ozone attainment area must adopt a similar rule by July 1, 2006, unless its district board makes a finding in a public hearing that large CAFs will not contribute to violations of state or federal standards. Large CAFs have six months from the date of adoption of the district rule to submit their mitigation plans to the district; the districts have an additional six months to approve submitted plans. One year after submitting their plans (July 1, 2008), large CAFs must comply with the requirements of their mitigation plans.

D. Local Air District Rules

Because most Carl Moyer Program projects affect mobile sources that are subject to statewide regulation, few district rules affect Carl Moyer Program funding. However, future district rules impacting agricultural sources must be considered when determining whether projects provide reductions surplus to regulatory requirements.

Internal combustion engines: Prior to the adoption of SB 700, most air districts specifically exempted agricultural engines from prohibitory rules for stationary IC engines greater than 50 horsepower. As a result, stationary agricultural engine emissions were largely uncontrolled. These districts have amended (or will amend) their internal combustion engine rules to remove the agricultural operation exemption. In these districts, stationary internal combustion engines used in agricultural operations are now required (or will be required) to meet the emission standards/limits, permitting conditions, and compliance requirements of the local district.

Large Confined Animal Facilities: As outlined in the previous section, local air districts in federal ozone non-attainment areas are required to adopt rules developed to mitigate emissions from large CAFs. Local air districts in federal ozone attainment areas are also required to develop rules to mitigate large CAF emissions unless their district boards make a finding in a public hearing that large CAFs will not contribute to violations of state or federal standards. A number of air districts have or are preparing to adopt regulations to meet these requirements.

Fugitive Dust Control: A number of air districts require agricultural operations to reduce fugitive dust emissions through local rules. Local rules for particulate matter dust control generally require agricultural operations to implement a variety of practice-specific options to reduce particulate matter. These practices may include methods to reduce the movement of soil during land preparation, cultivation, and harvesting, suppression of dust on unpaved roads, alternatives to burning, and reduction of agricultural chemical applications.

IV. Potential Projects

Potential Carl Moyer Program projects for agricultural sources fall into three broad categories:

- Mobile source projects. Criteria for the projects may be found in Chapter 5: Compression Ignition Off-Road Equipment.
- Stationary and portable agricultural engines.
- Non-engine agricultural sources.

The Carl Moyer Program seeks cost-effective emission reductions from stationary and portable agricultural engines operating in California. Criteria are designed to ensure that the emission reductions expected through the deployment of electric motors, reduced-emission engines, or retrofit technologies under this program are real, surplus, enforceable, and quantifiable. In addition, at each district's discretion, eligible projects may be subject to funding or cost-effectiveness caps.

A. New Purchase

ARB staff is proposing that the only Carl Moyer Program eligible project for a new agricultural stationary or portable equipment purchase is a new electric motor. For the purposes of determining emission reductions, the new electric motor will be compared to an off-road diesel engine certified to the current off-road emission standards.

B. Repower

1. Repower with Electric Motors

Replacement of uncontrolled or older engines in agricultural operations with electric motors provides significant emission benefits. Diesel and SI engines may be repowered with electric motors. In addition, selected costs for necessary peripheral equipment associated with the motor (e.g., control panel, motor leads, service pole with guy wire, connecting electric line) may be included in determining the grant amount awarded.

In June 2005, the Public Utilities Commission approved a reduced electricity rate and line extension allowance for Pacific Gas and Electric (PG&E) and Southern California Edison (SCE) to be used for conversion of stationary agricultural IC engines to electric. Individuals enrolling in the PG&E and SCE incentive programs may receive funds through the Carl Moyer Program for an electric motor replacing an internal combustion engine, regardless of whether they are currently under Carl Moyer Program contract. Because of the limited enrollment timeframe, ARB will allow grantees currently under contract to negotiate new contracts if they choose to participate in the utilities' incentive programs. Please refer to Chapter 12: Zero-Emission Technologies for specific information on these projects.

2. Repower with Emission-Certified Engines

Stationary and portable agricultural engines may be repowered with new off-road engines certified to the current applicable off-road emission standards. This provision applies to repowers with diesel and SI engines. Diesel engines may be replaced with cleaner diesel or SI engines. SI engines may only be replaced with cleaner SI engines; projects replacing SI engines with diesel engines are not eligible for Carl Moyer Program funding. Emission reductions must be surplus to district rules and any permit conditions. Cost-effectiveness calculations will be based on the rebuild cost of the engine being replaced.

3. Repower with SI Engines Exceeding Local District Requirements

Very few SI engines used in stationary and portable applications have been certified to meet applicable emission standards. Because under certain conditions SI engines can be significantly cleaner than diesel engines, Carl Moyer Program funds may be used to fund purchases of non-certified SI engines in some cases. This provision is available until January 1, 2008. This provides two years for engine manufacturers to certify SI engines for agricultural use. The emission reductions provided by a non-certified SI engine must be surplus to any local district rules. Emission reduction calculations will be based on the rebuild cost of the engine being replaced.

Non-certified SI engines purchased through the Carl Moyer Program will be required to have best available emission control components, and will be subject to source testing and monitoring requirements as described in the Project Criteria or local district requirements, whichever is more stringent. The costs associated for testing and monitoring may not be included in the grant award.

C. Retrofit

A retrofit involves modifications to the engine and/or fuel system such that the retrofitted engine does not have the same specifications as the original engine. Retrofit projects that reduce NOx may be applicable to certain diesel or SI engine families. Emission control technologies that have been verified for use to reduce NOx and PM10 emissions in other applications for on-road or off-road diesel or SI engines may be applicable to stationary and portable agricultural engines. A NOx retrofit for an uncontrolled diesel engine must be verified to reduce emissions to the applicable new engine tier standard or less for a given engine size and not increase particulate matter. An emission-certified stationary or portable engine may use a retrofit kit that is verified to reduce NOx or NOx + non-methane hydrocarbon (NMHC) emissions by at least 15 percent from the applicable emission standard. Uncontrolled SI engines may use a retrofit kit verified to reduce emissions to the currently applicable standard for large SI equipment, or if not feasible, with a retrofit kit verified to reduce emissions to at least 3.0 g/bhp-hr. The emission reductions provided by a retrofit kit must be surplus to the local district rule. Emission reduction calculations will be based on the emission rates of the existing engine being retrofitted.

Additional information on retrofit emission control strategies is provided in Appendix F.

D. Non-Engine Projects

Recent legislative changes have extended the Carl Moyer Program to non-engine agricultural sources of air pollution. ARB staff propose that the Board direct the Executive Officer to develop and approve project criteria for non-engine agricultural sources where technology is available to ensure the emission reductions are real, surplus, quantifiable, and enforceable. However, no specific project criteria are proposed at this time due to the limited data available on specific control technologies. ARB staff will continue to work closely with the districts and interested stakeholders to monitor technological developments to determine when and if it is it appropriate to develop project criteria for non-engine sources.

Potential control technologies and regulatory options will be evaluated for suitability under Carl Moyer Program requirements. During these evaluations, ARB staff will consider:

- Whether the technology provides real, quantifiable and enforceable emission reductions.
- The availability of standardized testing procedures that will quantify emission reductions from these technologies.

- Availability of baseline emission factors.
- Potential multi-media issues.

While engines have a statewide certification or verification process to prove the emission levels are achieved in practice, there is no comparable statewide process for stationary and area-wide sources. In developing statewide project criteria for non-engine technology, ARB staff will need to consider how to assure that emission reductions are achieved.

If non-engine agricultural projects include reductions of non-combustion PM, the criteria will include a weighting factor for non-combustion PM for use in the cost-effectiveness formula.

The following sections provide background on some potential non-engine agricultural projects.

1. Livestock Operations

Air emissions of concern from livestock include ammonia, nitrous oxide, methane, carbon dioxide, volatile organic compounds (VOC), hydrogen sulfide, and particulate matter. The emissions can come from animal housing, storage areas for manure and wastewater, cropland where manure is applied, and directly from the cows. Livestock emissions are most significant in the San Joaquin Valley and the South Coast Air Basin.

The South Coast Air Quality Management District has adopted Rule 1127 - Emission Reductions from Livestock Waste in 2004. This rule requires dairies to clear manure from corrals more frequently and send the manure to an emissions-controlled compost facility, an anaerobic digester or to agricultural land where manure is approved for spreading as fertilizer.

The San Joaquin Valley Unified Air Pollution Control District recently approved a VOC emission factor to be used for permitting San Joaquin Valley dairies. The District reviewed important classes of VOC constituents and key dairy processes individually before approving a total dairy emission factor of 19.3 lbs/year/head. The District will consider regulations to reduce emissions from dairies in the near future.

With the upcoming SB 700 deadlines for approving large CAF mitigation plans, there is a need for a rapid, objective assessment of which technologies are most likely to be successful in California's unique economic, regulatory, and environmental conditions. The Dairy Manure Technology Feasibility Assessment Panel, created and hosted by the ARB, was convened in February 2005 to carry out this work. Members were drawn from government, industry, academia, and environmental and conservation groups.

The Panel evaluated technologies for their potential to reduce environmental impacts resulting from air emissions and from releases of nutrients, salts, and pathogens to the environment. The Panel is assessing the ability of the technology to prevent releases of contaminants and is considering their efficacy in reducing environmental impacts, energy production (if any), economic performance (including saleable products produced by the technology), quality of supporting data, and the development status. The Panel's draft report is scheduled for release in mid-October 2005.

In general, potential technologies may be classified into categories including:

- Thermal conversion (including combustion and gasification).
- Solid-liquid separation (including dehydration).
- Composting.
- Anaerobic digestion.
- Aerators/mixers.
- Nitrification/denitrification.
- Covers.
- Microbials, enzymes, and other additives.
- Feed management.
- Trapping nutrients in biomass (crops, plants in constructed wetlands, algae, fish, etc.).
- Combination systems (such as wastewater treatment plants).

It is likely that no single technology will solve all of the problems associated with dairy manure and each dairy will likely require its own unique combination of technologies to address the specific problems of that area. Research stsill needs to be done on VOC emissions to quantify amounts emitted from each portion of the dairy, and reactivity of the chemical species to form ozone. Without this information and a lack of standard testing procedures, it is difficult to assess how various technologies will reduce these emissions, reduce ozone formation, and improve air quality.

2. Other Projects

Non-combustion particulate matter reductions can be achieved through the use of chemical dust suppressants, road paving, and harvesting equipment with catch-frame technology to eliminate the need for sweeping. For some of these projects, multimedia impacts must also be considered.

Another potential project is the evaluation of irrigation pump efficiency. Improvement in pump efficiency through parts replacement and repair has the potential for emission reductions of NOx, ROG and PM by reduced work by the engine or motor for water output.

V. Proposed Project Criteria

The project criteria below have been designed to provide districts and potential applicants with a list of minimum eligibility requirements for Carl Moyer Program funding. Criteria focus on emission reductions, cost-effectiveness, and the ability for a project to be completed within the timeframe of the program. Additional information about funding electric motors for irrigation pumps is available in Chapter 12: Zero-Emission Technologies.

Participating districts retain the authority to impose additional requirements in order to address local concerns.

A. General

- Projects that replace non-mobile agricultural engines with electric motors should be encouraged. After electric motors, priority should be given to engine repowers with certified engines, and then to engine retrofits and non-certified engines, if applicable.
- Emission reductions obtained through Carl Moyer Program projects must not be required by any federal, state or local regulation, memorandum of agreement/understanding with a regulatory agency, settlement agreement, mitigation requirement, or other legal mandate.
- Projects must meet a cost-effectiveness of $14,300 per weighed ton of NOx + ROG + combustion PM10 reduced calculated in accordance with the cost-effectiveness methodology discussed in this chapter.
- No emission reductions generated by the Carl Moyer Program shall be used as marketable emission reduction credits, or to offset any emission reduction obligation of any person or entity.
- No project funded by the Carl Moyer Program shall be used for credit under any federal or state emission averaging banking and trading program.
- Carl Moyer Program grants can be no greater than a project's incremental cost. The incremental cost is the cost of the project minus the baseline cost. The incremental cost shall be reduced by the value of any current financial incentive that reduces the project price, including tax credits or deductions, grants, or other public financial assistance.
- Projects must have a minimum project life of three years. ARB may approve shorter project life on a case-by-case basis. Projects with shorter lives may be subject to additional funding restrictions, such as a lower cost-effectiveness limit or a project cost cap.
- The contract term must extend to the end of the project life.
- Potential projects that fall outside of these criteria may be considered on a case-by-case basis if evidence provided to the air district suggests potential surplus, real, quantifiable, and enforceable emission reduction benefits.

- Air districts must consult with ARB staff to determine eligibility of all projects considered for funding on a case-by-case basis. All projects considered on a case-by-case basis must receive ARB approval prior to receiving program funding.

- An engine must be rated at greater than 25 hp, which is equivalent to an electric motor greater than 19 kW.

- Projects must operate at least 75 percent of total equipment hours in California.

- The default project life when determining project benefits for new purchases or repowers shall be ten years for electric motors. The default project life for engines without documentation shall be seven years. A longer project life may be used with approval by ARB staff, however, sufficient documentation must be provided to ARB that supports the selected project life based on the actual remaining useful life. The default project life does not consider upcoming regulatory requirements. Project life may be shorter due to regulatory requirements.

B. New Purchase

- Engine purchases for new 2005 or later model year agricultural stationary or portable equipment can only be electric motors.

C. Repower

- A repower of an uncontrolled or emission certified (1996+ model year) diesel engine must be with one of the following:
  - A new electric motor.
  - A new off-road diesel engine certified to the current applicable emission standards.
  - A new off-road spark-ignited (SI) engine certified to the current applicable emission standards.
  - A new SI engine that exceeds local district emission requirements and is subject to and complies with local district permitting, monitoring, record keeping and reporting requirements. This criterion will sunset on January 1, 2008.

- A repower of an uncontrolled SI engine must be with one of the following:
  - A new electric motor.
  - A new off-road SI engine certified to the current applicable emission standards.
  - A new SI engine that exceeds local district emission requirements and is subject to and complies with local district permitting, monitoring, record keeping and reporting requirements. This criterion will sunset on January 1, 2008.

- A repower of an emissions-controlled SI engine must be with one of the following:
  - A new electric motor.
  - A new off-road SI engine certified to the current applicable emission standards.

- A new SI engine that meets or exceeds local district emission requirements and is subject to and complies with local district permitting, monitoring, record keeping and reporting requirements, provided that the new engine provides a NOx emission reduction of at least 15% from the baseline engine NOx emissions. This criterion will sunset on January 1, 2008.

- Electric motors may replace diesel or SI engines. The applicant must have documentation of payment to the local utility company for power installation. This requirement of documentation also applies to new installations.

- Off-road diesel engines must be certified for sale in California and must comply with durability and warranty requirements.

- The use of a non-certified SI engine shall be subject to approval by ARB staff. Emissions testing of a non-certified SI engine shall be conducted using an ARB-approved source testing procedure, such as ARB Test Method 100.

- Non-certified SI engines shall be required to include currently available emission control components such as closed-loop fuel control systems, and three-way catalysts.

- Non-certified SI engines shall be subject to source testing with an ARB-approved testing procedure following local district requirements.

- Non-certified SI engines must be emission tested using a portable analyzer every 1,000 hours of operation and at least annually, or following local district monitoring requirements, whichever is most stringent. The emission tests shall measure NOx and hydrocarbon emissions.

- The costs associated with source testing and monitoring requirements for non-certified SI engines are not eligible for funding.

D. Retrofit

- A retrofit of an uncontrolled diesel engine that reduces NOx must be with a retrofit kit that is verified to reduce NOx or NOx+NMHC emissions to the applicable new engine Tier standard or less for a given engine size.

- A retrofit of an uncontrolled SI engine that reduces NOx must be with a retrofit kit that is verified to reduce NOx+NMHC emissions to the currently applicable standard for off-road large spark-ignited equipment. If this is not feasible, the project must reduce NOx+NMHC emissions to at least 3.0 g/bhp-hr or less.

- A retrofit of an emission-certified (1996+ model year) off-road diesel engine that reduces NOx must be with a retrofit kit that is verified to reduce NOx or NOx+NMHC emissions by at least 15 percent from the applicable NOx or NOx+NMHC emission standard.

- Reduced-emission retrofit kits must be verified following California test procedures and must comply with durability and warranty requirements.

E. Scrap

- A baseline engine in a repower project must be destroyed by scrapping or drilling a hole in the engine block rendering it inoperable unless prior approval for alternate disposition has been granted by ARB staff. At the discretion of the district, core charges are eligible for funding and, if including, must be part of the cost-effectiveness calculation.

VI. Cost-Effectiveness

Cost-effectiveness methodology and sample project calculations are provided in Appendices C and D. Emission reduction benefits are calculated by comparing the emission levels and operating parameters of the baseline engine and the replacement, reduced emission engine or motor. The emission reductions and cost-effectiveness of an agricultural engine project may be calculated based on annual hours of operation or annual fuel consumption.

VII. Minimum Project Requirements

A. Application

The minimum application information for stationary and portable agricultural engine projects is in Table 10-4. Districts may request additional information from the applicant.

A disclosure must also be included stating that the proposed project has not been funded and is not being considered for funding by another air district, ARB, or any other public agency. Any applicant who is found to have submitted multiple applications for the same project may be banned from submitting future applications to any and all Carl Moyer Program solicitations and may be subject to criminal sanctions. A project funded cooperatively by multiple air districts is eligible for funding if the project parameters are coordinated amongst the participating districts and the project meets all applicable Carl Moyer Program criteria. Applicants are allowed to re-apply for project funding if a previous application has been rejected and is no longer being considered for funding.

Third party applications are not allowed. The owner of the engine must sign and agree to the application. However, a third party (e.g. engine dealer or distributor) may complete an application or part of an application on an owner's behalf. Applications must include a signature section for third parties. The third party signature section must include signature and date lines, and blanks for the third party to list how much they are being paid, if anything, to complete the application and what source of funds are being used to pay them. To make the Carl Moyer Program accessible to all potential applicants, including applicants that cannot afford to hire third party assistance, districts are encouraged to provide technical assistance to applicants in completing the application.

Table 10-4
Minimum Application Information for Stationary and Portable Agricultural Engine Projects

1. Air District: 2. Applicant Demographics Company Name: Business Type: Mailing Address: Location Address: Contact Number: 3. Project Description Project Name: Project Type: Equipment Function: Subject to District Permitting Requirements? (Y/N) 4. NOx Reduction Incremental Cost-Effectiveness Analysis Basis: (Mileage/Fuel/Hours of Operation) 5. VIN or Serial Number: 6. Application: (Repower, Retrofit or New) 7. Annual Fuel Consumption: 8. Hours of Operation: 9. Old Engine Information Horsepower Rating: Engine Make: Engine Model: Engine Year: 10. New Engine/Motor Information Horsepower Rating: Engine Make: Engine Model: Engine Year: Fuel Type:	11. NOx Emissions Reductions Baseline NOx Emissions Factor (g/bhp-hr): Reduced NOx Emissions Factor (g/bhp-hr): Estimated Annual NOx Emissions Reductions: Estimated Lifetime NOx Emissions Reductions: 12. ROG Emissions Reductions Baseline ROG Emissions Factor (g/bhp-hr): Reduced ROG Emissions Factor (g/bhp-hr): Estimated Annual ROG Emissions Reductions: Estimated Lifetime ROG Emissions Reductions: 13. PM Emissions Reductions Baseline PM Emissions Factor (g/bhp-hr): Reduced PM Emissions Factor (g/bhp-hr): Estimated Annual PM Emissions Reductions: Estimated Lifetime PM Emissions Reductions: 14. Percent Operated in California: 15. Project Life (years): 16. Cost ($) of the Base Engine: 17. Cost ($) of the New Engine/Motor: 18. District Incentive Grant Requested

B. Reporting and Monitoring

Owners of stationary and portable agricultural engines participating in the Carl Moyer Program are required to keep appropriate records during the life of the project. During the project life, the district has the authority to conduct periodic checks or solicit operating records from the recipient of Carl Moyer Program funds. This is to ensure that the engine is being operated as stated in the project application. The recipient must maintain and update operating records throughout the project life and have them available to the district upon request. Annual records must contain, at a minimum, total actual hours of operations or estimated amount of fuel used from actual fuel receipts. Actual hours of operations are acceptable for an engine equipped with a non-reset hour meter.

Monitoring may be required to comply with district requirements and to ensure the program incentives are being applied toward the project as specified in the application. To ease the tracking of the equipment over the life of the project, a district registration certificate may be issued to the equipment owner.

VIII. References

ARB, 2003. Air Resources Board. Staff Report: Initial Statement of Reasons, Airborne Toxic Control Measure for Stationary Compression-Ignition Engines. http://www.arb.ca.gov/regact/statde/isor.pdf

ARB, 2005. Air Resources Board. Staff Report: Initial Statement of Reasons, Public Hearing to Consider the Large Confined Animal Facility Definition. http://www.arb.ca.gov/regact/lcaf05/isor.pdf

CASS, 2003. California Agricultural Statistics Service. California Agricultural Statistics, 2003. California Agricultural Overview. http://www.nass.usda.gov/ca/bul/agstat/indexcas.htm

Chapter Eleven

LIGHT-DUTY VEHICLES

This is a new chapter that addresses the project criteria for on-road, light-duty vehicle projects under the Carl Moyer Program. The chapter contains a brief overview of the light-duty vehicle emission inventory, current engine emission standards, available control technologies, potential projects eligible for funding, and emission reduction and cost-effectiveness calculation methodologies.

I. Introduction

Light-duty vehicles include passenger cars and light-duty trucks such as pick-up trucks, sport utility vehicles (SUVs), and vans. In 2005, the estimated number of light-duty vehicles in California is over 21 million vehicles. This number is expected to increase to over 23 million vehicles by 2010. Light-duty vehicles are major contributors to California's ozone and particulate matter air pollution. Although emissions from light-duty vehicles are decreasing with the implementation of stricter emission control standards, light-duty vehicles contribute about half of the ozone producing emissions from all on-road vehicles.

II. Emissions

The oxides of nitrogen (NOx), reactive organic gas (ROG), and particulate matter (PM10) emissions from the light-duty fleet are shown in Table 11-1. In addition to these pollutants, light-duty vehicles emit toxic air contaminants and carbon monoxide (CO).

Table 11-1
Statewide Emissions from On-Road Light-Duty Vehicles
(tons per day)

	Population	NOx	ROG	PM10
2005	21,500,000	574	583	29
2010	23,700,000	388	405	32

Older, light-duty vehicles (pre-1990 model years) account for 56 percent of the ROG and 41 percent of the NOx emissions from all light-duty vehicles in 2005 despite accounting for only 19 percent of the vehicle population and less than 13 percent of the vehicle miles traveled (VMT). Generally, these older vehicles emit more pollutants because of less restrictive emission standards and increased wear and tear on drive train and emission control components. Additionally, the subset of older vehicles that are not well maintained has a higher probability of being high emitters. As a result, older vehicles tend to be major contributors to ozone and particulate matter air pollution in California.

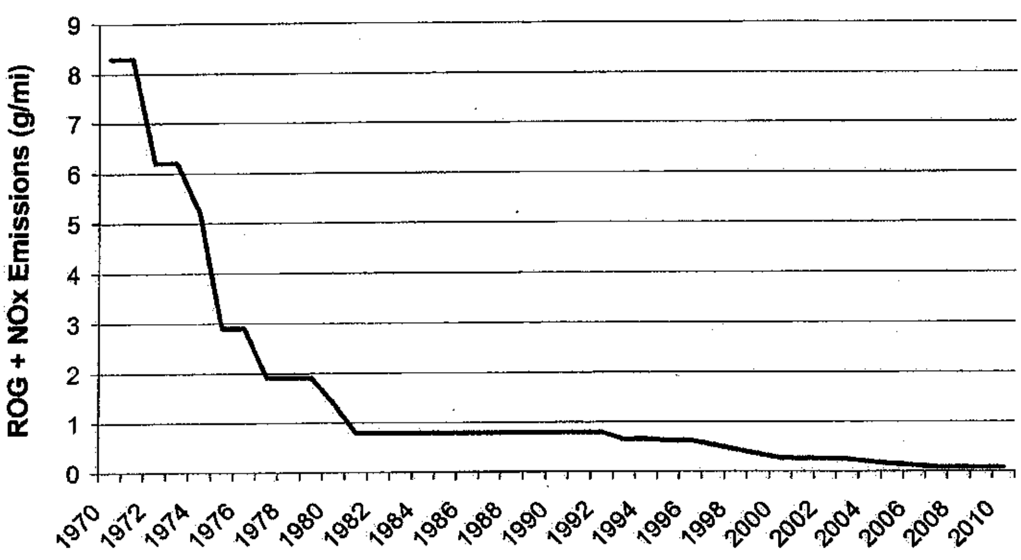
III. Regulatory Requirements

California's emission controls for light-duty vehicles date back to the 1960s. Emission standards have become more restrictive over the years, enabled by new control technologies and cleaner fuels.

Since the 1990s, the Low Emission Vehicle (LEV) regulations have been the cornerstone of the ARB's program to reduce emissions from light-duty vehicles. The LEV program, implemented in 1994, established four tiers of low emission standards and provided manufacturers with the option of certifying their vehicles to any mix of these standards as long as they complied with an average non-methane organic gas annual fleet requirement. The fleet average requirement gradually decreased each year between 1994 and 2003, resulting in the introduction of a greater number of cleaner vehicles each proceeding model year. The LEV II regulation, adopted in 1998, set even more stringent, declining fleet average emission requirements for 2004 through 2010 as well as lowering the NOx emission standards.

Figure 11-1 shows the progressively more stringent emission standards for new light-duty vehicles from 1970 through 2010. As a result of the ARB's LEV program, a new 2005 model year car is on average 99 percent cleaner than an uncontrolled car.

Figure 11-1
Emission Standards for New Light-Duty Vehicles
1970-2010



California also has requirements to ensure vehicles' emission control systems continue to work throughout their lives. Under the Inspection and Maintenance Program (Smog Check), vehicles are tested biennially to ensure that they stay clean as they age. A Smog Check includes a tailpipe emissions test and a visual inspection of the emission control system. For vehicles equipped with on-board diagnostic (OBD II) systems (model years 1996 and later), the inspection also includes a check of the malfunction indicator light to ensure that no problems have been detected with the vehicle's emission control system.

IV. Potential Projects

Under the general heading of light-duty vehicle projects, the ARB has identified two programs that are eligible for funding under the Carl Moyer Program: voluntary accelerated vehicle retirement (VAVR) and voluntary vehicle repair (VVR). Both programs have the potential to decrease excess emissions from older, high emitting vehicles. These Guidelines will focus on implementing the VAVR program under the Carl Moyer Program. The ARB staff will continue to assess how to incorporate VVR into the Carl Moyer Program and anticipates providing guidance on VVR in 2006. As part of this assessment, the ARB staff will also evaluate extending the guidance to medium-duty vehicles.

A. VAVR Programs

The goal of VAVR programs is to retire older, more polluting vehicles earlier than their expected lifetime, thereby eliminating air pollution emissions associated with their operation. VAVR programs are strictly voluntary programs overseen by the ARB and administered by local air districts. Enterprise operators are contracted by the district and are responsible for evaluating, approving, and disposing of qualified light-duty vehicles. Real emission reductions can be achieved as vehicles are still fully operational and have a useful life remaining. Therefore, to qualify for a VAVR program, a vehicle msut meet registration, functionality, and equipment eligibility criteria. To accommodate car collectors and others with potential interest in vehicles offered for retirement, VAVR programs provide the public with an opportunity to purchase vehicles in whole or in part before the vehicle is entered into the VAVR program. Vehicles accepted into the program for emission reductions must be retired by crushing the vehicle to such a degree that the vehicle and its parts are rendered unusable.

B. Legislative and Regulatory History of VAVR

Vehicle scrapping programs were first introduced in California in the early 1990s. In the 1994 State Implementation Plan (SIP), the ARB included a measure calling for a vehicle scrapping program in the South Coast Air Basin. Senate Bill 501 (Calderon, 1995) directed the ARB to adopt a regulation governing VAVR which would include market-based, privately-operated VAVR enterprises and the generation of emission reduction credits. (See California Health and Safety Code sections 44100-44122, in part.) The ARB adopted VAVR regulations in 1998 and amended these regulations in 2002 [ARB, 1998 and ARB, 2001]. In 1998 and 1999, the ARB conducted a pilot program for retiring light-duty vehicles in the South Coast Air Basin. While the results of the pilot program were encouraging, funding limitations did not permit expansion of the program to achieve the emission reductions called for in the SIP.

The 2003 SIP did not contain an explicit commitment to vehicle retirement because sufficient funding for such programs had not been secured. However, the SIP did acknowledge the need to provide incentives for VAVR programs in the long term. Legislative changes to the Carl Moyer Program enacted with the signing of Assembly Bill 923 (Firebaugh, 2004) added light-duty vehicle projects to the list of allowable projects and provided additional means of funding VAVR programs to reduce NOx, ROG, and PM10 emissions.

C. District VAVR and the BAR Vehicle Retirement Programs

Four districts have recently operated or continue to operate VAVR programs including the Bay Area Air Quality Management District (AQMD), San Diego Air Pollution Control District (APCD), Santa Barbara APCD, and South Coast AQMD. Between 2000 and 2003, these districts scrapped over 21,000 vehicles or over 5,000 vehicles per year.

In addition to district VAVR programs, the Bureau of Automotive Repair's (BAR) Smog Check Program includes a voluntary vehicle retirement element. As part of BAR's Consumer Assistance Program, owners of qualifying vehicles that fail the biennial inspection are given the option of voluntarily retiring their vehicle rather than repairing it. BAR offers $1,000 in exchange for the vehicle.

District VAVR programs work outside of BAR's Smog Check Program to ensure that district programs generate emission reductions that are surplus to the those obtained through the Smog Check. BAR's program covers vehicles that have failed their biennial Smog Check while the district programs cover vehicles that have passed their biennial Smog Check or are "off cycle" for Smog Check (i.e., not due for their biennial inspection). To ensure that the two programs do not compete with one another, vehicles that are within 60 days from their next required Smog Check must pass the Smog Check inspection under the VAVR regulation. If the vehicles are between 61 to 90 days of the next Smog Check, the district must verify that the vehicle has not failed the Smog Check inspection before the vehicle can be accepted. Additionally, the vehicle cannot be operating under either a BAR repair cost waiver or economic hardship extension.

D. Remote Sensing

Studies by the ARB, BAR, the U.S. Environmental Protection Agency (U.S. EPA), and the University of Denver, Colorado, among others, have shown that remote sensing devices (RSD) can be effective tools in identifying high emitting vehicles [BAR, 2001; U.S. EPA; Stedman, 1994; and Stedman].

Remote sensing typically uses infrared and, at times, ultraviolet spectroscopy to measure the concentrations of air pollutants in vehicle exhaust while the vehicle is in use on the roadway. Concentrations of ROG, NOx, and CO in parts per million or percent are recorded along with the vehicle's speed and rate of acceleration and a photo of the license plate.

The ARB staff is proposing to include the option of using RSD to identify high emitting vehicles that can then be contacted for participation in voluntary early retirement programs. Staff is taking a two-step approach to integrate RSD into the Carl Moyer Program and the VAVR regulation. As a first step, the ARB would authorize an RSD-based "High-Emitting Vehicle Identification, Repair, and Scrapping Program" to be run by the South Coast AQMD starting in Spring 2006. Then, the ARB would use the data from this program to revise the VAVR regulation and provide additional Carl Moyer Program guidance in 2006 to fully incorporate RSD. The revisions would codify the use of RSD; establish protocols for quantifying emission reductions; and determine the appropriate application of Moyer funds to RSD-based VAVR programs. As part of this guidance, the ARB would evaluate what elements related to the use of RSD would be eligible for funding under the Carl Moyer Program consistent with legislative requirements and Board direction. After the ARB revises the regulation and Carl Moyer Program guidance, any district may develop and implement an RSD-based VAVR program.

The South Coast project will mark the first time an RSD-based VAVR program has been implemented. Because the methodology for calculating the emission reductions associated with retiring or repairing high-emitting vehicles has not been established and the level of vehicle owner participation cannot be predicted in advance, the cost-effectiveness of the program cannot be fully established in advance. Carl Moyer Program funds can only be used for projects that meet the $14,300 per weighted ton cost-effectiveness limit. By undertaking this introductory RSD program, the South Coast Air District is taking some risk if the program ultimately exceeds the cost-effectiveness limit.

V. Proposed Project Criteria

Light-duty vehicle projects will initially be limited to VAVR programs that meet the ARB's VAVR regulations. As noted above, the proposed Guidelines also provide for an RSD implementation program in the South Coast. The project criteria listed below provide districts with the minimum qualifications for the Carl Moyer Program.

The criteria listed below highlight many, but not all, of the requirements of the ARB's VAVR regulation. VAVR programs must meet all of the requirements of the regulation. Districts starting VAVR programs using Carl Moyer Program funding should reference these Guidelines as well as the regulation. Where the Carl Moyer Program Guidelines go beyond the requirements of the regulation, it is noted below. Participating districts retain the authority to impose additional requirements to address local concerns.

A. General Requirements

- Emission reductions obtained through Carl Moyer Program projects must not be required by any federal, state, or local regulation; memorandum of agreement/understanding with a regulatory agency; settlement agreement; mitigation requirement; or other legal mandate.

- Projects must meet a cost-effectiveness of $14,300 per weighed ton of NOx + ROG + combustion PM10 reduced calculated in accordance with the cost-effectiveness methodology discussed in this chapter.

- No emission reductions generated by the Carl Moyer Program shall be used as marketable emission reduction credits or to offset any emission reduction obligation of any person or entity.

- Projects must have a minimum project life of three years. The ARB may approve shorter project life on a case-by-case basis. Projects with shorter lives may be subject to additional funding restrictions, such as a lower cost-effectiveness limit or a project cost cap. The contract term must extend to the end of the project life. The default project life does not consider upcoming regulatory requirements.

- Potential projects that fall outside of these criteria may be considered on a case-by-case basis if evidence provided to the ARB suggests potential surplus, real, quantifiable, and enforceable emission reduction benefits.

- Air districts must consult with ARB staff to determine eligibility of all projects considered for funding on case-by-case basis. All projects considered on a case-by-case basis must receive ARB approval prior to receiving program funding.

- Participation in a light-duty VAVR program shall be entirely voluntary for vehicle owners.

- VAVR programs shall comply with all provisions of the VAVR regulations found in Title 13 California Code of Regulations, Division 3, Chapter 13, Article 1, section 2601 et seq.

- VAVR programs seeking funding under the Carl Moyer Program shall comply with all applicable provisions of the Carl Moyer Program Guidelines including "Administration of the Carl Moyer Program."

- Funding of program administrative costs, including advertising or outreach, shall be limited to the amount allowable under statute.

B. Vehicle Eligibility Requirements

- The vehicle to be retired must be currently registered with the Department of Motor Vehicles (DMV) as an operating vehicle and must have been registered for at least 24 consecutive months prior to the final date of the sale to a VAVR enterprise to an address, or addresses, within the district in which the VAVR enterprise is operated.

Smog Checks must be performed as required by the DMV in order for the vehicle to be considered registered.

1. A vehicle may also be eligible if the owner of the vehicle placed the vehicle in planned non-operational status per Vehicle Code section 4604, et seq., for a total of 2 months during the continuous 24 month registration period, occurring at least 3 months prior to the date of sale to the VAVR enterprise.

2. A vehicle may also be eligible if the registration has lapsed for a period not to exceed 180 days during the previous 24 months and all appropriate registration fees and late penalties have been paid to the DMV, provided that the vehicle is registered for at 90 days immediately prior to its date of sale to a VAVR enterprise.

NOTE: These eligibility requirements are stricter than the ARB's current VAVR regulation but are consistent with the requirements of Health and Safety Code section 44094.

- The vehicle to be retired shall be driven to the VAVR enterprise purchase site under its own power and shall pass a functional and equipment eligibility inspections as specified in the ARB's VAVR regulation.

- The vehicle to be retired shall not be operating under a Smog Check repair cost waiver.

- If a vehicle volunteered for retirement is within 60 days of its next required Smog Check inspection, the vehicle shall pass the Smog Check inspection without receiving a repair cost waiver or economic hardship extension prior to acceptance by a VAVR enterprise operator.

- If a vehicle volunteered for retirement is within 61-90 days of its next required Smog Check inspection, the district shall verify that the vehicle has not failed a Smog Check inspection during this time frame.

C. Calculating Emission Reductions

- Emission reductions from VAVR programs shall be calculated in accordance with the methodology specified in the ARB's VAVR regulations. Emission reductions, by model year of vehicle retired, are shown in Table 11-2. (The table is also included in Appendix B, Tables for Emission-Reduction and Cost-Effectiveness Calculations, at Table B-21.)

- The project life for a vehicle retirement project is three years as specified in the ARB's VAVR regulation.

D. Offering Vehicles/Parts to the Public

- The enterprise operator must inform the district of the vehicles that are ready for dismantling.
- The district must provide a detailed description of the vehicle to interested parties including collectors and enthusiasts.
- The enterprise operator must wait a minimum of 10 days before submitting a Notice to Dismantle to the DMV.
- If an interested person contacts the enterprise operator, the enterprise operator must hold the vehicle for an additional, minimum of 7 days.
- Non-emission-related and non-drive train parts from the vehicle may be sold at the sole discretion of the enterprise operator.
- Engine, emission-related parts, transmission, and drive train parts must be removed from the vehicle and destroyed after the 10 day waiting period but prior to offering the remaining parts for sale. (Emission-related and drive train parts are defined in the VAVR regulation.)
- If a vehicle or its emission-related or drive train parts are sold instead of retired, no emission reductions will be generated, and Carl Moyer Program funds may to be used for retiring the vehicle.

E. Recordkeeping

- For each vehicle retired, the district shall retain the following information:

  1. Vehicle Identification Number (VIN).
  2. Vehicle license plate number.
  3. Vehicle model year.
  4. Vehicle odometer reading.
  5. Vehicle make and model.
  6. Name, address, and phone number of legal owner selling vehicle to the enterprise operator.
  7. Name and business address of inspector conducting the vehicle's eligibility inspection, if the VAVR enterprise operator contracts with an ARB-approved inspection entity to perform the vehicle functional and equipment eligibility inspection.
  8. Date of purchase of vehicle by enterprise operator.
  9. Date of vehicle retirement.
  10. Emission reduction claimed.

- The VAVR enterprise operator shall maintain the following:

1. Reproduction of California Certificate of Title and registration, as signed-off by the seller at time of final sale to the VAVR enterprise.
2. Reproduction of the applicable certificate of functional and equipment eligibility;
3. Reproduction of the applicable Notice to Dismantler (DMV Registration 42 form).
4. Reproduction of written documentation from the DMV verifying that a vehicle meets the vehicle registration requirements of the ARB's VAVR regulations.
5. If the retired vehicle was within 60 days of its next required Smog Check inspection, a reproduction of documentation that the vehicle passed its Smog Check inspection.

- Districts and enterprise operators shall retain these records for the life of the project plus an additional three years.

NOTE: This requirement is stricter than the ARB's current VAVR regulation which requires that records be maintained for the life of the project but is consistent with the Carl Moyer Program administrative requirements.

F. Criteria for South Coast AQMD RSD/Scrapping/Repair Project

- The South Coast AQMD may operate an RSD-based high-emitting vehicle identification, repair, and scrapping program.

- Prior to project implementation, the district shall submit a detailed project plan for approval by the ARB's Executive Officer (EO).

1. The plan shall include a detailed protocol describing the installation, calibration, and operation of RSD that will be used to identify high emitters along with the methodology for processing of the data collected.
2. The plan shall include itemized, estimated project costs including, but not limited to, the funds allocated to vehicle repair and the number of vehicles to be repaired; the funds allocated to vehicle retirement and the number of vehicles to be retired; and the costs allocated to RSD data collection, data analysis, outreach, and solicitation of vehicle owners.
3. The plan shall include a sample of the letter that the South Coast AQMD intends to send to vehicle owners soliciting their voluntary participation in the project.
4. The project must follow the plan, and any substantive changes must be pre-approved by the EO.

- The South Coast AQMD shall permit the ARB to perform emissions testing on a subset of the retired vehicles selected by the ARB prior to dismantling.

- As part of the Carl Moyer Program reporting requirements, the South Coast AQMD shall report on each vehicle retired or repaired under this program.

- The ARB may conduct periodic auditing of the program, and the South Coast AQMD shall provide any required information concerning the program.

- If vehicle records are missing, incomplete, or chronically late, the ARB may disallow emission reduction credit for that vehicle.

- The ARB has not yet established the methodology for calculating the extra emission benefits from retiring high-emitting vehicles identified using RSD. Because of this, the emission reductions achieved under this project shall be calculated in accordance with a new methodology that will be established during the next revision of the VAVR regulation.

- An acceleration simulation mode (ASM) Smog Check test must be run on all vehicles being retired or repaired during this introductory RSD/scrapping/repair project to help establish the emission reduction calculation methodology.

VI. Emission Reduction and Cost-Effectiveness Calculations

For VAVR projects, the emission reduction benefits represent the difference in the emission levels of the retired vehicle and the replacement vehicles. The ARB approved the methodology for calculating emission reductions associated with VAVR at its December 1998 Board meeting [ARB, 1998]. Emission reductions, by model year of vehicle retired, calculated in accordance with the approved methodology are listed in Table 11-2. The table lists the reductions over the full three year life of a vehicle retirement project. The methodology for retiring high-emitting vehicles identified via RSD has not yet been established.

A detailed description of how to calculate cost-effectiveness can be found in Appendix C: Cost-Effectiveness Calculation Methodology and Appendix D: Example Calculations.

Table 11-2
Voluntary Accelerated Light-Duty Vehicle Retirement Program
Emission Reductions for Calendar Year 2006*
Total Pounds Per Vehicle Over 3 Year Credit Life

	Emission Reductions (pounds) – 3 Year Credit Life			
Model Year	**NOx**	**ROG****	**CO**	**PM10**
65 and earlier	151	496	2,757	0.68
66	145	471	2,552	0.67
67	148	477	2,611	0.65
68	156	492	2,731	0.81
69	162	504	2,841	0.56
70	169	438	2,971	0.99
71	172	449	2,990	0.95
72	177	458	3,037	0.83
73	180	469	3,082	0.64
74	159	401	2,859	1.20
75	145	345	2,861	1.17
76	130	222	2,673	1.04
77	108	183	2,546	1.13
78	107	186	2,493	1.10
79	95	168	1,625	0.90
80	85	129	1,373	1.13
81	62	108	1,092	1.22
82	66	101	1,085	1.36
83	73	85	934	1.22
84	73	74	883	1.05
85	69	59	575	0.89
86	71	61	527	0.91
87	67	71	468	0.92
88	67	65	430	0.85
89	50	46	492	0.84
90	38	45	529	0.81
91	38	42	514	0.76
92	40	41	510	0.71
93	35	31	279	0.64
94	19	17	21	0.54

* Table is repeated in Appendix B, Table B-21
** Includes exhaust and evaporative emissions

Source: EMFAC2002, Version 2.2, statewide, annual average. Assumes average 1965 through 2006 vehicle as replacement vehicle for vehicles retired in calendar year 2006.

This table updates the emission reductions provided in the ARB's VAVR regulation consistent with the methodology in the staff report, Proposed Regulations for Voluntary Accelerated Light-Duty Vehicle Retirement Enterprises, released October 23, 1998, and approved by the ARB on December 10, 1998.

VII. Minimum Project Application Requirements

Districts must submit a VAVR plan to the ARB, consistent with the Carl Moyer Program Guidelines. The district must receive written approval of the plan from the ARB's EO prior to implementing the VAVR program under the Carl Moyer Program. The district must also follow all other Carl Moyer Program reporting requirements.

The district plan must at a minimum include:

1. The name, title, and telephone number of the district contact for the VAVR program.
2. An evaluation of environmental justice considerations including, but not limited to, outreach addressing community needs.
3. An estimate of the number of vehicles that may be retired and an estimate of the cost-effectiveness of the program along with all assumptions and calculations that were used to derive the estimate (recognizing that the ultimate cost-effectiveness will depend on the mix of vehicles actually retired).
4. A sample of the enterprise operation contract.
5. A description of the methods that will be used and a timetable for monitoring and auditing enterprise operations.
6. A copy of the statement of certification that an enterprise operator has demonstrated compliance with all applicable provisions of the regulation.
7. The methodology and sample records for verifying that a vehicle is eligible for inclusion in the VAVR program including confirmation of compliance with any Smog Check requirements.
8. The protocol for informing the public of the availability of eligible vehicles for sale.
9. A sample of the records that will be required of the enterprise operator.
10. A description of changes to the VAVR program that are more stringent than those listed in the statewide regulation (if a district chooses to adopt requirements beyond those required).
11. Any additional information necessary to explain or clarify how the district plan complies with the VAVR regulation and the Carl Moyer Program.

The annual report shall contain, for each vehicle retired, at a minimum:

1. Vehicle Identification Number (VIN).
2. Vehicle license plate number.
3. Vehicle model year.
4. Vehicle odometer reading.
5. Vehicle make and model.
6. Name, address, and phone number of legal owner selling vehicle to the enterprise operator.
7. Name and business address of inspector conducting the vehicle's eligibility inspection, if the VAVR enterprise operator contracts with an ARB-approved inspection entity to perform the vehicle functional and equipment eligibility inspection.
8. Date of purchase of vehicle by enterprise operator.
9. Date of vehicle retirement.

10. Emission reductions claimed.

VIII. References

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Chapter Twelve

ZERO-EMISSION TECHNOLOGIES

This is a new chapter that highlights some of the available zero-emission technologies eligible for Carl Moyer Program funding. It provides more detail on zero-emission technologies and, for some project types, provides additional project criteria. It also describes emission reduction and cost-effectiveness calculation methodologies. This chapter is a supplement to other chapters in these Guidelines: it does not replace or supersede any other criteria.

I. Introduction

A. Benefits of Zero-Emission Projects

Zero-emission technology is a key element of California's long-term plan for attaining health-based air quality standards. Electric motors are the most commercially viable zero-emission technology available today. In general, replacing internal combustion engines with electric motors provides major reductions in oxides of nitrogen (NOx) and particulate matter (PM10). Zero-emission technologies also have a number of societal benefits that re not quantified in the Carl Moyer Program. These include reductions in toxic air contaminants, greenhouse gases, petroleum consumption and noise pollution. In addition, electricity production does not have as many "upstream" emission impacts as the production of combustible fuels. Refining, storage and delivery all have associated emissions from routine operations and accidents (e.g., fuel spills). Furthermore, unlike other technologies with emission control devices that may lose effectiveness over time, with zero-emission equipment there is no emission rate deterioration. Electric equipment will remain emission-free throughout its useful life.

Although the purchase price of electric equipment can be higher than comparable internal combustion engine equipment, owners and operators generally realize significant fuel and maintenance cost savings. The higher purchase price is sometimes recouped through these savings during the life of the equipment. Higher salvage values and longer lives can provide electric equipment with an economic advantage compared to internal combustion engine equipment. In addition, electric equipment operators sometimes derive indirect benefits from privileges like access to restricted areas, use of carpool lanes and even public relations benefits.

Yet, despite these attributes and the fact that electric technologies may be well-suited for a multitude of applications, there have been relatively few zero-emission projects funded by the Carl Moyer Program. Many prospective buyers still perceive electric equipment to be an unfamiliar, risky technology or are deterred by the higher initial investment. The Carl Moyer Program can address both of these issues, first by serving as a source of information regarding electric technologies and, second, by providing grants to help offset increased costs. Zero-emission projects should become increasingly competitive within the Carl Moyer Program. New regulations, tighter emission standards, increasing petroleum prices, and technology advances are helping to make zero-emission technologies more competitive. As regulatory requirements continue to decrease baseline emission levels, Carl Moyer Program applicants need to find cleaner technologies to qualify for funding.

The Air Resources Board (ARB) staff is proposing to require that districts encourage zero-emission projects. This encouragement can be demonstrated in a number of ways. Districts operating on a "first-come-first-served" basis may rotate zero-emission projects to the top of the list, regardless of when the applications were submitted. Districts that solicit projects and rank them by cost-effectiveness may choose to fund zero-emission projects first, regardless of their cost-effectiveness (as long as the project does not exceed $14,300 per weighted ton). Alternatively, districts may earmark a percentage of their allocation for zero-emission projects or increase outreach efforts that target zero-emission projects. Any of these strategies are acceptable, as well as other means of encouragement. Districts' policies and procedures must describe how they plan to encourage zero-emission technologies.

B. Types of Zero-Emission Projects

To date, the Carl Moyer Program has funded approximately 231 electric forklifts, 55 hybrid-electric buses, 7 electric motor driven agricultural pumps, and 4 electric battery hybrid locomotives. In addition, 30 truck stop spaces are scheduled to be equipped with IdleAire systems to reduce truck idling under the Carl Moyer Program. In all of these projects, the NOx-only cost effectiveness is very favorable. These projects will be even more cost-effective when reactive organic gases (ROG) and combustion PM are taken into account with the proposed new weighted cost-effectiveness formula. Zero-emission projects have an inherent emissions advantage because there is no NOx versus PM trade-off (as with some diesel projects) and no additional cost for controlling PM or ROG.

In addition to agricultural pumps, buses, locomotives, and forklifts, there are several other applications where zero-emission technologies are capable of replacing combustion engines. Marine ports, airport ground support equipment (GSE), and industrial equipment are all good candidates for zero-emission technology. In addition, electric motors can substitute for idling trucks and engines used for truck refrigeration units. All these applications are eligible for the Carl Moyer Program funding, and zero-emission technologies are the cleanest option.

In the following section, we discuss the availability and provisions for using zero and near-zero emission technologies. For new applications of zero-emission technologies not addressed elsewhere in the Guidelines, such as truck parking space electrification, we outline the parameters for Carl Moyer Program eligibility. Although many of these projects will be assessed on a case-by-case basis at this time, our intent is to provide a general framework for evaluation. As with all projects, emission reductions must be surplus, real, quantifiable, and enforceable and the project must meet the cost-effectiveness threshold of $14,300 per weighted ton.

Most Carl Moyer Program projects can simply substitute an electric motor for an internal combustion engine. In those cases, the same criteria and methodologies apply as for a typical repower or new purchase, except as noted in the criteria section of this chapter. All relevant regulations and MOUs discussed or referred to in the respective chapters also apply to zero-emission projects. The only difference is that the new or replacement piece of equipment has no emissions.

II. Regulatory Requirements

Regulatory requirements that apply to the baseline equipment are included in the respective chapters pertaining to the category of equipment under consideration. Because there are no regulatory requirements for Carl Moyer Program categories that mandate zero-emission technologies, emission reductions resulting from using such technologies will always be surplus.

III. Potential Zero-Emission Projects

A. Electrically-Driven Agricultural Equipment

Agricultural equipment, such as pumps, provides an ideal application and the potential for wide-scale deployment of a zero-emission technology. Statewide, several thousand internal-combustion engines are used for pumping water for agricultural purposes. To date over 2,000 pumps have been replaced using Carl Moyer Program funds, all but a few of those replacements were with diesel engines. Farmers are reluctant to purchase electrically driven pumps for several reasons but the high cost of installing infrastructure and unpredictable electricity rates have been the primary deterrents to purchasing electric motor pumps. In addition, farmers usually have to pay substantial fixed charges for electricity even when the electric pump is not used. Because of these issues, most farmers opt for diesel pumps.

A new utility company incentive program coupled with Carl Moyer Program funding provides an opportunity to go electric. Pacific Gas and Electric (PG&E) and Southern California Edison (SCE) have developed a rate-based incentive program that helps make electric motor irrigation pumps cost-competitive with diesel pumps. These new incentive rates, which have been approved by the Public Utility Commission, are structured with the intent to achieve cost parity between owning and operating electrically driven agricultural pumps and diesel pumps capable of equal output. The rates were developed with a diesel price assumption of $1.15 per gallon. The rates are guaranteed to remain fixed (with the exception of a one and one half percent annual increase) until the year 2015. With current diesel prices more than double the assumed $1.15 price, electrically driven pumps should prove a viable economic option to diesel-powered pumps. The PG&E and SCE incentive programs are first-come-first-served programs that are accepting applications through July 31, 2007.

The PG&E and SCE incentive programs also provide funding to partially or fully offset the cost of extending power lines to the pump sites and eliminate the fixed demand charge, so customers do not have to pay a fee for the months that the pump is not operated. Carl Moyer Program funding coupled with the PG&E and SCE incentive programs can provide lower electricity rates, price stability, infrastructure subsidies and waived demand charges, making electric motor pumps a very attractive option.

In order to qualify for the PG&E or SCE incentive program, the applicant must replace an internal combustion engine (excluding those fired with natural gas) used for irrigation pumping which was installed and operational prior to September 1, 2004. In addition, the replaced engine must be destroyed or, if purchased with Carl Moyer Program funds, surrendered, destroyed, relocated or removed as instructed by the ARB and the local air district. ARB staff is proposing that all Tier 1 engines originally funded by the Carl Moyer Program that are replaced through the PG&E or SCE incentive program be destroyed as described in the Administration Chapter (Chapter Two, Part I of the Proposed Carl Moyer Program Guidelines). Staff further proposes that Tier 2 engines currently under Moyer contract be relocated to replace a dirtier engine within the air district; the dirtier engine must then be destroyed. Districts should conduct pre-inspections to ensure the dirtier engine is operational, and post-inspections to ensure that the replacement Tier 2 engine is properly installed and functioning.

Districts may allow the sale of Tier 2 engines that are replaced through the PG&E or SCE incentive program within the district if documentation is provided to establish the chain-of-custody of the engine, and the sale price. If the district allows the sale of Tier 2 engines, all proceeds from the sale must be divided between the applicant and the district based upon the ratio of original funding provided for the purchase of the Tier 2 Moyer engine. Funds returned to the district must be spent on Moyer eligible projects (funds may be used to offset the added cost of the pre- and post-inspections). If the Tier 2 engine cannot be relocated within the district, it must be destroyed.

Because the PG&E and SCE incentive programs are a limited time offer, the ARB staff is proposing to allow pump engines currently under Carl Moyer Program contract to be replaced with electric motors under the incentive programs, with the contract to be revised to reflect the use of an electric motor. The remaining project life of the initially funded engine project would be added to the project life for the new electric motor pump project. The increased project life would be used in the cost-effectiveness calculation, and the contract duration will be increased accordingly.

For replacement agricultural pump engines not currently funded by the Carl Moyer Program, ARB staff proposes to allow applicants to use one-half of the normal rebuild cost for the baseline cost. Normally, Carl Moyer Program participants apply for grants at the time an engine needs to be rebuilt. In these cases, the grower would pay the base rebuild cost, while the Program would fund the incremental cost of a repowering with a newer, cleaner engine. Because the PG&E and SCE incentive programs are a limited time first-come, first-served offer, some growers may choose to replace their engines with an electric motor before the normal rebuild interval for their engine. Because it will be difficult to determine where each individual engine is in its rebuild cycle, ARB staff proposes to assume that all engines taking advantage of the PG&E and SCE incentive programs are halfway through their rebuild cycle – and that the applicant's base cost would be half the rebuild cost.

Carl Moyer Program applicants using the PG&E and SCE incentive programs will also have to make adjustments to the emission reduction calculations. Because to date virtually no electric agricultural pump projects have been funded through Carl Moyer Program grants, the PG&E and SCE incentive programs take credit for the emission reduction between a Tier 3 engine and an electric motor. As a condition of the PG&E and SCE incentive programs, these emission reductions must be donated to the Carl Moyer Program for clean air. The emission reduction benefit between the replaced engine and a Tier 3 engine, may be included in the cost-effectiveness calculation to determine the grant amount. An example of this calculation is provided in Appendix D.

Proposed Project Criteria for Electrically Driven Agricultural Equipment

- Purchases of new 2005 or later model year agricultural equipment can only be electric motors.
- Priority must be given to projects that replace stationary agricultural engines with electric motors.
- Agricultural equipment that use an electric motor may use a default 10 year project life for calculating cost-effectiveness.
- Costs for necessary peripheral equipment associated with the motor (e.g., control panel, motor leads, service pole with guy wire, and connecting electric line) may be included in the grant award amount.
- District match funds may be used for infrastructure purchase and installation.
- District match funds may be used to offset the higher cost of electricity relative to diesel fuel, if applicable. In this case, the fuel cost difference will be accounted for when calculating the cost-effectiveness of the project.
- All electric-driven equipment must have a functioning kilowatt-hour meter, or other method approved by the local air district, to monitor usage.

B. Marine Shore-Side Provided Power

In addition to being the largest source of air pollution in many districts, ports are often situated in environmental justice areas. For these reasons, ports are a primary focus for emission reduction strategies throughout the state. Governor Schwarzenegger has directed state and regional air agencies to work together with the U.S. Environmental

Protection Agency, industry and community stakeholders to address port-related sources of air pollution.

The largest emission source at ports is marine vessels. One strategy for reducing marine vessel emissions is "cold ironing" where ships plug into shore-side power while docked, rather than continuously running their diesel engines to generate electricity. Cold-ironing requires the proper electrical supply connections from the shore — lines, transformers, switching gear, cables, etc. — and the necessary hook-ups on the ship.

Cold ironing, long used for naval vessels, has recently been implemented in the non-military sector in Juneau, Alaska and at the Port of Los Angeles. Four specially-equipped cruise ships plug into shore-side power in Juneau during hotelling operations, while a container vessel plugs in at the electrified berth in Los Angeles. In addition, the Port of Long Beach has begun work to provide dockside electricity to accommodate two retrofitted oil tankers and work has begun in Seattle to convert a berth for cruise ships. Other ports in the U.S. and worldwide are also considering cold-ironing. Early results of ARB's shore-electrification feasibility study indicate that cold-ironing is a cost-effective measure to reduce pollutants from a variety of ships — namely, cruise ships, container ships, and refrigerated bulk ships — at several California ports.

Most marine projects in the Carl Moyer Program deal with harbor craft. Cold ironing projects go beyond harbor craft and include cruise ships, tankers, and freighters. Because cold ironing is a nascent technology, it is difficult to specifically identify the exact components that will be eligible for Carl Moyer Program funding. Because each cold ironing project will be unique, ARB staff is proposing that they be considered for grant funding on a case-by-case basis. The cost-effectiveness and grant amount will depend on a number of issues such as interface compatibility, operating voltage, energy needs and electricity availability at the dock. However, evidence must be submitted to the air district to prove that all emission reductions are surplus, real, quantifiable, and enforceable and the cost-effectiveness limit is not exceeded. Applications will be evaluated based on factors including, but not limited to, frequency and duration of port visitations, energy usage at the dock, seasonal operating variances and regularity of travel routes.

C. Forklifts and Other Large Spark-Ignition Equipment

The Carl Moyer Program has two general emission control strategies for forklifts -- (1) purchase of new electric forklifts instead of new internal combustion engine (ICE) forklifts; and (2) retrofit or repower of internal combustion forklifts that do not lend themselves to electric substitution. Specific project criteria for funding large spark-ignition (LSI) engines are not yet formalized in these proposed Carl Moyer Program Guidelines pending the Board's action in late 2005 on the staff's proposed regulations for LSI engines and equipment. Chapter Six provides additional background discussion on this project category and potential criteria that could be used to establish funding eligibility under the Carl Moyer Program for both strategies. Staff is proposing that until the Board adopts the LSI regulation, districts may continue to fund forklift projects using the 2003 Carl Moyer Program Guidelines. During this interim period, additional zero-emission LSI projects may be considered on a case-by-case basis.

D. Airport Ground Support Equipment

Electric GSE have several attributes that make them appeal to users. Participants of demonstration and fleet conversion programs like the way that electric GSE handle and appreciate the fact that they are more "task specific". Battery weight often provides valuable ballast needed to lift heavy objects or push airplanes; usage is often conducive to charging cycles; there are no odors; and no liquid fuel required in the aircraft staging area. Most importantly, electric GSE can be cost-effective and generally have relatively short payback periods. Electric GSE are commercially available and commonly used for a number of equipment types including belt loaders, baggage tractors, aircraft tugs, lifts, ground power units, cargo loaders, lavatory carts and air-start units. However, the higher capital cost of electric equipment is often a deterrent to prospective buyers. Carl Moyer Program funds can be used to offset this initial capital investment.

As discussed in Chapter Seven, there are currently no regulations requiring the use of electric ground support equipment (GSE) at airports but there is a Memorandum of Understanding that involves five airports in southern California (Los Angeles, Ontario, Orange County, Burbank, and Long Beach). The Carl Moyer Program will fund the purchase of new electric GSE instead of new GSE powered by internal combustion engines if this equipment is surplus to the MOU; is not used to meet the requirements of any regulation, including the upcoming large-spark ignition regulation; is not funded through any other incentive program; and is not used to generate credits of any type.

E. Idling Reduction Technologies

Truck drivers idle their propulsion engines for a number of reasons but the main purpose is for interior climate control -- heating and cooling the cab/sleeper compartment of the truck. A pilot survey on truck idling trends conducted in Northern California indicates that 67 percent of idling is to provide heating and 83 percent for air conditioning [Brodrick et al., 2001]. Therefore, devices capable of providing heating and air conditioning without operating the propulsion internal combustion engine may substantially reduce emissions associated with truck idling. ARB staff proposes such devices be eligible for funding in the Carl Moyer Program.

Idling emissions, as well as fuel consumption, can be reduced by installing an available zero-emission idling control technology such as an on-board non-internal combustion engine device; by using a site-specific off-vehicle technology such as IdleAire; or by combining on and off-vehicle technologies.

Available zero-emission on-vehicle technologies include generators or upgraded alternators coupled with inverter/chargers and electric heating ventilation and air conditioning (HVAC) systems. On-board battery packs or fuel cells are also an option.

Off-vehicle technologies include grid-supplied electricity at truck stops and advanced truck stop electrification (e.g., IdleAire). The use of these devices, in lieu of operating the heavy-duty engine at idle, will result in significant NOx reductions. Reductions in PM and ROG are also expected but to a lesser extent depending on the type of alternative idle reduction device/strategy used.

In October 2005, the Board will consider a proposal that would limit idling of heavy duty trucks equipped with sleeper berths. This proposal would prohibit heavy duty trucks with sleeper berths from idling more than five minutes unless certain conditions are met. If the Board approves the staff recommendations, the baseline for calculating the benefits of truck idle reduction projects would be a certified diesel APU. Zero-emission technologies would be eligible for funding using the lower emission baseline.

1. Idling Reduction Technology Options

Because the vast majority of truck idling occurs away from truck stops, the most effective idle reduction technologies are those that are available to meet operator needs at any location idling occurs. The costs of these technologies vary widely, although the initial capital investment can typically be recovered within one to three years from reduced fuel and maintenance savings. Still, truck owners and operators have not been receptive to these solutions because of their higher initial cost.

Another on-board idle reduction system utilizes electric heating, ventilation, and air conditioning (HVACs) instead of internal combustion engine-driven HVACs. These electric HVACs can be powered directly from the grid, a fuel cell, or from energy stored in battery packs. The battery packs can be charged from the grid, from the truck's alternator, or from a small on-board gen-set. Fuel cells are an emerging zero-emission technology that may also substitute for idling truck engines or auxiliary power units in the future.

ARB staff proposes to continue to help defray the initial cost of equipping the truck with the necessary idle-reducing electric equipment. The Carl Moyer Program would pay up to $5,500 toward electric equipment and up to $3,400 for its installation. In order to be eligible for funding, 75 percent of the applicant's usage must take place within California.

2. Truck Stop Electrification

Installation of electric power infrastructure at truck stops, or truck stop electrification (TSE), is gaining support as an idling reduction strategy. Under this option, trucks would be provided with 110 volt alternating current (AC) electrical power at truck stops to run the electric air conditioning, heating and onboard appliances. The electric supply can also be used to charge on-board batteries for electricity use away from the truck stop. Truck stops would need to be equipped with electrical outlets throughout the parking spaces and trucks would need to be equipped, at a minimum, with inverter/chargers and electrical power connections. If fitted with batteries, the truck could use electricity away from the truck stop. The inverter/charger is used to charge the truck batteries and to convert the truck's 12 volt direct current (DC) batteries to 120 volt AC power for all onboard appliances. Currently, AC power inverters that are built into the truck are offered as a factory option by Freightliner, Volvo and International. The cost for inverter/chargers is approximately $1,400, a 600-700 Ah lead acid battery pack (good for about 8-15 hours of HVAC and appliance operation) costs approximately $8,000.

As discussed above, the Carl Moyer Program would pay up to $5,500 toward electric equipment on-board the truck and up to $3,400 for its installation. TSE infrastructure installation at truck stops costs approximately $2,000 per truck parking space. District matching funds may be used to offset this cost.

3. Advanced Truck Stop Electrification

An alternative to the TSE system that does not need truck modifications has been introduced by IdleAire Technologies. This system provides heating and air conditioning to the truck, as well as electrical power for on-board appliances. It also provides basic services such as telephone and internet access and cable or satellite television. The unit is connected to the truck through a console mounted to the truck window using a template insert. The console contains all the necessary connections and controls, including a card reader for the billing system. The infrastructure cost is approximately $17,000 per parking space but may vary depending on the number of parking spaces installed.

Several advanced truck stop electrification projects have been installed with state and local funding. Staff is proposing to allow Carl Moyer Program funds to be used for installing advanced truck stop electrification systems (e.g., IdleAire systems). In these cases, a partial payment would be made upfront to help offset the initial capital investment. The remainder of the grant amount would be paid out in installments based on system utilization. The amount of the initial payment and subsequent installments will be determined on a case-by-case basis.

The truck idling reduction projects described are just a few of many zero-emission idle reduction strategies. Other technologies and projects may also be eligible for Carl Moyer Program funding on a case-by-case basis. As with all projects, emission reductions must be surplus, real, quantifiable, and enforceable and the project must meet the cost-effectiveness threshold of $14,300 per weighted ton of emission reductions.

F. Transportation Refrigeration Units

Electric standby transportation refrigeration units allow the engine to be turned off when a compatible electric power supply is available to operate the transportation refrigeration unit (TRU). Diesel engine emissions are eliminated while the TRU is plugged in at the facility. TRU manufacturers currently offer an electric standby option on most models but very few trucks operating in the United States – less than one percent of trucks with TRUs – opt for these units. Electric standby TRU models are common in Europe where approximately 90 percent of all truck TRUs have some type of electricity plug-in capability. As currently designed, however, the electric motors are only sized to hold a temperature set point and may not have sufficient power to pre-cool large trailer enclosures. This technology does not reduce emissions when the vehicle is away from an electricity source.

Electrically-driven TRUs could, in the long term, be powered by fuel cells. This would allow the TRU to operate emission-free while enroute or when stopped at a facility, regardless of the availability of electricity. As previously mentioned, fuel cell technology for this application is not currently market-ready.

ARB is proposing to evaluate zero-emission TRU projects on a case-by-case basis. Criteria for other TRU projects are discussed in Chapter Four of the proposed Carl Moyer Program Guidelines.

G. Other Zero-Emission Projects

This chapter addresses some of the most likely zero-emission technology projects. It is by no means a complete list of zero-emission technology projects. Other zero-emission technology projects either require no special consideration (e.g., an internal combustion engine is directly replaced with an electric motor) or are described in the appropriate chapters (e.g., electric TRUs and power plug-in units to reduce locomotive idling). Zero-emission technology projects not specifically addressed in this chapter or elsewhere in the proposed Guidelines may be considered for Carl Moyer Program funding on a case-by-case basis. As with all projects, emission reductions must be surplus, real, quantifiable, and enforceable and the project must meet the cost-effectiveness threshold of $14,300 per weighted ton.

ARB staff will continue to work closely with interested stakeholders to monitor technological developments in effort to determine when it may be appropriate to develop or modify criteria for zero-emission projects. If necessary, ARB will issue advisories to inform prospective applicants and districts of any new policy developments regarding Carl Moyer Program projects using zero-emission technologies.

On September 6, 2005, Governor Schwarzenegger signed Senate Bill 467 (Lowenthal) which requires the ARB to revise the Carl Moyer Program Guidelines to include projects in which an applicant turns in off-road equipment powered by internal combustion engines and replaces that equipment with new zero-emission technologies. This legislation will take effect on January 1, 2006. ARB staff will evaluate how to incorporate the requirements of this legislation into the Carl Moyer Program in 2006.

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THE CARL MOYER PROGRAM GUIDELINES

PART III of IV

AGRICULTURAL ASSISTANCE PROGRAM

Proposed
September 30, 2005

AGRICULTURAL ASSISTANCE PROGRAM

The Agricultural Assistance Program was created through provisions of Assembly Bill 923 (AB 923, Firebaugh) and went into effect on January 1, 2005. This legislation authorizes local districts to increase the motor vehicle registration fee. One of the projects which may be funded with the monies is compliance with emission reduction requirements for previously unregulated agricultural sources of air pollution. Unlike the Carl Moyer Program, the Agricultural Assistance Program does not require the emissions reductions to be surplus. This document presents an overview of the Agricultural Assistance Program, current regulations, potential project types, application requirements, and methodology for calculating the cost-effectiveness of total reductions for a project.

I. Background

Local air districts may impose a surcharge on motor vehicle registration fees (up to $4 per vehicle) for air quality improvement strategies (California Health and Safety Code (HSC) sections 41081 and 44229). In 2004, AB 923 provided districts with the authority to increase the allowable surcharge by up to an additional $2. Districts receiving the additional $2 surcharge may use the funds to implement four specific programs:

- projects funded through the Carl Moyer Program.
- the new purchase, retrofit, repower, or add-on of previously unregulated equipment for agricultural sources.
- school bus purchases through the Lower Emission School Bus Program.
- an accelerated vehicle retirement or repair program.

The Agricultural Assistance Program was created to implement the second program: "the new purchase, retrofit, repower, or add-on of previously unregulated equipment for agricultural sources."

Districts funds from the two dollar surcharge that are applied to the Agricultural Assistance Program may be used to help agricultural operations meet local and state air quality requirements. Qualified projects are eligible for funding for a minimum of three years from the date of adoption of an applicable rule or standard, or until the compliance date of that rule or standard, whichever is later. Eligible projects are not required to provide surplus emission reductions. The emission benefits of projects funded by the Agricultural Assistance Program are already counted in the emission benefits of individual local or state rules. District funds applied to the Agricultural Assistance Program do not count for district match funds in the Carl Moyer Program.

"Agricultural source of air pollution," for the purposes of AB 923 and the Agricultural Assistance Program, is defined in HSC section 39011.5(a) as a source or group of sources used in the production of crops or raising of fowl or animals located on contiguous property and under common ownership or control. Four categories of emission sources are identified as part of this definition:

- confined animal facilities (CAFs).
- internal combustion engines, including portable and off-road engines, unless used to propel instruments of husbandry.
- sources subject to requirements of Title V, the federal Operating Permitting Program for major stationary sources.
- sources of emissions otherwise subject to district regulation.

The statutory provisions of AB 923 also require that Agricultural Assistance Program projects follow the Carl Moyer Guidelines. Proposed project criteria are based on the Carl Moyer Program Guidelines, with modifications to the surplus emission reductions requirements and cost-effectiveness methodology.

II. Statutory and Regulatory Requirements

A. SB 700

In 2003, Senate Bill 700 (SB 700, Florez) amended and added air pollution control requirements in the HSC (sections 39011.5, 39023.3, 40724, 40724.5, 40724.6, 40724.7, 40731, 42301.16, 42301.17, 42301.18, 42310, and 44559.9) to include requirements for agricultural sources of air pollution. Some of the key requirements of this legislation are listed below:

- The legislation created a definition for "agricultural source of air pollution." The definition is provided in the preceeding section of this document.

- The legislation removed language exempting agricultural sources from air quality permits in the HSC in its entirety. As a result, agricultural operations may be required to obtain air permits from local districts.

- The legislation established specific agricultural source permitting and exemption requirements for local districts.

- The legislation required certain districts to adopt by regulation a set of measures to reduce emissions from agricultural sources in federal particulate matter non-attainment areas.

- The legislation required the ARB to establish a definition for a "large" CAF, and required certain districts to adopt rules requiring large CAFs to obtain permits and implement emission mitigation measures.

B. Stationary Diesel Engine ATCM

In February 2004, the Board adopted an air toxics control measure (ATCM) for stationary compression ignition (CI) engines greater than 50 horsepower. The Board amended the ATCM in May 2005. The control measure requires new CI engines for agricultural operations, including those used to repower agricultural equipment, to meet ARB and federal new off-road engine PM certification standards for engines of the same horsepower and model year. The only exception to this requirement is for the installation of Tier 2 engines funds through January 1, 2008 purchased with Carl Moyer Program.

ARB staff is currently working on the development of in-use stationary diesel agricultural engine requirements to be considered by the Board in early 2006.

C. Large Confined Animal Facility Definition

In response to the requirements of SB 700, the Board approved a definition for large CAF on June 23, 2005. The definition (shown in Table 1) is based on headcount of livestock categories and takes into consideration the federal ozone attainment status of districts as well as livestock population and operational practices of facilities. A recordkeeping component requires the owner or operator of a large CAF to keep a daily record of animals at the facility and to submit the information to the local air district consistent with applicable local rules.

Table 1
Large Confined Animal Facility Definition by Livestock Category
(facilities at or exceeding threshold are considered large)

Livestock Category	Non-Attainment Areas*	Attainment Areas*
Dairy	1,000 milk producing cows	2,000 milk producing cows
Beef feedlots	2,500 beef cattle	5,000 beef cattle
Other Cattle Operations	7,500 calves, heifers, or other cattle	15,000 calves, heifers, or other cattle
Chickens – Broilers	650,000	1,300,000
Chickens – Egg Layers	650,000	1,300,000
Turkeys	100,000	200,000
Swine	3,000	6,000
Sheep and Goats	15,000	30,000
Horses	2,500	5,000
Ducks	650,000	1,300,000
Rabbits, Pheasants, Llamas, Others	30,000	60,000

*Federal 1-hour ozone designation as of January 1, 2004

By July 1, 2006, air districts in federal ozone non-attainment areas must adopt rules requiring large CAFs to submit a mitigation plan to reduce air contaminants to the extent feasible. Each air district in a federal ozone attainment area must adopt a similar rule by July 1, 2006, unless its district board makes a finding in a public hearing that large CAFs will not contribute to violations of state or federal standards. Large CAFs have six months from the date of adoption of the district rule to submit their mitigation plans to the district; the districts have an additional six months to approve submitted plans. One year after submitting their plans (July 1, 2008), large CAFs must comply with the requirements of their mitigation plans.

D. Local Air District Rules

Internal combustion engines: Prior to the adoption of SB 700, most air districts specifically exempted agricultural engines from prohibitory rules for stationary IC engines greater than 50 horsepower. As a result, stationary agricultural engine emissions were largely uncontrolled. These districts have amended (or will amend) their internal combustion engine rules to remove the agricultural operation exemption. In these districts, stationary internal combustion engines used in agricultural operations are now required (or will be required) to meet the emission standards/limits, permitting conditions, and compliance requirements of the local district.

Large Confined Animal Facilities: As outlined in the previous section, local air districts in federal ozone non-attainment areas are required to adopt rules developed to mitigate emissions from large CAFs. Local air districts in federal ozone attainment areas are also required to develop rules to mitigate large CAF emissions unless their district boards make a finding in a public hearing that large CAFs will not contribute to violations of state or federal standards. A number of air districts have or are preparing to adopt regulations to meet these requirements.

Fugitive Dust Control: A number of air districts require agricultural operations to reduce fugitive dust emissions through local rules. Local rules for particulate matter dust control generally require agricultural operations to implement a variety of practice-specific options to reduce particulate matter. These practices may include methods to reduce the movement of soil during land preparation, cultivation, and harvesting, suppression of dust on unpaved roads, alternatives to burning, and reduction of agricultural chemical applications.

IV. Potential Projects

The statutory provisions of AB 923 include requirements for Agricultural Assistance Program eligible projects:

- Projects must involve the new purchase, retrofit, repower, or add-on of equipment.
- Projects must reduce emissions from previously unregulated sources; that is, sources that are unregulated as of January 1, 2005 (the effective date of the legislation), but are subject to regulation at the time of the grant.
- Projects must be funded within three years of rule adoption or before the compliance date of the rule, whichever is later.

- The ARB must determine that the applicable rule complies with HSC sections 40913, 40914, and 40915 pertaining to district attainment plan measures. District plans must be designed to achieve and maintain the state ambient air quality standards by the earliest practicable date through the use of all feasible measures. ARB routinely reviews district rules for compliance with these requirements and will treat agriculture-related rules the same way.

Proposed criteria for the Agricultural Assistance Program are adapted from the proposed 2005 Carl Moyer Program Guidelines and are designed to ensure that the emission reductions expected through the deployment of electric motors, reduced-emission engines, or retrofit technologies under this program are real, enforceable, and quantifiable. ARB staff is proposing that all projects must meet a weighted cost-effectiveness of total reductions criterion of $14,300 per weighted ton of pollutants reduced. In addition, at each district's discretion, eligible projects may be subject to funding or cost-effectiveness of total reductions caps. A project must be in operation for at least three years from the time it is first put into operation; ARB may approve a shorter project life on a case-by-case-basis.

A. New Purchase

ARB staff is proposing that the only eligible project for a new agricultural stationary or portable equipment purchase is a new electric motor. For the purposes of determining emission reductions, the new electric motor will be compared to an off-road diesel engine certified to the current off-road emission standards.

B. Repower

1. Repower with Electric Motors

Replacement of uncontrolled or older engines in agricultural operations with electric motors provides significant emission benefits. Diesel and SI engines may be repowered with electric motors. In addition, selected costs for necessary peripheral equipment associated with the motor (e.g., control panel, motor leads, service pole with guy wire, connecting electric line) may be included in determining the grant amount awarded.

In June 2005, the Public Utilities Commission approved a reduced electricity rate and line extension allowance for Pacific Gas and Electric (PG&E) and Southern California Edison (SCE) to be used for conversion of stationary agricultural IC engines to electric. Individuals enrolling in the PG&E and SCE incentive programs may receive funds through the Agricultural Assistance Program for an electric motor replacement of an internal combustion engine. Please refer to Chapter 12: Zero Emission Technologies in the proposed 2005 Carl Moyer Program Guidelines for specific information on these projects.

2. Repower with Emission-Certified Engines

Stationary and portable agricultural engines may be repowered with new off-road engines certified to the current applicable off-road emission standards. This provision applies to repowers with diesel and spark-ignited (SI) engines. Diesel engines may be replaced with cleaner diesel or SI engines. SI engines may only be replaced with cleaner SI engines; projects replacing SI engines with diesel engines are not eligible for Agricultural Assistance Program funding. Cost-effectiveness of total reductions calculations will be based on the rebuild cost of the engine being replaced.

3. Repower with SI Engines Meeting Local District Requirements

Very few SI engines used in stationary and portable applications have been certified to meet applicable emission standards. Because under certain conditions, SI engines can be significantly cleaner than diesel engines, Agricultural Assistance Program funds may be used to fund purchases of non-certified SI engines in some cases. This provision is available until January 1, 2008. This provides two years for engine manufacturers to certify SI engines for agricultural use. Emission reduction calculations will be based on the rebuild cost of the engine being replaced.

Non-certified SI engines purchased through the Agricultural Assistance Program will be required to have best available emission control components, and will be subject to local district source testing and monitoring requirements. The costs associated for testing and monitoring may not be included in the grant award.

C. Retrofit

A retrofit involves modifications to the engine and/or fuel system such that the retrofitted engine does not have the same specifications as the original engine. Retrofit projects that reduce NOx may be applicable to certain diesel or SI engine families. Emission control technologies that have been verified for use to reduce NOx and PM emissions in other applications for on-road or off-road diesel or SI engines may be applicable to stationary and portable agricultural engines. A NOx retrofit for an uncontrolled diesel engine must be verified to reduce emissions to the applicable new engine tier standard or less for a given engine size and not increase particulate matter. An emission-certified stationary or portable engine may use a retrofit kit that is verified to reduce NOx or NOx + non-methane hydrocarbon (NMHC) emissions by at least 15 percent from the applicable emission standard. Uncontrolled SI engines may use a retrofit kit verified to reduce emissions to the currently applicable standard for large SI equipment, or if not feasible, with a retrofit kit verified to reduce emissions to at least 3.0 g/bhp-hr. The emission reductions provided by a retrofit kit must meet local district rule requirements. Emission reduction calculations will be based on the emission rates of the existing engine being retrofitted.

D. Non-Engine Projects

ARB staff propose that the Board direct the Executive Officer to develop project criteria for non-engine agricultural sources where technology is available to ensure the emission reductions are real, quantifiable, and enforceable. However, no specific project criteria are proposed due to the limited data available on specific control technologies. ARB staff will continue to work closely with the districts and interested stakeholders to monitor technological developments to determine when and if it is it appropriate to develop project criteria for non-engine sources.

Agricultural Assistance Program funding will not be available for non-engine agricultural projects until ARB staff develop Carl Moyer Program project criteria for these sources. Potential control technologies and regulatory options will be evaluated for suitability under Agricultural Assistance Program requirements. During these evaluations, ARB staff will consider:

- whether the technology provides real, quantifiable and enforceable emission reductions.
- the availability of standardized testing procedures that will quantify emission reductions from these technologies.
- availability of baseline emission factors.
- potential multi-media issues.

While engines have a statewide certification or verification process to prove the emission levels are achieved in practice, there is no comparable statewide process for stationary or area-wide sources. In developing statewide project criteria for non-engine technology ARB staff will need to consider how to assure reductions are achieved.

If non-engine agricultural projects include reductions of non-combustion PM, the criteria will include a weighting factor for non-combustion PM for use in the cost-effectiveness of total reductions formula.

The following sections provide background on some potential non-engine agricultural projects.

1. Livestock Operations

Air emissions of concern from livestock include ammonia, nitrous oxide, methane, carbon dioxide, volatile organic compounds (VOC), hydrogen sulfide, and particulate matter. The emissions can come from animal housing, storage areas for manure and wastewater, cropland where manure is applied, and directly from the cows. Livestock emissions are most significant in the San Joaquin Valley and the South Coast Air Basin.

The South Coast Air Quality Management District adopted Rule 1127 - Emission Reductions from Livestock Waste in 2004. This rule requires dairies to clear manure from corrals more frequently and send the manure to an emissions-controlled compost facility, an anaerobic digester or to agricultural land where manure is approved for spreading as fertilizer.

The San Joaquin Valley Unified Air Pollution Control District recently adopted a VOC emission factor to be used for permitting San Joaquin Valley dairies. The District reviewed important classes of VOC constituents and key dairy processes individually before approving a total dairy emission factor of 19.3 lbs/year/head. The District will consider regulations to reduce emissions from dairies in the near future.

With the upcoming SB 700 deadlines for approving large CAF mitigation plans, there is a need for a rapid, objective assessment of which technologies are most likely to be successful in California's unique economic, regulatory, and environmental conditions. The Dairy Manure Technology Feasibility Assessment Panel, created and hosted by the ARB, was convened in February 2005 to carry out this work. Members were drawn from government, industry, academia, and environmental and conservation groups.

The Panel evaluated technologies for their potential to reduce environmental impacts resulting from air emissions and from releases of nutrients, salts, and pathogens to the environment. The Panel is assessing the ability of the technology to prevent releases of contaminants and is considering their efficacy in reducing environmental impacts, energy production (if any), economic performance (including saleable products produced by the technology), quality of supporting data, and the development status. The Panel's draft report is scheduled for release in mid-October 2005.

In general, potential technologies may be classified into categories including:

- Thermal conversion (including combustion and gasification).
- Solid-liquid separation (including dehydration).
- Composting.
- Anaerobic digestion.
- Aerators/mixers.
- Nitrification/denitrification.
- Covers.
- Microbials, enzymes, and other additives.
- Feed management.
- Trapping nutrients in biomass (crops, plants in constructed wetlands, algae, fish, etc.).
- Combination systems (such as wastewater treatment plants).

It is likely that no single technology will solve all of the problems associated with dairy manure and each dairy will likely require its own unique combination of technologies to address the specific problems of that area. Research still needs to be done on VOC emissions to quantify amounts emitted from each portion of the dairy, and reactivity of the chemical species to form ozone. Without this information and a lack of standard testing procedures, it is difficult to assess how various technologies will reduce these emissions, reduce ozone formation, and improve air quality.

2. Other Projects

Non-combustion particulate matter reductions can be achieved through the use of chemical dust suppressants, road paving, and harvesting equipment with catch-frame technology to eliminate the need for sweeping. For some of these projects, multimedia impacts must also be considered.

Another potential project is the evaluation of irrigation pump efficiency. Improvement in pump efficiency through parts replacement and repair has the potential for emission reductions of NOx, ROG and PM10 by reduced work by the engine or motor for water output.

V. Proposed Project Criteria

The project criteria below have been designed to provide districts and potential applicants with a list of minimum eligibility requirements for Agricultural Assistance Program funding. Criteria focus on emission reductions, cost-effectiveness of total reductions, and the ability for a project to be completed within the timeframe of the program. Additional information about funding electric motors for irrigation pumps is available in Chapter 12: Zero Emission Technologies of the proposed 2005 Carl Moyer Program Guidelines.

Participating districts retain the authority to impose additional requirements in order to address local concerns.

A. General

- The Agricultural Assistance Program may be used to fund projects from previously unregulated agricultural sources of air pollution for a minimum of three years from the adoption of an applicable rule or until the compliance date, whichever is later. Emission reductions are not required to be surplus.

- Projects must meet a cost-effectiveness of total reductions of $14,300 per weighed ton of NOx + ROG + combustion PM10 reduced calculated in accordance with the cost-effectiveness of total reductions methodology discussed in this chapter.

- No project funded by the Agricultural Assistance Program shall be used for credit under any federal or state emission averaging banking and trading program.

- Agricultural Assistance Program grants can be no greater than a project's incremental cost. The incremental cost is the cost of the project minus the baseline cost. The incremental cost shall be reduced by the value of any current financial incentive that reduces the project price, including tax credits or deductions, grants, or other public financial assistance.

- Projects must have a minimum project life of three years. ARB may approve shorter project life on a case-by-case basis. Projects with shorter lives may be subject to additional funding restrictions, such as a lower cost-effectiveness of total reductions limit or a project cost cap.

- The contract term must extend to the end of the project life.

- Potential projects that fall outside of these criteria may be considered on a case-by-case basis if evidence provided to the air district suggests potential, real, quantifiable, and enforceable emission reduction benefits.

- Air districts must consult with ARB staff to determine eligibility of all projects considered for funding on a case-by-case basis. All projects considered on a case-by-case basis must receive ARB approval prior to receiving program funding.

- An engine must be rated at greater than 25 hp, which is equivalent to an electric motor greater than 19 kW.

- Projects must operate at least 75 percent of total equipment hours in California.

- The default project life when determining project benefits for new purchases or repowers shall be ten years for electric motors. The default project life for engines without documentation shall be seven years. A longer project life may be used with approval by ARB staff, however, sufficient documentation must be provided to ARB that supports the selected project life based on the actual remaining useful life.

B. New Purchase

- Engine purchases for new 2005 or later model year agricultural stationary or portable equipment can only be electric motors.

C. Repower

- A repower of an uncontrolled or emission certified (1996+ model year) diesel engine must be with one of the following:
  - A new electric motor.
  - A new off-road diesel engine certified to the current applicable emission standards.
  - A new off-road spark-ignited (SI) engine certified to the current applicable emission standards.
  - A new SI engine that meets or exceeds local district emission requirements and is subject to and complies with local district permitting, monitoring, record keeping and reporting requirements. This criterion will sunset on January 1, 2008.

- A repower of an uncontrolled SI engine must be with one of the following:
  - A new electric motor.
  - A new off-road SI engine certified to the current applicable emission standards.
  - A new SI engine that meets or exceeds local district emission requirements and is subject to and complies with local district permitting, monitoring, record keeping and reporting requirements. This criterion will sunset on January 1, 2008.

- A repower of an emissions-controlled SI engine must be with one of the following:
  - A new electric motor.
  - A new off-road SI engine certified to the current applicable emission standards.
  - A new SI engine that meets or exceeds local district emission requirements and is subject to and complies with local district permitting, monitoring, record keeping and reporting requirements, provided that the new engine provides a NOx emission reduction of at least 15% from the baseline engine NOx emissions. This criterion will sunset on January 1, 2008.

- Electric motors may replace diesel or SI engines. The applicant must have documentation of payment to the local utility company for power installation. This requirement of documentation also applies to new installations.

- Off-road diesel engines must be certified for sale in California and must comply with durability and warranty requirements.

- The use of a non-certified SI engine shall be subject to approval by ARB staff. Emissions testing of a non-certified SI engine shall be conducted using an ARB-approved source testing procedure, such as ARB Test Method 100.

- Non-certified SI engines shall be required to include currently available emission control components such as closed-loop fuel control systems, and three-way catalysts.

- Non-certified SI engines shall be subject to source testing with an ARB-approved testing procedure following local district requirements.

- Non-certified SI engines shall be subject to NOx and hydrocarbon emission readings using a portable analyzer following local district monitoring requirements.

- The costs associated with source testing and monitoring requirements for non-certified SI engines are not eligible for funding.

D. Retrofit

- A retrofit of an uncontrolled diesel engine that reduces NOx must be with a retrofit kit that is verified to reduce NOx or NOx+NMHC emissions to the applicable new engine Tier standard or less for a given engine size.

- A retrofit of an uncontrolled SI engine that reduces NOx must be with a retrofit kit that is verified to reduce NOx+NMHC emissions to the currently applicable standard for off-road large spark-ignited equipment. If this is not feasible, the project must reduce NOx+NMHC emissions to at least 3.0 g/bhp-hr or less.

- A retrofit of an emission-certified (1996+ model year) off-road diesel engine that reduces NOx must be with a retrofit kit that is verified to reduce NOx or NOx+NMHC emissions by at least 15 percent from the applicable NOx or NOx+NMHC emission standard.

- Reduced-emission retrofit kits must be verified following California test procedures and must comply with durability and warranty requirements.

E. Scrap

- A baseline engine in a repower project must be destroyed by scrapping or drilling a hole in the engine block rendering it inoperable unless prior approval for alternate disposition has been granted by ARB staff.

VI. Cost-Effectiveness of Total Reductions

Projects funded through the Agricultural Assistance Program are not required to achieve surplus emission reductions. The cost-effectiveness calculations used in the Carl Moyer Program are not appropriate for evaluating Agricultural Assistance Program projects because those calculations are based on surplus emission reductions.

In order to ensure that the technologies and costs of projects funded by the Agricultural Assistance Program are generally comparable to those funded by the Carl Moyer Program, ARB staff is proposing to require Agricultural Assistance Program projects to meet a "cost-effectiveness of total reductions" criterion. The cost-effectiveness of total reductions would be determined by subtracting the emissions of the new engine from the emissions of the old engine. Districts may set more restrictive cost-effectiveness of total reductions limits when implementing local programs.

The cost-effectiveness of total reductions is the annualized cost divided by the emission reductions as if no regulatory requirement existed:

$$\frac{\text{Annualized Cost (\$/year)}}{\text{Weighted Emission Reductions if no Regulatory Requirement Existed (tons/yr)}}$$

For example, the cost-effectiveness of total reductions calculations for an agricultural irrigation pump engine would generally assume a project life of seven years, even if a local rule for agricultural use engines takes effect in two years.

The cost-effectiveness of total reductions cannot be compared to the cost-effectiveness of Carl Moyer Program-eligible projects because it includes the total emission reductions associated with a project instead of only the surplus emission reductions.

As described in the proposed 2005 Carl Moyer Program Guidelines the weighted total emission reductions are estimated by taking the sum of the project's annual emission reductions of NOx, ROG, and combustion PM using the following formula:

<u>Weighted Total Emission Reductions</u> = NOx reductions (tons/yr) + ROG reductions (tons/yr) + 20*[combustion PM reductions (tons/yr)]

NOx and ROG emissions are given equal weight; combustion PM is given a greater weighting due to the higher cost of reducing PM emissions.

The annual emission reductions for each pollutant (NOx, ROG, and combustion PM) are determined by calculating the annual emissions for the baseline technology, and then subtracting from it the annual emissions of the reduced technology. Annual emissions may be calculated based on hours of operation or fuel consumption.

<u>Annual Emissions Based on Hours of Operation</u> = Emission Standard (g/bhp-hr) * Engine Horsepower * Load Factor * Activity (hrs/yr) * ton/907,200 g

<u>Annual Emissions Based on Fuel Consumption</u> = Emission Standard (g/bhp-hr) * Energy Consumption Factor (bhp-hr/gal) * Activity (gal/yr) * ton/907,200 g

The emission standards and load factors for off-road diesel engines and large SI engines found in Appendix B of the proposed 2005 Carl Moyer Program Guidelines may be used for these calculations. The energy consumption factor may be calculated: 1) by dividing the horsepower rating of the engine by its fuel economy expressed in units of gallons per hour (gal/hr), or 2) by dividing the energy density of the fuel (in units of BTU/gal) by the brake-specific fuel consumption of the engine. The default energy consumption factor for a stationary agricultural irrigation pump engine greater than 50 hp is 17.56 bhp-hr/gal.

Annualized cost is the amortization of the one-time incentive grant amount for the life of the project to yield an estimated annual cost. The annualized cost is calculated by multiplying the incremental cost by the capital recovery factor (CRF).

<u>Annualized cost</u> ($) = CRF * incremental cost

The CRF is the level of earnings reasonably expected by investing state funds in various financial instruments over the length of an Agricultural Assistance Program project. The CRF uses an interest rate and project life to determine the rate at which earnings could reasonably be expected if the same funds were invested over a length of time equaling the project life. The CRF is calculated following formula:

Capitol Recovery Factor (CRF) = $[(1 + i)^n (i)] / [(1 + i)^n - 1]$

Where
i = discount rate (4%)
n = project life (at least 3 years, see project criteria for default maximums)

The discount rate of 4 percent reflects the prevailing earning potential for state funds that could reasonably be expected by investing state funds in various financial instruments over the length of the minimum project life of Agricultural Assistance Program projects

Table B-1 in Appendix B of the proposed 2005 Carl Moyer Program Guidelines lists the CRF for various project lives using a discount rate of 4 percent.

The incremental cost of a project is calculated by subtracting the cost of the baseline technology from the cost of the reduced technology.

Incremental Cost ($) = Cost of Reduced Technology – Cost of Baseline Technology

Generally, the cost of the baseline technology for a new purchase is the price of a new piece of equipment meeting the current emission standards. The cost of the baseline technology for a repower is the cost of rebuilding the existing engine.

An example of calculating the cost-effectiveness of total reductions is provided below. In this example, a district regulation requires that uncontrolled stationary engines used in agricultural operations must be retired from service by January 1, 2008. The project cannot meet the three year surplus emission reductions requirement for the Carl Moyer Program, but is eligible for funding through the Agricultural Assistance Program.

Example: Engine Repower (diesel to diesel) Based on Hours

Baseline Technology information:
- Baseline Technology (application): 1990 John Deere C 8.3P
- Engine horsepower (application): 285 hp
- Activity (application): 3,000 hours per year
- Load factor (default): 0.65
- Emission Factors: 7.60 g/bhp-hr NOx; 0.82 g/bhp-hr ROG; 0.274 g/bhp-hr PM10
- Baseline rebuild cost (quote provided with application): $4,000

Reduced Technology information:
- Reduced Technology (application): 2005 John Deere 6081HF70-275
- Engine horsepower (application): 275 hp
- Activity (application): 3,000 hr/yr
- Load factor: 0.67

- Emission Factors: 4.15 g/bhp-hr NOx; 0.12 g/bhp-hr ROG; 0.088 g/bhp-hr PM10
- New engine cost (quote provided with application): $22,500

<u>Emission Reduction Calculations:</u>
Annual NOx baseline technology emissions
(7.60 g/bhp-hr * 285 hp * 0.65 * 3,000 hrs)(ton/907,200 g) = 4.65 tons/yr NOx
Annual NOx reduced technology emissions
(4.15 g/bhp-hr * 275 hp * 0.67 * 3,000 hrs)(ton/907,200 g) = 2.53 tons/yr NOx
Annual ROG baseline technology emissions
(0.82 g/bhp-hr * 285 hp * 0.65 * 3,000 hrs)(ton/907,200 g) = 0.50 tons/yr ROG
Annual ROG reduced technology emissions
(0.12 g/bhp-hr * 275 hp * 0.67 * 3,000 hrs)(ton/907,200 g) = 0.07 tons/yr ROG
Annual Combustion PM baseline technology emissions
(0.274 g/bhp-hr * 285 hp * 0.65 * 3,000 hrs)(ton/907,200 g) = 0.168 tons/yr PM10
Annual Combustion PM reduced technology emissions
(0.088 g/bhp-hr * 275 hp * 0.67 * 3,000 hrs)(ton/907,200 g) = 0.054 tons/yr PM10

- NOx emission benefits = 4.65 tons/yr – 2.53 tons/yr = 2.12 tons/yr NOx
- ROG emission benefits = 0.50 tons/yr – 0.07 tons/yr = 0.43 tons/yr ROG
- PM10 emission benefits = 0.168 tons/yr – 0.054 tons/yr = 0.114 tons/yr PM10

Weighted Total Emission Reductions = 2.12 tons/yr + 0.44 tons/yr + 20(0.114 tons/yr)
= 4.84 weighted tons/yr

Project life: 7 years; CRF = 0.167

Incremental Cost = $22,500 - $4,000 = $18,500

Annualized Cost = 0.167 * $18,500 = $3,090/yr

<u>Cost-Effectiveness of Total Reductions:</u>
($/yr)/(weighted tons/yr) = ($3,090)/(4.84 weighted tons/yr)
= $638/tons of weighted emissions reduced

The cost-effectiveness for this project is less than $14,300 per weighted ton of total emissions reduced. This project qualifies for the maximum amount of grant funds requested.

VII. Minimum Project Requirements

A. Application

The minimum application information for stationary and portable agricultural engine projects is in Table 2. Districts may request additional information from the applicant.

Table 2
Minimum Application Information for Stationary and Portable Agricultural Engine Projects
Agricultural Assistance Program

1. Air District: 2. Applicant Demographics Company Name: Business Type: Mailing Address: Location Address: Contact Number: 3. Project Description Project Name: Project Type: Equipment Function: Subject to District Permitting Requirements? (Y/N) 4. NOx Reduction Incremental Cost-Effectiveness of Total Reductions Analysis Basis: (Mileage/Fuel/Hours of Operation) 5. VIN or Serial Number: 6. Application: (Repower, Retrofit or New) 7. Annual Fuel Consumption: 8. Hours of Operation: 9. Old Engine Information Horsepower Rating: Engine Make: Engine Model: Engine Year: 10. New Engine/Motor Information Horsepower Rating: Engine Make: Engine Model: Engine Year: Fuel Type:	11. NOx Emissions Reductions Baseline NOx Emissions Factor (g/bhp-hr): Reduced NOx Emissions Factor (g/bhp-hr): Estimated Annual NOx Emissions Reductions: Estimated Lifetime NOx Emissions Reductions: 12. ROG Emissions Reductions Baseline ROG Emissions Factor (g/bhp-hr): Reduced ROG Emissions Factor (g/bhp-hr): Estimated Annual ROG Emissions Reductions: Estimated Lifetime ROG Emissions Reductions: 13. PM Emissions Reductions Baseline PM Emissions Factor (g/bhp-hr): Reduced PM Emissions Factor (g/bhp-hr): Estimated Annual PM Emissions Reductions: Estimated Lifetime PM Emissions Reductions: 14. Percent Operated in California: 15. Project Life (years): 16. Cost ($) of the Base Engine: 17. Cost ($) of the New Engine/Motor: 18. District Incentive Grant Requested:

A disclosure must also be included stating that once an applicant submits an application for a specific engine to one district or ARB as part of a multi-district solicitation, the owner shall not submit an application to any other source of funds, including, but not limited to, other districts or ARB for the same engine. Any applicant who is found to have submitted multiple applications for the same engine will, at a minimum, be disqualified from funding for that engine from all sources and may also be banned from submitting future applications to any and all Agricultural Assistance Program and Carl Moyer Program solicitations.

Third party applications are not allowed. The equipment owner must sign and agree to the application. However, a third party (e.g. engine dealer or distributor) may complete an application or part of an application on an owner's behalf. Applications must include a signature section for third parties. The third party signature section must include signature and date lines, and blanks for the third party to list how much they are being paid, if anything, to complete the application and what source of funds are being used to pay them. Districts are encouraged to provide technical assistance to applicants in completing the application.

B. Reporting and Monitoring

Owners of stationary and portable agricultural engines participating in the Agricultural Assistance Program are required to keep appropriate records for the life of the project and for three years after the project life is completed. The district has the authority to conduct periodic checks or solicit operating records from the recipient of Agricultural Assistance Program funds. This is to ensure that the engine is being operated as stated in the project application. The recipient must maintain and update operating records throughout the project life and have them available to the district upon request. Annual records must contain, at a minimum, total actual hours of operations or estimated amount of fuel used from actual fuel receipts. Actual hours of operations are acceptable for an engine equipped with a non-reset hour meter.

Monitoring may be required to comply with district requirements and to ensure the program incentives are being applied toward the project as specified in the application. To ease the tracking of the equipment over the life of the project, a district registration certificate may be issued to the equipment owner.

Districts providing Agricultural Assistance Program incentive funds must maintain separate record for projects funded through the Carl Moyer Program and the Agricultural Assistance Program.

VIII. References

CASS 2003. California Agricultural Statistics Service. California Agricultural Statistics, 2003. California Agricultural Overview. http://www.nass.usda.gov/ca/bul/agstat/indexcas.htm

ARB 2005. Air Resources Board. The Carl Moyer Memorial Air Quality Standards Attainment Program Guidelines, Proposed Revision 2005.

THE CARL MOYER PROGRAM GUIDELINES

PART IV

APPENDICES

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APPENDIX A

ACRONYMS

APPENDIX A

ACRONYMS

AAP	Agricultural Assistance Program
AB	Assembly Bill
ABT	Average Banking and Trading
AC	Alternating Current
AECP	Alternative Emission Control Plan
AESS	Automatic Engine Start-Stop
Ah	Amp-hour
APCD	Air Pollution Control District
APCO	Air Pollution Control Officer
APU	Auxiliary Power Unit
AQMD	Air Quality Management District
ARB	California Air Resources Board
ASM	Acceleration Simulation Mode
ATCM	Airborne Toxic Control Measure
ATE	Advanced Travel Center Electrification
AVL	Automatic Vehicle Locator
BACT	Best Available Control Technology
BAR	Bureau of Automotive Repair
bhp	Brake Horsepower
BNSF	Burlington Northern and Santa Fe Railroad
BTU	British Thermal Unit
C/E	Cost Effectiveness
CAF	Confined Animal Facility
CCR	California Code of Regulations
CI	Compression Ignition
CNG	Compressed Natural Gas
CO	Carbon Monoxide
COG	Council of Governments
CRF	Capital Recovery Factor
DC	Direct Current
DDHS	Diesel Driven Heating System
DECS	Diesel Emission Control Strategy
DMV	Department of Motor Vehicles
DOC	Diesel Oxidation Catalyst
DOE	Department of Energy
DPF	Diesel Particulate Filter
E/S	Electric Standby
ECF	Energy Consumption Factor
ECF	Energy Consumption Factor
EF	Emission Factor
EGR	Exhaust Gas Recirculation

EMFAC	ARB's On-Road Motor Vehicle Emission Inventory Model
EMU	Electronic Monitoring Unit
EO	Executive Order
EQIP	Environmental Quality Incentives Program
ERCs	Emission Reduction Credits
ES	Emission Standards
FBC	Fuel-Borne Catalyst
FCF	Fuel Correction Factor
FEL	Family Emission Limit
FTA	Federal Transit Administration
FTF	Flow-Through Filter
FY	Fiscal Year
g	gram
g/bhp-hr	gram per brake horsepower-hour
gal	Gallon
GPS	Geographic Positioning System
GSE	Ground Support Equipment
GTL	Gas-to-Liquid
GVWR	Gross Vehicle Weight Rating
HC	Hydrocarbons
HD	Heavy-Duty
HDDE	Heavy-Duty Diesel Engine
HDT	Heavy-Duty Truck
HDV	Heavy-Duty Vehicle
HEB	Hybrid-Electric Bus
HHDV	Heavy Heavy-Duty Vehicle
hp	Horsepower
hr	Hour
HSC	California Health and Safety Code
HVAC	Heating, Ventilation and Air Conditioning
IC	Internal Combustion
ICE	Internal Combustion Engine
ILD	Idle Limiting Device
IMO	International Maritime Organization
IPI Team	Incentive Program Implementation Team
IRS	Internal Revenue Service
ISO	International Standards Organization
kW	Kilowatt
lbs	Pounds
LETRU	Low Emission Transport Refrigeration Unit
LF	Load Factor
LHD	Light Heavy-Duty
LNG	Liquefied Natural Gas
LPG	Liquefied Propane Gas
LSI	Large Spark Ignited
MDO	Marine Diesel Oil

MGO	Marine Gas Oil
MHDV	Medium Heavy-Duty Vehicle
mi	Mile
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MV Fee	Motor Vehicle Registration Fee
MY	Model Year
NADA	National Automotive Dealership Association
NMHC	Non-Methane Hydrocarbons
NOFA	Notice of Funds Available
NOx	Oxides of Nitrogen
OBD II	On-Road Diagnostics, Phase II
OEM	Original Equipment Manufacturer
PAH	Polycyclic Aromatic Hydrocarbons
PEM	Proton Exchange Membrane
PG&E	Pacific Gas and Electric
PM	Particulate Matter
PM10	Inhalable Particulate Matter
RFP	Request for Proposals
ROG	Reactive Organic Gas
RSD	Remote Sensing Device
SB	Senate Bill
SCAB	South Coast Air Basin
SCAQMD	South Coast Air Quality Management District
SCE	Southern California Edison
SCR	Selective Catalytic Reduction
SIP	State Implementation Plan
SMAQMD	Sacramento Metropolitan Air Quality Management District
SOF	Soluble Organic Fraction
SOFC	Solid Oxide Fuel Cell
SOP	Statement of Principles
SORE	Small Off Road Engine
STB	Surface Transportation Board
STD	Standard
SULEV	Super Ultra Low Emission Vehicle
SUV	Sport-Utility Vehicle
SWCV	Solid Waste Collection Vehicle
TAC	Toxic Air Contaminant
TFV	Transit Fleet Vehicle
THC	Total Hydrocarbon
TIP	Transportation Implementation Plan
tpd	Tons Per Day
TRU	Transport Refrigeration Unit
TSE	Truck Stop Electrification
U.S. EPA	U.S. Environmental Protection Agency
UB	Urban Bus

ULETRU	Ultra Low Emission Transport Refrigeration Unit
ULEV	Ultra Low Emission Vehicle
UP	Union Pacific Railroad
V	Volt
VAVR	Voluntary Accelerated Vehicle Retirement
VIN	Vehicle Identification Number
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compound
VVR	Voluntary Vehicle Repair
yr	Year
ZEB	Zero Emission Bus

APPENDIX B

TABLES FOR EMISSION REDUCTION AND COST-EFFECTIVENESS CALCULATIONS

APPENDIX B

TABLES FOR EMISSION REDUCTION AND COST-EFFECTIVENESS CALCULATIONS

This appendix presents tables summarizing the data needed to calculate the emission reductions and cost-effectiveness of potential projects. Included are data such as engine emission factors, load factors, and other conversion factors used in the calculations discussed in Appendix C: Cost-Effectiveness Calculation Methodology and Appendix D: Example Calculations.

The emission factors in the tables reflect preliminary data developed by ARB staff as part of a comprehensive effort to update the emissions models used for on-road motor vehicles and off-road mobile sources. These draft data were made available on ARB's website in early 2005, but are subject to change as staff completes its analyses and the associated model development. ARB staff will issue Carl Moyer Program Advisories to update the tables as necessary.

ALL PROJECTS

Table B-1
Capital Recovery Factors (CRF) for Various Project Life
At Four Percent Discount Rate

Project Life	CRF
3	0.360
4	0.275
5	0.225
6	0.191
7	0.167
8	0.149
9	0.134
10	0.123
11	0.114
12	0.107
13	0.100
14	0.095
15	0.090
16	0.086
17	0.082
18	0.079
19	0.076
20	0.074

HEAVY-DUTY ON-ROAD VEHICLES

Table B-2
Heavy-Duty Engines 2004-2006 Certified to Optional Standard
Converted Optional Emission Standards
(g/bhp-hr)

EO Certification Level	Converted Emission Standards		
NOx + NMHC	**Diesel NOx**	**Diesel ROG**	**Alternative Fuel NOx**
1.8	1.59	0.09	1.44
1.5	1.33	0.07	1.20
1.2	1.06	0.06	0.96
0.9	0.80	0.04	0.72
0.6	0.53	0.03	0.48
0.3	0.27	0.01	0.24
PM10	**Diesel PM10**		**Alternative Fuel PM10**
0.03	0.023		0.030
0.02	0.015		0.020
0.01	0.008		0.010

Table B-3
Heavy-Duty Alternative Fuel Engines
Converted Emission Standards
(g/bhp-hr)

Model Year	NOx	PM10
1988 – 1989	6.0	0.60
1990	6.0	0.60
1991 – 1993	5.0	0.25
1994 – 1997	5.0	0.10
1998 - September 2002	4.0	0.10
October 2002 – 2006	2.0	0.10
2007	1.2	0.01
2010	0.2	0.01

Table B-4
Medium Heavy-Duty Vehicles 14,001-33,000 lbs GVWR
NOx, ROG, and PM10 Emission Factors
(g/mile)

Model Year	NOx	ROG	PM10
Pre-1984	17.21	0.29	0.792
1984 – 1986	16.65	0.29	0.720
1987 – 1990	14.60	0.18	0.504
1991 – 1993	12.18	0.16	0.288
1994 – 1997	10.70	0.10	0.216
1998 – 2002	9.77	0.08	0.144
2003+	5.39	0.08	0.216
2004 – 2006	5.12	0.08	0.216
2007+	0.51	0.02	0.024

Table B-5
Diesel Heavy Heavy-Duty Vehicles 33,000+ lbs GVWR
NOx, ROG, and PM10 Emission Factors
(g/mile)

Model Year	NOx	ROG	PM10
Pre-1975	26.23	1.65	2.225
1975 – 1976	25.02	1.50	2.002
1977 – 1979	23.72	1.31	1.735
1980 – 1983	22.23	1.08	1.397
1984 – 1986	21.02	0.88	1.123
1987 – 1990	19.72	0.55	0.950
1991 – 1993	18.23	0.45	0.641
1994 – 1997	18.41	0.26	0.475
1998	23.72	0.22	0.281
1999 – 2002	18.51	0.21	0.389
2003 – 2006	13.21	0.22	0.360
2007 – 2009	7.26	0.14	0.040
2010+	1.32	0.06	0.040

Table B-6
Diesel Urban Buses
NOx, ROG, and PM10 Emission Factors
(g/mile)

Model Year	NOx	ROG	PM10
Pre-1987	42.95	1.78	0.929
1987 – 1990	37.39	1.78	0.878
1991 – 1993	23.71	1.75	0.835
1994 – 1995	27.75	1.72	1.015
1996 – 1998	36.43	1.71	1.217
1999 – 2002	18.96	1.71	0.418
2003	9.49	0.73	0.086
2004 – 2006	2.37	0.73	0.086
2007+	0.95	0.73	0.096

Table B-7
Natural Gas Urban Buses
NOx and PM10 Emission Factors
(g/mile)

Model Year	NOx	PM10
1991 – 1993	25.40	0.020
1994 – 1995	11.20	0.020
1996 – 1998	20.00	0.020
1999 – 2002	20.00	0.020
2003	10.00	0.004
2004 – 2006	7.50	0.004
2007+	1.00	0.004

Table B-8
Conversion Factors for NOx, ROG and PM10
Heavy-Duty Vehicle Projects
(bhp-hr/mile)

Model Year	Medium Heavy-Duty Diesel 14,001-33,000 lbs.	Heavy Heavy-Duty Diesel 33,000 lbs. +	Urban Bus 33,000 lbs. +	School Bus
Pre-1978	2.3	2.9	4.3	2.3
1978 – 1981	2.3	2.8	4.3	2.3
1982 – 1983	2.3	2.8	4.3	2.3
1984 – 1990	2.3	2.7	4.3	2.3
1991 – 1995	2.3	2.7	4.3	2.3
1996+	2.3	2.6 [a]	4.3	2.3

a - 2.6 bhp-hr/mile is for all heavy-duty line haul trucks (class 8).

HEAVY-DUTY TRUCK IDLE REDUCTION

Table B-9
Heavy Heavy-Duty Vehicle Idling Emission Factors*
(g/hr)

Model Years	NOx	ROG	PM10
Pre-1975	54.50	186.85	25.30
1975 – 1976	63.45	164.42	21.05
1977 – 1979	74.65	139.65	16.70
1980 – -1983	90.35	111.32	12.11
1984 – 1986	106.00	88.29	8.77
1987 – 1989	121.50	70.42	6.34
1991 – 1993	120.50	65.61	6.11
1994 – 1997	136.00	52.26	4.43
1998	164.50	37.77	2.62
1999-2002	171.00	34.28	2.28
2003	187.00	27.24	1.65
2004 – 2006	191.50	25.56	1.50
2007 – 2009	191.50	25.56	0.83
2010+	191.50	25.56	0.15

*Factors are for truck idling at a RPM >800

Table B-10
Emission Factors for Small Off-Road Diesel Engines
(g/bhp-hr)

Horsepower	Model Year	NOx	ROG	PM10
< 11	Pre-1995	9.30	1.26	0.720
< 11	1995 – 1999	8.70	0.88	0.410
< 11	2000 – 2004	5.76	0.57	0.376
< 11	2005 – 2007	4.14	0.41	0.304
< 11	2008 – 2020	4.14	0.41	0.152
11 - <25	Pre-1995	6.44	1.54	0.550
11 - <25	1995 – -1999	6.44	0.75	0.413
11 - <25	2000 – -2004	5.49	0.54	0.306
11 - <25	2005 – 2007	4.33	0.43	0.306
11 - <25	2008 – 2020	4.33	0.43	0.152

TRANSPORT REFRIGERATION UNITS

Table B-11
TRU Engine Load Factors
(Default Values)

Engine Horsepower	Load Factor
<25 hp	0.64
25 to 50 hp	0.53

OFF-ROAD EQUIPMENT
AND
STATIONARY AND PORTABLE AGRICULTURAL ENGINES

Table B-12
Emission Factors for Off-Road Diesel Engines
(g/bhp-hr)

Horsepower	Tier	NOx	ROG	PM10
25-49	Uncontrolled pre-1988	6.51	2.21	0.547
	Uncontrolled post-1988	6.42	2.17	0.547
	1	5.26	1.74	0.480
	2	4.63	0.29	0.280
	4a	4.55	0.12	0.128
	4b	2.75	0.12	0.008
50-74	Uncontrolled pre-1988	12.09	1.73	0.605
	Uncontrolled post-1988	8.14	1.19	0.497
	1	6.54	1.19	0.552
	2	4.75	0.23	0.192
	4a	2.74	0.12	0.064
	4b	2.74	0.12	0.008
75-99	Uncontrolled pre-1988	12.09	1.73	0.605
	Uncontrolled post-1988	8.14	1.19	0.497
	1	6.54	1.19	0.552
	2	4.75	0.23	0.192
	3	2.74	0.12	0.192
	4a	2.15	0.11	0.008
	4b	0.26	0.06	0.008
100-174	Uncontrolled pre-1970	13.02	1.59	0.554
	Uncontrolled 1970 – 1971	12.09	1.32	0.475
	Uncontrolled 1972 – 1979	11.16	1.20	0.396
	Uncontrolled 1980 – 1984	10.23	1.13	0.396
	Uncontrolled 1985- – 1987	10.23	1.06	0.396
	Uncontrolled post-1987	7.60	0.82	0.274
	1	6.54	0.82	0.304
	2	4.17	0.19	0.128
	3	2.32	0.12	0.112
	4a	2.15	0.11	0.008
	4b	0.26	0.06	0.008
175-299	Uncontrolled pre-1970	13.02	1.52	0.554
	Uncontrolled 1970 – 1971	12.09	1.26	0.475
	Uncontrolled 1972 – 1979	11.16	1.14	0.396
	Uncontrolled 1980 – 1984	10.23	1.08	0.396
	Uncontrolled 1985- – 1987	10.23	1.01	0.396

Horsepower	Tier	NOX	ROG	PM10
	Uncontrolled post-1987	7.60	0.82	0.274
	1	5.93	0.38	0.120
	2	4.15	0.12	0.088
	3	2.32	0.12	0.088
	4a	1.29	0.08	0.008
	4b	0.26	0.06	0.008
300-750	Uncontrolled pre 1970	13.02	1.52	0.533
	Uncontrolled 1970 – 1971	12.09	1.26	0.454
	Uncontrolled 1972 – 1979	11.16	1.14	0.382
	Uncontrolled 1980 – 1984	10.23	1.08	0.382
	Uncontrolled 1985 – 1987	10.23	1.01	0.382
	Uncontrolled post 1987	7.60	0.82	0.274
	1	5.93	0.38	0.120
	2	3.79	0.12	0.088
	3	2.32	0.12	0.088
	4a	1.29	0.08	0.008
	4b	0.26	0.06	0.008
>750	Uncontrolled pre 1970	13.02	1.52	0.533
	Uncontrolled 1970 – 1971	12.09	1.26	0.454
	Uncontrolled 1972 – 1979	11.16	1.14	0.382
	Uncontrolled 1980 – 1984	10.23	1.08	0.382
	Uncontrolled 1985 – 1987	10.23	1.01	0.382
	Uncontrolled post 1987	7.60	0.82	0.274
	1	5.93	0.38	0.120
	2	3.87	0.12	0.088
	4a	2.24	0.12	0.048
	4b	2.24	0.06	0.016

Table B-13
Default Load Factors for Off-Road Heavy-Duty Diesel Engines In Agricultural and Construction Applications

Category	Equipment Type	Load Factor
Agriculture	Agricultural Mowers	0.43
	Agricultural Tractors	0.7
	Balers	0.58
	Combines	0.7
	Hydro Power Units	0.48
	Sprayers	0.5
	Swathers	0.55
	Tillers	0.78
	Irrigation Pumps	0.65
	Other Agricultural Equipment	0.51
Construction	Cranes	0.43
	Crawler Tractors	0.64
	Crushing/Processing	0.78
	Excavators	0.57
	Graders	0.61
	Off-Highway Tractors	0.65
	Off-Highway Trucks	0.57
	Pavers	0.62
	Other Paving Equipment	0.53
	Rollers	0.56
	Rubber-Tired Dozers	0.59
	Rubber-Tired Loaders	0.54
	Scrapers	0.72
	Signal Boards	0.78
	Skid Steer Loaders	0.55
	Surfacing Equipment	0.45
	Tractors/Loaders/Backhoes	0.55
	Trenchers	0.75
	Other Construction Equipment	0.62

LARGE SPARK IGNITION ENGINES

Table B-14
Emission Factors for Off-Road LSI Engines by Model Year
(g/bhp-hr)

Horsepower	Fuel	Model Year	NOx	ROG	PM10
25-49	Gasoline	Uncontrolled – all years	8.01	3.81	0.060
		2001	6.91	3.00	0.060
		2002	5.52	2.37	0.060
		2003	4.52	1.64	0.060
		2004-2006	1.33	0.72	0.060
		2007-2009	0.89	0.48	0.060
		2010+	0.27	0.14	0.060
	Alt Fuel	Uncontrolled – all years	13.00	1.25	0.060
		2001	10.40	1.05	0.060
		2002	7.79	0.84	0.060
		2003	5.19	0.64	0.060
		2004-2006	1.95	0.13	0.060
		2007-2009	1.30	0.08	0.060
		2010+	0.39	0.03	0.060
50-120	Gasoline	Uncontrolled – all years	11.84	2.66	0.060
		2001	9.58	2.11	0.060
		2002	7.32	1.56	0.060
		2003	5.06	1.00	0.060
		2004-2006	1.78	0.26	0.060
		2007-2009	1.19	0.18	0.060
		2010+	0.36	0.05	0.060
	Alt Fuel	Uncontrolled – all years	10.51	1.40	0.060
		2001	8.54	1.16	0.060
		2002	6.56	0.92	0.060
		2003	4.57	0.68	0.060
		2004-2006	1.58	0.14	0.060
		2007-2009	1.05	0.10	0.060
		2010+	0.32	0.03	0.060
>120	Gasoline	Uncontrolled – all years	12.94	1.63	0.060
		2001	10.29	1.35	0.060
		2002	7.64	1.07	0.060
		2003	4.98	0.79	0.060
		2004-2006	1.94	0.16	0.060

Horsepower	Fuel	Model Year	NOx	ROG	PM10
		2007-2009	1.29	0.11	0.060
		2010+	0.39	0.03	0.060
	Alt Fuel	Uncontrolled – all years	10.51	1.25	0.060
		2001	8.53	1.05	0.060
		2002	6.54	0.85	0.060
		2003	4.56	0.64	0.060
		2004-2006	1.58	0.13	0.060
		2007-2009	1.05	0.08	0.060
		2010+	0.32	0.03	0.060

AIRPORT GROUND SUPPORT EQUIPMENT

Table B-15
Default Load Factors and Annual Operating Hours

Equipment	Horsepower	Load Factor	Annual Hours	
			LSI	Diesel
Belt Loader	51-120	0.50	810	1038
Baggage Tug	130-175	0.55	876	1624
Cargo Loaders	51-120	0.50	719	902
A/C Tugs wide body	250-500	0.80	515	759
A/C Tugs narrow body	121-175	0.80	551	606
Lifts	51-120	0.50	376	917
Ground Power Units	120-175	0.75	796	968

LOCOMOTIVES

Table B-16
Locomotive Emission Factors[a]
(g/bhp-hr)

Engine Model Year	Type	NOx	PM10[b]	ROG[b,c]
Pre-1973 (Uncontrolled)	Line-haul	11.70	0.288	0.47
	Switcher	15.66	0.396	0.99
1973-2001 (Tier 0)	Line-haul	7.74	0.288	0.47
	Switcher	11.34	0.396	0.99
2002-2004 (Tier 1)	Line-haul	6.03	0.288	0.47
	Switcher	8.91	0.396	0.99
2005 and later (Tier 2)	Line-haul	4.50	0.153	0.26
	Switcher	6.57	0.189	0.51

a - Emission factors from *U.S. EPA Technical Highlights - Emission Factors for Locomotives*, December 1997, with fuel correction factors (FCF) applied. NOx and PM10 FCFs for all Carl Moyer Program categories is 0.9

b - HC and PM standards are less stringent than actual emission rates. Emission factors reflect actual emission rates per U.S. EPA document cited above.

c - HC to ROG conversion rate = 0.98.

Table B-17
NOx and PM10 Idle-Limiting Device Emission Reduction Factors

Type	Factor
Switchers	0.90
Line-Haul	0.97
Passenger	0.97

Note: Factors based on assumption ILD reduces locomotive engine idling by 50 percent.

MARINE VESSELS

Table B-18
Harbor Craft Propulsion and Auxiliary Engine Emission Factors (g/bhp-hr)

Horsepower	Year	NOx	ROG	PM10
50-99	pre-1988	12.09	1.73	0.605
	1988-2004	8.14	1.19	0.497
	2005+	4.22	0.54	0.320
100-174	pre-1970	13.02	1.59	0.554
	1970-1971	12.09	1.32	0.475
	1972-1979	11.16	1.20	0.396
	1980-1984	10.23	1.13	0.396
	1985-1987	10.23	1.06	0.396
	1988-2003	7.60	0.82	0.274
	2004+	4.17	0.39	0.240[a]
175-299	pre-1970	13.02	1.52	0.554
	1970-1971	12.09	1.26	0.475
	1972-1979	11.16	1.14	0.396
	1980-1984	10.23	1.08	0.396
	1985-1987	10.23	1.01	0.396
	1988-2003	7.60	0.82	0.274
	2004+	4.17	0.39	0.160[b]
300-750	pre-1970	13.02	1.52	0.533
	1970-1971	12.09	1.26	0.454
	1972-1979	11.16	1.14	0.382
	1980-1984	10.23	1.08	0.382
	1985-1987	10.23	1.01	0.382
	1988-2003	7.60	0.82	0.274
	2004+	4.17	0.39	0.160
>750	pre-1970	13.02	1.52	0.533
	1970-1971	12.09	1.26	0.454
	1972-1979	11.16	1.14	0.382
	1980-1984	10.23	1.08	0.382
	1985-1987	10.23	1.01	0.382
	1988-2006	7.60	0.82	0.274
	2007+ (1.2 ≤ D < 5.0[c])	4.17	0.39	0.160
	2007+ (5 ≤ D < 15[c])	4.60	0.44	0.216
	2007+ (15 ≤ D < 20[c])	5.03	0.48	0.400
	2007+ (20 ≤ D < 25[c])	5.77	0.54	0.400
	2007+ (25 ≤ D < 30[c])	6.35	0.59	0.400

a - If engine displacement < 0.9 liters/cyl, PM10 = 0.320 g/bhp-hr; If engine displacement ≥1.2 liters/cyl.,PM10 =0.160 g/bhp-hr.
b – If engine displacement < 1.2 liters/cyl., PM10 = 0.24 g/bhp-hr.
c – Engine displacement in liters per cylinder.

Table B-19
Harbor Craft Load Factors

Engine	Vessel Type	Factor
Propulsion	Commercial Fishing	0.27
	Charter Fishing	0.52
	Ferry/Excursion	0.76
	Crew & Supply	0.45
	Pilot	0.51
	Tow	0.68
	Tug	0.50
	Work	0.45
	Other	0.52
Auxiliary	Tug	0.31
	Other	0.43

Table B-20
Harbor Craft
Fuel Consumption Rate Factors
(bhp-hr/gal)

Engine Displacement	Fuel Consumption Rate
< 5 liters/cylinder	18.5
≥ 5 liters/cylinder	20.8

LIGHT-DUTY VEHICLES

Table B-21
Voluntary Accelerated Light-Duty Vehicle Retirement Program
Emission Reductions for Calendar Year 2006*
Total Pounds Per Vehicle Over 3 Year Credit Life

	Emission Reductions (pounds) – 3 Year Credit Life			
Model Year	**NOx**	**ROG****	**CO**	**PM10**
65 and earlier	151	496	2,757	0.68
66	145	471	2,552	0.67
67	148	477	2,611	0.65
68	156	492	2,731	0.81
69	162	504	2,841	0.56
70	169	438	2,971	0.99
71	172	449	2,990	0.95
72	177	458	3,037	0.83
73	180	469	3,082	0.64
74	159	401	2,859	1.20
75	145	345	2,861	1.17
76	130	222	2,673	1.04
77	108	183	2,546	1.13
78	107	186	2,493	1.10
79	95	168	1,625	0.90
80	85	129	1,373	1.13
81	62	108	1,092	1.22
82	66	101	1,085	1.36
83	73	85	934	1.22
84	73	74	883	1.05
85	69	59	575	0.89
86	71	61	527	0.91
87	67	71	468	0.92
88	67	65	430	0.85
89	50	46	492	0.84
90	38	45	529	0.81
91	38	42	514	0.76
92	40	41	510	0.71
93	35	31	279	0.64
94	19	17	21	0.54

* Table is repeated in the Light-Duty Vehicle Chapter, Table 11-2
** Includes exhaust and evaporative emissions

Source: EMFAC2002, Version 2.2, statewide, annual average. Assumes average 1965 through 2006 vehicle as replacement vehicle for vehicles retired in calendar year 2006.

This table updates the emission reductions provided in ARB's VAVR regulation consistent with the methodology in the staff report, *Proposed Regulations for Voluntary Accelerated Light-Duty Vehicle Retirement Enterprises*, released October 23, 1998, and approved by ARB on December 10, 1998.

REFERENCES

The information in these tables has already been incorporated into the preceding emission factor tables. These tables are included for informational purposes.

Table B-22
NOx and NMHC Fraction Default Values
For All Engines Except TRUs

Diesel Engines		Alternative Fuel Engines	
NOx	NMHC	NOx	NMHC
0.95	0.05	0.80	0.20

Table B-23
NOx and NMHC Fractions for TRUs

Horsepower Category	Model Year	NOx	NMHC
< 25 hp	All	0.80	0.20
25 to 50 hp	2004 and earlier	0.80	0.20
25 to 50 hp	2005 to 2008	0.90	0.10
25 to 50 hp	2008 and later	0.95	0.05

Table B-24
Fuel Correction Factors for On-Road Diesel Engines

		SCAB and Ventura			All Other Areas		
Calendar Year	**Model Year**	**NOx**	**PM10**	**HC**	**NOx**	**PM10**	**HC**
Pre 1985	All	1.00	1.00	1.00	1.00	1.00	1.00
1985 - 1993	All	1.00	0.96	1.00	1.00	1.00	1.00
1994 - 2006	All	0.93	0.75	0.72	0.93	0.75	0.72
2007+	Pre-2007	0.93	0.72	0.72	0.93	0.72	0.72
2007+	2007+	0.93	0.80	0.72	0.93	0.80	0.72

Table B-25
Fuel Correction Factors for California Clean Diesel Fuel (pre-2007) and Ultra Low Sulfur Diesel (post-2007) for Off-Road Diesel Engines

Area	HP Group	Calendar Years	Model Years	NOx	PM10
South Coast and Ventura	All	Pre-1985	All	1.000	1.000
	All	1985-1993	All	1.000	0.950
All	All	Pre-1994	All	1.000	1.000
	<25	1994-2006	Pre-1995	0.930	0.750
			1995+	0.950	0.822
		2007+	Pre-1995	0.930	0.720
			1995-2010	0.948	0.800
	25-50	1994-2006	Pre-1999	0.930	0.750
			1999-2010	0.948	0.822
		2007+	Pre-1999	0.930	0.720
			1999-2010	0.948	0.800
	51-100	1994-2006	Pre-1998	0.930	0.750
			1998-2010	0.948	0.822
		2007+	Pre-1998	0.930	0.720
			1998-2010	0.948	0.800
	101-175	1994-2006	Pre-1997	0.930	0.750
			1997-2010	0.948	0.822
		2007+	Pre-1997	0.930	0.720
			1997-2010	0.948	0.800
	176+	1994-2006	Pre-1996	0.930	0.750
			1996-2010	0.948	0.822
		2007+	Pre-1996	0.930	0.720
			1996-2010	0.948	0.800
	All	2007+	2011+	0.948	0.852

APPENDIX C

COST-EFFECTIVENESS CALCULATION METHODOLOGY

APPENDIX C

COST-EFFECTIVENESS CALCULATION METHODOLOGY

I. Introduction

To receive Carl Moyer Program funding, each project must meet the maximum cost-effectiveness limit of $14,300 per weighted ton of surplus NOx, ROG, and PM10 (PM10 means combustion PM) emissions reduced. Only Carl Moyer Program funding, funding under the district's fiduciary budget authority, or funding provided by a port authority (to meet the match fund requirement) are included in determining the cost-effectiveness of surplus emission reductions. For more details see Part 1, Program Overview and Administrative Requirements, Chapter 2 Administration of the Carl Moyer Program.

II. General Cost-Effectiveness Calculations

The cost-effectiveness of a project is determined by dividing the annual cost of the potential project by the annual weighted surplus emission reductions that will be achieved by the project as shown in formula C-1 below.

Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton):

$$\frac{\textit{Annualized Cost (\$/yr)}}{\textit{Annual Weighted Surplus Emission Reductions (tons/yr)}}$$

Descriptions on how to calculate annual emission reductions and annualized cost are provided in the following sections.

A. Calculating the Annual Weighted Surplus Emission Reductions

Annual weighted emission reductions are estimated by taking the sum of the project's annual surplus pollutant reductions following formula C-2 below. This will allow projects that reduce one, two, or all three of the covered pollutants to be evaluated for eligibility to receive Carl Moyer Program funding. While NOx and ROG emissions are given equal weight; emissions of combustion PM10 (such as diesel exhaust PM10 emissions) has been identified as a toxic air contaminant and thus carry a greater weight in the calculation.

Formula C-2: Annual Weighted Surplus Emission Reductions:

*NOx reductions (tons/yr) + ROG reductions (tons/yr) + [20 * (PM10 reductions (tons/yr)]*

The annual surplus weighted emission reduction result is used to complete formula C-1 to determine the cost-effectiveness of surplus emission reductions.

In order to determine the annual surplus emission reductions by pollutant, formula C-3 below must be completed for each pollutant (NOx, ROG, and PM10), for the baseline technology and the reduced technology, totaling up to 6 calculations:

1. Annual emissions of NOx for the baseline technology
2. Annual emissions of NOx for the reduced technology
3. Annual emissions of ROG for the baseline technology
4. Annual emissions of ROG for the reduced technology
5. Annual emissions of PM10 for the baseline technology
6. Annual emissions of PM10 for the reduced technology

These calculations are completed for each pollutant by multiplying the engine emission factor or converted emission standard by the annual activity level and by other adjustment factors as specified for the calculation methodologies presented.

The **baseline technology** is the technology applied under normal business practices, such as, an engine certified by ARB to the current emission standards for new purchases; or the existing engine in a vehicle or equipment for repowers and retrofits.

The **reduced technology** is the newer technology used by the applicant to obtain surplus emission reductions. The newer technology may be one of the following:

- For a new purchase it would be the engine certified by ARB to reduce NOx emissions by at least 30 percent less than the current NOx emission standard, or certified by ARB to the optional NOx or NOx+NMHC emission standard. Locomotive and marine vessel new purchases have slightly different criteria. Please see the specific source category cost-effectiveness criteria for more information.
- For a repower it would be the replacement engine certified by ARB (for locomotives and marine vessels it would be EPA verified) to a minimum of 15 percent less than the NOx emissions from the baseline technology (existing engine).
- For a NOx retrofit it would be an ARB-verified retrofit technology that will reduce NOx emissions by a minimum of 15 percent from the NOx emissions of the baseline technology.
- For a PM retrofit it would be the ARB-verified diesel emission control strategy (DECS) that reduces PM emissions as level 1 (25 percent reduction), level 2 (50 percent reduction), or level 3 (85 percent reduction).

Since the emission factor or converted standard is given in units of grams, a conversion from grams to tons is also required, as described in formula C-3 below.

Formula C-3: Estimated Annual Emissions by Pollutant (tons/yr):

*Emission Factor or Converted Emission Standard (g/bhp-hr) * Annual Activity * Adjustment Factor(s)* (ton/907,200g)*

The Carl Moyer Program allows the emissions reductions from a project to be calculated using the following activity factors on an annual basis:

- Hours of operation,
- Fuel consumption, or
- Miles traveled.

Specific activity factors allowed for each project category may differ and are identified in the source category chapters of the Carl Moyer Program Guidelines.

1. Calculating Annual Emissions Based on Hours of Operation

When actual annual hours of equipment operation are the basis for determining emission reductions, the equipment activity level must be based on a properly functioning hour meter. (See Part 1, Program Overview and Administrative Requirements, Chapter 2 Administration of the Carl Moyer Program, section VII and the relative source category chapter for additional information on this topic). In addition, the horsepower rating of the engine and an engine load factor found in Appendix B must be used. A default load factor of 0.43 is used for those projects where no specific equipment load factor is available in Appendix B. The method for calculating emission reductions based on hours of operation is described in formula C-4 below.

Formula C-4: Estimated Annual Emissions based on hours of Operation (tons/yr):

*Emission Factor or Converted Emission Standard (g/bhp-hr) * Horsepower * Load Factor* Activity (hrs/yr) * ton/907,200g*

The engine load factor is an indicator of the nominal amount of work done by the engine for a particular application. It is given as a fraction of the rated horsepower of the engine and varies with engine application. For projects in which the reduced technology horsepower exceeds that of the baseline technology horsepower, the load factor must be adjusted following formula C-5 below. It is important to understand the replacement load factor must never exceed 100 percent in cases where the replacement engine is significantly smaller than the existing engine.

Formula C-5: Replacement Load Factor:

$$\text{Load Factor}_{baseline} * hp_{baseline}/hp_{reduced}$$

2. Calculating Annual Emissions Based on Fuel Consumption

When annual fuel consumption is used for determining emission reductions, the equipment activity level must be based on annual fuel usage within California provided by the applicant. Fuel records must be maintained by the engine owner as described in Part 1, Program Overview and Administrative Requirements, Chapter 2 Administration of the Carl Moyer Program, section VII.

An energy consumption factor (ECF) must be used to convert emissions given in g/bhp-hr to units of grams of emissions per gallon of fuel used (g/gal). The ECF is a number that combines the effects of engine efficiency and the energy content of the fuel used in that engine into an approximation of the amount of work output by an engine for each unit of fuel consumed. Formula C-6 below is the formula for calculating annual emissions based on annual fuel consumed.

Formula C-6: Estimated Annual Emissions based on Fuel Consumed using Emission Factors or Converted Emission Standard (tons/yr):

*Emission Factor or Converted Emission Standard (g/bhp-hr) * ECF (hp-hr/gal) * Activity (gal/yr) * ton/907,200g*

For on-road projects, if the emission factor is in g/mile, a unit conversion factor (bhp-hr/mile) found in Table B-8 in Appendix B must be used to convert from g/mile to g/bhp-hr. This is completed by dividing the emission factor (g/mile) by the conversion factor (bhp-hr/mile) resulting in (g/bhp-hr). Formula C-7 below is used to calculate annual emissions for fuel based on-road calculations.

Formula C-7: Estimated Annual Emissions based on Fuel Consumed using On-Road Emission Factors (tons/yr):

*[On-Road Emission Factor (g/mile)/Unit Conversion Factor (bhp-hr/mile)] * ECF (hp-hr/gal) * Activity (gal/yr) * ton/907,200g*

3. Calculating Annual Emissions Based on Annual Miles Traveled

Calculations based on annual miles traveled are only used for on-road projects. Mileage records must be maintained by the engine owner as described in Part 1, Program Overview and Administrative Requirements, Chapter 2 Administration of the Carl Moyer Program, section VII and the relative source category chapter.

<u>Calculations Using Emission Factors:</u> There is no conversion since the emission factors for on-road projects provided are given in units of g/mile. Formula C-8 describes the method for calculating pollutant emissions based on emission factors and miles traveled.

Formula C-8: Estimated Annual Emissions based on Mileage using Emission Factors (tons/yr):

*Emission Factor (g/mile) * Activity (miles/yr) * ton/907,200g*

<u>Calculating Annual Emissions Based on Converted Standards</u>: The unit conversion factor found in Table B-8 in Appendix B is used to convert the units of the converted emission standard (g/bhp-hr) to g/mile. Formula C-9 describes the method for calculating pollutant emissions using converted emission standards.

Formula C-9: Estimated Annual Emissions based on Mileage using Converted Emission Standards (tons/yr):

*Converted Emission Standard (g/bhp-hr) * Unit Conversion (bhp-hr/mile) * Activity (miles/yr) * ton/907,200g*

4. Calculating Annual Surplus Emission Reductions by Pollutant

The final step in this portion of the calculations is to determine the annual surplus emission reductions by pollutant. For new purchases and repower projects, subtract the annual emissions for the reduced technology from the annual emissions for the baseline technology following formula C-10 below.

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases:

Annual Emissions for the Baseline Technology – Annual Emissions for the Reduced Technology

For retrofits, multiply the baseline technology pollutant emissions by the percent of emission reductions that the ARB-verified reduced technology is verified to following formula C-11 below.

Formula C-11: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Retrofits:

*Annual Emissions for the Baseline Technology * Reduced Technology Verification Percent*

Calculations must be done for each pollutant, NOx, PM10, and ROG, giving a total of three calculations.

For a repower + retrofit calculation the baseline to be used for the retrofit portion of the calculation will be the repower's reduced technology emissions. For fleet modernization projects the baseline will be the newer vehicle emissions.

The annual surplus emission reductions by pollutant would be used in Formula C-2 to calculate the annual surplus emission reductions.

B. Determining the Annualized Cost

Annualized cost is the amortization of the one-time incentive grant amount for the life of the project to yield an estimated annual cost. The annualized cost is calculated by multiplying the incremental cost by the capital recovery factor (CRF). The resulting annualized cost is used to complete formula C-12 to determine the cost-effectiveness of surplus emission reductions.

Formula C-12: Annualized Cost ($):

*CRF * incremental cost ($)*

1. Calculating the CRF

The CRF is the level of earnings reasonably expected by investing state funds in various financial instruments over the length of a Carl Moyer Program project. The CRF uses an interest rate and project life to determine the rate at which earnings could reasonably be expected if the same funds were invested over a length of time equaling the project life. The CRF is calculated following formula C-13 below.

Formula C-13: Capitol Recovery Factor (CRF):

$$[(1 + i)^n (i)] / [(1 + i)^n - 1]$$

Where
i = discount rate (4 percent)
n = project life (at least 3 years see specific project criteria for default maximums)

The discount rate of 4 percent reflects the prevailing earning potential for state funds that could reasonably be expected by investing state funds in various financial instruments over the length of the minimum project life of Carl Moyer Program projects

Table B-1 in Appendix B lists the CRF for various project lives using a discount rate of 4 percent. Use the result from formula C-13 to complete formula C-12 to determine the annualized cost of a project.

2. Calculating the Incremental Cost

The incremental cost is determined by subtracting the cost of the baseline technology from the cost of the reduced technology, as described in formula C-14 below.

Formula C-14: Incremental Cost ($):

Cost of Reduced Technology ($) – Cost of Baseline Technology ($)

Generally the cost of the baseline technology for a new purchase is the price of a new piece of equipment meeting the current emission standards. The cost of the baseline technology for a repower is the cost of rebuilding the existing engine. For retrofits, there is no baseline technology cost; hence the entire cost of the retrofit is eligible for funding.

For fleet modernization projects, the incremental cost is determined by adjusting the value given to the vehicle by the National Automotive Dealership Association (N.A.D.A.), as described in formula C-15 below.

Formula C-15: Incremental Cost for Fleet Modernization Projects ($):

When the replacement vehicle is not new:

N.A.D.A value

where the N.A.D.A value is the retail value of the used vehicle * 72 percent.

When the replacement vehicle is new:

*Invoice of the New Vehicle * 80 percent*

Use the results from formula C-14 or C-15 to complete formula C-12 to determine the annualized cost of a project.

III. List of Formulas

For an easy reference, the necessary formulas to calculate the cost-effectiveness of surplus emission reductions for a project funded through the Carl Moyer Program are provided below.

Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton):

$$\frac{\text{Annualized Cost (\$/yr)}}{\text{Annual Weighted Surplus Emission Reductions (tons/yr)}}$$

Formula C-2: Annual Weighted Surplus Emission Reductions:

NOx reductions (tons/yr) + ROG reductions (tons/yr) + [20 * PM10 reductions (tons/yr)]

Formula C-3: Estimated Annual Emissions by Pollutant (tons/yr):

Emission Factor or Converted Emission Standard (g/bhp-hr) * Annual Activity * Adjustment Factor(s)* (ton/907,200g)

Formula C-4: Estimated Annual Emissions based on hours of Operation (tons/yr):

Emission Factor or Converted Emission Standard (g/bhp-hr) * Horsepower * Load Factor* Activity (hrs/yr) * ton/907,200g

Formula C-5: Replacement Load Factor:

$$\text{Load Factor}_{\text{baseline}} * \text{hp}_{\text{baseline}}/\text{hp}_{\text{reduced}}$$

Formula C-6: Estimated Annual Emissions based on Fuel Consumed using Emission Factors or Converted Emission Standard (tons/yr):

Emission Factor or Converted Emission Standard (g/bhp-hr) * ECF (hp-hr/gal) * Activity (gal/yr) * ton/907,200g

Formula C-7: Estimated Annual Emissions based on Fuel Consumed using On-Road Emission Factors (tons/yr):

[On-Road Emission Factor (g/mile)/Unit Conversion Factor (bhp-hr/mile)] * ECF (hp-hr/gal) * Activity (gal/yr) * ton/907,200g

Formula C-8: Estimated Annual Emissions based on Mileage using Emission Factors (tons/yr):

Emission Factor (g/mile) * Activity (miles/yr) * ton/907,200g

Formula C-9: Estimated Annual Emissions based on Mileage using Converted Emission Standards (tons/yr):

Converted Emission Standard (g/bhp-hr) * Unit Conversion Factor (bhp-hr/mile) * Activity (miles/yr) * ton/907,200g

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases:

Annual Emissions for the Baseline Technology – Annual Emissions for the Reduced Technology

Formula C-11: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Retrofits:

Annual Emissions for the Baseline Technology * Reduced Technology Verification Percent

Formula C-12: Annualized Cost ($):

CRF * incremental cost ($)

Formula C-13: Capitol Recovery Factor (CRF):

$$[(1 + i)^n (i)] / [(1 + i)^n - 1]$$

Where i = discount rate (4 percent) and n = project life (at least 3 years see specific project criteria for default maximums)

Formula C-14: Incremental Cost ($):

Cost of Reduced Technology ($) – Cost of Baseline Technology ($)

Formula C-15: Incremental Cost for Fleet Modernization Projects ($):

When the replacement vehicle is not new:

N.A.D.A value

where the N.A.D.A value is the retail value of the used vehicle * 72 percent.

When the replacement vehicle is new:

Invoice of the New Vehicle * 80 percent

APPENDIX D

EXAMPLE CALCULATIONS

APPENDIX D

EXAMPLE CALCULATIONS

TABLE OF CONTENTS

I. On-Road Heavy-Duty Vehicles

This section provides several examples of calculations for determining the cost-effectiveness of surplus emission reductions for on-road projects.

A. General Criteria for On-Road Cost-Effectiveness Calculations

- Funded projects must have a minimum project life of 3 years. Project life is the number of years that a Carl Moyer Program project will operate in California under the conditions specified in the grant funding agreement.

- The default project life for on-road projects are as follows:

School buses ≥ 33,000 GVWR - New	20 years
Buses ≥ 33,000 GVWR - New	12 years
Other On-Road - New	10 years
Repowers + Retrofits	5 years
Retrofits	5 years

  Applicants must provide documentation to justify a longer project life.

- Only the minimum verified levels of NOx and PM10 emission reductions will be used to calculate cost-effectiveness for retrofit projects.

- In these calculations, PM10 refers to combustion particulate matter.

- ROG reductions cannot be counted in projects where the new engine or retrofit device are not verified or certified for ROG.

- When the model year of the vehicle chassis and the model year of the existing engine are different, the newer of the two model years, either the vehicle or the engine, shall be used to determine the baseline emissions for calculations.

- When calculating the baseline emissions for a glider kit repower project, the baseline for the project is the chassis year or the old engine model year, whichever is newer.

- The incremental emission difference between the lower FEL level to the required emission standard cannot be used for the purpose of calculating Carl Moyer Program emission benefits. The maximum amount of emission reduction that can be claimed is the difference between the applicable required emission standard for the replacement engine (not the FEL level) and the baseline emission level of the existing engines.

- Most on-road calculations will be based on mileage. Refuse haulers and street sweepers may have fuel based calculations if fuel receipts can be provided to document previous usage. Other vehicles may also use fuel based calculations on a case-by-case basis.

- Refuse vehicles and street sweepers often have two engines, one for motive power and one for auxiliary operations. Emission benefits are calculated individually for each engine using fuel consumption rates for each unit if available. If individual engine fuel consumption information is not available, the applicant must provide and document an estimate for the typical activities of each engine based on best engineering judgment so that emissions can be determined. Factors such as fuel economy, typical operating loads, and hours of operation for each engine must be provided.

- Table D-1 provides the source of emission factors to be used in on-road cost-effectiveness calculations.

Table D-1
On-Road Heavy-Duty Vehicle Calculations
Source of Emission Factors

	New		**Repower**		**Retrofit**	
Vehicle Type	**Baseline Factor**	**Reduced Factor**	**Baseline Factor**	**Reduced Factor**	**Baseline Factor**	**Reduced Factor**
Medium Heavy Duty Vehicle	B-4	B-2 or B-3	B-3 or B-4	B-3 or B-4	B-4	% verified as shown on Executive Order
Heavy Duty Vehicle	B-5	B-2 or B-3	B-3 or B-5	B-3 or B-5	B-5	% verified as shown on Executive Order
Urban Bus (Alternative Fuel)	B-7	B-2 or B-3	B-7	B-7	B-7	% verified as shown on Executive Order
Urban Bus (Diesel)	B-6	B-2 or B-3	B-6	B-6 or B-7	B-6	% verified as shown on Executive Order

- The energy consumption factor to be used for all on-road fuel based calculations is 18.5 bhp/hr-gal.

- The baseline cost for retrofit projects is zero ($0). The full cost of a retrofit is potentially eligible for funding.

- For retrofit projects that only take credit for NOx reductions from a Level 3 DECS (because the PM10 reductions are required by regulation) the baseline cost is $8,000, unless the applicant documents a lower cost. The maximum funding for such projects would be the retrofit cost minus the default cost.

- Applicants may claim ROG emission reductions from DECS if hydrocarbon emission reductions for that technology are obtained from the ARB's retrofit website at: http://www.arb.ca.gov/diesel/verdev/verdev.htm. For the Carl Moyer Program, ROG emission reductions will be credited at the 25 percent, 50 percent, and 85 percent reduction levels. To calculate emission reductions of ROG for the Carl Moyer Program, applicants should use the percentage reduction of hydrocarbons from the ARB's retrofit website to determine the appropriate "level" of emission reductions. For example, a technology that provides a 40 percent emission reduction of hydrocarbons would be permitted to apply a 25 percent reduction in ROG emissions for determining eligibility and grant amount in the Carl Moyer Program.

- Although electronic monitoring units are not required by the ARB, when an EMU is required by a district, it is an eligible expense for any category.

- FTA provides up to an 80 percent grant for new urban bus purchases. For these projects the incremental cost would be the difference between the FTA grant amount and the cost of the reduced technology or baseline technology.

- The cost of alternative fuel projects must be based on the total amortized cost of hardware (i.e., new engine or repower), and fuel, if applicable.

- If all Carl Moyer Program criteria are met and the project is not a "fuel-only" project, the incremental cost of alternative fuel can be considered a qualified matching contribution from a district.

B. Examples

Example 1 – New Purchase of LNG Heavy-Duty Truck

A trucking company proposes to purchase a new 2005 model year heavy heavy-duty truck equipped with a LNG engine certified to the optional standard of 1.8 g/bhp-hr NOx + NMHC instead of a new heavy heavy-duty truck equipped with a diesel engine. This vehicle operates 100 percent of the time in California.

<u>Baseline Technology Information</u>:

- Baseline technology (application): 2005 diesel heavy heavy-duty on road truck
- Cost (quote provided with application): $180,000
- New diesel vehicle emission rates (Table B-5): 13.21 g/mi NOx, 0.22 g/mi ROG, 0.360 g/mi PM10
- Activity (application): 100,000 mi/yr
- Percent operate in California (application): 100 percent

<u>Reduced Technology Information</u>:

- Reduced technology (application): 2005 heavy-duty LNG truck
- Cost (quote provided with application): $220,000
- New LNG vehicle emission standard (Table B-2): 1.44 g/bhp-hr NOx, 0.030 g/bhp-hr PM10

- Conversion factor to convert g/bhp-hr to g/mi (Table B-8): 2.6 bhp-hr/mi

Emission Reduction Calculations:
Formula C-8: Estimated Annual Emissions based on Mileage using Emission Factors (use for baseline calculations)

Formula C-9: Estimated Annual Emissions based on Mileage using a Converted Emission Standards (use for reduced calculations)

1. Annual NOx baseline technology emissions
   (13.21 g/mi * 100,000 mi/yr)(ton/907,200 g) = 1.46 tons/yr NOx
2. Annual NOx reduced technology emissions
   (1.44 g/bhp-hr * 2.6 bhp-hr/mi * 100,000 mi/yr)(ton/907,200 g)
   = 0.41 tons/yr NOx
3. Annual PM10 baseline technology emissions
   (0.360 g/mi * 100,000 mi/yr)(ton/907,200 g) = 0.04 tons/yr PM10
4. Annual PM10 reduced technology emissions
   (0.030 g/bhp-hr * 2.6 bhp-hr/mi * 100,000 mi/yr)(ton/907,200 g)
   = 0.009 tons/yr PM10

ROG emission factors not available for reduced technology therefore ROG emission reductions cannot be calculated.

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases

- NOx emission benefits = 1.46 tons/yr – 0.41 tons/yr = 1.05 tons/yr NOx
- PM10 emission benefits = 0.040 tons/yr – 0.009 tons/yr = 0.031 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
1.05 + 20(0.031) = 1.67 weighted tons/yr

Annualized Cost:
Project Life: 10 years
CRF (Table B-1) = 0.123

Formula C-14: Incremental Cost
$220,000 -$180,000 = $40,000

Formula C-12: Annualized Cost
$40,000 * 0.123 = $4,920/yr

Cost-Effectiveness:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
($4,920/yr)/(1.67 weighted tons/yr)
= $2,946/ton of weighted surplus emissions reduced

The weighted cost-effectiveness for the example is less than $14,300 per ton of pollutants reduced. This project qualifies for the maximum amount of grant funds requested.

Example 2 – Diesel to Diesel Heavy-Duty Truck Repower + Retrofit

A line haul trucking company proposes to repower a 1994 heavy heavy-duty diesel truck with a model year 2003 certified diesel engine and retrofit the engine with a Level 3 retrofit that is verified for both PM10 and NOx reductions. This vehicle operates 90 percent of the time in California.

Baseline Technology Information:
- Baseline technology (application): 1994 diesel heavy heavy-duty engine
- Cost rebuild (quote provided with application): $8,000
- Baseline cost of retrofit: $0
- Emission rates (Table B-5): 18.41 g/mi NOx, 0.26 g/mi ROG, 0.475 g/mi PM10
- Activity (application): 60,000 mi/yr
- Percent operated in California (application): 90 percent

Reduced Technology Information:
- Reduced technology (application): 2003 diesel heavy heavy-duty engine
- Repower cost (quote provided with application): $35,000
- Retrofit cost (quote provided with application): $18,000 + $600 annual filter maintenance
- Emission rates (Table B-5): 13.21 g/mi NOx, 0.22 g/mi ROG, 0.360 g/mi PM10
- Retrofit verification emission levels (EO): 25 percent reduction of NOx and 85 percent reduction of PM10. ROG is not counted since the retrofit device is not verified for ROG.

Emission Reduction Calculations:
Formula C-8: Estimated Annual Emissions based on Mileage using Emission Factors
1. Annual NOx baseline technology emissions
   (18.41 g/mi * 0.90 * 60,000 mi/yr)(ton/907,200 g) = 1.10 tons/yr NOx
2. Annual NOx reduced technology emissions
   (13.21 g/mi * 0.90 * 60,000 mi/yr)(ton/907,200 g) = 0.79 tons/yr NOx
3. Annual ROG baseline technology emissions
   (0.26 g/mi * 0.90 * 60,000 mi/yr)(ton/907,200 g) = 0.02 tons/yr ROG
4. Annual ROG reduced technology emissions
   (0.22 g/mi * 0.90 * 60,000 mi/yr)(ton/907,200 g) = 0.01 tons/yr ROG
5. Annual PM10 baseline technology emissions
   (0.475 g/mi * 0.90 * 60,000 mi/yr)(ton/907,200 g) = 0.028 tons/yr PM10

6. Annual PM10 reduced technology emissions
   (0.360 g/mi * 0.90 * 60,000 mi/yr)(ton/907,200 g) = 0.021 tons/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases

- NOx emission benefits = 1.10 tons/yr – 0.79 tons/yr = 0.31 tons/yr NOx
- ROG emission benefits = 0.02 tons/yr – 0.01 tons/yr = 0.01 tons/yr ROG
- PM10 emission benefits= 0.028 tons/yr – 0.021 tons/yr = 0.007 tons/yr PM10

Formula C-11: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Retrofits

0.79 tons/yr NOx * 0.25 = 0.20 tons/yr NOx
0.021 tons/yr PM10 * 0.85 = 0.018 tons/yr PM10

Total NOx Emission Benefits

0.31 + 0.20 = 0.51 tons/yr NOx

Total PM10 Emission Benefits

0.007 + 0.018 = 0.025 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions

0.51 + 0.01 + 20(0.025) = 1.02 weighted tons/yr

Annualized Cost:
Project Life: 5 years
CRF (Table B-1) = 0.225

Formula C-14: Incremental Cost

($35,000 + $18,000 + ($600*5) -$8,000 = $48,000

Formula C-12: Annualized Cost

$48,000 * 0.225 = $10,800/yr

Cost-Effectiveness:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)

($10,800/yr)/(1.02 weighted tons/yr) =
$10,588/ton of weighted surplus emissions reduced

The cost-effectiveness for the example is less than $14,300 per ton of weighted pollutants reduced. This project qualifies for the maximum amount of grant funds requested.

Example 3 – Diesel Heavy-Duty Truck Retrofit
A trucking company proposes to retrofit a 2005 heavy heavy-duty diesel truck with a Level 3 retrofit that is verified for both PM and NOx reductions. This vehicle operates 80 percent of the time in California.

Baseline Technology Information:
- Baseline technology (application): 2005 heavy heavy-duty diesel truck
- Cost (retrofits are eligible for full cost unless being installed to meet regulatory requirements): $0
- New diesel vehicle emission rates (Table B-5): 13.21 g/mi NOx; 0.360 g/mi of PM10
- Activity (application): 100,000 mi/yr
- Percent operated in California (application): 80 percent

Reduced Technology Information:
- Retrofit verification emission levels (EO): 25 percent reduction of NOx and 85 percent reduction of PM10. ROG is not counted since the retrofit device is not verified for ROG.
- Retrofit cost (quote provided with application): $18,000 + $600 annual filter maintenance

Emission Reduction Calculations:
Formula C-8: Estimated Annual Emissions based on Mileage using Emission Factors
1. Annual NOx baseline technology emissions
   (13.21 g/mi * 0.80 * 100,000 mi/yr)(ton/907,200 g) = 1.16 tons/yr NOx
2. Annual PM10 baseline technology emissions
   (0.360 g/mi * 0.80 * 100,000 mi/yr)(ton/907,200 g) = 0.032 tons/yr PM10

Formula C-11: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Retrofits
1.16 * 0.25 = 0.29 tons/yr NOx
0.032 * 0.85 = 0.027 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
0.29 + 0 + 20(0.027) =0.83 weighted tons/yr

Annualized Cost:
Project Life: 5 years
CRF (Table B-1): = 0.225

Formula C-14: Incremental Cost
($18,000 + ($600*5) -$0 = $21,000

Formula C-12: Annualized Cost
0.225 * 21,000 =$4,725/yr

Cost-Effectiveness:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
($4,725/yr)/(0.83 weighted tons/yr) =
$5,693/ton of weighted surplus emissions reduced

For retrofit projects that only take credit for NOx reductions from a Level 3 DECS (because the PM reductions are required by regulation) the baseline cost is $8,000, unless an applicant documents a lower cost. The maximum funding for such projects would be the retrofit cost minus the default cost.

The cost-effectiveness for the example is less than $14,300 per ton of pollutants reduced. This project qualifies for the maximum amount of grant funds requested.

Example 4 –Purchase of a New CNG Street Sweeper

A company proposes to purchase a new CNG street sweeper instead of a diesel sweeper. The GVWR of the new vehicle is 24,000 lbs. The CNG engine is certified to the optional emission standard of 1.2 g/bhp-hr for NOx+NMHC and 0.01 g/bhp-hr for PM10. This vehicle operates 100 percent of the time in California.

Baseline Technology Information:
- Baseline technology (application): 2005 heavy heavy-duty diesel vehicle
- Cost (quote provided with application): $125,000
- New diesel vehicle emission rates (Table B-5): 5.12 g/mi NOx, 0.08 g/mi ROG, 0.216 g/mi PM10
- Conversion factor to convert g/mile to g/bhp-hr (Table B-8): 2.3 bhp-hr/mi
- Energy consumption factor: 18.5 bhp-hr/gal
- Activity (application): 5,000 gal/yr
- Percent operated in California (application): 100 percent

Reduced Technology Information:
- Reduced technology (application): 2005 heavy heavy-duty CNG vehicle
- Cost (quote provided with application): $160,000
- New CNG vehicle emission standard (Table B-2): 0.96 g/bhp-hr NOx, 0.01 g/bhp-hr PM10
- Energy consumption factor: 18.5 bhp-hr/gal

Emission Reduction Calculations:

Formula C-7: Estimated Annual Emissions based on Fuel Consumed using On-Road Emission Factors (tons/yr)

1. Annual NOx baseline technology emissions
   (5.12 g/mi / 2.3 bhp-hr/mi)(5,000 gal/yr)(18.5 bhp-hr/gal)(ton/907,200 g)
   = 0.23 tons/yr NOx
2. Annual PM10 baseline technology emissions
   (0.216 g/mi / 2.3 bhp-hr/mi)(5,000 gal/yr)(18.5 bhp-hr/gal)(ton/907,200 g)
   = 0.01 tons/yr PM10

Formula C-6: Estimated Annual Emissions based on Fuel Consumed using Emission Factor or Converted Emission Standards (tons/yr)

3. Annual NOx reduced technology emissions
   (0.96 g/bhp-hr)(5,000 gal/yr)(18.5 bhp-hr/gal)(ton/907,200 g)
   = 0.10 tons/yr NOx

4. Annual PM10 reduced technology emissions
   (0.01 g/bhp-hr)(5,000 gal/yr)(18.5 bhp-hr/gal)(ton/907,200 g)
   = 0.001 tons/yr PM10

ROG emission factors not available for reduced technology therefore
ROG emission reductions cannot be calculated.

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases
- NOx emission benefits = 0.23 tons/yr – 0.10 tons/yr = 0.13 tons/yr NOx
- PM10 emission benefits = 0.01 tons/yr – 0.001 tons/yr = 0.009 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
0.13 + 20(0.009) = 0.31 weighted tons/yr

Annualized Cost:
Project Life: 10 years
CRF (Table B-1): = 0.123

Formula C-14: Incremental Cost
$160,000 -$125,000 = $35,000

Formula C-12: Annualized Cost
0.123 * $35,000 = $4,305/yr

Cost-Effectiveness:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
($4,305/yr)/(0.31 weighted tons/yr) =
$13,887/ton of weighted surplus emissions reduced

The cost-effectiveness for the example is less than $14,300 per ton of pollutants reduced. This project qualifies for the maximum amount of grant funds requested.

Example 5 - Repower + Retrofit of Street Sweeper

A company proposes to repower a 2001 diesel street sweeper with a 2006 diesel engine certified to the optional heavy-duty engine standard of 1.8 g/bhp-hr NOx + NMHC and 0.3 g/hbp-hr PM10. The company will also retrofit the engine with a Level 3 retrofit that is verified for both PM and NOx reductions. This vehicle has a GVWR of 19,000 lbs. and operates 100 percent of the time in California.

Baseline Technology Information:
- Baseline technology (application): 2001 diesel heavy heavy-duty engine
- Cost of rebuild (quote provided with application): $14,000
- Emission rates (Table B-4): 9.77 g/mi NOx, 0.08 g/mi ROG, 0.144 g/mi PM10
- Conversion factor to convert g/mile to g/bhp-hr (Table B-8): 2.3 bhp-hr/mi

- Energy consumption factor: 18.5 bhp-hr/gal
- Activity (application): 7,667 gal/yr
- Percent operated in California (application): 100 percent

Reduced Technology Information:
- Reduced technology (application): 2006 diesel heavy heavy-duty engine
- Cost (quote provided with application): $47,750
- Converted emission standard (Table B-2): 1.44 g/bhp-hr NOx; 0.030 g/bhp-hr PM10
- Retrofit Cost (quote provided with application): $18,000 + $600 annual filter maintenance
- Retrofit verification emission levels (EO): 25 percent reduction of NOx and 85 percent reduction of PM10. ROG is not counted since the retrofit device is not verified for ROG.
- Energy consumption factor: 18.5 bhp-hr/gal

Emission Reduction Calculations:
Formula C-6: Estimated Annual Emissions based on Fuel Consumed using Emission Factors or Converted Emission Standards (tons/yr)
1. Annual NOx baseline technology emissions
   (9.77 g/mi / 2.3 bhp-hr/mi)(7,667 gal/yr)(18.5 bhp-hr/gal)(ton/907,200 g)
   = 0.66 tons/yr NOx
2. Annual PM10 baseline technology emissions
   (0.144 g/mi / 2.3 bhp-hr/mi)(7,667 gal/yr)(18.5 bhp-hr/gal)(ton/907,200 g)
   = 0.010 tons/yr PM10

Formula C-7: Estimated Annual Emissions based on Fuel Consumed using On-Road Emission Factors (tons/yr)
3. Annual NOx reduced technology emissions
   (1.44 g/bhp-hr)(7,667 gal/yr)(18.5 bhp-hr/gal)(ton/907,200 g)
   = 0.23 tons/yr NOx
4. Annual PM10 reduced technology emissions
   (0.030 g/bhp-hr)(7,667 gal/yr)(18.5 bhp-hr/gal)(ton/907,200 g)
   = 0.005 tons/yr PM10

ROG emission factors not available for reduced technology therefore
ROG emission reductions cannot be calculated.

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases
- NOx emission benefits = 0.66 tons/yr - 0.23 tons/yr = 0.43 tons/yr NOx
- PM10 emission benefits = 0.010 tons/yr – 0.005 tons/yr = 0.005 tons/yr PM10

Formula C-11: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Retrofits

0.23 tons/yr NOx * 0.25 = 0.06 tons/yr NOx
0.005 tons/yr PM10 * 0.85 = 0.004 tons/yr PM10

Total NOx Emission Benefits
0.43 + 0.06 = 0.49 tons/yr NOx

Total PM10 Emission Benefits
0.005 + 0.004 = 0.009 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
0.49 +20(0.009) = 0.67 weighted tons/yr

<u>Annualized Cost</u>:
Project Life: 5 years
CRF (Table B-1) = 0.225

Formula C-14: Incremental Cost
$68,750 -$14,000 = $54,750

Formula C-12: Annualized Cost
0.225 * $54,750 = $12,319/yr

<u>Cost-Effectiveness</u>:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
($12,319/yr)/(0.67 weighted tons/yr) =
$18,387/ton of weighted surplus emissions reduced

The cost-effectiveness for this example is greater than the $14,300 per ton weighted cost-effectiveness requirement. In order to meet the $14,300 per ton weighted cost-effectiveness requirement, this project would only qualify for a fraction of the incremental cost – $42,582. This amount is determined by multiplying the maximum allowed cost-effectiveness by the estimated annual emission reductions and dividing by the capital recovery factor:

($14,300 * 0.67)/0.225 = $42,582

Example 6 –Purchase of a New CNG Bus

A transit agency proposes to purchase a new 2005 CNG bus certified to the alternative fuel optional standard of 1.2 g/bhp-hr NOx + NMHC and 0.01 g/bhp-hr PM10 instead of a new CNG bus certified to the current alternative fuel standard of 2.5g/bhp-hr NOx+NMHC. The baseline cost for this project is based on a diesel engine. This new CNG bus is surplus to the ARB transit bus fleet rule. The CNG engine was certified to the optional NOx+NMHC emission standard of 1.2 g/bhp-hr and 0.01 g/bhp-hr of PM10. The new bus will operate 100 percent of the time in California.

<u>Baseline Technology Information</u>:
- Baseline technology (application): 2005 CNG urban bus
- Cost (quote provided with application): $350,000

- Emission standard (Table B-7): 7.50 g/mi NOx and 0.004 g/mi PM10
- Activity (application): 50,000 mi/yr
- Percent operated in California (application): 100 percent

Reduced Technology Information:
- Reduced technology (application): 2005 CNG urban bus certified to optional standard
- Cost (quote provided with application): $390,000
- Converted emission standard (Table B-2): 0.96 g/bhp-hr NOx and 0.010 g/bhp-hr PM10
- Conversion factor to convert the standard in g/bhp-hr to g/mi (Table B-8): 4.3 bhp-hr/mi

Emission Reduction Calculations:
Formula C-8: Estimated Annual Emissions based on Mileage using Emission Factors
1. Annual NOx baseline technology emissions
   (7.5 g/mi)(50,000 mi/yr)(ton/907,200 g) = 0.41 tons/yr NOx
2. Annual PM10 baseline technology emissions
   (0.004 g/mi)(50,000 mi/yr)(ton/907,200 g) = 0.0002 tons/yr PM10

Formula C-9: Estimated Annual Emissions based on Mileage using a Converted Emission Standards
3. Annual NOx reduced technology emissions
   (0.96 g/bhp-hr * 4.3 bhp-hr/mi)(50,000 mi/yr)(ton/907,200 g)
   = 0.23 tons/yr NOx
4. Annual PM10 reduced technology emissions
   (0.010 g/bhp-hr * 4.3 bhp-hr/mi)(50,000 mi/yr)(ton/907,200 g)
   = 0.002 tons/yr PM10

ROG emission factors not available for reduced technology therefore ROG emission reductions cannot be calculated.

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases

- NOx emission benefits = 0.41 tons/yr – 0.23 tons/yr = 0.18 tons/yr NOx
- PM10 emission benefits = 0.0002 tons/yr – 0.002 tons/yr =(-)0.002 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
0.18 + 20(-0.002) = 0.14 weighted tons/yr

Annualized Cost:
Project Life: 12 years
CRF (Table B-1) = 0.107

Transit agencies receive an 80 percent grant from the Federal Transportation Agency for most new vehicle purchases. This grant must be subtracted before calculating the incremental cost.

Transit agency's cost for baseline technology: $350,000 * 0.20 = $70,000
Transit agency's cost for reduced technology: $390,000 * 0.20 = $78,000

Formula C-14: Incremental Cost
$78,000 - $70,000 = $8,000

Formula C-12: Annualized Cost
0.107 * $8,000 = $856/yr

Cost-Effectiveness:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
($856/yr)/(0.14 weighted tons/yr) =
$6,114/ton of weighted surplus emissions reduced

The cost-effectiveness for the example is less than $14,300 per ton of pollutants reduced. This project qualifies for the maximum amount of grant funds requested.

C. Auxiliary Engine Calculations

To calculate the emission benefits of an auxiliary engine, see the Example #3 in the off-road section of this Appendix.

II. On-Road Heavy-Duty Fleet Modernization

This section provides examples of calculations for determining the cost-effectiveness of surplus emission reductions for fleet modernization projects.

A. General Criteria for Fleet Modernization Cost-Effectiveness Calculations

- Target vocations are eligible for a five year project life.
- Applicants may claim ROG emission reductions from DECS if hydrocarbon emission reductions for that technology are obtained from the ARB's retrofit website at: http://www.arb.ca.gov/diesel/verdev/verdev.htm. For the Carl Moyer Program, ROG emission reductions will be credited at the 25 percent, 50 percent, and 85 percent reduction levels. To calculate emission reductions of ROG for the Carl Moyer Program, applicants should use the percentage reduction of hydrocarbons from the ARB's retrofit website to determine the appropriate "level" of emission reductions. For example, a technology that provides a 40 percent emission reduction of hydrocarbons would be permitted to apply a 25 percent reduction in ROG emissions for determining eligibility and grant amount in the Carl Moyer Program.
- For these calculations, PM10 refers to combustion PM10.

B. Examples

Example 1 – Replacement of a Heavy-Heavy Duty Truck from a Targeted Vocation
A participant wants to scrap an old, heavy heavy-duty truck used to haul cargo from the Port of Long Beach and replace it with a newer, used truck. The participant has provided conclusive documentation that for the last three years the old truck operated 100 percent of the time in and around the Port area. The replacement truck will be equipped with a Level 1 diesel emission control system (DECS) and an electronic monitoring unit (EMU). The replacement truck is required to continue operating in the same vocation and location for the life of the project.

Baseline Technology Information

- Baseline technology (application): 1983 heavy heavy-duty diesel truck
- Emission rates (Table B-5): 22.23 g/mi NOx, 1.08 g/mi ROG, 1.397 g/mi PM10
- Activity (application): 42,000 miles/year
- Percent operated in California (application): 100 percent
- Vocation (application): Port hauling

Reduced Technology Information:

- Reduced technology (application): 2000 heavy heavy-duty diesel truck
- Emission rates (Table B-5): 18.51 g/mi NOx, 0.21 g/mi ROG, 0.389 g/mi PM10

- Retrofit verification emission levels (EO): 25 percent NOx; 85 percent PM reduction
- Cost (quote provided with application): $40,000
- DECS cost (quote provided with application): $18,300
- EMU cost: $1,150 (Includes installation and monitoring for five years)

<u>Emission Reduction Calculations:</u>

Formula C-8: Estimated Annual Emissions Based on Mileage Using Emission Factors

1. Annual NOx baseline technology emissions
   (22.23 g/mi * 42,000 mi)(ton/ 907,200 g) = 1.029 tons/yr NOx
2. Annual NOx reduced technology emissions
   (18.51 g/mi * 42,000 mi)(ton/ 907,200 g) = 0.857 tons/yr NOx
3. Annual ROG baseline technology emissions
   (1.08 g/mi * 42,000 mi) (ton/ 907,200 g) = 0.05 tons/yr ROG
4. Annual ROG reduced technology emissions
   (0.21 g/mi * 42,000 mi)(ton/ 907,200 g) = 0.010 tons/yr ROG
5. Annual PM10 baseline technology emissions
   (1.397 g/mi * 42,000 mi)(ton/ 907,200 g) = 0.065 tons/yr PM10
6. Annual PM10 reduced technology emissions
   (0.389 g/mi * 42,000 mi)(ton/ 907,200 g) = 0.018 tons/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases:

- NOx Emission Benefits = 1.029 tons/yr - 0.857 tons/yr = 0.172 tons/yr NOx
- ROG Emission Benefits = 0.050 tons/yr - 0.010 tons/yr = 0.040 tons/yr ROG
- PM10 Emission Benefits = 0.065 tons/yr - 0.018 tons/yr = 0.047 tons/yr PM10

Formula C-11: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Retrofits:
Emission benefits of the replacement truck with the DECS providing an additional 25 percent NOx and 85 percent PM reduction

0.857 tons/yr NOx * 0.25 = 0.214 tons/yr NOx
0.018 tons/yr PM10 * 0.85 = 0.015 tons/yr PM10

Total NOx Emission Benefits

0.172 tons/yr + 0.214 tons/yr = 0.386 tons/yr NOx

Total PM10 Emission Benefits

0.047 tons/yr + 0.015 tons/yr = 0.062 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions

0.386 tons/yr + 0.040 tons/yr + 20(0.062 tons/yr) = 1.666 weighted tons/yr

<u>Annualized Cost</u>
Project Life = 5 Years
CRF (Table B-1) = 0.225

Formula C-15: Incremental Cost
NADA Value of Replacement Truck:
0.72 * $40,000 = $28,800
Replacement Truck + DECS + EMU:
$28,800 + $18,300 + $1,150 = $48,250
Formula C-12: Annualized Cost
$48,250 * 0.225 = $10,856/yr

Cost-Effectiveness
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions
=($10,856/yr) / (1.666 weighted tons/yr)
= $6,516 weighted tons/yr

In this example, the cost-effectiveness is less than threshold of $14,300 per weighted ton of pollutants reduced. This project qualifies for $28,800, the maximum amount of grant funds requested. The applicant will take out a loan to pay the remaining $12,000 for the replacement truck.

Example 2 – Tiered Transaction

The owner of a 2000 model year, heavy heavy-duty truck wants to purchase a new 2005 model year truck meeting the optional NOx standard. He has proposed a tiered transaction where he will buy a new truck and contribute his 2000 model year truck to the owner of a 1990 truck. The owner of the old truck has agreed to scrap the old, heavy heavy-duty truck that is used exclusively to haul agricultural commodities. The old truck owner has provided conclusive documentation that for the last three years the truck operated 100 percent of the time in the Central Valley region. The replacement truck will be equipped with a Level 3 diesel emission reduction system (DECS) and an electronic monitoring unit (EMU). The replacement truck is required to continue operating in the same vocation and location for the life of the project.

a. Fleet Modernization Transaction

Old Vehicle Information (Baseline Technology):
- Model: 1990 heavy heavy-duty diesel truck
- Activity: 65,000 miles/year
- Vocation: Agriculture (qualifies as a target vocation)
- Percent Operation in California: 100 percent
- Emission Rates (Table B-5): 19.72 g/mi NOx , 0.55 g/mi ROG, 0.950 g/mi PM10

Replacement Truck Information (Reduced Technology):
- Model: 2000 heavy heavy-duty diesel truck
- Cost (quote provided with application): $50,000
- Emission Rates (Table B-5): 18.51 g/mi NOx, 0.21 g/mi ROG, 0.389 g/mi PM10
- DECS Cost: $19,100 (Level 3, 25 percent NOx + 85 percent PM Reduction)
- EMU Cost: $1,150 (Includes installation and monitoring for five years)

<u>Emission Reduction Calculations:</u>

Formula C-8: Estimated Annual Emissions Based on Mileage Using Emission Factors

1. Annual NOx baseline technology emissions
   (19.72 g/mi * 65,000 mi) / (ton/907,200 g) = 1.41 tons/yr NOx
2. Annual NOx reduced technology emissions
   (18.51 g/mi * 65,000 mi) / (ton/907,200 g) = 1.33 tons/yr NOx
3. Annual ROG baseline technology emissions
   (0.55 g/mi * 65,000 mi) / (ton/907,200 g) = 0.04 tons/yr ROG
4. Annual ROG reduced technology emissions
   (0.21 g/mi * 65,000 mi) / (ton/907,200 g) = 0.02 tons/yr ROG
5. Annual PM10 baseline technology emissions
   (0.950 g/mi * 65,000 mi) / (ton/907,200 g) = 0.068 tons/yr PM10
6. Annual PM10 reduced technology emissions
   (0.389 g/mi * 65,000 mi) / (ton/907,200 g) = 0.028 tons/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant

- NOx Emission Benefits = (1.41 -1.33) tons/yr = 0.08 tons/yr NOx
- ROG Emission Benefits = (0.04 - 0.02) tons/yr = 0.02 tons/yr ROG
- PM10 Emission Benefits = (0.068 - 0.028) tons/yr = 0.040 tons/yr PM10

Formula C-11: Annual Surplus Emission Reductions with DECS

Emission Benefits of the Replacement Truck with the DECS providing an additional 25 percent NOx and 85 percent PM reduction

- NOx Emission Benefits = (1.33 tons/yr * 0.25) = 0.33 tons/yr NOx
- PM10 Emission Benefits = (0.028 tons/yr * 0.85) = 0.024 tons/yr PM10

Total NOx Emission Benefits
0.08 tons/yr + 0.33 tons/yr = 0.41 tons/yr NOx

Total PM10 Emission Benefits
0.040 tons/yr + 0.024 tons/yr = 0.064 tons/yr PM10

Formula C.2: Annual Weighted Surplus Emission Reductions

0.41 tons/yr + 0.02 tons/yr + 20(0.064 tons/yr) = 1.71 weighted tons/yr

<u>Annualized Cost</u>

Project Life = 5 Years (target vocations are eligible for 5 year project life)
Capital Recovery Factor = 0.225 (Table B-1)

<u>Incremental Cost</u>

NADA Value of Replacement Truck: $36,000

Replacement Truck + DECS + EMU
= $36,000 + $19,100 + $1,150 = $56,250

Formula C-12: Annualized Cost
Incremental Cost * Capital Recovery Factor
$56,250 * 0.225 = $12,656

Cost-Effectiveness
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions
($12,656/yr) / (1.71 weighted ton/yr)
= $7,401/ton of weighted surplus emissions reduced

b. New Vehicle Transaction

Baseline Technology Information:
- Baseline Technology: 2005 heavy heavy-duty diesel truck
- Cost (quote provide with application): $110,000
- Emission Rates (Table B-5): 13.21 g/mi NOx, 0.360 g/mi PM10
- Percent operation in California (application): 100 percent

Reduced Technology Information (New, Low Emission, Optional Standard Truck):
- Reduced technology (application): 2005 heavy-duty LNG truck certified to the 1.8 NOx + NMMC + 0.030 PM Standard
- Cost (quote provided with application): $150,000
- New LNG vehicle emission standard (Table B-2): 1.44 g/bhp-hr NOx, 0.030 g/bhp-hr PM10
- Conversion factor to convert the standard to g/mi (Table B-8): 2.6 bhp-hr/mi
- Activity: 75,000 mi/year

Emission Reduction Calculations:
Formula C-8: Estimated Annual Emissions Based on Mileage Using Emission Factors (used for baseline calculations)

Formula C-9: Estimated Annual Emissions Based on Mileage Using Converted Emission Standards (used for reduced calculations)

1. Annual NOx baseline technology emissions
   (13.21 g/mi * 75,000 mi/yr)(ton / 907,200 g) = 1.09 tons/yr NOx
2. Annual NOx reduced technology emissions
   (1.44 g/bhp-hr * 2.6 bhp-hr/mi * 75,000 mi/yr)(ton / 907,200 g) = 0.31 tons/yr NOx
3. Annual PM10 baseline technology emissions
   (0.360 g/mi * 75,000 mi/yr)(ton / 907,200 g) = 0.030 tons/yr PM10
4. Annual PM10 reduced technology emissions
   (0.030 g/bhp-hr * 2.6 bhp-hr/mi * 75,000 mi/yr)(ton /907,200 g) = 0.006 tons/yr PM10

ROG emission factors not available for reduced technology therefore ROG emission reductions cannot be calculated.

Formula C-10: Annual Surplus Emission Reductions by Pollutant for New Purchases
- NOx emission benefits = 1.09 tons/yr – 0.31 tons/yr = 0.78 tons/yr NOx
- PM10 emission benefits = 0.030 tons/yr – 0.006 tons/yr = 0.024tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
0.78 tons/year + 20(0.024) tons/year = 1.26 weighted tons/yr

Annualized Cost:
Project Life: 10 years
CRF (Table B-1) = 0.123

Formula C-14: Incremental Cost
$150,000 - $110,000 = $40,000

Formula C-12: Annualized Cost
$40,000 * 0.123 = $4,920/yr

Cost-Effectiveness:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
= ($4,920/yr) / (1.26 weighted tons/yr)
= $3,904/ton of weighted surplus emissions reduced

c. Tiered Transaction Calculations

Annualized Cost of the Tiered Transaction
Fleet Mod. Project Life: 5 Years (Target vocations have 5 year project life)
CRF (Table B-1) = 0.225

New, Low NOx Truck Project Life: 10 Years
CRF (Table B-1) = 0.123

Incremental Cost of the Tiered Transaction:
(Incremental Cost Of The Fleet Mod Project from section a) + (Incremental Cost Of The New, Low NOx Project from section b)
$56,250 + $40,000 = $96,250

Annualized Cost of the Tiered Transaction
(Annualized Cost of Fleet Mod. Project from section a) + (Annualized Cost of New, Low NOx Project from section b)
$12,656 + $4,920 = $17,576

Emission Reductions
Annual Weighted Surplus Emission Reductions of the Tiered Transaction

(Weighed Emissions Reductions of the Fleet Mod Project) + (Weighed Emission Reductions of the New, Low-NOx Project)

(1.71 weighted tons/yr) + (1.26 weighted tons/yr) = 2.97 weighted tons/yr

Cost-Effectiveness of the Tiered Transaction
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
= ($17,567/yr) / (2.97 weighted tons/year)
= $5,915/year of weighted surplus emissions reduced

In this example, the cost-effectiveness is less than the threshold of $14,300 per weighted ton of pollutants reduced. Both tiered transaction project applicants qualify for the maximum amount of grant funds requested. A breakdown of the project cost follows:

- Carl Moyer Program incentives for the tiered transaction project:

Replacement truck (72 percent of $50,000 + full cost of EMU and retrofit)	$ 56,250
New truck (Incremental cost)	$ 40,000
Total Carl Moyer incentives	**$ 96,250**

- Net cost of the tiered transaction to the fleet mod. participant:

Cost of the replacement truck:	$ 50,000
Cost of EMU and retrofit	$ 20,250
Total cost of truck/EMU/retrofit	$ 70,250
Carl Moyer Incentive	-$56,250
Net cost to participant	**$14,000**

- Net cost of the tiered transaction to the new low NOx truck purchaser:

Cost of the new, low NOx truck:	$150,000
Value of the 2000 replacement truck:	$ 50,000
Carl Moyer Incentive	-$ 40,000
Payment received for replacement truck	-$ 50,000
Net cost to participant for new truck	**$110,000**

III. Heavy-Duty Truck Idle Reduction

This section provides an example calculation for determining the cost-effectiveness of surplus emission reductions for heavy-duty truck idling reducing technology projects.

A. General Criteria for Heavy-Duty Truck Idling Reducing Technologies Cost-Effectiveness Calculations

- The actual capital cost, up to $5,500, of an APU may be funded.
- The installation cost of an APU, including installation of an hour meter, up to a maximum of $1,700 per diesel APU and a maximum of $3,400 per alternative fuel, electric motor, or fuel cell APU, may be funded.
- The cost of a PM retrofit may be funded provided the overall project cost effectiveness is under the limit of $14,300
- For these calculations, PM10 refers to combustion PM10.
- The minimum project life is three years.
- Annual hours of equipment operation for determining emission reductions must be based only on readings from an installed and fully operational hour meter. A properly functioning hour meter is required to support equipment activity information included in the application for CMP funding.
- Applicants may claim ROG emission reductions from DECS if hydrocarbon emission reductions for that technology are obtained from the ARB's retrofit website at: http://www.arb.ca.gov/diesel/verdev/verdev.htm. For the Carl Moyer Program, ROG emission reductions will be credited at the 25 percent, 50 percent, and 85 percent reduction levels. To calculate emission reductions of ROG for the Carl Moyer Program, applicants should use the percentage reduction of hydrocarbons from the ARB's retrofit website to determine the appropriate "level" of emission reductions. For example, a technology that provides a 40 percent emission reduction of hydrocarbons would be permitted to apply a 25 percent reduction in ROG emissions for determining eligibility and grant amount in the Carl Moyer Program.
- Default maximum project life:

Off-road new purchase	10 years
Off-road repower	7 years
Repower + retrofit	5 years
Retrofit	5 years

  Project life beyond the default maximum may be submitted with documentation for approval by ARB.

B. Examples

Example 1 - Diesel APU Project Repower
A truck operator proposes to purchase an APU, powered by a 2005 certified Kubota Z482B two-cylinder diesel engine, rated at 10.3 hp. The APU will be installed on a 2004 Class 8 line haul truck, to substitute for the truck's idling load. The APU will use fuel from the truck's tank.

The Kubota engine is controlled by a governor and will be set to run at a constant engine speed of 3200 RPM. This will make 2.7 kilowatts (5.33 hp) of power available from the APU while the APU engine is operating at its optimum engine efficiency of about 19.5 percent. A Level 3 PM retrofit device is installed on the main engine exhaust with the exhaust of the APU routed through the main engine exhaust.

The APU cost is $5,000 and PM retrofit costs about $6,000. The installation cost is $1,500 including an hour meter for a total cost of $12,500. The reading on the hour meter is the data item used by the operator to determine the APU's maintenance schedule. The truck operator will also use the reading on the hour meter to document the hours that the APU is used in California.

<u>Baseline Technology Information:</u>
- Engine: 2004 HHDV
- Annual hours of operation: 1,800
- Emission factors (From Table B-9): 191.5 g/hr NOx, 25.56 g/hr ROG, 1.50 g/hr PM10

<u>Reduced Technology Information:</u>
- Engine: 10.3 hp APU
- Model year: 2005
- Power requirements: 2.7 kilowatts = 1.99 hp
- APU idling substitution rate: 100 percent
- Annual hours of operation: 1,800
- Capital cost of APU: $5,000
- Capital cost of PM trap: $6,000
- Installation cost: $1,500
- Emission factors (Table B-10): 4.14g/bhp-hr NOx, 0.41g/bhp-hr ROG, 0.304 g/bhp-hr PM10

<u>Emissions Reduction Calculations:</u>
Formula C-4: Estimated Annual Emissions based on Hours of Operation (tons/yr):
1. Annual NOx baseline technology emissions
   (191.5 g/hr)(1,800 hr/yr)/(907,200 g/ton) = 0.38 tons/yr NOx
2. Annual NOx reduced technology emissions
   (4.14 g/bhp-hr)(1.99 hp)(1,800 hr/yr)/907,200 g/ton = 0.016 tons/yr NOx
3. Annual ROG baseline technology emissions
   (25.56 g/hr)(1,800 hr/yr)/907,200 g/ton = 0.05 tons/yr ROG

4. Annual ROG reduced technology emissions
   (0.41 g/bhp-hr)(1.99 hp)(1,800 hr/yr)/907,200 g/ton = 0.0016 tons/yr ROG
5. Annual PM10 baseline technology emissions
   (1.50 g/hr)(1,800 hr/yr)/907,200 g/ton = 0.003 tons/yr PM10
6. Annual PM10 reduced technology emissions
   (0.306 g/bhp-hr)(1.99 hp)(1,800 hr/yr)/907,200 g/ton = 0.00112 tons/yr PM10

Formula C-10 Annual Surplus Emission Reductions by pollutant (tons/yr) for Repowers and New Purchases

- NOx emission benefits = 0.38 tons/yr - 0.016 tons/yr = 0.364 tons/yr NOx
- ROG emission benefits = 0.05 tons/yr - 0.0016 ton/yr = 0.048 tons/yr ROG
- PM10 emission benefits = 0.003 tons/yr - 0.0012 tons/yr = 0.0018 tons/yr PM10

Formula C-11: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Retrofits:
0.003 tons/yr PM10 *.85 = 0.0025 tons/yr

Total PM10 Emission Benefits
0.0018 + 0.0025 tons/yr = 0.0043 tons/yr

Formula C-2, Annual Weighted Surplus Emission Reductions:
(0.364 tons/yr)+(0.048 tons/yr)+20(0.0043 tons/yr) = 0.498 weighted tons/yr

<u>Annualized Cost:</u>
Project Life: 3 years
CRF (Table B-1): = 0.360

Formula C -14-Incremental Cost:
$5,000 + $6,000 + $1,500 = $12,500

Formula C- 12-Annualized Cost
0.360 * $12,500 = $4,500/yr

<u>Cost Effectiveness:</u>
Formula C-1 Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton):
($4,500/yr)/(0.498 weighted tons/yr)
=$9,036/ton of weighted surplus emissions reduced

The cost-effectiveness for the example is less than $14,300 per ton of weighted average emissions reduced and the project qualifies for the full amount requested $12,500.

IV. Transport Refrigeration Units

This section provides two examples of calculations for determining the cost-effectiveness of surplus emission reductions for TRU projects.

A. General Criteria for TRU Cost-Effectiveness Calculations:

- TRU emission reduction calculations will use either fuel-based or hour-based formula for cost-effectiveness calculations.
- Annual hours of equipment operation for determining emission reductions must be based only on readings from an installed and fully operational hour meter. A properly functioning hour meter is required to support equipment activity information included in the application for CMP funding.
- TRU engine emissions increase with load. Load factors have been determined for TRU engines and have been found to vary by engine horsepower category. Table B-11 shows the default load factors assigned for use in the Carl Moyer Program.
- Baseline and reduced engine emission factors are listed in Table B-12 Appendix B.
- Applicants may claim ROG emission reductions from DECS if hydrocarbon emission reductions for that technology are obtained from the ARB's retrofit website at: http://www.arb.ca.gov/diesel/verdev/verdev.htm. For the Carl Moyer Program, ROG emission reductions will be credited at the 25 percent, 50 percent, and 85 percent reduction levels. To calculate emission reductions of ROG for the Carl Moyer Program, applicants should use the percentage reduction of hydrocarbons from the ARB's retrofit website to determine the appropriate "level" of emission reductions. For example, a technology that provides a 40 percent emission reduction of hydrocarbons would be permitted to apply a 25 percent reduction in ROG emissions for determining eligibility and grant amount in the Carl Moyer Program.

B. Examples

Example 1 – Repower

A TRU owner proposes to purchase and install a new engine in an existing trailer TRU that uses a 1999 model year TRU Tier 1 engine rated at 37.8 hp. From records, the owner knows the existing TRU engine has operated an average of 1,300 hours per year. The owner anticipates this operating trend will continue for the next three years. He doesn't know what the TRU engine load factor is for his operations. Both the old and new operations occur 100 percent in California. The replacement engine will be a 2006 model year Tier 2 engine rated at 37.8 hp. The cost of the new certified engine will be $4,000; the cost to replace the existing engine with a remanufactured 1999 model year engine is $3200. Installation and engineering costs for the repower will be

$700 greater than replacement with a remanufactured engine due to the need to modify motor mounts.

Baseline Technology Information:
- Baseline technology (application): 1999 engine
- Emission factors (Table B-12): 5.26 g/bhp-hr NOx, 1.74 g/bhp-hr ROG, 0.480 g/bhp-hr PM10 (Tier 1)
- Engine rated HP (application): 37.8 hp
- Default load factor (Table B-11): 0.53
- Annual hours of operation (application): 1,300 hours

Reduced Technology Information:
- Reduced technology (application): 2006 engine
- Emission factors (Table B-12): 4.63 g/bhp-hr NOx, 0.29 g/bhp-hr ROG, 0.280 g/bhp-hr PM10 (Tier 2)
- Reduced engine rated HP (application): 37.8 hp
- Default load factor (Table B-11): 0.53

Emission Reduction Calculations:
Formula C-4: Estimated Annual Emissions based on Hours of Operation (tons/yr)
1. Annual NOx baseline technology emissions
   (5.26 g/bhp-hr)(37.80 hp)(0.53)(1,300 hrs/yr)(1 ton/907,200 g)
   = 0.15 tons/yr NOx
2. Annual NOx reduced technology emissions
   (4.63 g/bhp-hr)(37.80 hp)(0.53)(1,300 hrs/yr)(1 ton/907,200 g)
   = 0.13 ton/yr NOx
3. Annual ROG baseline technology emissions
   (1.74 g/bhp-hr)(37.80 hp)(.53)(1,300 hrs/yr)(1ton/907,200 g)
   = 0.05 tons/yr ROG
4. Annual ROG reduced technology emissions
   (0.290 g/bhp-hr)(37.80 hp)(0.53)(1,300 hrs/yr)(1 ton/907,200 g)
   = 0.01 ton/yr ROG
5. Annual PM10 baseline technology emissions
   (0.480 g/bhp-hr)(37.8 hp)(0.530)(1,300 hrs/yr)(1 ton/907,200 g)

   = 0.014 tons/yr tons/yr PM10

6. Annual PM10 reduced technology emissions
   (0.280 g/bhp-hr)(37.80 hp)(0.530)(1,300 hrs/yr)(1 ton/907,200 g)
   = 0.008 tons/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases
- NOx emission benefits = 0.15 tons/yr - 0.13 tons/yr = 0.01 tons/yr NOx
- ROG emission benefits = 0.05 tons/yr - 0.01 tons/yr = 0.04 tons/yr ROG
- PM10 emission benefits = 0.014 tons/yr - 0.008 tons/yr = 0.006 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions:
0.01 + 0.04 + 20(0.006) = 0.17 weighted tons/yr

Annualized Cost:
Project Life: 3 years
CRF (Table B-1): = 0.360

Formula C -14: Incremental Cost:
\$4,000 + \$700 - \$3,200 = \$1,500

Formula C-12: Annualized Cost
\$1,500 * 0.360 = \$540/yr

Cost Effectiveness:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions (\$/ton):
(\$540yr)/(0.17 weighted ton/yr)
= \$3,176/ton of weighted surplus emissions reduced

This project would qualify for a \$1,500 Carl Moyer Program grant, covering all of the capital and installation costs of the project.

Example 2 – Retrofit
A TRU owner decides to retrofit a 34 hp model year 2001 TRU Tier 1 engine with a verified Level 3 active diesel particulate filter (DPF) system that uses a fuel-borne catalyst (FBC). The capital cost for the DPF system with FBC dosing unit is \$2,800, including installation. The owner reports operating the TRU 2,000 hours per year. The project would commence by January 1, 2007. The applicant is willing to commit to a three year project life.

Surplus emissions from early compliance:
Model year 2001 TRU engines must comply with the TRU ATCM's LETRU In-Use Performance Standard (Level 2 – 50 percent PM reduction) by the end of 2008. Model year 2001 TRU engines must also comply with the TRU ATCM's ULETRU standard (Level 3 – 85 percent PM reduction) by the end of 2015. Therefore, all of the emission reductions in 2007 and 2008 would be surplus. And, in the third year of the project, 2009, the surplus emissions would be 35 percent (85 percent minus 50 percent) of the baseline engine emissions. The ARB test data shows ROG reductions of 55 percent from use of the DPF. For the Carl Moyer Program, the applicant may count a 50 percent ROG reduction for the cost-effectiveness calculation.

Baseline Technology Information:
- Baseline technology (application): 34 hp model year 2001 TRU engine
- Baseline engine rated HP (application): 34 hp
- Default load factor (Table B-11): 0.53 (assumed to stay constant before and after project)
- Annual hours of operation (application): 2,000 hr/yr

- Emission factors (Table B-12): 1.74 g/bhp-hr ROG, 0.480 g/bhp-hr PM10

Reduced Technology Information:

- Reduced technology (application): Level 3 active diesel particulate filter (DPF) system that uses a fuel-borne catalyst (FBC).
- Retrofit verification emission level (EO): 50 percent ROG, 85 percent PM10
- Cost (quote provided by applicant): $2,800 for DPF system with FBC dosing including installation.
- Annual hours of operation (application): 2,000 hr

Emission Reduction Calculations

Formula C-4: Estimated Annual Emissions based on hours of Operation (tons/yr)

1. Annual ROG baseline technology emissions
   (1.74 g/bhp-hr)(0.53)(2,000 hr)(1 ton/907,200 g) = 0.07 tons/yr ROG
2. Annual PM10 baseline technology emissions
   (0.480 g/bhp-hr)(34.00 hp)(0.530)(2,000 hrs/yr)(1 ton/907,200 g)
   = 0.019 tons/yr PM10

Formula C-11: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Retrofits

Estimated emission reductions are:

2007: 0.07 tons/yr * 0.50 = 0.04 tons/yr ROG
2008: 0.07 tons/yr * 0.50 = 0.04 tons/yr ROG
2009: 0.07 tons/yr * 0.50 = 0.04 tons/yr ROG

2007: 0.019 tons/yr * 0.85 = 0.016 tons/yr PM10
2008: 0.019 tons/yr * 0.85 = 0.016 tons/yr PM10
2009: 0.019 tons/yr * 0.35 = 0.007 tons/yr PM10

Average PM10 Reductions = (0.016 tons/yr PM10 + 0.016 tons/yr PM10 + 0.007 tons/yr PM10)/3 = 0.013 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions

0.04 + 20(0.013) = 0.30 weighted tons/yr

Annualized Cost:

Project Life: 3 years

CRF (Table B-1): = 0.360

Formula C-14: Incremental Cost

$2,800 – $0 = $2,800

(Note: Annual operating costs above normal (e.g., cost of FBC) cannot be paid for with Carl Moyer Program funds, but air districts may elect to pay for these with matching funds.)

Formula C-12: Annualized Cost
0.360 * $2,800 = $1,008/yr

<u>Cost-Effectiveness</u>:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
($1,008/yr)/(0.30 weighted ton/yr)
=$3,360/ ton of weighted surplus emissions reduced

The cost-effectiveness is below the $14,300 threshold. This project would therefore qualify for a $2,800 Carl Moyer Program grant covering all of the capital costs and installation costs of the project

V. Off-Road Compression-Ignition Engines

This section provides four examples of calculations for determining the cost-effectiveness of surplus emission reductions for off-road compression-ignition projects.

A. General Criteria for Off-Road Compression-Ignition Engine Cost-Effectiveness Calculations

- Off-road emission reduction calculations will use either fuel-based or hour-based formula for weighted cost-effectiveness calculations.

- Annual hours of equipment operation for determining emission reductions must be based only on readings from an installed and fully operational hour meter. A properly functioning hour meter is required to support equipment activity information included in the application for CMP funding.

- For applications or equipment not listed in Table B-13 in Appendix B, a default load factor of 0.43 must be used.

- The replacement load factor should never exceed 100 percent in cases where the replacement engine is significantly smaller than the existing engine

- Baseline and reduced engine emission factors are listed in Table B-12 of Appendix B.

- For off-road equipment capable of operation with a new certified on-road engine instead of a new off-road engine (i.e., yard hostlers, yard goats), emission benefits from the baseline engine will be based on an on-road engine. If an applicant provides sufficient documentation to show that past practices involve predominantly the use of off-road engines in yard hostlers, then an off-road engine emission factor baseline can be used.

- For new purchases of off-road equipment powered by an on-road engine, emission benefits relative to the baseline engine are calculated based on on-road engine emission factors. If an applicant provides ARB with documentation showing that in past practice, the fleet has been powered by off-road engines, then the baseline emission may be calculated using the off-road engine emission factors.

- For calculations based on fuel consumption, use the default energy consumption factor (ECF) of 18.5 bhp-hr/gallon.

- Default project life

	Default
Off-road new purchase	10 years
Off-road repower	7 years

Off-road repower and retrofit	5 years
Retrofit	5 years

Project life beyond the default project life may be submitted with documentation for approval by ARB.

- Applicants may claim ROG emission reductions from DECS if hydrocarbon emission reductions for that technology are obtained from the ARB's retrofit website at: http://www.arb.ca.gov/diesel/verdev/verdev.htm. For the Carl Moyer Program, ROG emission reductions will be credited at the 25 percent, 50 percent, and 85 percent reduction levels. To calculate emission reductions of ROG for the Carl Moyer Program, applicants should use the percentage reduction of hydrocarbons from the ARB's retrofit website to determine the appropriate "level" of emission reductions. For example, a technology that provides a 40 percent emission reduction of hydrocarbons would be permitted to apply a 25 percent reduction in ROG emissions for determining eligibility and grant amount in the Carl Moyer Program.

B. Examples

Example 1 – Repower with a Tier 2 Engine and Retrofit with a Level 3 DECS
A construction company wants to repower an uncontrolled scraper with a Tier 2 engine. The baseline engine is a 300 hp 1987 Caterpillar 3306 that operates for 1,500 hours per year and would cost $11,500 to rebuild. The applicant is proposing to install a 300 hp 2004 Caterpillar C9 that costs $80,000. This equipment operates 100 percent of the time in California and has a project life of 5 years. A Level 3 diesel particulate filter has been verified for use on a 2004 Caterpillar C9 engine and has a cost of $15,000. Since installation of a retrofit device is required for off-road projects if available and feasible, the cost-effectiveness of the project including the installation of the DECS must be determined.

Baseline Technology Information:
- Engine: 1987 Caterpillar 3306
- HP(application): 300
- Hours of operation (application): 1,500
- Cost of rebuild (quote provided with application): $11,500
- Load factor (Table B-13): 0.72
- Emission factors (Table B-12): 10.23 g/bhp-hr NOx; 1.01 g/bhp-hr ROG; 0.382 g/bhp-hr PM10

Reduced Technology Information:
- Engine: 2004 Caterpillar C9 (Executive Order U-R-001-0247; Engine family 4CPXL08.8HSK)
- HP(application): 300
- Hours of operation (application): 1,500
- Cost of new engine (quote provided with application): $80,000
- Load factor (Table B-13): 0.72

- Emission factors (Table B-12): 3.79 g/bhp-hr NOx; 0.12 g/bhp-hr ROG; 0.088 g/bhp-hr PM10
- Percent operating in California (application): 100 percent
- Retrofit: Level 3 verified reductions: 85 percent PM10
- Cost of retrofit (quote provided with application): $15,000

Emission Reduction Calculations:

Formula C-4: Estimated Annual Emissions based on Hours of Operation (tons/yr)

1. Annual NOx baseline technology emissions
   10.23 g/bhp-hr *300 hp*0.72*1500 hr*(ton/907,200 g) = 3.65 tons/yr NOx
2. Annual NOx reduced technology emissions
   3.79 g/bhp-hr *300 hp*0.72*1500 hr*(ton/907,200 g) = 1.35 tons/yr NOx
3. Annual ROG baseline technology emissions
   1.01 g/bhp-hr *300 hp* 0.72*1500 hr*(ton/907,200 g) = 0.36 tons/yr ROG
4. Annual ROG reduced technology emissions
   0.12 g/bhp-hr *300 hp*0.72*1500 hr*(ton/907,200 g) = 0.04 tons/yr ROG
5. Annual PM10 baseline technology emissions
   0.382 g/bhp-hr *300 hp*0.72*1500 hr*(ton/907,200 g) = 0.136 tons/yr PM10
6. Annual PM10 reduced technology emissions
   0.088 g/bhp-hr *300 hp*0.72*1500 hr*(ton/907,200 g) = 0.031 tons/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases

- Emission benefits NOx = 3.65 tons/yr - 1.35 tons/yr = 2.30 tons/yr NOx
- Emission benefits ROG = 0.36 tons/yr - 0.04 tons/yr = 0.32 tons/yr ROG
- Emission benefits PM10 = 0.136 tons/yr - 0.031 tons/yr = 0.105 tons/yr PM10

Formula C-11: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Retrofits

0.031 tons/yr PM10 * 0.85 = 0.026 tons/yr PM10

Total PM10 Emission Benefits

0.105 tons/yr + 0.026 tons/yr = 0.131 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions

2.30 tons/yr + 0.32 tons/yr + 20(0.131 tons/yr) = 5.24 weighted tons/yr

Annualized Cost:

Project Life: 5 years

CRF (Table B-1): = 0.225

Formula C-14: Incremental Cost

$95,000 - $11,500 = $83,500

Formula C-12: Annualized Cost

0.225 * $83,500 = $18,788

<u>Cost-Effectiveness:</u>
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
($18,788/yr)/(5.24 weighted tons/yr)
= $3,585/tons of weighted surplus emissions reduced

Example 2 – New Purchase
An applicant wants to purchase a new yard tractor with an LNG 250 hp on-road engine certified to ARB's Heavy Duty Optional Standard (2004 Cummins C Gas Plus 8.3 L) at a cost of $96,800. The applicant has provided documentation that they would normally have purchased a yard tractor with a 2004 250 hp Tier 2 off-road diesel engine at a cost of $61,250. The annual hours of operation is 1,250 hours, the equipment operates 100 percent of the time in California, and has a project life of 10 years. The default load factor is 0.43.

<u>Baseline Technology Information:</u>
- Engine: 2004 Tier 2 off-road diesel engine
- HP (application): 250
- Annual hours of operation (application): 2,000
- Default load factor: 0.43
- Cost of new equipment (quote provided with application): $61,250
- Emission factors (Table B-12): 4.15 g/bhp-hr NOx; 0.12 g/bhp-hr ROG; 0.088 g/bhp-hr PM10

<u>Reduced Technology Information:</u>
- Engine (application): 2004 Cummins C Gas Plus (Executive Order A-021-0362)
- HP (application): 250
- Annual hours of operation (application): 2,000
- Default load factor: 0.43
- Cost of new equipment (quote provided with application): $96,800
- Converted emission standards (Table B-2): 1.44 g/bhp-hr NOx; 0.030 g/bhp-hr PM10
- Percent operating in California (application): 100 percent

<u>Emission Reduction Calculations:</u>
Formula C-4: Estimated Annual Emissions based on hours of Operation (tons/yr)
1. Annual NOx baseline technology emissions
   4.15 g/bhp-hr *250 hp*0.43*2,000 hr*(ton/907,200 g) = 0.98 tons/yr NOx
2. Annual NOx reduced technology emissions
   1.44 g/bhp-hr *250 hp*0.43*2,000 hr*(ton/907,200 g) = 0.34 tons/yr NOx
3. Annual PM10 baseline technology emissions
   0.088 g/bhp-hr *250 hp*0.43*2,000 hr*(ton/907,200 g) = 0.021 tons/yr PM10
4. Annual PM10 reduced technology emissions
   0.030 g/bhp-hr *250 hp*0.43*2,000 hr*(ton/907,200 g) = 0.007 tons/yr PM10

ROG emission factors not available for reduced technology therefore ROG emission reductions cannot be calculated.

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases

- Emission benefits NOx =0.98 tons/yr - 0.34 tons/yr = 0.64 tons/yr NOx
- Emission benefits PM10= 0.021 tons/yr - 0.007 tons/yr = 0.014 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
0.64 tons/yr + 20(0.014 tons/yr) = 0.92 weighted tons/yr

Annualized Cost:
Project Life: 10 years
CRF (Table B-1): = 0.123

Formula C-14: Incremental Cost
$96,800 - $61,250 = $35,550

Formula C-12: Annualized Cost
0.123 * 35,550 = $4,373/yr

Cost-Effectiveness:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
($4,373/yr)/ (0.92 weighted tons/yr)
= $4,753/tons of weighted surplus emissions reduced

Example 3 – Auxiliary Engine Repower
An applicant wants to repower the auxiliary engine of a street sweeper with a Tier 2 engine. The baseline engine is a Tier 1 200 hp engine that consumes an estimated 4,500 gallons fuel per year and would cost $7,000 to rebuild. The applicant is proposing to install a 200 hp Tier 2 engine that costs $35,000. This equipment operates 100 percent of the time in California and has a project life of 7 years. No retrofit device has been verified for this engine or equipment.

Baseline Technology Information:
- Engine (application): Tier 1 off-road diesel engine
- HP (application): 200 (not used for calculation, but used to determine appropriate emission factors)
- Annual fuel consumption (application): 4,500
- Cost of rebuild (quote provided with application): $7,000
- Energy consumption factor: 18.5 bhp-hr/gal
- Emission factors (Table B-12): 5.93 g/bhp-hr NOx; 0.38 g/bhp-hr ROG; 0.120 g/bhp-hr PM10

Reduced Technology Information:
- Engine (application): Tier 2 off-road diesel engine

- HP (application): 200 (not used for calculation, but used to determine appropriate emission factors)
- Annual fuel consumption (application): 4,500 gallons
- Cost of new equipment (quote provided with application): $35,000
- Energy consumption factor: 18.5 bhp-hr/gal
- Emission factors (Table B-12): 4.15 g/bhp-hr NOx; 0.12 g/bhp-hr ROG; 0.088 g/bhp-hr PM10
- Percent operating in California (application): 100 percent

Emission Reduction Calculations:
Formula C-6: Estimated Annual Emissions based on Fuel Consumed using Emission Factors or Converted Emission Standard (tons/yr)
1. Annual NOx baseline technology emissions
   5.93 g/bhp-hr *18.5 bhp-hr/gal *4,500 gal*(ton/907,200 g) = 0.54 tons/yr NOx
2. Annual NOx reduced technology emissions
   4.15 g/bhp-hr *18.5 bhp-hr/gal *4,500 gal*(ton/907,200 g) = 0.38 tons/yr NOx
3. Annual ROG baseline technology emissions
   0.38 g/bhp-hr *18.5 bhp-hr/gal *4,500 gal*(ton/907,200 g) = 0.03 tons/yr ROG
4. Annual ROG reduced technology emissions
   0.12 g/bhp-hr *18.5 bhp-hr/gal *4,500 gal*(ton/907,200 g) = 0.01 tons/yr ROG
5. Annual PM10 baseline technology emissions
   0.120 g/bhp-hr *18.5 bhp-hr/gal *4,500 gal*(ton/907,200 g) = 0.011 tons/yr PM10
6. Annual PM10 reduced technology emissions
   0.088 g/bhp-hr *18.5 bhp-hr/gal *4,500 gal*(ton/907,200 g) = 0.008 tons/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases
- Emission benefits NOx = 0.54 tons/yr - 0.38 tons/yr = 0.16 tons/yr NOx
- Emission benefits ROG = 0.03 tons/yr - 0.01tons/yr = 0.02 tons/yr ROG
- Emission benefits PM10 = 0.011 tons/yr -0.008 tons/yr = 0.003 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
0.16 tons/yr + 0.02 tons/yr + 20(0.003 tons/yr) = 0.24 weighted tons/yr

Annualized Cost:
Project Life: 7 years
CRF (Table B-1): = 0.167

Formula C-14: Incremental Cost
$35,000 - $7,000 = $28,000

Formula C-12: Annualized Cost
0.167 * $28,000 = $4,676

Cost-Effectiveness:

Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
($4,676/yr/ (0.24 weighted tons/yr)
= $19,483/tons of weighted surplus emissions reduced

The cost-effectiveness for this example is greater than the $14,300 per weighted ton cost-effectiveness requirement. In order to meet the $14,300 per weighted ton cost-effectiveness requirement, this project would only qualify for a fraction of the incremental cost $20,551. This amount is determined by multiplying the maximum allowed cost --effectiveness by the estimated annual emission reductions and divided by the capital recovery factor:

($14,300 * 0.24)/0.167 = $20,551

Example 4 – Retrofit of a Tier 1 Engine with a Level 2 DECS

A Level 2 diesel oxidation catalyst with emulsified fuel has been verified for use on a yard tractor with a Tier 1 110 hp 2002 Case 4TA-390 engine. The cost of installing the retrofit is $2,000 and is verified for 50 percent reductions of PM10 and 15 percent reductions of NOx. The yard tractor consumes 5,000 gallons of fuel per year. There is an incremental cost for the fuel of $0.20/ gallon that is eligible for funding with match funds by the district. The incremental cost was calculated with information provided from the applicant (i.e. quote from distributor). Retrofit projects have a maximum project life of 5 years.

Baseline Technology Information:

- Engine: 2002 Case 4TA-390
- Gallons consumed (application): 5,000 gal/yr
- Cost: $0
- Energy consumption factor: 18.5 bhp-hr/gal
- Emission factors (Table B-12): 6.54 g/bhp-hr NOx; 0.304 g/bhp-hr PM10

Reduced Technology Information:

- Level 2 verified reductions: 15 percent NOx; 50 percent PM10
- Cost of retrofit (quote provided with application): $2,000
- Percent operating in California (application): 100 percent

Emission Reduction Calculations:

Formula C-6: Estimated Annual Emissions based on Fuel Consumption using Emission Factors or Converted Emission Standard (tons/yr)

1. Annual NOx baseline technology emissions
   6.54 g/bhp-hr * 5,000 gal* 18.5 bhp-hr/gal *(ton/907,200 g) = 0.67 tons/yr NOx
2. Annual PM10 baseline technology emissions
   0.304 g/bhp-hr * 5,000 gal * 18.5 bhp-hr/gal *(ton/907,200 g) = 0.031 tons/yr PM10

Formula C-11: Annual Surplus Emission Reductions by Pollutant (tons/yr) for retrofits

- 0.67 tons/yr * 0.15 = 0.10 tons/yr NOx
- 0.031 tons/yr * 0.50 = 0.016 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
0.10 tons/yr + 0 tons/yr + 20(0.016 tons/yr) = 0.42 weighted tons/yr

Annualized Cost:
Project Life: 5 years
CRF (Table B-1): = 0.225

Formula C-14: Incremental Cost
$2,000 - $0 = $2,000

Formula C-12: Annualized Cost
0.225 * $2,000 = $450

Cost-Effectiveness:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
($450/yr)/(0.42 weighted tons/yr)
= $1,071/tons of weighted surplus emissions reduced

Calculations with incremental cost of fuel paid for with district funds (if district chooses to provide funding for increased fuel cost)

5,000 gal/ yr * 5 years project life * $0.20/gal = $5,000

District may pay up to $5,000 for incremental cost of fuel.

Annualized Cost:
Project Life: 5 years
CRF (Table B-1): = 0.225

Formula C-14: Incremental Cost
($2,000 + $5,000) - $0 = $7,000

Formula C-12: Annualized Cost
0.225 * $7,000 = $1,575

Cost-Effectiveness:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
($1,575/yr)/(0.34 weighted tons/yr)
= $4,632/tons of weighted surplus emissions reduced

VI. Large Spark-Ignition Off-Road Equipment

Example calculations will be included once project criteria are developed.

VII. Ground Support Equipment

Sample calculations will be added once project criteria are developed.

VIII. Locomotives

This section provides four examples of calculations for determining cost-effectiveness of surplus emission reductions for locomotive projects.

A. General Criteria for Locomotive Cost-Effectiveness Calculations

- Baseline emissions for a locomotive engine repower are based upon federal emission requirements for engine remanufacture (see Chapter VIII, Section III) and the corresponding emission rates in Table B-16. Baseline costs for a locomotive engine repower equal the actual remanufacture cost or $50,000, whichever is greater.

- For the purposes of the Carl Moyer Program, an alternative technology switcher is defined as a hybrid (e.g., Green Goat) or multiple engine switcher in which an existing locomotive chassis is significantly refurbished with a new engine, brakes, electronic controls, and/or other equipment. An alternative technology switcher must meet Tier 2 locomotive emission standards and achieve a NOx emission rate of no greater than 5.67 g/bhp-hr. An alternative technology switcher project is considered a new locomotive purchase.

- Baseline emissions for an alternative technology switcher project reflect Tier 0 emission rates for Class I locomotives and uncontrolled emission rates for Class III locomotives. The cost of an alternative technology switcher eligible for Carl Moyer Program funding shall not exceed 60 percent of the total cost of the new switcher for Class I locomotives, and 80 percent of the total cost of the new switcher for Class III locomotives.

- Baseline emissions and costs for a new locomotive purchase project which is not an alternative technology switcher reflect Tier 2 emission rates and the cost of a new Tier 2 locomotive, respectively.

- Locomotive repower or ILD projects must achieve a 15 percent NOx reduction beyond existing emission levels.

- All locomotive purchase and repower projects (except alternative technology switchers) must include purchase and installation of an automatic engine start-stop (AESS) ILD to reduce unnecessary engine idling if the locomotive is not already equipped with such a device and AESS installation is technically feasible.

- If not already required by a rule, regulation, MOU, or other legal mandate, the purchase and installation cost of an AESS is eligible for Carl Moyer Program funding, subject to the following limitations:

  - The Carl Moyer Program may provide actual equipment costs up to a maximum of $8,000 for a locomotive-specific AESS.

  - The Carl Moyer Program may provide the lower amount of actual installation costs of the AESS, up to a maximum of $3,400.
  - AESS emission reductions are calculated by applying the ILD emission reduction factors in Table B-17 to the reduced engine emissions.

- Because of uncertainty in locomotive load factors, locomotive project activity must be based upon annual fuel consumption.

- The energy consumption rate for a locomotive engine is 20.8 bhp-hr per gallon. The energy consumption rate for an on- or off-road engine used in a locomotive application is 18.5 bhp-hr per gallon.

- Class I freight locomotive projects must have a minimum project life of ten years. All other locomotive projects have a minimum project life of three years.

- The maximum project life for a locomotive project is 20 years.

- The baseline emission rates used to determine emission reductions and cost-effectiveness for locomotives subject to the South Coast MOU reflect the Tier 2 locomotive emission factors for line-haul and switch locomotives identified in Table B-16.

- Baseline activity for a new locomotive purchase should reflect fuel consumption of an existing locomotive or locomotives with similar functions and characteristics. For example, if the new switch locomotive is intended to replace the activity of an existing switch locomotive in the same rail yard, annual fuel consumption is based upon that of the existing switcher. For alternative technology locomotive projects, if the baseline locomotive activity derives from locomotives without a functioning ILD, the ILD emission reduction factor is applied to the new locomotive emission calculations. The ILD emission reduction factor is found in Table B-17. Examples 3 and 4 utilize estimated locomotive activity for a new locomotive purchase.

- The ILD factor is applied to locomotive activity in order to reflect the benefits of reduced idling. The ILD factor is also applied under certain circumstances to reflect the reduced engine idling associated with advanced locomotive technology projects (See previous bullet). Finally, the ILD factor is applied to Class I locomotive baseline emission calculations, if the baseline locomotive does not have a functioning ILD and baseline fuel consumption does not reflect ILD usage. Use of the ILD factor is necessary in this final circumstance because, as signatories to the Statewide Locomotive MOU, Class I railroads will be required to install an ILD on virtually all their locomotives.

B. Examples

Example 1 – Switch Locomotive Engine Repower (Class III Railroad)
A Class III railroad operator opts to replace an existing 1971 model year switch locomotive engine with a 2006 model year locomotive engine. The existing locomotive consumes 40,000 gallons of fuel per year. The cost to rebuild the existing engine is \$48,000, while the cost to purchase and install the new engine is \$350,000. The cost to purchase an automatic engine start-stop ILD is \$8,000, while installation of the device costs \$3,000. The railroad company will commit to a 10 year project life. Emission reductions are calculated as follows:

Baseline Technology Information:
- Locomotive model year (application): 1971
- Locomotive emission rate (Table B-16): 15.66 g/bhp-hr NOx, 0.99 g/bhp-hr ROG, 0.396 g/bhp-hr PM10
- Activity (application): 40,000 gal/year
- Energy consumption factor = 20.8 bhp-hr/gal

Reduced Technology Information:
- Engine model year (application): 2006
- Emission rate (Table B-16): 6.57 g/bhp-hr NOx, 0.51 g/bhp-hr ROG, 0.189 g/bhp-hr PM10
- Activity (application): 40,000 gal/year
- Energy consumption factor = 20.8 bhp-hr/gal
- ILD emission reduction factor (Table B-17): 0.90

Emission Reduction Calculations:
Formula C-6: Estimated Annual Emissions based on Fuel Consumed using Emission Factors or Converted Emission Standard (tons/yr):

1. Annual NOx baseline technology emissions
(15.66 g/bhp-hr*40,000 gal/yr*20.8 bhp-hr/gal)*(ton/907,200g)
= 14.36 ton/yr NOx
2. Annual NOx reduced technology emissions
(6.57 g/bhp-hr*40,000 gal/yr*20.8 bhp-hr/gal*0.90)*(ton/907,200g)
= 5.42 ton/yr NOx
3. Annual ROG baseline technology emissions
(0.99 g/bhp-hr *40,000 gal/yr*20.8 bhp-hr/gal)*(ton/907,200g)
= 0.91 ton/yr ROG
4. Annual ROG reduced technology emissions
(0.51 g/bhp-hr*40,000 gal/yr*20.8 bhp-hr/gal *0.90)*(ton/907,200g)
= 0.42 ton/yr ROG
5. Annual combustion PM10 baseline technology
(0.396 g/bhp-hr*40,000 gal/yr*20.8 bhp-hr/gal)*(ton/907,200g)
= 0.363 ton/yr PM10

6. Annual combustion PM10 reduced technology emissions
(0.189 g/bhp-hr*40,000 gal/yr*20.8 bhp-hr/gal *0.90)*(ton/907,200g)
= 0.156 ton/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases

- NOx emission benefits = 14.36 tons/yr – 5.42 tons/yr = 8.94 tons/yr NOx
- ROG emission benefits = 0.91 tons/yr - 0.42 tons/yr = 0.49 tons/yr ROG
- PM10 emission benefits= 0.363 tons/yr - 0.156 tons/yr = 0.207 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
8.94 tons/yr + 0.49 tons/yr + 20(0.207 tons/yr) = 13.57 weighted tons/yr

Annualized Cost:
Project Life: 10 years
CRF (Table B-1): = 0.123

Formula C-14: Incremental Cost
($350,000 + $11,000) - $50,000 = $311,000

Formula C-12: Annualized Cost
0.123 * $311,000 = $38,253/yr

Cost-Effectiveness:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
($38,253/yr)/(13.57 weighted tons/yr)
= $2,819/tons of weighted surplus emissions reduced

Example 2 – Line-Haul Locomotive Engine Repower (Class I Railroad)
A Class I railroad operator opts to replace his existing 1976 line-haul locomotive engine with a 2006 model year locomotive engine. Based on the fuel receipts, it is determined that the existing and new locomotive engines will consume 75,000 gallons of fuel per year. The cost to rebuild the existing engine is $65,000, while the cost of the new engine plus installation is $390,000. The locomotive is not equipped with an ILD. The railroad will have to install an ILD as a signatory to the Statewide MOU; this aspect of the project is therefore not eligible for Carl Moyer Program funding. The railroad will commit to a 20 year project life. Emission reductions are calculated as follows:

Baseline Technology Information:

- Locomotive model year (application): 1976
- Emission rate (Table B-16): 7.74 g/bhp-hr NOx, 0.47 g/bhp-hr ROG, 0.288 g/bhp-hr PM10
- Activity (application): 75,000 gal/year
- Energy consumption factor = 20.8 bhp-hr/gal
- ILD emission reduction factor(Table B-17): 0.97

Reduced Technology Information:

- Engine model year (application): 2006
- Emission rate (Table B-16): 4.50 g/bhp-hr NOx, 0.26 g/bhp-hr ROG, 0.153 g/bhp-hr PM10
- Activity (application): 75,000 gal/year
- Energy consumption factor = 20.8 bhp-hr/gal
- ILD emission reduction factor (Table B-17): 0.97

Emission Reduction Calculations:

Formula C-6: Estimated Annual Emissions based on Fuel Consumed using Emission Factors or Converted Emission Standard (tons/yr):

1. Annual NOx baseline technology emissions
   (7.74 g/bhp-hr * 20.8 bhp-hr/gal * 75,000 gal/yr * 0.97) *(ton/907,200g)
   = 12.91 ton/yr NOx
2. Annual NOx reduced technology emissions
   (4.50 g/bhp-hr * 20.8 bhp-hr/gal * 75,000 gal/yr* 0.97) *(ton/907,200g)
   = 7.51 ton/yr NOx
3. Annual ROG baseline technology emissions
   (0.47 g/bhp-hr * 20.8 bhp-hr/gal * 75,000 gal/yr * 0.97) *(ton/907,200g)
   = 0.78 ton/yr ROG
4. Annual ROG reduced technology emissions
   (0.26 g/bhp-hr * 20.8 bhp-hr/gal * 75,000 gal/yr* 0.97) *(ton/907,200g)
   = 0.43 ton/yr ROG
5. Annual combustion PM10 baseline technology
   (0.288 g/bhp-hr * 20.8 bhp-hr/gal * 75,000 gal/yr * 0.97) *(ton/907,200g)
   = 0.480 ton/yr PM10
6. Annual combustion PM10 reduced technology emissions
   (0.153 g/bhp-hr * 20.8 bhp-hr/gal * 75,000 gal/yr* 0.97) *(ton/907,200g)
   = 0.255 ton/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases

- Emission benefits NOx = 12.91 tons/yr - 7.51 tons/yr = 5.40 tons/yr NOx
- Emission benefits ROG = 0.78 tons/yr - 0.43 tons/yr = 0.35 tons/yr ROG
- Emission benefits PM10 = 0.480 tons/yr - 0.255 tons/yr = 0.225 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions

5.40 tons/yr + 0.35 tons/yr + 20(0.225 tons/yr) = 10.25 weighted tons/yr

Annualized Cost:

Project Life: 20 years

CRF (Table B-1): = 0.074

Formula C-14: Incremental Cost

$390,000 - $65,000 = $325,000

Formula C-12: Annualized Cost
0.074 * $325,000 = $24,050/yr

Cost-Effectiveness:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
($24,050/yr)/(10.25 weighted tons/yr)
= $2,346/tons of weighted surplus emissions reduced

Example 3 – Hybrid Switch Locomotive Purchase (Class I Railroad)
A Class I railroad has the opportunity to purchase a locomotive frame refurbished with an 800 horsepower Tier 2 certified off-road engine. Because the project is a hybrid locomotive project, involves significantly refurbishing the existing locomotive frame with a new battery and other equipment, meets Tier 2 locomotive emission standards and emits NOx at a rate over 30 percent below the Tier 2 locomotive emission standard, the project is considered a new locomotive purchase. Based on fuel consumption data from other switchers at the rail yard where the locomotive is to be deployed, the locomotive is projected to consume 45,000 gallons per year. The cost of the locomotive project is $1.1 million. The project life is 10 years. Emission reductions are calculated as follows:

Baseline Technology Information:
- Baseline locomotive model year: none
- Baseline emission rates (reflect locomotive Tier 0 emission factors, Table B-16): 11.34 g/bhp-hr NOx, 0.99 g/bhp-hr ROG, 0.396 g/bhp-hr PM
- Activity (application): 45,000 gal/year
- Energy consumption factor = 20.8 bhp-hr/gal
- ILD emission reduction factor (Table B-17): 0.90

Reduced Technology Information:
- Engine model year: 2006
- Reduced emission rates (reflect off-road Tier 2 emission factors, Table B-12): 3.87 g/bhp-hr NOx, 0.12 g/bhp-hr ROG, 0.088 g/bhp-hr PM10
- Activity (application): 45,000 gal/year
- Energy consumption factor = 18.5 bhp-hr/gal
- ILD emission reduction factor (Table B-17): 0.90

Emission Reduction Calculations:
Formula C-6: Estimated Annual Emissions based on Fuel Consumed using Emission Factors or Converted Emission Standard (tons/yr):
1. Annual NOx baseline technology emissions
   (11.34 g/bhp-hr * 45,000 gal/yr * 20.8 bhp-hr/gal * 0.90) *(ton/907,200g)
   = 10.53 ton/yr NOx
2. Annual NOx reduced technology emissions
   (3.87 g/bhp-hr * 45,000 gal/yr * 18.5 bhp-hr/gal * 0.90) *(ton/907,200g)
   = 3.20 ton/yr NOx

3. Annual ROG baseline technology emissions
   (0.99 g/bhp-hr * 45,000 gal/yr * 20.8 bhp-hr/gal * 0.90) *(ton/907,200g)
   = 0.92 ton/yr ROG
4. Annual ROG reduced technology emissions
   (0.12 g/bhp-hr * 45,000 gal/yr * 18.5 bhp-hr/gal * 0.90) *(ton/907,200g)
   = 0.10 ton/yr ROG
5. Annual combustion PM10 baseline technology
   (0.396 g/bhp-hr * 45,000 gal/yr * 20.8 bhp-hr/gal * 0.90) *(ton/907,200g)
   = 0.368 ton/yr PM10
6. Annual combustion PM10 reduced technology emissions
   (0.088 g/bhp-hr * 45,000 gal/yr * 18.5 bhp-hr/gal * 0.90) *(ton/907,200g)
   = 0.073 ton/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases

- Emission benefits NOx = 10.53 tons/yr – 3.20 tons/yr = 7.33 tons/yr NOx
- Emission benefits ROG = 0.92 tons/yr - 0.10 tons/yr = 0.82 tons/yr ROG
- Emission benefits PM10 = 0.368 tons/yr - 0.073 tons/yr = 0.295 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
7.33 tons/yr + 0.82 tons/yr + 20(0.295 tons/yr) = 14.05 weighted tons/yr

<u>Annualized Cost:</u>
Project Life: 10 years
CRF (Table B-1): = 0.123

Formula C-14: Incremental Cost
$1,100,000 * 0.60 = $660,000

Formula C-12: Annualized Cost
0.123 * $660,000 = $81,180/yr

<u>Cost-Effectiveness:</u>
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
($81,180/yr)/(14.05 weighted tons/yr)
= $5,778/tons of weighted surplus emissions reduced

Example 4 – Multiple Engine Switcher Purchase (Class III Railroad)
A Class III railroad operator has the opportunity to purchase a switch locomotive with three Tier 3 certified 700 horsepower off-road engines. Because this is a switcher with new electronics, a new battery, and other components, which meets Tier 2 locomotive emission standards and which emits NOx at a level at least 30 percent below the Tier 2 locomotive emission standard, the project is evaluated as a new locomotive purchase. Fuel receipts indicate switch locomotives in the rail yard not equipped with an ILD consume 45,000 gallons of fuel per year. The cost of the new multiple engine switcher is $975,000. The project life is 5 years. Emission reductions are calculated as follows:

Baseline Technology Information:

- Locomotive model year: none
- Locomotive emission rate (uncontrolled, Table B-16): 15.66 g/bhp-hr NOx, 0.99 g/bhp-hr ROG, 0.396 g/bhp-hr PM10
- Activity (application): 45,000 gal/year
- Energy consumption factor = 20.8 bhp-hr/gal

Reduced Technology Information:

- Engine model year: 2006
- Emission rates (reflect off-road Tier 3 emission factors, Table B-12): 2.32 g/bhp-hr NOx, 0.12 g/bhp-hr ROG, 0.088 g/bhp-hr PM10
- Activity (application): 45,000 gal/year
- Energy consumption factor = 18.5 bhp-hr/gal
- ILD emission reduction factor (Table B-17): 0.90

Emission Reduction Calculations:

Formula C-6: Estimated Annual Emissions based on Fuel Consumed using Emission Factors or Converted Emission Standard (tons/yr):

1. Annual NOx baseline technology emissions
   (15.66 g/bhp-hr * 45,000 gal/yr * 20.8 bhp-hr/gal) *(ton/907,200g)
   = 16.16 ton/yr NOx
2. Annual NOx reduced technology emissions
   (2.32 g/bhp-hr * 45,000 gal/yr * 18.5 bhp-hr/gal * 0.90) *(ton/907,200g)
   = 1.92 ton/yr NOx
3. Annual ROG baseline technology emissions
   (0.99 g/bhp-hr * 45,000 gal/yr * 20.8 bhp-hr/gal) *(ton/907,200g)
   = 1.02 ton/yr ROG
4. Annual ROG reduced technology emissions
   (0.12 g/bhp-hr * 45,000 gal/yr * 18.5 bhp-hr/gal * 0.90) *(ton/907,200g)
   = 0.10 ton/yr ROG
5. Annual combustion PM10 baseline technology
   (0.396 g/bhp-hr * 45,000 gal/yr * 20.8 bhp-hr/gal) *(ton/907,200g)
   = 0.409 ton/yr PM10
6. Annual combustion PM10 reduced technology emissions
   (0.088 g/bhp-hr * 45,000 gal/yr * 18.5 bhp-hr/gal * 0.90) *(ton/907,200g)
   = 0.073 ton/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases

- Emission benefits NOx = 16.16 tons/yr – 1.92 tons/yr = 14.24 tons/yr NOx
- Emission benefits ROG = 1.02 tons/yr – 0.10 tons/yr = 0.92 tons/yr ROG
- Emission benefits PM10 = 0.409 tons/yr – 0.073 tons/yr = 0.336 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions

14.24 tons/yr + 0.92 tons/yr + 20(0.336 tons/yr) = 21.88 weighted tons/yr

<u>Annualized Cost:</u>
Project Life: 5 years
CRF (Table B-1): = 0.225

Formula C-14: Incremental Cost
$975,000 * 0.80 = $780,000

Formula C-12: Annualized Cost
0.225 * $780,000 = $175,500/yr

<u>Cost-Effectiveness:</u>
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
($175,500/yr)/(21.88 weighted tons/yr)
= $8,021/tons of weighted surplus emissions reduced

IX. Marine Vessels

This section provides three examples of calculations for determining the cost-effectiveness of surplus emission reductions for marine vessel projects.

A. General Criteria for Marine Vessel Cost-Effectiveness Calculations

- Engines on marine vessels with wet exhaust systems are eligible for Carl Moyer Program funding if the project vessel meets all other applicable program requirements. The wet exhaust systems themselves are not eligible for Carl Moyer Program funding. A wet exhaust factor of 0.80 must be applied to the baseline and reduced emission propulsion and auxiliary engine emission calculations for all projects on vessels with wet exhaust systems.

- Projects must have a minimum project life of three years.

- The maximum project life for marine vessel projects (equivalent to the average engine life reported by U.S. EPA) is as follows:

Engine displacement ≤5.0 liter/cyl.	16 years
Engine displacement >5.0 liter/cyl.	23 years
Auxiliary engines	17 years

B. Examples

Example 1 – Tugboat Propulsion Engine Repower

A tugboat operator wishes to replace a 1975 model year 1,200 horsepower tugboat propulsion engine during the normal overhaul period with a 2006 model year 1,200 horsepower engine. Both engines have a displacement of 7.0 liters per cylinder. The operator documents that the vessel consumes 95,000 gallons of fuel annually within California Coastal Waters. The cost to rebuild the old engine is $100,000. The cost to purchase and install the new engine and new GPS unit on the vessel are $250,000 and $2,500, respectively. The operator commits to a 5 year project life. Emission reductions are calculated as follows:

<u>Baseline Technology Information:</u>

- Baseline technology (application): 1975
- Engine horsepower (application): 1,200 hp
- Engine emission rate (Table B-18): 11.16 g/bhp-hr NOx, 1.14 g/bhp-hr ROG, 0.382 g/bhp-hr PM10
- Activity (application): 95,000 gal/yr
- Engine displacement (application): 7.0 liters/cylinder
- Fuel consumption rate (Table B-20): 20.8 bhp-hr/gal

<u>Reduced Technology Information:</u>

- Reduced technology (application): 2005
- Engine horsepower (application) = 1,200 hp

- Engine emission rate (Table B-18): 7.60 g/bhp-hr NOx, 0.82 g/bhp-hr ROG, 0.274 g/bhp-hr PM10
- Activity (application): 95,000 gal/yr
- Fuel consumption rate (Table B-20): 20.8 bhp-hr/gal

<u>Emission Reduction Calculations:</u>
Formula C-6: Estimated Annual Emissions based on Fuel Consumed using Emission Factors or Converted Emission Standards (tons/yr)

1. Annual NOx baseline technology emissions
   (11.16 g/bhp-hr)(95,000 gal/yr)(20.8 bhp-hr/gal)(ton/907,200 g)
   = 24.31 ton/yr NOx
2. Annual NOx reduced technology emissions
   (7.60 g/bhp-hr * 95,000 gal/yr * 20.8 bhp-hr/gal)(ton/907,200 g)
   = 16.55 ton/yr NOx
3. Annual ROG baseline technology emissions
   (1.14 g/bhp-hr * 95,000 gal/yr * 20.8 bhp-hr/gal)(ton/907,200 g)
   = 2.48 ton/yr ROG
4. Annual ROG reduced technology emissions
   (0.82 g/bhp-hr * 95,000 gal/yr * 20.8 bhp-hr/gal)(ton/907,200 g)
   = 1.79 ton/yr ROG
5. Annual PM10 baseline technology emissions
   (0.382 g/bhp-hr * 95,000 gal/yr * 20.8 bhp-hr/gal)(ton/907,200 g)
   = 0.832 ton/yr PM10
6. Annual PM10 reduced technology emissions
   (0.274 g/bhp-hr * 95,000 gal/yr * 20.8 bhp-hr/gal)(ton/907,200 g)
   = 0.597 ton/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases

- NOx emission reductions = 24.31 tons/yr – 16.55 tons/yr = 7.76 tons/yr NOx
- ROG emission reductions = 2.48 tons/yr – 1.79 tons/yr = 0.69 tons/yr ROG
- PM10 emission reductions = 0.832 tons/yr – 0.597 tons/yr= 0.235 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
7.76 + 0.69 +20(0.235) = 13.15 weighted tons/yr

<u>Annualized Cost:</u>
Project life = 5 years
CRF (Table B-1) = 0.225

Formula C-14: Incremental Cost
($250,000 + $2,500) - $100,000 = $152,500

Formula C-12: Annualized Cost
($152,500 * 0.225) = $34,312/yr

Cost-Effectiveness:
Formula C-1: Cost-Effectiveness of Surplus Emission Reductions
($34,312/year)/(13.15 weighted tons/yr)
= $2,609/ton of weighted surplus emissions reduced

Example 2 – Fishing Vessel Auxiliary Engine Repower
A charter fishing vessel owner wishes to repower a 125 horsepower 1985 auxiliary engine with a new 2005 model year 200 horsepower engine. The new engine has a displacement 1.3 liters per cylinder. The vessel owner has documented that the vessel auxiliary engine operates for 900 hours annually in California waters. The cost to rebuild the existing engine is $2,600. The cost to purchase and install a new engine and GPS unit is $52,500. The applicant will commit to a 10 year project life. Emission reductions are calculated as follows:

Baseline Technology Information:
- Baseline technology (application): 1985
- Engine horsepower (application): 125 hp
- Engine emission rate (Table B-18): 10.23 g/bhp-hr NOx, 1.06 g/bhp-hr ROG, 0.396 g/bhp-hr PM10
- Activity (application): 900 hr/yr
- Engine load factor (Table B-19): 0.43

Reduced Technology Information:
- Reduced technology (application): 2005
- Engine horsepower (application) = 200 hp
- Emission rate (Table B-18): 4.17 g/bhp-hr NOx, 0.39 g/bhp-hr ROG, 0.160 g/bhp-hr PM10
- Activity (application): 900 hr/yr
- Engine displacement (application) = 1.3 liters per cylinder
- Load adjustment (*Formula C-5: Replacement Load Factor*):
  = 0.43*(125 hp/200 hp) = 0.27

Emission Reduction Calculations:
Formula C-4: Estimated Annual Emissions based on Hours of Operation (tons/yr)
1. Annual NOx baseline technology emissions
   (10.23 g/bhp-hr * 900 hr/yr * 125 hp * 0.43)(ton/907,200 g)
   = 0.55 ton/yr NOx
2. Annual NOx reduced technology emissions
   (4.17 g/bhp-hr * 900 hr/yr * 200 hp * 0.27)(ton/907,200 g)
   = 0.22 ton/yr NOx
3. Annual ROG baseline technology emissions
   (1.06 g/bhp-hr * 900 hr/yr * 125 hp * 0.43)(ton/907,200 g)
   = 0.06 ton/yr ROG
4. Annual ROG reduced technology emissions
   (0.39 g/bhp-hr * 900 hr/yr * 200 hp * 0.27)(ton/907,200 g)
   = 0.02 ton/yr ROG

5. Annual PM10 baseline technology emissions
   (0.396 g/bhp-hr * 900 hr/yr * 125 hp * 0.43)(ton/907,200 g
   = 0.021 ton/yr PM10
6. Annual PM10 reduced technology emissions
   (0.14 g/bhp-hr * 900 hrs/year * 200 hp * 0.27)(ton/907,200 g)
   = 0.008 ton/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases

- NOx emission reductions = 0.55 tons/yr – 0.22 tons/yr = 0.33 tons/yr NOx
- ROG emission reductions = 0.06 tons/yr – 0.02 tons/yr = 0.04 tons/yr ROG
- PM10 emission reductions = 0.021 tons/yr – 0.008 tons/yr= 0.013 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions

0.33 tons/yr + 0.04 tons/yr + 20(0.013 tons/yr) = 0.63 weighted tons/yr

Annualized Cost:

Project life = 10 years

CRF (Table B-1) = 0.123

Formula C-14: Incremental Cost

$52,500 - $2,600 = $49,900

Formula C-12: Annualized Cost

($49,900 * 0.123) = $6,137/yr

Cost-Effectiveness:

Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)

($6,137/year)/ (0.63 weighted tons/yr)

= $9,741/ton of weighted surplus emissions reduced

Example 3 – Fishing Vessel Propulsion Engine Repower (Wet Exhaust System)

A commercial fishing vessel owner wishes to repower a 1973 250 horsepower propulsion engine with a new 2006 model year 250 horsepower engine. The existing and replacement engines both have a displacement of 1.4 liters per cylinder. The vessel has a wet exhaust system. The vessel owner has documented that the vessel propulsion engine consumes 24,000 gallons of fuel annually in California waters. The cost to rebuild the existing engine is $3,250. The cost to purchase and install a new engine is $51,300. The vessel will be outfitted with a new GPS unit for $2,300. The applicant will commit to a 5 year project life. Emission reductions are calculated as follows:

Baseline Technology Information:

- Baseline technology (application): 1973
- Engine horsepower (application): 250 hp

- Engine emission rate (Table B-18): 11.16 g/bhp-hr NOx, 1.14 g/bhp-hr ROG, 0.396 g/bhp-hr PM10
- Activity (application): 24,000 gal/yr
- Engine displacement (application): 1.4 liters/cylinder
- Fuel consumption rate (Table B-20): 18.5 bhp-hr/gal
- Wet exhaust emission factor (default): 0.80

<u>Reduced-Emission Technology Information:</u>
- Reduced technology (application): 2006
- Engine horsepower (application): 250 hp
- Emission rate (Table B-18): 4.17 g/bhp-hr NOx, 0.39 g/bhp-hr ROG, 0.160 g/bhp-hr PM10
- Activity (application): 24,000 gal/yr
- Engine displacement (application): 1.4 liters per cylinder
- Fuel consumption rate (Table B-20): 18.5 bhp-hr/gal
- Wet exhaust emission factor (default) = 0.80

<u>Emission Reduction Calculations:</u>
Formula C-6: Estimated Annual Emissions based on Fuel Consumed using Emission Factors or Converted Emission Standard (tons/yr)

1. Annual NOx baseline technology emissions
   (11.16 g/bhp-hr * 24,000 gal/yr * 18.5 bhp-hr/gal * 0.80)(ton/907,200 g)
   = 4.30 ton/yr NOx
2. Annual NOx reduced technology emissions
   (4.17 g/bhp-hr * 24,000 gal/yr * 18.5 bhp-hr/gal * 0.80)(ton/907,200 g)
   = 1.63 ton/yr NOx
3. Annual ROG baseline technology emissions
   (1.14 g/bhp-hr * 24,000 gal/yr * 18.5 bhp-hr/gal * 0.80)(ton/907,200 g)
   = 0.45 ton/yr ROG
4. Annual ROG reduced technology emissions
   (0.39 g.bhp-hr * 24,000 gal/yr * 18.5 bhp-hr/gal * 0.80)(ton/907,200 g)
   = 0.15 ton/yr ROG
5. Annual PM10 baseline technology emissions
   (0.396 g/bhp-hr * 24,000 gal/yr * 18.5 bhp-hr/gal * 0.80)(ton/907,200 g)
   = 0.155 ton/yr PM10
6. Annual PM10 reduced technology emissions
   (0.160 g/bhp-hr * 24,000 gal/yr * 18.5 bhp-hr/gal * 0.80)(ton/907,200 g)
   = 0.063 ton/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant for Repowers and New Purchases

- NOx Emission Reductions = 4.30 tons/yr – 1.63 tons/yr = 2.67 tons/yr NOx
- ROG Emission Reductions = 0.45 tons/yr – 0.15 tons/yr = 0.30 tons/yr ROG
- PM10 Emission Reductions = 0.155 tons/yr – 0.063 tons/yr
  = 0.092 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
2.67 + 0.30 +20(0.092) = 4.81 weighted tons/yr

<u>Annualized Cost:</u>
Project life = 5 years
CRF (Table B-1) = 0.225

Formula C-14: Incremental Cost
($51,300 + 2,300) - $3,250 = $50,350

Formula C-12: Annualized Cost
$50,350 * 0.225 = $11,328/yr

<u>Cost Effectiveness:</u>
Formula C-1: Cost-Effectiveness of Surplus Emission Reductions
($11,328/year)/(4.81 weighted tons/yr) =
$2,355/ ton of weighted surplus emissions reduced

X. Agricultural Sources

This section provides three examples of calculations for determining the cost-effectiveness of surplus emission reductions for agricultural source projects.

A. General Criteria for Agricultural Source Cost-Effectiveness Calculations

- Projects must have a minimum project life of three years. ARB may approve a shorter project life on a case-by-case basis. Projects with shorter lives have be subject to additional funding restrictions, such as a lower cost-effectiveness limit or a project cost cap.

- The default project life when determining project benefits for new purchases to repowers shall be ten years for electric motors and for engines with documentation. The default project life for engines without documentation shall be seven years. A longer project life may be used with approval by ARB staff, however, sufficient documentation must be provided to ARB that supports the selected project life based on actual remaining useful life.

- In these calculations PM10 refers to combustion particulate matter.

- Emission reduction calculations may be based on hours of operation or on fuel usage.

- Baseline and reduced technology emission factors are listed in Table B-12 and B-14 of Appendix B.

- Load factors for selected equipment categories are in Table B-13 of Appendix B.

- For emission reduction calculations based on fuel usage, an energy consumption factor must be used. The default energy consumption factor for stationary agricultural irrigation pump engines greater than 50 hp is 17.56 bhp-hr/gal. An energy consumption factor may be calculated: 1) by dividing the horsepower rating of the engine by its fuel economy expressed in units of gallons per hour (gal/hr), or 2) by dividing the energy density of the fuel (in units of BTU/gal) by the brake-specific fuel consumption of the engine.

B. Examples

Example 1 - Repower (diesel to diesel) Based on Hours

Baseline Technology Information:

- Baseline technology (application): 1977 John Deere JD6466A
- Engine horsepower (application): 182 hp
- Activity (application): 3,000 hours per year

- Load factor (Table B-13): 0.65
- Emission factors (Table B-12): 11.16 g/bhp-hr NOx; 1.14 g/bhp-hr ROG; 0.396 g/bhp-hr PM10
- Baseline rebuild cost (quote provided with application): $3,500

<u>Reduced Technology Information:</u>
- Reduced technology (application): 2005 John Deere 6068HF275-225
- Engine horsepower (application): 184 hp
- Activity (application): 3,000 hr/yr
- Load factor (Table B-13): 0.65
- Emission factors (Table B-12): 4.15 g/bhp-hr NOx; 0.12 g/bhp-hr ROG; 0.088 g/bhp-hr PM10
- New engine cost (quote provided with application): $20,320 (includes hour meter)

<u>Emission Reduction Calculations</u>:
Formula C-4: Estimated Annual Emissions Based on Hours of Operation (tons/yr)
1. Annual NOx baseline technology emissions
   (11.16 g/bhp-hr * 182 hp * 0.65 * 3,000 hrs)(ton/907,200 g) = 4.37 tons/yr NOx
2. Annual NOx reduced technology emissions
   (4.15 g/bhp-hr * 184 hp * 0.65 * 3,000 hrs)(ton/907,200 g) = 1.64 tons/yr NOx
3. Annual ROG baseline technology emissions
   (1.14 g/bhp-hr * 182 hp * 0.65 * 3,000 hrs)(ton/907,200 g) = 0.45 tons/yr ROG
4. Annual ROG reduced technology emissions
   (0.12 g/bhp-hr * 184 hp * 0.65 * 3,000 hrs)(ton/907,200 g) = 0.05 tons/yr ROG
5. Annual PM10 baseline technology emissions
   (0.396 g/bhp-hr * 182 hp * 0.65 * 3,000 hrs)(ton/907,200 g) = 0.155 tons/yr PM10
6. Annual PM10 reduced technology emissions
   (0.088 g/bhp-hr * 184 hp * 0.65 * 3,000 hrs)(ton/907,200 g) = 0.035 tons/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases
- NOx emission benefits = 4.37 tons/yr – 1.64 tons/yr = 2.73 tons/yr NOx
- ROG emission benefits = 0.45 tons/yr – 0.05 tons/yr = 0.40 tons/yr ROG
- PM10 emission benefits = 0.155 tons/yr – 0.035 tons/yr = 0.120 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
2.73 tons/yr + 0.40 tons/yr + 20(0.120 tons/yr) = 5.53 weighted tons/yr

<u>Annualized Cost:</u>
Project life: 7 years
CRF (Table B-1): 0.167

Formula C-14: Incremental Cost
$20,320 - $3,500 = $16,820

Formula C-12: Annualized Cost
0.167 * $16,820 = $2,809/yr

Cost-Effectiveness:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions
($2,809/yr)/(5.53 weighted tons/yr)
= $508/tons of weighted surplus emissions reduced

The cost-effectiveness for this project is less than $14,300 per weighted ton of emissions reduced. This project qualifies for the maximum amount of grant funds requested.

Example 2 - Repower (diesel to diesel) Based on Fuel Use

Baseline Technology information:
- Baseline Technology (application): 1979 Cummins NTC 220
- Engine horsepower (application): 220 hp
- Annual fuel consumption (application): 8,000 gal/yr
- Energy consumption factor (default): 17.56 bhp-hr/gal
- Emission Factors (Table B-12): 11.16 g/bhp-hr NOx; 1.20 g/bhp-hr ROG; 0.396 g/bhp-hr PM1010
- Rebuild cost (quote provided with application): $2,500

Reduced Technology information:
- Reduced Technology (application): 2005 Case I-H PX190
- Engine horsepower (application): 190 hp
- Energy consumption factor (supplied by manufacturer): 20 bhp-hr/gal
- Annual fuel consumption (equation in bullets above): (17.56/20)bhp-hr/gal * 8,000 gal/yr = 7,024 gal/yr
- Emission Factors (Table B-12): 4.15 g/bhp-hr NOx; 0.12 g/bhp-hr ROG; 0.088 g/bhp-hr PM1010
- New engine cost (quote provided with application): $16,500 (includes hour meter)

Emission Reduction Calculations:
Formula C-6: Estimated Annual Emissions Based on Fuel Consumed using Emission Factors or Converted Emission Standard (tons/yr)
1. Annual NOx baseline technology emissions
   (11.16 g/bhp-hr * 17.56 bhp-hr/gal * 8,000 gal)(ton/907,200 g) = 1.73 tons/yr NOx
2. Annual NOx reduced technology emissions
   (4.15 g/bhp-hr * 20 bhp-hr/gal * 7,024 gal/yr)(ton/907,200 g) = 0.64 tons/yr NOx
3. Annual ROG baseline technology emissions
   (1.20 g/bhp-hr * 17.56 bhp-hr/gal * 8,000 gal)(ton/907,200 g) = 0.19 tons/yr ROG
4. Annual ROG reduced technology emissions
   (0.12 g/bhp-hr * 20 bhp-hr/gal * 7,024 gal/yr)(ton/907,200 g) = 0.02 tons/yr ROG
5. Annual PM10 baseline technology emissions
   (0.396 g/bhp-hr * 17.56 bhp-hr/gal * 8,000 gal)(ton/907,200 g) = 0.061 tons/yr PM10

6. Annual PM10 reduced technology emissions
   (0.088 g/bhp-hr * 20 bhp-hr/gal * 7,024 gal/yr)(ton/907,200 g) = 0.014 tons/yr PM10

Formula C-9: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases

- NOx emission benefits = 1.73 tons/yr – 0.64 tons/yr = 1.09 tons/yr NOx
- ROG emission benefits = 0.19 tons/yr – 0.02 tons/yr = 0.17 tons/yr ROG
- PM10 emission benefits = 0.061 tons/yr – 0.014 tons/yr = 0.047 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
1.09 tons/yr + 0.17 tons/yr + 20(0.047 tons/yr) = 2.20 weighted tons/yr

<u>Annualized Cost:</u>
Project life: 7 years
CRF (Table B-1): 0.167

Formula C-14: Incremental Cost
$16,500 - $2,500 = $14,000

Formula C-12: Annualized Cost
0.167 * $14,000 = $2,338/yr

<u>Cost-Effectiveness:</u>
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions
($2,338/yr)/(2.20 weighted tons/yr)
= $1,063/tons of weighted surplus emissions reduced

The cost-effectiveness for this project is less than $14,300 per weighted ton of emissions reduced. This project qualifies for the maximum amount of grant funds requested.

Example 3 – Natural Gas Repower Based on Hours

<u>Baseline Technology information:</u>

- Baseline Technology (application): 1980 Detroit Diesel 8V71
- Engine horsepower (application): 220 hp
- Activity (application): 2,000 hours per year
- Load factor (Table B-13): 0.65
- Emission Factors (Table B-12): 10.23 g/bhp-hr NOx; 1.08 g/bhp-hr ROG; 0.396 g/bhp-hr PM10
- Rebuild cost (quote provided with application): $6,000

<u>Reduced Technology information:</u>

- Reduced Technology (application): 2005 Cummins GTA 8.3
- Engine horsepower (application): 200 hp
- Activity (application): 2,000 hr/yr

- Load factor (Table B-13): 0.65
- Emission Factors (Table B-14): 1.58 g/bhp-hr NOx; 0.13 g/bhp-hr ROG; 0.060 g/bhp-hr PM10
- New engine cost (quote provided with application): $29,000 (includes hour meter)

<u>Emission Reduction Calculations:</u>
Formula C-4: Estimated Annual Emissions Based on Hours of Operation (tons/yr)

1. Annual NOx baseline technology emissions
   (10.23 g/bhp-hr * 220 hp * 0.65 * 2,000 hrs)(ton/907,200 g) = 3.23 tons/yr NOx
2. Annual NOx reduced technology emissions
   (1.58 g/bhp-hr * 200 hp * 0.65 * 2,000 hrs)(ton/907,200 g) = 0.45 tons/yr NOx
3. Annual ROG baseline technology emissions
   (1.08 g/bhp-hr * 220 hp * 0.65 * 2,000 hrs)(ton/907,200 g) = 0.34 tons/yr ROG
4. Annual ROG reduced technology emissions
   (0.13 g/bhp-hr * 200 hp * 0.65 * 2,000 hrs)(ton/907,200 g) = 0.04 tons/yr ROG
5. Annual PM10 baseline technology emissions
   (0.396 g/bhp-hr * 220 hp * 0.65 * 2,000 hrs)(ton/907,200 g) = 0.125 tons/yr PM10
6. Annual PM10 reduced technology emissions
   (0.060 g/bhp-hr * 200 hp * 0.65 * 2,000 hrs)(ton/907,200 g) = 0.017 tons/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases

- NOx emission benefits = 3.23 tons/yr – 0.45 tons/yr = 2.78 tons/yr NOx
- ROG emission benefits = 0.34 tons/yr – 0.04 tons/yr = 0.30 tons/yr ROG
- PM10 emission benefits = 0.125 tons/yr – 0.017 tons/yr = 0.108 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
2.78 tons/yr + 0.30 tons/yr + 20(0.108 tons/yr) = 5.24 weighted tons/yr

<u>Annualized Cost:</u>
Project life: 7 years
CRF (Table B-1): 0.167

Formula C-14: Incremental Cost
$29,000 - $6,000 = $23,000

Formula C-12: Annualized Cost
0.167 * $23,000 = $3,841/yr

<u>Cost-Effectiveness:</u>
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions
($3,841/yr)/(5.24 weighted tons/yr)
= $733/tons of weighted surplus emissions reduced

The cost-effectiveness for this project is less than $14,300 per weighted ton of emissions reduced. This project qualifies for the maximum amount of grant funds requested.

XI. Light-Duty Vehicles

This section provides an example calculation for determining the cost-effectiveness of surplus emission reductions for light-duty vehicle projects.

A. General Criteria for Light-Duty Vehicle Cost-Effectiveness Calculations

- Emission reductions from VAVR programs shall be calculated in accordance with the methodology specified in the ARB's VAVR regulations. Emission reductions, by model year of vehicle retired, are shown in Table 11-2. (The table is also included in Appendix B, Tables for Emission-Reduction and Cost-Effectiveness Calculations, at Table B-21.)

- The project life for a vehicle retirement project is three years as specified in the ARB's VAVR regulation.

- In calculating cost-effectiveness, the total cost is the full cost paid by the district using State funds (i.e, the total paid to the enterprise operator to retire a vehicle, not just the amount paid to the vehicle owner).

- Cost-effectiveness is calculated without interim rounding to the annualized cost or the annual weighted surplus emission reduction.

- For these calculations, PM10 refers to combustion PM10.

B. Examples

Example 1 - Voluntary Accelerated Vehicle Retirement Project
A district pays $750 to retire a 1980 model year light-duty vehicle during calendar year 2006. Please note that the cost of $750 is the total cost paid by the district with Carl Moyer Program or AB 923 funds to the enterprise operator to retire the vehicle, not just the amount paid to the vehicle owner.

<u>Emissions Reduction Calculations:</u>

Table B-21 lists the emission reductions over the 3 year project life in pounds.

- NOx emission benefit
  = 85 pounds over 3 years (from Table B-21)
  = (85 lb)/[(3 yrs)*(2000 lb/ton)] = 0.0142 tons/yr NOx

- ROG emission benefit
  = 129 pounds over 3 years (from Table B-21)
  = (129 lb)/[(3 yrs)*(2000 lb/ton)] = 0.0215 tons/yr ROG

- PM10 emission benefit
  = 1.13 pounds over 3 years (from Table B-21)
  = (1.13 lb)/[(3 yrs)*(2000 lb/ton)] = 0.000188 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions
0.0142 + 0.0215 + 20*(0.000188) = 0.0394 weighted tons/yr

Annualized Cost:

Project life: 3 years
CRF (Table B-1) = 0.360

Total cost: $750

Formula C-12: Annualized cost
0.360 * $750 = $270/yr

Cost-Effectiveness:

Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton)
($270/yr)/(0.0394 weighted tons/yr)
= $6,850/weighted ton of surplus emissions reduced

XII. Zero-Emission Technologies

This section provides several examples of calculations for determining the cost-effectiveness of surplus emission reductions for zero-emission projects.

A. General Criteria for Zero-Emission Technology Cost-Effectiveness Calculations

Electrically Driven Agricultural Pumps

- Agricultural pumps that use an electric motor may use a 10 year project life for calculating cost effectiveness.
- All electric-driven agricultural pumps must have a functioning kilowatt-hour meter, or other method approved by the local air district, to monitor usage.
- Participants in the PG&E/SCE rate incentive programs must use Tier 3 engine emission factors for calculating reduced technology emissions.
- Participants in the PG&E/SCE rate incentive programs may use one-half the rebuild cost for calculating incremental cost.
- Participants in the PG&E/SCE rate incentive programs that are replacing a baseline Tier 2 engine still under contract with the Carl Moyer Program may use zero rebuild cost for calculating incremental cost.
- For these calculations, PM10 refers to combustion PM10.
- The minimum project life is three years.

Electric Idle Reduction

- The actual capital cost, up to $5,500, of an APU may be funded.
- The installation cost of an APU, including installation of an hour meter, up to a maximum of $3,400 per electric motor or fuel cell APU may be funded.

B. Examples

Example 1 – Replacing a Diesel Pump Engine with a Electric Pump Motor: Not Participating in PG&E/SCE Incentive Program

An applicant wants to purchase a 2005 GE 5K445FT328, 100 hp (75 kW) electric pump motor to replace a 1991 Caterpillar 3116, 155 hp diesel pump engine with uncontrolled emissions. The motor costs $26,700; otherwise the applicant would have to rebuild the diesel engine at a cost of $7,000. On average, the applicant currently operates the diesel pump engine at 65 percent of the maximum load rating for 2,000 hours each year. The pump operates 100 percent of the time in California.

Baseline Technology Information:

- Engine (application): 1991 Caterpillar 3116, diesel off-road engine (uncontrolled)
- Engine HP (application): 155 hp
- Load factor (default for agricultural pumps): 0.65
- Activity (application): 2,000 hours per year
- Cost rebuild (quote provided with application): $7,000
- Emission factors (Table B-12): 7.60 g/bhp-hr NOx; 0.82 g/bhp-hr ROG; 0.274 g/bhp-hr PM10

Reduced Technology Information:

- Engine (application): 2005 GE 5K445FT328, electric motor
- Engine HP (application): 100 hp (75 kW)
- Activity (application): 2,000 hours per year
- Percent operate in California (application): 100 percent
- Cost of new equipment (quote provided with application): $26,700
- Emissions: 0 g/bhp-hr NOx; 0 g/bhp-hr ROG; 0 g/bhp-hr PM10

Emission Reduction Calculations:

Formula C-4: Estimated Annual Emissions Based on Hours of Operation

1. Annual NOx baseline technology emissions
   (7.60 g/hp-hr *155 hp * 0.65 * 2,000 hrs)/(907,200 g/ton) = 1.69 tons/yr NOx
2. Annual NOx reduced technology emissions = 0 tons/yr
3. Annual ROG baseline technology emissions
   (0.82 g/hp-hr *155 hp * 0.65 * 2,000 hrs)/(907,200 g/ton) = 0.18 tons/yr ROG
4. Annual ROG reduced technology emissions = 0 tons/yr
5. Annual PM10 baseline technology emissions
   (0.274 g/hp-hr *155 hp *0.65 * 2,000 hrs)/(907,200 g/ton) = 0.061 tons/yr PM
6. Annual PM10 reduced technology emissions = 0 tons/yr

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases

- Emission benefits NOx = 1.69 tons/yr - 0 tons/yr = 1.69 tons/yr NOx
- Emission benefits ROG = 0.18 tons/yr - 0 tons/yr = 0.18 tons/yr ROG
- Emission benefits PM10 = 0.061 tons/yr - 0 tons/yr = 0.013 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions

1.69 + 0.18 + 20(0.061) = 3.09 weighted tons/yr

Annualized Cost:

Project Life: 10 years

CRF (Table B-1) = 0.123

Formula C-14: Incremental Cost
$26,700 – $7,000 = $19,700

Formula C-12: Annualized Cost
$19,700 * 0.123 = $2,423/yr

Cost-Effectiveness:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/weighted ton)
($2,423/yr)/(3.09 weighted ton/yr)
= $784/weighted ton of surplus emissions reduced

The cost-effectiveness for the example is less than $14,300 per weighted ton of pollutants reduced. This project qualifies for the maximum amount of grant funds requested.

Example 2 – Replacing a Diesel Pump Engine with a Electric Pump Motor: Applicant Is Participating in PG&E/SCE Incentive Program

An applicant wants to purchase a 2005 GE 5K445FT328, 100 hp (75 kW) electric pump motor to replace a 1991 Caterpillar 3116, 155 hp diesel pump engine with uncontrolled emissions. The motor costs $26,700; otherwise the applicant would have to rebuild the diesel engine at a cost of $7,000. On average, the applicant currently operates the diesel pump engine at 65 percent of the maximum load rating for 2,000 hours each year. The pump operates 100 percent of the time in California. The applicant is eligible and has been accepted in the PG&E/SCE rate incentive program.

Baseline Technology Information:
- Engine (application): 1991 Caterpillar 3116, diesel off-road (uncontrolled)
- Engine HP (Application): 155 hp
- Load factor (default for agricultural pumps): 0.65
- Activity (application): 2,000 hours per year
- Cost to rebuild (quote provided with application): $7,000
- Emission factors (Table B-12): 7.60 g/bhp-hr NOx; 0.82 g/bhp-hr ROG; 0.274 g/bhp-hr PM10

Reduced Technology Information:
- Engine (application): 2005 GE 5K445FT328, electric
- Engine HP (application): 100 hp (75 kW)
- Activity (application): 2,000 hours per year
- Percent operate in California (application): 100 percent
- Cost of new equipment (quote provided with application): $26,700
- *Emissions: Applicant can only claim emission benefit from baseline to a comparable Tier III engine.*

<u>Electric motor:</u> 0 g/bhp-hr NOx; 0 g/bhp-hr ROG; 0 g/bhp-hr PM
<u>Tier III 155 hp diesel engine</u> (Table B-12): 2.32 g/bhp-hr NOx; 0.12 g/bhp-hr ROG; 0.112g/bhp-hr PM10

<u>Emission Reduction Calculations:</u>
Formula C-4: Estimated Annual Emissions Based on Hours of Operation
1. Annual NOx baseline technology emissions
   (7.60 g/hp-hr * 155 hp * 0.65 * 2,000 hrs)/(907,200 g/ton) = 1.69 tons/yr NOx
2. Annual NOx Tier III technology emissions
   (2.32 g/hp-hr * 155 hp * 0.65 * 2,000 hrs)/(907,200 g/ton) = 0.52 tons/yr NOx
3. Annual ROG baseline technology emissions
   (0.82 g/hp-hr * 155 hp * 0.65 * 2,000 hrs)/(907,200 g/ton) = 0.18 tons/yr ROG
4. Annual ROG Tier III technology emissions
   (0.12 g/hp-hr * 155 hp * 0.65 * 2,000 hrs)/(907,200 g/ton) = 0.03 tons/yr ROG
5. Annual PM10 baseline technology emissions
   (0.274 g/hp-hr * 155 hp * 0.65 * 2,000 hrs)/(907,200 g/ton) = 0.061 tons/yr PM10
6. Annual PM10 Tier III technology emissions
   (0.112 g/hp-hr * 155 hp * 0.65 * 2,000 hrs)/(907,200 g/ton) = 0.025 tons/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases
- Emission benefits NOX = 1.69 tons/yr- 0.52 tons/yr = 1.17 tons/yr NOx
- Emission benefits ROG = 0.18 tons/yr - 0.03 tons/yr = 0.15 tons/yr ROG
- Emission benefits PM10 = 0.061 tons/yr - 0.025 tons/yr = 0.036 tons/yr PM10

Formula C.2 – Annual Weighted Surplus Emission Reductions
1.17 + 0.15 + 20(0.036) = 2.04 weighted tons/yr

<u>Annualized Cost:</u>
Project Life: 10 years
CRF (Table B-1) = 0.123

Formula C-14: Incremental Cost
$26,700 – ($7,000/2) = $23,200 *Applicant may use one-half rebuild cost for baseline, as per criteria

Formula C-12: Annualized Cost
$23,200 * 0.123 = $2,854/yr

<u>Cost-Effectiveness:</u>
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/weighted ton)
($2,854/yr)/(2.04 weighted ton/yr)
= $1,399/weighted ton of surplus emissions reduced

The cost-effectiveness for the example is less than $14,300 per weighted ton of pollutants reduced. This project qualifies for the maximum amount of grant funds requested.

Example 3 – Replacing a Diesel Pump Engine with a Electric Pump Motor: Applicant Is Participating in PG&E/SCE Incentive Program and Replaced Engine Is a CMP-Funded Tier II Engine

An applicant wants to purchase a 2005 GE 5K445FT328, 100 hp (75 kW) electric pump motor to replace a Tier 2 155 hp diesel pump engine. The motor costs $26,700. On average, the applicant currently operates the diesel pump engine at 65 percent of the maximum load rating for 2,000 hours each year. The pump operates 100 percent of the time in California. The Tier 2 engine was purchased with Carl Moyer Program funds three years ago, and is still under contract. The engine has not reached its rebuild interval. The applicant is eligible and has been accepted in the PG&E/SCE rate incentive program.

<u>Baseline Technology Information:</u>
- Engine (application): 2004 Tier 2 diesel off-road
- Engine HP (application): 155 hp
- Load factor(default for agricultural pumps): 0.65
- Activity (application): 2,000 hours per year
- Cost rebuild (quote provided with application): $0

<u>Tier II 155 hp diesel engine</u> (Table B-12): 4.17 g/bhp-hr NOx; 0.19 g/bhp-hr ROG; 0.128 g/bhp-hr PM10

<u>Reduced Technology Information:</u>
- Engine (application): 2005 GE 5K445FT328, electric
- Engine HP (application): 100 hp (75 kW)
- Activity (application): 2,000 hours per year
- Percent operate in California (application): 100 percent
- Cost of new equipment (quote provided with application): $26,700
- *Emissions: Applicant can only claim emission benefit from baseline to a comparable Tier III engine.*
  <u>Tier III 155 hp diesel engine</u> (Table B-12): 2.32 g/bhp-hr NOx; 0.12 g/bhp-hr ROG; 0.112g/bhp-hr PM10

<u>Emission Reduction Calculations</u>:
Formula C-4 - Estimated Annual Emissions based on Hours of Operation
1. Annual NOx baseline technology emissions
   (4.17 g/hp-hr * 155 hp * 0.65 * 2,000 hrs)/(907,200 g/ton) = 0.93 tons/yr NOx
2. Annual NOx Tier III technology emissions
   (2.32 g/hp-hr * 155 hp * 0.65 * 2,000 hrs)/(907,200 g/ton) = 0.52 tons/yr NOx
3. Annual ROG baseline technology emissions
   (0.19 g/hp-hr * 155 hp * 0.65 * 2,000 hrs)/(907,200 g/ton) = 0.04 tons/yr ROG

4. Annual ROG Tier III technology emissions
   (0.12 g/hp-hr * 155 hp * 0.65 * 2,000 hrs)/(907,200 g/ton) = 0.03 tons/yr ROG
5. Annual PM10 baseline technology emissions
   (0.128 g/hp-hr * 155 hp * 0.65 * 2,000 hrs)/(907,200 g/ton)= 0.028 tons/yr PM10
6. Annual PM10 Tier III technology emissions
   (0.112 g/hp-hr * 155 hp * 0.65 * 2,000 hrs)/(907,200 g/ton)= 0.025 tons/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases

- Emission benefits NOX = 0.93 tons/yr- 0.52 tons/yr = 0.41 tons/yr NOx
- Emission benefits ROG = 0.04 tons/yr - 0.03 tons/yr = 0.01 tons/yr ROG
- Emission benefits PM10= 0.028 tons/yr - 0.025 tons/yr = 0.003 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions

0.41 tons/yr + 0.01 tons/yr + 20(0.003 tons/yr) = 0.480 weighted tons/yr

<u>Annualized Cost:</u>
Project Life: 10 years
CRF (Table B-1) = 0.123

Formula C-14: Incremental Cost
$26,700 – $0* = $26,700 *Applicant may use a rebuild cost of $0 since they are still under Moyer contract and are not to their rebuild interval.

Formula C-12: Annualized Cost
$26,700 * 0.123 = $3,284/yr

<u>Cost-Effectiveness</u>:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/weighted ton)
($3,284/yr)/(0.480 weighted ton/yr)
= $6,842/weighted ton of surplus emissions reduced

The cost-effectiveness for the example is less than $14,300 per weighted ton of pollutants reduced. This project qualifies for the maximum amount of grant funds requested.

Example 4 – Electric Idle Reduction Package Replaces Main Diesel Engine Idling
An applicant wants to purchase an electric package that includes an electric HVAC, a large alternator, and inverter/charger and a lead acid battery pack. These units will replace all idling that uses the truck's main propulsion engine. The package costs $10,000 and another $2,000 for installation. The applicant currently idles his 1999 MY truck engine an average of 1,250 hours each year.

Baseline Technology Information:

- Main engine model year (application): 1999
- Annual hours of idling (application): 1,250
- Main Engine idling emission rate (Table B-9): 171.00 g/hr NOx, 34.28 g/hr ROG, g/hr 2.28 PM10

Reduced Technology Information:

- 110 VAC, 60 Hz HVAC (8300 BTU) ; 270 A alternator; lead acid battery pack; inverter/charger (application)
- Annual hours of idling (application): 1,250
- Percent operate in California (application): 100 percent
- Cost of new equipment (quote provided with application): $10,000
- Cost of installation (quote provided with application): $2,000
- Electric emission rates: 0 g/bhp-hr NOx; 0 g/bhp-hr ROG; 0 g/bhp-hr PM10

Emission Reduction Calculations:

Formula C-4: Estimated Annual Emissions based on Hours of Operation

1. Annual NOx baseline technology emissions
   (171.00 g/hr * 1,250 hrs)/(907,200 g/ton) = 0.24 tons/yr NOx
2. Annual NOx reduced technology emissions = 0 tons/yr NOx
3. Annual ROG baseline technology emissions
   (34.28 g/hr * 1,250 hrs)/(907,200 g/ton) = 0.05 tons/yr ROG
4. Annual ROG reduced technology emissions = 0 tons/yr ROG
5. Annual combustion PM10 baseline technology emissions
   (2.28 g/hr * 1,250 hrs)/(907,200 g/ton) = 0.003 tons/yr PM10
6. Annual combustion PM10 reduced technology emissions = 0 tons/yr PM10

Formula C-10: Annual Surplus Emission Reductions by Pollutant (tons/yr) for Repowers and New Purchases

- Emission benefits NOX = 0.24 tons/yr - 0 tons/yr = 0.24 tons/yr NOx
- Emission benefits ROG = 0.05 tons/yr - 0 tons/yr = 0.05 tons/yr ROG
- Emission benefits PM10 = 0.003 tons/yr - 0 tons/yr = 0.003 tons/yr PM10

Formula C-2: Annual Weighted Surplus Emission Reductions

0.24 tons/yr + 0.05 tons/yr + 20(0.003 tons/yr) = 0.350 weighted tons/yr

Annualized Cost:

Project Life: 5 years

CRF (Table B-1) = 0.225

Formula C-14: Incremental Cost

Capital cost: $10,000 CMP will pay up to $5,500, as per guideline criteria
Installation cost: $2,000
$5,500 + $2,000= $7,500

Formula C-12: Annualized Cost
$7,500 * 0.225 = $1,688/yr

Cost-Effectiveness:
Formula C-1: Cost-Effectiveness of Weighted Surplus Emission Reductions ($/weighted ton)
($1,688/yr)/(0.350 weighted ton/yr)
= $4,823/weighted ton of surplus emissions reduced

The cost-effectiveness for the example is less than $14,300 per weighted ton of pollutants reduced. This project qualifies for the maximum amount of grant funds requested.

Example 5 – Purchase of TRU with Electric Standby Option
The TRU owner proposes to purchase a TRU that is equipped with electric standby in lieu of one without this option. This would virtually eliminate TRU engine operation while the TRU is at the facility. The TRU owner has submitted records that show his fleet of facility-controlled TRUs has operated an average of three hours per day of TRU engine run time while at the facility. The incremental cost of the E/S option is $2,000. Facility infrastructure would cost $5,000. TRUs operate at the facility 360 days per year. The new TRU would be equipped with a 2006 engine rated at 36.2 hp to maintain cooling when the truck is not at the facility.

Baseline Technology
- Engine rating = 36.2 hp
- Model year = 2006
- Default load factor = 0.53
- Emission factors (Table B-12): 4.63 g/bhp-hr NOx, 0.29 g/bhp-hr ROG, 0.280 g/bhp-hr PM10

Reduced Technology
- Electric standby = zero emissions
- Annual TRU engine activity replaced with electric standby =
  (3 hrs/day)(360 days/yr) = 1,080hr/yr

Emission Reduction Calculations:
Formula C-4: Estimated Annual Emissions based on hours of Operation (tons/yr)
1. Annual NOx baseline technology emissions
   (4.63 g/bhp-hp)(36.2 hp)(0.53)(1,080 hrs/yr)(1 ton/907,200g)
   = 0.10 tons/yr NOx
2. Annual NOx reduced technology emissions
   (0 g/bhp-hr)(36.2hp)(0.53)(1,080hrs)(1 ton/907,200g)
   = 0 ton/yr NOx
3. Annual ROG baseline technology emissions
   (0.29 g/bhp-hr)(36.20hp)(.53)(1,080 hrs/yr)(1ton/907,200g)
   = 0.007 tons/yr ROG

4. Annual ROG reduced technology emissions
   (0 g/bhp-hr)(36.2hp)(0.53)(1,080hrs)(1 ton/907,200g)
   = 0 ton/yr ROG
5. Annual PM10 baseline technology emissions
   (0.280 g/bhp-hp)(36.2 hp)(0.530)(1,080 hrs/yr)(1 ton/907,200g)
   = 0.006 tons/yr tons/yr PM10
6. Annual PM10 reduced technology emissions
   (0 g/bhp-hp)(36.2 hp)(0.530)(1,080 hrs/yr)(1 ton/907,200g)
   = 0 tons/yr PM10

Formula C-10: Annual Surplus Emission Reductions by pollutant (tons/yr) for Repowers and New Purchases

- NOx emission benefits = 0.10 tons/yr - 0 tons/yr = 0.10 tons/yr NOx
- ROG emission benefits = 0.007 tons/yr - 0 tons/yr = 0.007 tons/yr ROG
- PM10emission benefits = 0.006 tons/yr - 0 tons/yr = 0.006 tons/yr PM10

Formula C-2, Annual Weighted Surplus Emission Reductions:

0.10 tons/yr + 0.007 tons/yr + 20(0.006 tons/yr) = 0.227 weighted tons/yr

Annualized Cost:

Project Life: 3 years

CRF (Table B-1): =0.360

Incremental Cost: =$2,000

Formula C- 12-Annualized Cost

0.360 * $2,000 = $720/yr

Cost Effectiveness:

Formula C-1 Cost-Effectiveness of Weighted Surplus Emission Reductions ($/ton):

($720/yr)/(0.227 weighted tons/yr)

= $3,172/ton of weighted surplus emissions reduced

The $5,000 cost for electric power plugs cannot be funded by Carl Moyer Program because it is considered infrastructure. The air district may pay for this with district match funds.

This project qualifies for the $2,000 cost of the E/S option.

APPENDIX E

DESCRIPTION OF CERTIFICATION AND VERIFICATION EXECUTIVE ORDERS

APPENDIX E

DESCRIPTION OF CERTIFICATION AND VERIFICATION

I. New Engine Certification

The Air Resources Board (ARB) certifies engines destined for sale in California and provides the engine manufacturers with an Executive Order (EO) for each certified engine family. An example of an EO is shown in Figure E-1. The EO includes general information about the certified engine such as engine family, displacement, horsepower rating(s), intended service class, and emission control systems. It also shows the applicable certification emission standards as well as the average emission levels measured during the actual certification test procedure. For the purpose of the Carl Moyer Program, the certification emission standards are used to calculate emission reductions. The certification emission standards are shown in the row titled "(DIRECT) STD" under the respective "FTP" column headings for each pollutant. For instance, the Cummins 8.3 liter natural gas engine illustrated in Figure E-1 was certified to a combined oxides of nitrogen plus non-methane hydrocarbon (NOx+NMHC) emission standard of 1.8 g/bhp-hr, a carbon monoxide (CO) emission standard of 15.5 g/bhp-hr, and a particulate matter (PM) emission standard of 0.03 g/bhp-hr.

In the case where an EO shows emission values in the rows labeled "AVERAGE STD" and/or "FEL", the engine is certified for participation in an averaging, banking, and trading (AB&T) program. AB&T engines (i.e., all FEL-certified engines) are not eligible to participate in the CMP for new vehicle purchase projects since emission benefits from an engine certified to an FEL level are not surplus emissions.

Figure E-1
Sample Executive Order

ARB Executive Order for Heavy-Duty On-Road Engines

California Environmental Protection Agency AIR RESOURCES BOARD	CUMMINS INC.	EXECUTIVE ORDER A-021-0340 New On-Road Heavy-Duty Engines

Pursuant to the authority vested in the Air Resources Board (ARB) by Health and Safety Code (HSC) Division 26, Part 5, Chapter 2; and pursuant to the authority vested in the undersigned by HSC Sections 39515 and 39516 and Executive Order (EO) G-02-003; and

Pursuant to the December 15, 1998 Settlement Agreement (SA) between ARB and the manufacturer, and any modifications thereof to the Settlement Agreement;

IT IS ORDERED AND RESOLVED: That the engine and emission control systems produced by the manufacturer are certified as described below for use in on-road motor vehicles with a manufacturer's GVWR over 14,000 pounds. Production engines shall be in all material respects the same as those for which certification is granted.

MODEL YEAR	ENGINE FAMILY	ENGINE SIZE (liter)	FUEL TYPE (CNG/LNG=compressed/liquefied natural gas; LPG=liquefied petroleum gas)	STANDARDS & TEST PROCEDURE	INTENDED SERVICE CLASS (L/M/H HDD=light/medium/heavy heavy-duty (HD) diesel; UB=urban bus; HDO=HD Otto)
2003	3CEXH0505CBK	8.3	CNG / LNG	Diesel	UB
SPECIAL FEATURES & EMISSION CONTROL SYSTEMS		ENGINE MODELS / CODES (rated power in horsepower, hp)			
TBI, OC, HO2S, TC, CAC, PCM		CG-280 / 8012 (280 hp), CG-275 / 8009 (275 hp), CG-260 / 8006 (260 hp), CG-250 / 8003 (250 hp)			

GVWR=gross vehicle weight rating TWC/OC=three-way/oxidizing catalyst WU (prefix) =warm-up cat. O2S=oxygen sensor HO2S=heated O2S TBI=throttle body fuel injection MFI=multi port fuel injection SFI=sequential MFI DDI/IDI=direct /indirect diesel injection TC/SC=turbo/super charger CAC=charge air cooler EGR=exhaust gas recirculation AIR=secondary air injection PAIR=pulsed AIR SPL=smoke puff limiter ECM/PCM=engine /powertrain control module EM=engine modification 2 (prefix)=parallel (2) (suffix)=in series HC=hydrocarbon NMHC=non-methane HC NOx=oxides of nitrogen CO=carbon monoxide PM=particulate matter HCHO=formaldehyde g/bhp-hr=grams per brake horsepower-hour

The following are the exhaust emission standards (STD), or family emission limit(s) (FEL) as applicable, and certification levels (CERT) for this engine family under the "Federal Test Procedure" (FTP) (Title 13, California Code of Regulations, (13 CCR) Section 1956.1 (urban bus) or 1956.8 (other than urban bus)), and under the "Euro III Test Procedure" (EURO) in the Settlement Agreement, including EURO's "Not-to-Exceed" standard(s). "Diesel" CO certification compliance may have been demonstrated pursuant to Code of Federal Regulations, Title 40, Part 86, Subpart A, Section 86.091-23(c)(2)(i) in lieu of testing. (For flexible- and dual-fueled engines, the CERT values in brackets [ ] are those when tested on conventional test fuel. For multi-fueled engines, the STD and CERT values for default operation permitted in 13 CCR Section 1956.1 or 1956.8 are in parentheses.)

			EURO'S NOT-TO-EXCEED STD				NMHC: *		NOx: *		NMHC+NOx: 2.25		PM: 0.0375	
* = not applicable	HC		NMHC		NOx		NMHC+NOx		CO		PM		HCHO	
	FTP	EURO	FTP	EURO	FTP	EURO	FTP	EURO	FTP	EURO	FTP	EURO	FTP	EURO
(DIRECT) STD	*	*	*	*	*	*	1.8	1.8	15.5	15.5	0.03	0.03	*	*
AVERAGE STD	*	*	*	*	*	*	*	*	*	*	*	*	*	*
FEL	*	*	*	*	*	*	*	*	*	*	*	*	*	*
CERT	*	*	*	*	*	*	1.7	1.4	2.0	1.3	0.01	0.005	*	*

BE IT FURTHER RESOLVED: That certification to the FEL(s) listed above, as applicable, is subject to the following terms, limitations and conditions. The FEL(s) is the emission level declared by the manufacturer and serves in lieu of an emission standard for certification purposes in any averaging, banking, or trading (ABT) programs. It will be used for determining compliance of any engine in this family and compliance with such ABT programs.

BE IT FURTHER RESOLVED: That the listed engine models have been certified to the FTP optional NOx, or NMHC+NOx as applicable, and PM emission standard(s) listed above pursuant to 13 CCR Section 1956.1 or 1956.8.

BE IT FURTHER RESOLVED: That for the listed engine models, the manufacturer has submitted the materials to demonstrate certification compliance with 13 CCR Sections 1965 (emission control labels), and 2035 et seq. (emission control warranty).

BE IT FURTHER RESOLVED: That the listed engine models are conditionally certified subject to the following conditions: (1) The SA is in effect; (2) The manufacturer is in compliance with all applicable California emission regulations, and all SA's applicable requirements and any modifications thereof; (3) This EO is void with respect to any engine within this family determined to have a defeat device as that term is defined in the test procedures and SA. Any engine produced under the voided EO remains subject to stipulated penalties under the SA. Such penalties would begin to accrue upon manufacture of the first engine under this EO; (4) This EO expires at midnight on December 31, 2002; (5) Production of any engine within this family under this EO is acceptance of all conditions in this EO; and (6) ARB reserves the right to disapprove certification of this family, or any families using the same or similar auxiliary emission control device (AECD) strategies as this family is employing, based on all available information.

The Bureau of Automotive Repair will be notified by copy of this Executive Order.
Executed at El Monte, California on this 2ND day of October 2002.

Allen Lyons, Chief
Mobile Source Operations Division

II. Retrofit System Verification

The ARB's verification procedures provide a way to thoroughly evaluate the emission reduction capabilities and durability of a variety of emission control strategies as part of a retrofit in-use program. It ensures that emission reductions achieved by a control strategy are both real and durable and that production units in the field are achieving emission reductions which are consistent with their verification.

The ARB has a verification procedure for in-use strategies to control emissions from diesel engines (diesel emission control systems or DECS). The verification procedure requires a minimum PM reduction of at least 25 percent. If a diesel emission control strategy also reduces NOx emissions by at least 15 percent, that reduction can also be verified. Emission control strategies for diesel engines are verified based on a tiered verification classification shown in Table E-1 below. It is the responsibility of the diesel emission control strategies manufacturer to provide data to verify emission reduction claims. The ARB issues Executive Orders for verified emission control strategies destined for sale in California. An example of an EO for a retrofit emission control system for diesel engines is shown in Figure E-2.

Applicants may claim ROG emission reductions from DECS if hydrocarbon emission reductions for that technology are obtained from the ARB's retrofit website at: http://www.arb.ca.gov/diesel/verdev/verdev.htm. For the Carl Moyer Program, ROG emission reductions will be credited at the 25 percent, 50 percent, and 85 percent reduction levels. To calculate emission reductions of ROG for the Carl Moyer Program, applicants should use the percentage reduction of hydrocarbons from the ARB's retrofit website to determine the appropriate "level" of emission reductions. For example, a technology that provides a 40 percent emission reduction of hydrocarbons would be permitted to apply a 25 percent reduction in ROG emissions for determining eligibility and grant amount in the Carl Moyer Program.

ARB staff has also developed an interim retrofit verification procedure for large spark-ignition engines. This interim procedure can be used to verify retrofit systems to reduce NOx and HC emissions from spark-ignition engines until the interim procedure is formally adopted by the ARB.

Table E-1
Verification Levels for Diesel Emission Control Strategies

Pollutant	Emission 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

Figure E-2
Example of an EO for a Retrofit Emission Control System

State of California
AIR RESOURCES BOARD

EXECUTIVE ORDER DE-04-006-05

Pursuant to the authority vested in the Air Resources Board (ARB) by Health and Safety Code, Division 26, Part 5, Chapter 2; and pursuant to the authority vested in the undersigned by Health and Safety Code Section 39515 and 39616 and Executive Order G-02-003;

Relating to Exemptions under Section 27156 of the Vehicle Code, and Verification under Sections 2700 through 2710 of Title 13 of the California Code of Regulations

Johnson Matthey, Inc.
Continuously Regenerating Technology (CRT®) Particulate Filter

ARB has reviewed Johnson Matthey, Inc.'s request for verification of the CRT® Particulate Filter. Based on an evaluation of the data provided, and pursuant to the terms and conditions specified below, the Executive Officer of ARB hereby finds that the CRT® Particulate Filter reduces emissions of diesel particulate matter (PM) consistent with a Level 3 device (greater than or equal to 85 percent reductions) (Title 13 California Code of Regulations (CCR) Sections 2702 (f) and (g) and Section 2708). Accordingly, the Executive Officer determines that the system merits verification and, subject to the terms and conditions specified below, classifies the CRT® Particulate Filter as a Level 3 system, for the applications listed in Table 1 and engine families listed in Attachment 1.

Table 1: Appropriate Applications for the CRT® Particulate Filter

Diesel Emission Control Strategy	Application
CRT® Particulate Filter	All On-Road Applications only

The aforementioned verification is subject to the following terms and conditions:

- The engines are originally manufactured from model year 1994 through 2006 having the engine family numbers listed in Attachment 1.
- The engines do not employ exhaust gas recirculation, except for those engine families specified in Table 2 of Attachment 1.
- The engines are not used in a hybrid (e.g., diesel/electric) configuration.
- The application must have a duty cycle with an average temperature profile greater than 260 degrees Celsius for 40 percent of the operating cycle.
- The engine may or may not have a pre-existing original equipment manufacturer oxidation catalyst.
- The engine must not have a pre-existing diesel particulate filter.

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- The engine must be certified in California for on-road applications.
- The engine must be certified at a PM emission level of at most 0.1 grams per brake horsepower-hour (g/bhp-hr), and greater than 0.01 g/bhp-hr.
- The engine must be four-stroke.
- The engine must be turbocharged.
- The engine can be mechanically or electronically injected.
- The engine should be well maintained and not consume lubricating oil at a rate greater than that specified by the engine manufacturer.
- Lube oil, or other oil, should not be mixed with the fuel.
- The engine must be operated on:
  - diesel fuel (e.g. not alternative diesel fuels) with a sulfur content of no more than 15 parts per million by weight or
  - B20 defined, based on volume, as a mixture of 20 percent neat biodiesel (B100) that complies with ASTM D6751 and 80 percent diesel (e.g. not alternative diesel fuels) with a sulfur content of no more than 15 parts per million by weight.
- The other terms and conditions specified below.

IT IS ALSO ORDERED AND RESOLVED: That installation of the CRT® Particulate Filter, manufactured by Johnson Matthey, Inc. of 380 Lapp Road, Malvern, Pennsylvania 19355, has been found not to reduce the effectiveness of the applicable vehicle pollution control system, and therefore, the CRT® Particulate Filter is exempt from the prohibitions in Section 27156 of the Vehicle Code for installation on heavy-duty on-road vehicles listed in Attachment 1.

This exemption is only valid provided the engines meet the aforementioned conditions.

The CRT® Particulate Filter basic design is a diesel oxidation catalyst followed by a diesel particulate filter and a backpressure monitor. The major components of the CRT® Particulate Filter are identified in Attachment 2.

This Executive Order is valid provided that installation instructions for the CRT® Particulate Filter do not recommend tuning the vehicle to specifications different from those of the vehicle manufacturer.

Changes made to the design or operating conditions of the CRT® Particulate Filter, as exempted by ARB, which adversely affect the performance of the vehicle's pollution control system, shall invalidate this Executive Order.

No changes are permitted to the device. The ARB must be notified in writing of any changes to any part of the CRT® Particulate Filter. Any changes to the device must be evaluated and approved by ARB. Failure to do so shall invalidate this Executive Order.

Marketing of the CRT® Particulate Filter using identification other than that shown in this Executive Order or for an application other than that listed in this Executive Order shall be prohibited unless prior approval is obtained from ARB.

This Executive Order shall not apply to any CRT® Particulate Filter advertised, offered for sale, sold with, or installed on a motor vehicle prior to or concurrent with transfer to an ultimate purchaser.

As specified in the Diesel Emission Control Strategy Verification Procedure (Title 13 CCR Section 2706 (g)), the ARB assigns each Diesel Emission Control Strategy a family name. The designated family name for the verification as outlined above is: CA/JMI/2001/PM3/N00/ON/DPF01.

Additionally, as stated in the Diesel Emission Control Strategy Verification Procedure, Johnson Matthey, Inc. is responsible for honoring the required warranty (Section 2707) and conducting in-use compliance testing (Section 2709).

In addition to the foregoing, ARB reserves the right in the future to review this Executive Order and the exemption and verification provided herein to assure that the exempted and verified add-on or modified part continues to meet the standards and procedures of CCR, Title 13, Section 2222, et seq and CCR, Title 13, Sections 2700 through 2710.

Systems verified under this Executive Order shall conform to all applicable California emissions regulations.

This Executive Order does not release Johnson Matthey from complying with all other applicable regulations.

Violation of any of the above conditions shall be grounds for revocation of this Executive Order.

Executed at El Monte, California, this 15th day of August 2005.

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Robert H. Cross, Chief
Mobile Source Control Division

Attachment 1: ARB Approved Model Year 1994 to 2006 Engine Families for the CRT® Particulate Filter

Attachment 2: Part Numbers and Model Numbers of the CRT® Particulate Filter and Standard Part Numbers of Backpressure Monitor

APPENDIX F

RETROFIT EMISSION CONTROL STRATEGIES

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RETROFIT EMISSION CONTROL STRATEGIES

All retrofit systems must be verified by ARB in order to qualify for Carl Moyer Program funding. Potential compression-ignited (diesel) engine retrofits include diesel oxidation catalysts, diesel particulate filters, flow though filters and fuel additives. Potential spark-ignited engines include closed-loop fuel control, three-way catalyst, fuel injection, or any combination thereof.

I. Compression-Ignited (Diesel) Engines

A. Diesel Oxidation Catalysts

A diesel oxidation catalyst (DOC) reduces carbon monoxide (CO), hydrocarbons (HC), and the soluble organic fraction (SOF) of diesel PM through catalytic oxidation. Negligible reductions of the solid particle portion of PM also occur. Exhaust gases are not filtered, as with a diesel particulate filter (DPF) so the solid particles escape. A DOC reduces total PM emissions up to 30 percent. PM emission reductions at this higher end are typically associated with engines that emit "wet" PM (i.e., particles that have a higher percentage of SOF, unburned or partially burned fuel, adsorbed onto the particle surface). Older engines or engines that have less efficient fuel combustion typically produce PM with higher SOF. Engines that more efficiently combust the fuel would have less SOF adsorbed on the soot particle, so the PM emission reductions would be less on a percentage basis.

B. Passive Diesel Particulate Filters

A DPF uses a porous substrate to filter out PM particles from the exhaust. DPFs must "regenerate" or be cleaned periodically to remove the collected particulate matter. A passive DPF has a catalyst coating on the filter surfaces that lowers the PM ignition temperature, allowing the collected PM to burn off. Emissions of HC and CO are also reduced by catalytic oxidation. This approach is called "passive" regeneration because no outside source of energy or intervention is required for regeneration, making it very attractive due to its simplicity.

C. Active Diesel Particulate Filters

Active DPFs use an external source of energy or external intervention to increase the exhaust temperature to the point where PM oxidation can occur, achieving a regeneration. Additional heat may be added to the exhaust using electrical power, microwaves, or injecting fuel. Another approach uses periodic, short-duration use of an intake throttle to reduce the amount of excess air, so the exhaust temperature rises as a result of not having to heat the excess air. The temperature of the filter and collected PM increases until the PM burns off, at which point the throttle re-opens. Active DPFs systems can initiate regeneration when the backpressure on the filter reaches a specified level or the operator can initiate a regeneration when a warning light indicates backpressure has exceeded a set point. For applications where the engine-out PM is relatively high, or the exhaust temperature is relatively cool, active regeneration systems may be more effective than a passive DPF. Emission reductions of HC and CO can also occur in active DPFs, and to a greater extent if the DPF system uses lightly catalyzed surfaces or fuel-borne catalysts to assist in achieving regenerations.

D. Flow-Through Filters

Unlike the DPF, in which only the exhaust gases can pass through the substrate, the flow-though filter (FTF) does not physically "trap" and accumulate PM. Instead, exhaust flows through a medium (such as a wire mesh or metal foils) that has a high density of tortuous flow channels, thus giving rise to turbulent flow conditions that favor PM oxidation. The medium is typically treated with an oxidizing catalyst that is able to reduce emissions of PM, HC, and CO, or the FTF is used in conjunction with a fuel borne catalyst (FBC). The filtration efficiency of the FTF is typically lower than that of a DPF because unburned PM is not "trapped", but the FTF is less likely to plug under unfavorable conditions, such as high PM emissions or low exhaust temperature.

E. Fuel Additives

A fuel additive is designed to be added to fuel or fuel systems so that it is present in-cylinder during combustion. Fuel additives can reduce the total mass of PM emissions, with variable effects on CO, NOx and gaseous HC production. A fuel-borne catalyst (FBC) is an additive that is used with diesel fuel to aid in soot removal by decreasing the ignition temperature of the carbonaceous exhaust. FBCs can be used with passive and active filter systems to improve fuel economy, aid system performance, and decrease mass PM emissions. FBC/DPF systems have been verified for on-road use in California in medium duty and heavy-duty engines. In addition, FBC/DPF systems are in wide spread use in Europe in both on-road and off-road, mobile and stationary applications. Use of FBCs with DOCs or FTFs may not be verified for use in California since catalytic particle emissions occur and the consequences of such emissions are unknown.

II. Spark-Ignition Engines

Retrofit refers to modifications or additions made to an engine and/or fuel system such that the specifications of the retrofitted engine are not the same as the original engine. Retrofits for LSI equipment will likely incorporate advanced automotive-inspired emission control technologies that dramatically reduce emissions while still meeting operational requirements. These have already been in use on a variety of LSI equipment for about 10 years. To qualify for Carl Moyer Program funding, the retrofit technology must be verified for sale in California and must comply with established durability and warranty requirements.

A. Three-Way Catalyst

Three-way catalytic converters have helped manufacturers to meet progressively lower-emissions standards. Manufacturers have installed three-way catalysts on automobiles for more than 25 years. Advanced three-way catalysts will likely be components in new LSI retrofit kit, and have been shown to be robust in research demonstrations for the 2001 LSI regulation.

LSI catalyst volumes are much lower than light duty vehicles - between 40 to 60 percent of engine displacement. Precious metal loading of the catalytic converter in a current LSI application is typically half of that in automotive applications. LSI catalysts in retrofits will likely use multi-layered wash coats that increase precious metals performance to achieve lower emissions. Due to confined space on forklifts, the three-way catalysts are made such that they can be a direct fit replacement of the original vehicle silencer. Other LSI equipment will most likely be adaptable to catalyst additions.

B. Closed-Loop Fuel Control System

Central to automotive emission control systems is the closed-loop fuel control system. Since 1980, automotive emission control systems have used a closed-loop fuel control system to help reduce emissions. This technology has increasingly been applied to LSI retrofit technology in the last 10 years. A closed-loop fuel control system uses sensors to monitor exhaust gas concentrations, and feed this information back to an electronic control module, which in turn keeps the air to fuel mixture at an optimum level. The sensors (usually oxygen sensors) deteriorate over time, causing the system to lose emissions reduction ability, but equipment with sensors have indicator lights that can alert the operator of an sensor failure so that they can replace the oxygen sensors as needed.

C. Fuel-Injection System

To help ensure more precise metering of fuel and optimum combustion, carburetors will likely be replaced by sequential fuel injection or a more sophisticated regulator/mixer. Today's advanced systems must maintain an extremely tight stoichmetric air to fuel balance during nearly all engine operations because wide fluctuations from the stoichiometric position will result in less ability to reduce NOx and hydrocarbons.