

California Environmental Protection Agency

 **Air Resources Board**

IMPLEMENTATION GUIDANCE:

**ALTERNATIVE COMPLIANCE PLAN FOR
CARGO HANDLING EQUIPMENT
AND
ALTERNATIVE CONTROL OF EMISSIONS
FOR SHIP AUXILIARY ENGINES**



**Stationary Source Division
Emissions Assessment Branch**

December 2006

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

<u>Contents</u>	<u>Page</u>
I. Introduction.....	1
II. General Information.....	2
A. What is the ACP or ACE provision?	2
B. Who is allowed to use an ACP or ACE plan?	2
C. Why were the ACP and ACE provisions included in the regulations?	2
D. What alternative options are available?	3
E. How long is an approved ACP or ACE valid?	3
III. Application Process.....	3
A. How do I apply for an ACP or ACE?	3
B. What do I include in my application?	4
C. Will the application be made public?	4
D. What about confidentiality?	4
E. What happens after my application is received by the ARB?	5
F. What happens during the public review process?.....	6
G. When and how will I be notified of approval or disapproval?	7
IV. Estimating Emissions for Cargo Handling Equipment.....	7
A. How do I show that the emissions occurring under a proposed ACP will meet the requirements of the regulation?	7
B. How do I determine the emissions that would occur with direct compliance with the regulation?	8
C. How do I estimate the emissions that would occur with the use of an alternative emission control strategy (AECS)?	11
D. What documentation, recordkeeping, or reporting is necessary to demonstrate emission levels?	11

TABLE OF CONTENTS (CONTINUED)

<u>Contents</u>	<u>Page</u>
V. Estimating Emissions for Auxiliary Engine on Ocean-going Vessels	12
A. How do I show that the emissions occurring under a proposed ACE plan will meet the requirements of the regulation?	12
B. How do I determine the emissions that would occur with direct compliance with the regulation (i.e., using the specified marine distillate fuels)?	12
C. How do I estimate the emissions that would occur with the use of the alternative emission control strategy (ECS)?	13
D. How do I determine the pre-regulation baseline emissions?	14
E. How do I estimate the total emissions of each pollutant during the compliance period in the ACE plan (e.g., one year)?	14
F. What documentation, recordkeeping, or reporting will be necessary to demonstrate emission levels?	15
G. What if I comply using shore-side power?	16
H. What if I want to comply with the regulation under subsection (g)(1)(J), "Use of Shore-Side Power," but only plan to use shore-side power at one of two or more California ports visited?	16
VI. Post-Approval.....	18
A. Is an approved ACP or ACE transferable?	18
B. What if my processes or equipment change?	18
C. Can the ARB revoke or modify an approved ACP or ACE?	18
D. Can I get credits if my ACP or ACE reduces emissions more than is required?	18
VII. Examples of ACP and ACE Plans	19
A. Examples of ACP Applications for Cargo Handling Equipment	19
B. Examples of ACE Applications for Ocean-going Vessels	20
VIII. Contact Information.....	24

Appendix A: Cargo Handling Equipment Zero-Hour Emission Rates

Appendix B: Reference to Approved Test Methods

I. Introduction

In December 2005, the Air Resources Board (ARB or Board) approved statewide regulations that would significantly reduce emissions from two large source categories: ocean-going ship auxiliary engines and mobile cargo handling equipment (CHE) at ports and intermodal rail yards. The regulations will result in reductions in diesel particulate matter (PM), a toxic air contaminant identified by the Board in 1998, and oxides of nitrogen (NOx), which contribute to the formation of regional smog (or ozone) and fine PM. The regulations for ocean-going ship auxiliary engines will also reduce oxides of sulfur (SOx), another significant air pollutant that can impact human health, damage vegetation, and be transformed to sulfate PM in the atmosphere.

The regulations approved for adoption into the California Code of Regulations (CCR) are as follows: (1) Regulation for Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yards, title 13, CCR, section 2479 (CHE regulation); (2) Emission Limits and Requirements for Auxiliary Diesel Engines and Diesel-Electric Engines Operated on Ocean-going Vessels within California Waters and 24 Nautical Miles of the California Baseline, title 13, CCR, section 2299.1 (ocean-going ship auxiliary engine regulation); and (3) Airborne Toxic Control Measure for Auxiliary Diesel Engines and Diesel-Electric Engines Operated on Ocean-going Vessels within California Waters and 24 Nautical Miles of the California Baseline, title 17, CCR, section 93118. Regulations 2 and 3 are essentially identical; for simplicity, both regulations will hereinafter be referred to as the “ocean-going ship auxiliary engine regulation.”

The regulations above contain similar provisions that provide affected industries with the option of complying with the respective regulations through alternative means than expressly set forth in the regulations. The Alternative Compliance Plan (ACP) for the CHE regulation and the Alternative Control of Emissions (ACE) provision for the ocean-going ship auxiliary engine regulation allow owners or operators to demonstrate that equivalent emission reductions can be achieved through the use of alternative emission control strategies. For both the ACP and ACE, alternative strategies can include engine modifications, exhaust treatment control, and engine repowering, just to name a few. Additionally, the ACE provision allows for emissions averaging within a company’s fleet and special provisions to encourage the use of shore-side power. The application processes for both the ACP and the ACE provide multiple opportunities for public input.

The purpose of this document is to explain the regulatory aspects of the ACP and ACE provisions and provide guidance to those interested in applying for an ACP or ACE. The document discusses the provisions in general, the application process, how emissions can be estimated, and possible post-approval actions. Finally, the guidance provides examples of hypothetical CHE ACPs and ACEs for ocean-going ship auxiliary engines.

It is important to note that this document is not an ARB regulation, nor does it establish legal requirements. Due to the individual nature of each application, it is impossible to foresee all information that will be required to demonstrate that an alternative strategy

will meet the requirements of the ACP or ACE provisions. We recommend that you review the actual regulatory language cited in the CCR sections above along with this document. We also recommend contacting the ARB staff listed in section VIII of this document prior to submitting an ACP or ACE application to ensure that the overall approach can potentially be approved. In the event of an inconsistency or conflict with the regulations, the provisions of the regulations shall take precedence over this guidance document.

II. General Information

A. What is the ACP or ACE provision?

The ACP provision in the cargo handling equipment regulation, and the ACE provision in the ocean-going ship auxiliary engine regulation provide affected industries with the possible option of complying with the performance requirements of the respective regulations through alternative means than specifically set forth in the regulations. Under these provisions, the applicant can comply with the regulation by applying for and obtaining ARB approval of a detailed ACP or ACE plan. As specified in the ARB approved plan, the applicant would use the alternative control strategy(ies) that the applicant has demonstrated, to ARB's satisfaction by clear and convincing evidence, will result in equivalent or greater emission reductions compared to direct compliance with the regulations' performance requirements.

B. Who is allowed to use an ACP or ACE plan?

In the CHE regulation, any owner or operator of non-yard truck cargo handling equipment who is subject to the requirements of the CHE regulation may apply for an ACP, provided all of the included equipment is under the applicant's direct control and at the same port or intermodal rail yard.

For the ocean-going ship auxiliary engine regulations, any person subject to the requirements of the ocean-going ship auxiliary engine regulations may apply for an ACE, provided the included vessels are under the applicant's direct control and operate in the same port geographical area.

C. Why were the ACP and ACE provisions included in the regulations?

The ACP and ACE provisions were included in the CHE and ocean-going ship auxiliary engine regulations to provide affected companies with additional flexibility in complying with the regulations' emission limits and other requirements. Additionally, ARB believes the provisions can further encourage the development and use of emerging technologies to reduce emissions.

D. What alternative options are available?

Any alternative strategies that meet the requirements of the ACP or ACE provisions can be used to comply with the regulations. For the CHE ACP, alternatives may include, but are not limited to, engine modifications, exhaust treatment controls, engine repowers, equipment replacement, operational controls, alternative energy systems, and the use of alternative fuels or fuel additives. For the ocean-going ship ACE, alternatives may include, but are not limited to, alternative fuels, auxiliary engine modifications, exhaust treatment controls, or utilization of shore-side electrical power in lieu of onboard generators. Applicants are encouraged to develop and use innovative control strategies, provided such strategies are demonstrated to meet the ACE provisions.

E. How long is an approved ACP or ACE valid?

An approved CHE ACP is valid for up to one calendar year. An approved ACP will continue to be in effect for another calendar year as long as the applicant provides updated information for all elements of the approved ACP to the Executive Officer (EO) at least 30 days prior to the end of the first calendar year. The updated information must demonstrate that compliance with the ACP will continue for the next compliance period.

An approved ship auxiliary engine ACE is valid for up to one calendar year or a continuous 12-month period. An approved ACE plan will continue to be in effect for another compliance period of equal length as long as the applicant provides updated information for all elements of the approved ACE plan to the Executive Officer (EO) at least 30 days prior to the end of the first compliance period. The updated information must demonstrate that compliance with the ACE will continue for the next compliance period.

III. Application Process

A. How do I apply for an ACP or ACE?

Applications for the ACP or ACE should be submitted in writing to the EO for evaluation at the following address:

Executive Officer
ACP/ACE Application
Attention: SSD, Emissions Assessment Branch
California Air Resources Board
1001 "I" Street
Sacramento, CA 95814

Prior to submitting an official application, the applicant is encouraged to send an unofficial preliminary application or discuss potential concepts with ARB staff. ARB staff

contact information is included in Chapter VIII of this document. Staff will reply with comments and suggestions.

B. What do I include in my application?

You are strongly encouraged to review the ACP or ACE provisions in their entirety (subsection (h) in the CHE regulation and subsection (g) in the ship auxiliary engine regulations) to determine what information and documentation you will need to provide. Given each application's uniqueness, additional information may be needed depending on the specifics of the individual application. With that said, the application should contain, at a minimum, the following information.

1. company name, address, and contact information;
2. the equipment/vessel(s) that will be subject to your ACP or ACE plan, including equipment and engine make, model, year of manufacture, serial numbers, and other information that uniquely identifies the equipment/engine(s). For an ACE, include the vessel(s) name, country flag, and International Maritime Organization (IMO) identification number;
3. documentation, calculations, emissions test data, or other information that demonstrates that the emissions occurring from all the CHE under the ACP or auxiliary engines under the ACE plan will be no greater than the emissions that would have occurred through direct compliance with the regulation;
4. the specific recordkeeping, reporting, monitoring, and testing procedures you (the applicant) plan to use to demonstrate continued compliance with the ACP or ACE requirements; and
5. for an ACE, information on the California ports expected to be visited by the affected vessel(s) during the compliance period that the ACE will be in effect, the anticipated dates of those visits, and the potential planned overseas routes to and from these ports.

C. Will the application be made public?

Yes. To provide the public with an opportunity to review the content of the application, the EO will establish an internet site ("ACP/ACE internet site") in which all documents pertaining to an ACP or ACE application, to the extent that they do not contain information determined to be confidential, will be made available. The EO will also provide a copy of all such documents to each person who requests a copy of the documents; these persons will be treated as interested parties. The EO will provide two separate public comment periods during the ACP or ACE application process, which are described below.

D. What about confidentiality?

Because of the substantial public interest in the regulations and the ACP and ACE, we intend to make as much of the ACP/ACE-related documents available for public review

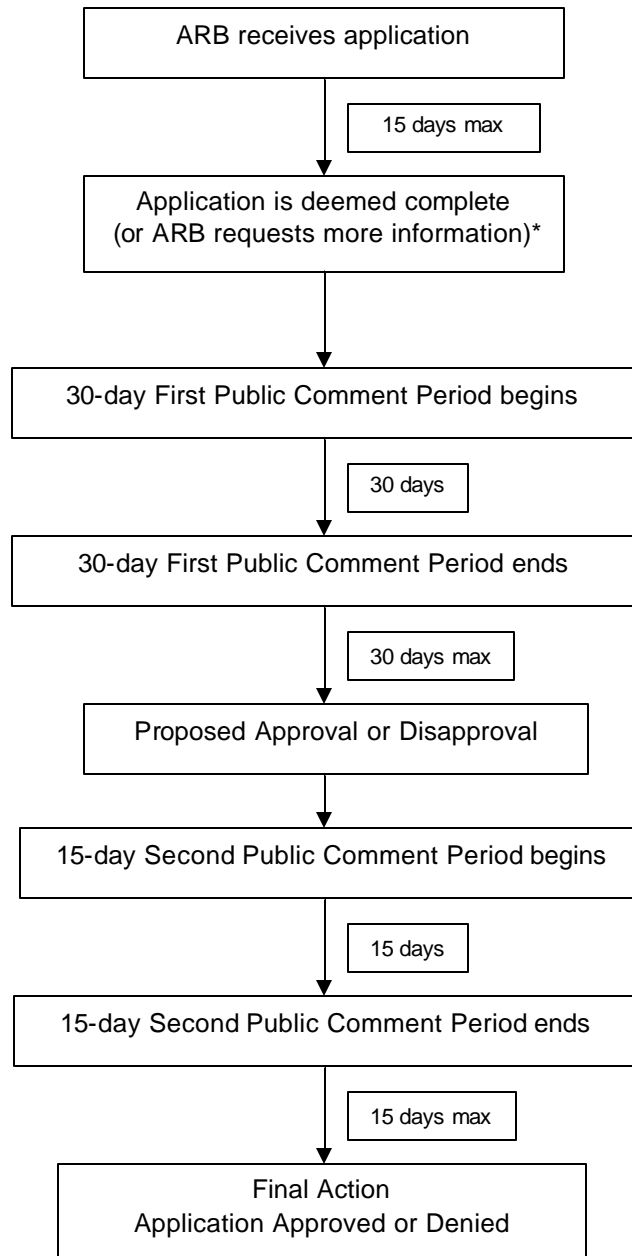
as State law permits. This includes the details of ACP and ACE applications, as well as the final approved plans. State law provides that certain information or data may be considered confidential and not subject to public release. In determining whether information is confidential and subject to disclosure, ARB staff will follow the procedures set forth in title 17, CCR, section 91000 et seq. Each applicant will be responsible for identifying any confidential information, except that emissions data shall not be identified as confidential.

E. What happens after my application is received by the ARB?

Within 15 days after receiving an ACP or ACE application, the EO will notify the applicant whether the application is deemed sufficiently complete to proceed with further evaluation. If the application is deemed incomplete, the notification will identify the application's deficiencies. Please note that the EO may also request additional information necessary to evaluate the application during any part of the ACP or ACE application process. The EO has an additional 15-day period for reviewing each set of documents or information submitted in response to an incomplete determination.

After the application is deemed complete, it will be made available on the ACP/ACE internet site for an initial 30-day public comment period. Within 30 days after the end of the first public comment period, the EO will notify the applicant and interested parties (generally via an e-mail list server notice) of ARB's proposed approval or disapproval of the proposed ACP or ACE plan. The notification will identify the start and end dates of a second (15-day) public comment period. Within 15 days after the end of the second public comment period, the EO will take final action to either approve or deny the ACP or ACE application and will notify the applicant accordingly. Figure 1 illustrates the ACP or ACE application process, followed by additional explanation of the public review process.

Figure 1: ACP/ACE Application Process



* If the application is incomplete, the ARB will notify the applicant, identifying the application's deficiencies. The EO will have an additional 15-day period to review each set of documents or information submitted in response to an incomplete application.

F. What happens during the public review process?

There are two separate public comment periods as follows:

1. 30-Day First Public Comment Period. After deeming an ACP or ACE application complete, the EO will provide a 30-day public comment period. The EO will notify all interested parties of the following:

- a. the applicant(s);
- b. the start and end dates for the 30-day first comment period; and
- c. the address of the ACP or ACE internet site where the application is posted.

The EO will make this notification available for public review on the ACP/ACE internet site. During the 30-day period, comments can be made on any element of the ACP or ACE application and whether the EO should approve or disapprove the application based on the contents and merits of the application. The EO will consider the comments received in determining ARB's proposed approval or disapproval of the ACP or ACE plan.

2. 15-Day Second Public Comment Period. Within 30 days after the first public comment period ends, the EO will notify the applicant and all interested parties of ARB's proposed approval or disapproval. This notification will propose to approve the application as submitted, disapprove the application, or approve the ACP or ACE application with modifications as deemed necessary by the EO. The notification will identify the start and end dates for the 15-day second public comment period. The EO will make this notification available for public review on the ACP/ACE internet site. During this second public comment period, any person may comment on the EO's proposed approval or disapproval of the ACP or ACE application and any element of the application. The EO will consider the comments received in determining whether to approve or deny the ACP or ACE.

G. When and how will I be notified of approval or disapproval?

Within 15 days after the second public comment period ends, the EO will take final action to either approve or deny an ACP or ACE application and will notify the applicant accordingly. If the application is denied or modified, the EO will state the reasons for the denial or modification in the notification. The notification to the applicant and approved ACP or ACE plan, if applicable, will be made available to the public on the ACP/ACE internet site. In addition, the EO will consider and address all comments received during the first and second public comment periods and provide responses to each comment on the ACP/ACE internet site.

IV. Estimating Emissions for Cargo Handling Equipment

A. How do I show that the emissions occurring under a proposed ACP will meet the requirements of the regulation?

Applicants must demonstrate that the emissions of PM and NO_x that would occur under an ACP will each be no greater than the emissions of these pollutants that would occur through direct compliance with the regulation during the applicable calendar year. Only emissions from non-yard truck CHE that are under an applicant's direct control at a

single port will be counted in the above calculation. In other words, an ACP cannot include equipment that operates at different ports even if the terminal owner or operator is the same. To ensure that the required emission reductions are achieved, an applicant's ACP must account for any potential variability or uncertainty in their plans that might affect emissions from the subject sources.

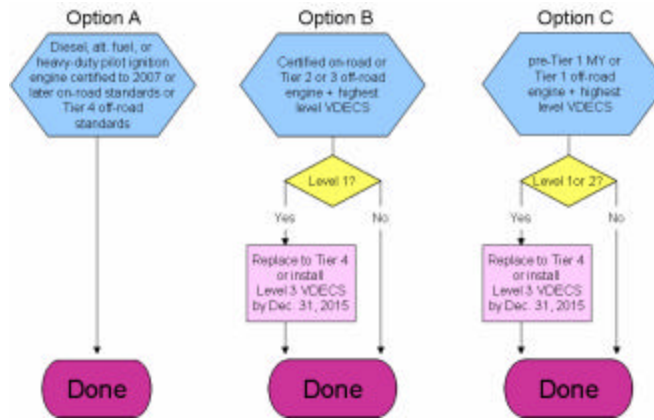
The regulation does not specify the methods by which the applicant can estimate emissions levels because there are numerous possibilities depending on the emission control strategies used. However, the discussion below provides some suggestions for methods that could be successfully used, depending on the circumstances.

B. How do I determine the emissions that would occur through direct compliance with the regulation?

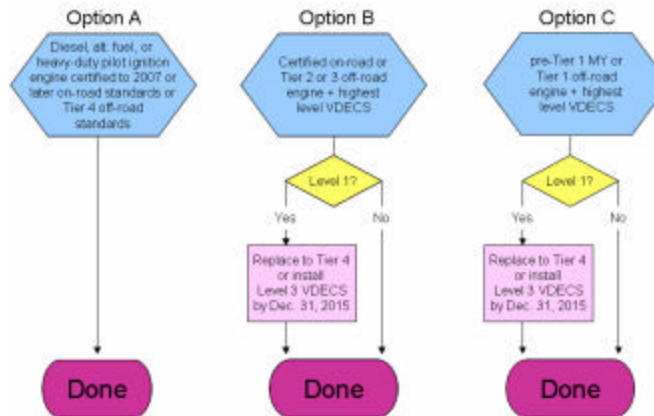
The emissions of diesel PM and NO_x each need to be estimated for the applicable calendar year assuming direct compliance with the regulation – that is, assuming the use of one of the compliance options specified in subsection (e)(3) of the regulation, as shown in Figure 2, and using the compliance schedule from subsection (e)(3) of the regulation as shown in Table 1.

Figure 2: Compliance Options for Non-Yard Truck Cargo Handling Equipment

Basic Container Handling Equipment



Bulk Cargo Handling Equipment



RTG Cranes

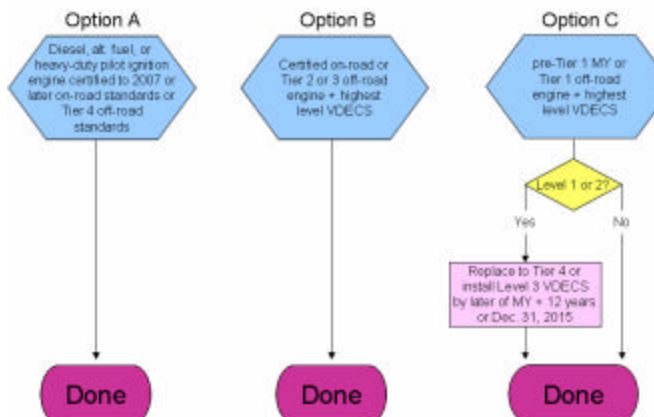


Table 1: Compliance Schedule for Non-Yard Truck Cargo Handling Equipment

Engine Model Years	Compliance Date ¹				
	Non-Yard Truck Fleets of 3 or Fewer	Non-Yard Truck Fleets of 4 or More			
		First 3 or 25% (whichever is greater)	50%	75%	100%
pre-1988	2007	2007	2008	2009	2010
1988-1995	2008	2008	2009	2010	2011
1996-2002	2009	2009	2010	2011	2012
2003-2006	2010	2010	2011	2012	2013

These emissions may be estimated based on methodology acceptable to the ARB, including, but not limited to, the following: (1) emissions testing of the actual engines included in the ACP, subtracting the emissions benefits of the compliance path (e.g., 25 percent PM reduction for a Level 1 verified diesel emission control strategy (VDECS)); or (2) emissions test data for the same make and model engines included in the ACP, as provided by the engine manufacturer or another reputable source, using the engine load factors and calculations for emission factors provided in Appendix B of the Initial Statement of Reasons (ISOR or Staff Report) for the regulation, and subtracting the emissions benefits of the compliance path. Load factors are shown below in Table 2, and zero-hour emission rates (from the ARB's OFFROAD Model) for calculating emission factors are shown in Appendix A.

Table 2: Engine Load Factors

Equipment Type	Engine Load Factor
Cranes (including Rubber-Tired Gantry cranes)	43%
Excavators	57%
Forklifts	30%
Container Handling Equipment (e.g., top picks, side picks, reach stackers)	59%
Other, General Industrial Equipment	51%
Sweeper/Scrubbers	68%
Tractors/Loaders/Backhoes	55%

The basic equation for estimating emissions, in pounds, from CHE over a period of time (e.g., the compliance period in the ACP) is shown below:

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

$$E_{y,t} = S \text{ Pop}_{t,v,x} * \text{HP} * \% \text{Load}_t * \text{EF}_{v,x} * \text{Hrs}_t * 0.002205^a$$

where

E	=	pollutant specific emissions (tons per year of NOx and diesel PM)
Pop	=	CHE type-specific population
HP	=	engine average rated brake horsepower
% Load	=	average engine load (load factor)
EF	=	deteriorated emission factor
Hrs	=	average annual use in hours
y	=	calendar year
t	=	equipment type (cranes, yard trucks, etc)
v	=	engine age (based on model year)
x	=	horsepower range of the engine

^a Conversion from grams to pounds.

To complete the equation above, deteriorated emission factors and fuel correction factors would be need to be calculated and applied. Each of these elements and how they are incorporated into the CHE emission estimates are discussed in Appendix B of the ISOR.

Emission calculations must be done for all equipment included in an ACP for the applicable compliance period (or calendar year). We recommend that testing be conducted in accordance with ARB, U.S. EPA, or ISO approved test methods, unless the applicant can provide clear and convincing evidence demonstrating that alternative test methods or modifications to approved methods will accurately estimate emissions.

C. How do I estimate the emissions that would occur with the use of an alternative emission control strategy (AECS)?

The emissions of NOx and PM each need to be estimated assuming the use of the AECS as specified in the application over the applicable calendar year. As appropriate, these emissions may be estimated based on: (1) emissions testing of the actual engines included in the plan with the AECS operational; or (2) test data for the same make and model engines with the AECS operational, as provided by the engine manufacturer or other reputable source or through the use of alternative methodology as approved by the EO. As above, we recommend that testing be conducted in accordance with ARB, U.S. EPA, or ISO approved test methods, unless the applicant can provide clear and convincing evidence demonstrating that alternative test methods or modifications to approved methods will accurately estimate emissions.

D. What documentation, recordkeeping, or reporting is necessary to demonstrate emission levels?

The extent of information and ongoing recordkeeping necessary will depend on the specifics of the application. For example, if emissions test data is submitted, then

emissions test results, test methods used, specific engines tested, fuel properties, fuel injection timing, and all other information necessary to establish that the emissions test data is appropriate, must be submitted with the initial application. If exhaust emission controls are used, then ongoing records may be required to establish that the equipment is used according to manufacturers' specifications, equipment maintenance is performed, and that the equipment continues to operate at the level specified in the ACP.

It is important to note that future regulatory activities may impact the approvability of an ACP. Emission reductions included in an ACP cannot include reductions that are otherwise required by any State, federal, or international rule, regulation, or statute.

V. Estimating Emissions for Auxiliary Engines on Ocean-going Vessels

A. How do I show that the emissions occurring under a proposed ACE plan will meet the requirements of the regulation?

Applicants must demonstrate that the emissions of diesel PM, NO_x, and SO_x (hereafter "emissions") that would occur under an ACE plan will *each* be no greater than the emissions of these pollutants that would occur through direct compliance with the regulation. Only emissions occurring within Regulated California Waters as defined in the regulation (i.e., approximately 24 nm offshore) will be counted in the above calculation. To ensure that the regulation requirements are met, an applicant's ACE must account for potential variability or uncertainty in their plans, such that under any circumstances, the required emission reductions are achieved.

In addition, an ACE plan must not result in adverse regional emission impacts. In other words, as defined in the regulation, the ACE plan must not result in increases in emissions at a port geographical area relative to the emissions that would have occurred prior to implementation of the regulation.

The regulation does not specify the methods by which the applicant can estimate emissions levels because there are numerous possibilities depending on the emission control strategies used. However, the discussion below provides some suggestions for methods that could be successfully used, depending on the circumstances.

B. How do I determine the emissions that would occur through direct compliance with the regulation (i.e., using the specified marine distillate fuels)?

The emissions of each pollutant need to be estimated assuming direct compliance with the regulation – that is, assuming the use of the marine distillate fuels specified in subsection (e)(1) of the regulation, as shown in Table 3 below. Until January 1, 2010, for marine gas oil, a sulfur content of 0.5% or less should generally be assumed since

marine gas oil used in ships visiting California averages 0.5% or less, according to the ARB's 2005 Oceangoing Ship Survey.

Table 3: Regulation Fuel Specifications and Implementation Dates

Implementation Date	Fuel Specification
January 1, 2007	Marine gas oil (DMA grade marine fuel); or Marine diesel oil (DMB grade marine fuel) at or below 0.5% sulfur
January 1, 2010	Marine gas oil (DMA grade marine fuel) at or below 0.1% sulfur

Depending on the circumstances, the applicant may estimate emissions using one of the following methods or such other methodology approved by ARB: (1) emissions testing of the actual engines included in the ACE plan using the specified fuels; (2) emissions test data for the same make and model engines included in the ACE plan as provided by the engine manufacturer or other reputable source using the specified fuels; or (3) emission factors provided in the staff report, as shown in Table 4 below.

Table 4: Marine Distillate Fuel Emission Factors

Fuel	PM	NOx	SOx
Marine Distillate (MGO/MDO @ 0.5% sulfur)	0.38 g/kW-hr	13.9 g/kW-hr	2.1 g/kW-hr
Marine Distillate (MGO/MDO @ 0.1% sulfur)	0.25 g/kW-hr	13.9 g/kW-hr	0.4 g/kW-hr

Source: Ship Auxiliary Engine Rule Initial Statement of Reasons for Proposed Rulemaking, 10/2005, Table VII-1 at p. VII-3.

We recommend that any testing be conducted in accordance with ARB, U.S. EPA, or ISO approved test methods, unless the applicant can provide clear and convincing evidence demonstrating that alternative test methods or modifications to approved methods will accurately estimate emissions.

C. How do I estimate the emissions that would occur with the use of the alternative emission control strategy (ECS)?

The emissions of each pollutant (diesel PM, NOx, and SOx) need to be estimated with the alternative emission control devices or methods implemented, as specified in the ACE application. As appropriate, these emissions may be estimated based on: (1) emissions testing of the actual engines included in the plan with the ECS operational; (2) test data for the same make and model engines with the alternative ECS operational, as provided by the engine manufacturer or other reputable source; or (3) through the use of an alternative methodology approved by the EO. As above, we recommend that testing be conducted in accordance with ARB, U.S. EPA, or ISO

approved test methods, unless the applicant can provide clear and convincing evidence demonstrating that alternative test methods or modifications to approved methods will accurately estimate emissions.

D. How do I determine the pre-regulation baseline emissions?

As mentioned in Section A above, emissions averaging in an ACE plan must not result in increases in emissions at a port geographical area relative to the emissions that would have occurred prior to implementation of the regulation. For some applications, it may be necessary to demonstrate this by estimating their emissions prior to the regulation.

As appropriate, these emissions may be estimated based on: (1) emissions testing of the actual engines included in the ACE plan using fuels representative of pre-regulation operation; (2) emissions test data for the same make and model engines included in the ACE plan, as provided by the engine manufacturer or other reputable source, using fuels representative of pre-regulation operation; or (3) emission factors provided in the staff report for the regulation, as show in Table 5 below, if similar pre-regulation fuels were used.

Table 5: Heavy Fuel Oil Emission Factors

Fuel	PM	NOx	SOx
Heavy fuel oil (IFO-380 @ 2.5% sulfur)	1.5 g/kW-hr	14.7 g/kW-hr	11.1 g/kW-hr

Source: Ship Auxiliary Engine Rule Initial Statement of Reasons for Proposed Rulemaking, 10/2005, Table VII-1 at p. VII-3.

E. How do I estimate the total emissions of each pollutant during the compliance period in the ACE plan (e.g., one year)?

Depending on the application, the total emissions occurring from all the engines covered under the ACE plan within Regulated California Waters may need to be summed for operation during the entire compliance period. This would apply in situations where the emission control strategy does not continuously provide emissions at or below the emissions resulting from direct compliance with the regulation. For example, under an application using fleet averaging, some vessels will be above and others below the emissions occurring with direct compliance, so the total emissions occurring in the compliance period will need to be calculated. A hypothetical example of this scenario is provided in Section VII B.3.

Generally, emissions test data will be supplied in terms of an emission factor expressed in grams of a specific pollutant generated per kilowatt-hour of energy output. Therefore, to determine the total emissions of a pollutant over the compliance period, the total amount of energy expended needs to be estimated based on the hours of operation in Regulated California Waters and the average engine power generated during operation. For engines operating at different loads, the hours of operation at each load will need to

be estimated, and in some cases the emission factor may need to be adjusted (especially for low load operation when emission factors are generally higher). The resulting emission estimates at each load will then need to be summed to calculate the total emissions for each engine.

An alternative methodology to estimate the amount of energy expended by an engine is by multiplying the amount of fuel consumed by the average energy consumption factor (ECF), the amount of energy expended per unit of fuel consumed for that engine. The equations below can be used to determine the total emissions (in tons) as discussed above. The emissions calculations may need to be performed separately for different engine loads if the ECF varies according to the load.

Estimated emissions (tons/yr) =

*Option 1: Emission factor (grams of pollutant/kW-hr) * hrs of operation during compliance period * engine power (kW) * 1 ton/907,200 grams; or*

*Option 2: Emission factor (grams of pollutant/kW-hr) * grams of fuel consumed during compliance period * ECF (kW-hr/gram fuel) * 1 ton/907,200 grams*

Where:

engine power = The rated maximum engine power multiplied by the % load factor (i.e., a 3,000 kW rated engine operating at 80% load equates to 2,400 kW)

ECF = energy consumption factor is the amount of energy generated per unit of fuel consumed. This is the reciprocal of the brake specific fuel consumption (BSFC), the ratio of the fuel consumed per unit of energy delivered. The BSFC is usually provided by the engine manufacturer.

F. What documentation, recordkeeping, or reporting will be necessary to demonstrate emission levels?

The extent of information and ongoing recordkeeping necessary will depend on the specifics of the application. For example, if emissions test data is submitted, then emissions test results, test methods used, specific engines tested, fuel properties, fuel injection timing, and all other information necessary to establish that the emissions test data is appropriate, must be submitted with the initial application. If exhaust emission controls are used, then ongoing records may be required to establish that the equipment is used within the Regulated California Waters, equipment maintenance is performed, and that the equipment continues to operate at the level specified in the ACE.

G. What if I comply using shore-side power?

An applicant has two compliance paths if they choose to comply with the regulation using shore-side power. First, they can comply under simplified procedures set forth in subsection (g)(1)(J) of the regulations, “Use of Shore-Side Power.” Under this provision, vessels that use shore-side power at dockside in lieu of their auxiliary engines shall be considered to meet the emission reduction requirements of the ACE while traveling in Regulated California Waters to the port where shore-side power is used and while traveling from that port to the next port of call. In other words, they do not need to use distillate marine fuels or other strategies with their auxiliary engines while traveling to and from the port where shore-side power is used. However, this provision only applies if the vessel connects to shore-side power and turns off all auxiliary engines within one hour of being secured at dockside, and continuously thereafter until no more than one hour prior to when the vessel leaves the terminal. In addition, power must be supplied by: (1) a utility company; or (2) another source with emissions per unit of delivered energy equivalent to or lower than the January 1, 2007 levels specified in title 17, CCR, sections 94200-94214, “Distributed Generation Certification Program” (contact ARB staff listed in Section VII of this document for details). When complying under subsection (g)(1)(J), the applicant does not need to submit emissions calculations in their ACE application.

If an applicant wants to use shore-side power as an emission control strategy, but cannot meet the requirements above (i.e., it may take more than one hour to connect to power after being secured at dockside), then the applicant can comply under the general ACE provisions. In this case, the applicant must submit detailed information demonstrating that the emissions under the ACE plan will be no greater than the emissions resulting from direct compliance with the regulation, the same as for other emission control strategies. The emissions calculations must include the overall “grid” emissions per unit of power delivered. The information in Table 6 below may be used:

Table 6: “Grid” Emission Factors

Pollutant	Emission Factor (grams/kW-hr)*
PM	0.0132
NOx	0.0863
SOx	0.0064

*Emissions for total State generation, including non-thermal generation. Based upon ARB staff estimates for total emissions from in-state power plants and CEC staff estimates for total power used in California, including out-of-state imports.

H. What if I want to comply with the regulation under subsection (g)(1)(J), “Use of Shore-Side Power,” but only plan to use shore-side power at one of two or more California ports visited?

As stated in sections (g)(1)(J)(3) and (g)(1)(J)(4) of the regulation, only travel to and from the port where shore-side power is utilized is automatically considered to meet the

emission reduction requirements of the ACE (i.e., the use of distillate fuels or other control strategies is not required during this travel). For example, if a vessel visits two California ports in succession, and only utilizes shore-side power at the first port, then the vessel shall only be considered to meet the emission reduction requirements of the ACE during the travel to the first port, while dockside at that port, and while traveling from the first to second port. The vessel shall not be considered to meet the emission reduction requirements of the ACE during the entire time it is docked at the second port and any subsequent travel from the second port to the next port of call. Therefore, at some point prior to stopping at the second port, the vessel operator will need to comply with the regulation through the use of the specified distillate fuels or other emission control strategies covered under the ACE provision. The ship operator will decide when to initiate these emission control strategies.

Similarly, if a vessel visits two California ports in succession, and only uses shore-side power at the second port visited, the vessel shall only be considered to meet the emission reduction requirements of the ACE provision during travel from the first to the second port, while docked at the second port, and any subsequent travel from the second port to the next port of call. Travel to the first port, and while dockside at the first port, shall not be considered to meet the emission reduction requirements of the ACE. Therefore, the vessel operator will need to comply with the regulation through the use of the specified distillate fuels or use other emission control strategies under the ACE provision.

For vessels making multiple California port visits in succession, the same principle applies. Namely, only travel to and from a port where shore-side power is utilized is considered to meet the emission reduction requirements of the ACE under section (g)(1)(J).

Mooring (anchoring) stops by passenger cruise ships are a special case. These are not considered to be “port visits.” However, during the time they are moored, they are not considered to meet the emission reduction requirements of the ACE under section (g)(1)(J), and must comply with the regulation through the use of the specified distillate fuels or use other emission control strategies under the ACE provision. For example, if a passenger cruise ship travels from Enseñada, Mexico, to Long Beach, utilizes shore-side power while docked at Long Beach, then moors off Catalina Island and subsequently travels back to Enseñada, the vessel will be considered to meet the emission reduction requirements of the ACE provision under (g)(1)(J) for all travel in Regulated California Waters, except during mooring off Catalina Island.

It is important to note that future regulatory activities may impact the approvability of an ACE. Emission reductions included in an ACE cannot include reductions that are otherwise required by any State, federal, or international rule, regulation, or statute.

VI. Post-Approval

A. Is an approved ACP or ACE transferable?

ACP and ACE plans are not transferable. When an ACP or ACE is approved, the EO will issue an executive order, which will only be applicable to the applicant who has direct control of the equipment/vessel(s) covered under that approved ACP or ACE plan. Therefore, if the equipment or vessel(s) are sold, leased, rented, etc. to another operator, the new owner or operator must apply for a new ACP or ACE if the new owner/operator wishes to continue operating that equipment/vessel under the ACP/ACE provisions. However, in most cases, it is anticipated that the data in the original application could be cited and resubmitted in a new application.

B. What if my processes or equipment change?

The EO must be notified within 30 days if the applicant learns of any information that would alter the emissions estimates submitted to the EO in support of the ACP or ACE application. The EO may approve these changes or revoke the ACP or ACE and require a new ACP or ACE application to be filed.

C. Can the ARB revoke or modify an approved ACP or ACE?

Yes. With 30-day notice to the ACP or ACE holder, the EO may revoke or modify, as needed, an approved ACP or ACE if any of the following occur:

1. there have been multiple violations of the ACP or ACE provisions or the requirements of the approved ACP or ACE plan;
2. the EO has reason to believe that an approved ACP or ACE has been granted that no longer meets the criteria or requirements for an ACP or ACE;
or
3. the applicant can no longer comply with the requirements of the approved ACP or ACE in its current form.

Public notification of a revocation or modification of an approved ACP or ACE will be made available on the ACP/ACE internet site.

D. Can I get credits if my ACP or ACE reduces emissions more than is required?

The regulations do not currently provide for the generation, banking, or trading of emission reduction credits under the ACP or ACE program, except for averaging within the same fleet (for the ACE only). That is, an owner or operator can use different control strategies on vessels within its fleet of vessels subject to the ACE provision, such that the average of emissions in diesel PM, NO_x, and SO_x across all those vessels within the same ACE plan would meet the emission limits.

VII. Examples of ACP and ACE Plans

This section contains hypothetical examples of ACP and ACE plans. The examples should be used for guidance only, as each application must be specific to the equipment/vessel(s) and alternative strategies that are proposed in the plans.

A. Examples of ACP Applications for Cargo Handling Equipment

1. Emission control devices used on a fleet of top picks and side picks

A terminal owner has four rubber-tired gantry cranes that have Tier 2 engines. The highest level VDECS currently available for the operator's specific engines is a Level 1. Under the regulation, this is one of the compliance options. However, instead of applying the Level 1 VDECS, the operator chooses to install on three of the four engines alternative, less expensive, but more effective, Level 2 controls that have not been verified by ARB but that the operator can install as part of a demonstration program for a manufacturer who is seeking verification. The ACP application will need to contain test data demonstrating that the emissions of diesel PM and NO_x with the alternative controls (Level 2 on three engines) will, in the aggregate, be less than or equal to the emissions when using the Level 1 VDECS over the course of the calendar year. Ongoing recordkeeping will be required on all four engines to demonstrate that these controls will be used at all times during the applicable ACP period. In order to continue using the alternative controls beyond the calendar year of the ACP, a new application will be required.

2. Higher level unverified emission control devices used on higher operating equipment in lieu of verified controls on all

A terminal owner has five Tier 2 top picks and three Tier 1 side picks. Level 1 VDECS are available for all engines, but the owner would like to install alternative, Level 2 controls on the side picks, which are operated more hours than the top picks, and leave the top picks uncontrolled. The ACP application will need to contain test data demonstrating that the total overall emissions of diesel PM and NO_x with the alternative, Level 2 controls on the side picks and uncontrolled top picks will each be no greater than the emissions when using the Level 1 VDECS on all of the equipment over the course of the ACP compliance period (calendar year). Table 7 below illustrates the PM emissions for this scenario for using hypothetical emission factors (EF), horsepower (HP), model years (MY), and annual hours of operation.

Table 7: PM Emissions Summary for ACP Scenario

<i>Equipment</i>	<i>MY</i>	<i>Rated HP</i>	<i>Load Factor</i>	<i>Annual Hours</i>	<i>PM EF (g/hp-hr)</i>	<i>PM Emissions (lbs)</i>	<i>PM Emissions w/Direct Compliance (lbs)</i>	<i>PM Emissions w/ACP (lbs)</i>
5 Top Picks	2003	250	0.59	1,500	0.12	272	204	272
3 Side Picks	1999	250	0.59	1,900	0.38	704	528	352
Totals:						976	732	624

Note: The calculations above have been simplified for the purposes of illustrating this example scenario and do not reflect deterioration factors or fuel correction factors.

While NOx emission calculations were not provided in Table 7, they would be required for an actual ACP application.

B. Examples of ACE Applications for Ocean-going Vessels

1. Emission control device used on one vessel

The operator of an auto carrier vessel plans to make several California port visits. The ship has three auxiliary engines, but will only use two on visits to California. Rather than use the distillate fuels specified in the regulation, the ship operator chooses to install emission control devices (e.g., exhaust scrubbers, selective catalytic reduction, etc.) on two of the three auxiliary engines. These emission controls are to be used during all operation of the auxiliary engines within Regulated California Waters.

The ACE application will need to contain test data demonstrating that the emissions of PM, NOx, and SOx with the emission controls operating will each be lower than the emissions when using the distillate fuels specified in the regulation. Ongoing recordkeeping and reporting will also be needed to demonstrate that these controls will be used at all times within Regulated California Waters, and that they are maintained according to the manufacturer’s instructions and achieving the necessary emission reductions. However, it will not be necessary to determine the overall total emissions over the compliance period in the ACE plan because the emissions will be lower than the emissions through direct compliance with the regulation at all times in Regulated California Waters.

2. Use of shore-side power under (g)(1)(J)

A tanker operator travels a regular route from Alaska to Richmond to Long Beach and back to Alaska. The tanker normally uses heavy fuel oil in its auxiliary engines. The tanker operator plans to submit an ACE application committing to plug in to shore-side power at Long Beach only. Specifically, the applicant plans to connect to shore-side power within one hour after being secured at the Long Beach terminal, and continuously thereafter until no more than one hour prior to leaving. As specified in

section (g)(1)(J)(4), the tanker will be considered to meet the emission reduction requirements of the ACE while: (1) traveling from Richmond to Long Beach; (2) while at dockside at Long Beach; and (3) while traveling from Long Beach to Alaska. In other words, during travel within Regulated California Waters from Richmond to Long Beach, and for up to one hour after arrival at Long Beach, the vessel can use heavy fuel oil as usual. In addition, the vessel can use heavy fuel oil on the trip from Long Beach back up to Alaska within Regulated California Waters. However, during travel from the California/Oregon border to Richmond, and at all times while docked at Richmond, the vessel will not be considered to meet the emission requirements of the ACE under section (g)(1)(J), and must comply with the regulation as usual (e.g., through the use of distillate marine fuels). Applications under section (g)(1)(J) are simplified because it is not necessary to document or calculate emissions.

Note that if the tanker operator decided that it could no longer comply with the provisions of section (g)(1)(J) (for example, because it cannot connect to shore-side power within one hour of being secured at dockside), then the operator can still apply under the general ACE provisions. However, in this case the ship operator will be required to demonstrate that the emissions under the ACE will be no greater than the emissions resulting from direct compliance with the regulation.

3. Fleet emissions averaging using emission controls and shore-side power

A shipping company operates three container ships. All of the ships operate on the same route from Hawaii to Los Angeles to Oakland and back to Hawaii. One of the ships (ship "A") makes 25 California trips annually, making two port calls with each trip (50 total port visits). The other two ships (ships "B" and "C") each make two trips to California annually, collectively making eight total port visits annually. The shipping company would like to install emission control devices on ship A that will achieve emission reductions beyond what is required by the regulation, while operating the other two ships using heavy fuel oil (HFO) without any controls. To achieve the necessary emission controls on ship A, the company chooses to use lower sulfur marine gas oil (MGO) and install emission controls (e.g., water scrubbers, selective catalytic reduction, diesel oxidation catalysts, etc.) on all auxiliary engines. In addition, since ship A will be visiting a terminal at the Port of Los Angeles that offers shore-side power hookups, ship A will be retrofitted to allow it to plug in at this terminal. Under this application, Ship A will use the lower sulfur fuels and emission controls during all operation of the auxiliary engines within Regulated California Waters, and shore-side power will be utilized whenever the ship visits the Los Angeles terminal (50% of the California port visits).

The ACE application will need to demonstrate that the emissions of PM, NO_x, and SO_x will each be no greater than the emissions from direct compliance with the regulation (i.e., use of MGO by all three ships). Figure 3 and Table 8 below illustrate direct compliance (using MGO) for PM emissions. Figure 4 and Table 9 below illustrate compliance under the ACE plan for PM using hypothetical emission factors, engine loads, and hours of operation. As shown, the ACE plan would result in less overall PM

emissions than direct compliance with the regulation (i.e., use of MGO fuel). In an actual ACE application, emissions figures for NOx and SOx would also be necessary, and calculations would be somewhat more detailed. For example, separate calculations may be needed for low load operation.

Under this scenario, emissions testing of the engines using the specified fuels and emission control equipment in the ACE plan will be needed. Ongoing recordkeeping and reporting will also be needed to demonstrate that the emission controls will be used at all times within Regulated California Waters, and that they are maintained according to the manufacturer’s instructions and achieving the necessary emission reductions.

Figure 3: Direct Compliance Using Marine Gas Oil (MGO)

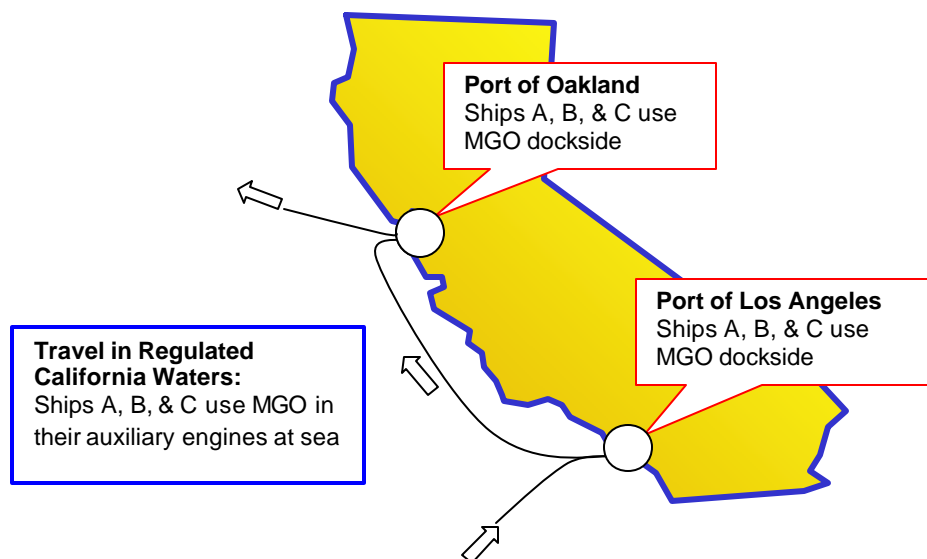


Table 8: Annual Emissions Summary with Compliance using Marine Gas Oil

Ship "A" Annual Emissions with Marine Gas Oil @ 25 CA visits/50 port calls					
Operating Mode	Time per visit or port call (hrs)	Annual Time in mode (hrs)	Power (kW)	PM Emission Factor (g/kW-hr)	PM Emissions (pounds)
Transiting	30 hrs/trip	750	1,000	0.38	628
Maneuvering	2 hrs/port call	100	3,000	0.38	251
Hotelling	50 hrs/port call	2,500	1,200	0.38	2,511
Total					3,390
Ship "B+C" Annual Emissions with Marine Gas Oil @ 4 visits/8 total CA port calls					
Operating Mode	Time per visit or port call (hrs)	Annual Time in Mode (hrs)	Power (kW)	PM Emission Factor (g/kW-hr)	PM Emissions (pounds)
Transiting	30 hrs/trip	120	1,000	0.38	100
Maneuvering	2 hrs/port call	16	3,000	0.38	40
Hotelling	50 hrs/port call	400	1,200	0.38	402
Total					542
Grand Total					3,932

Figure 4: Compliance under ACE Plan

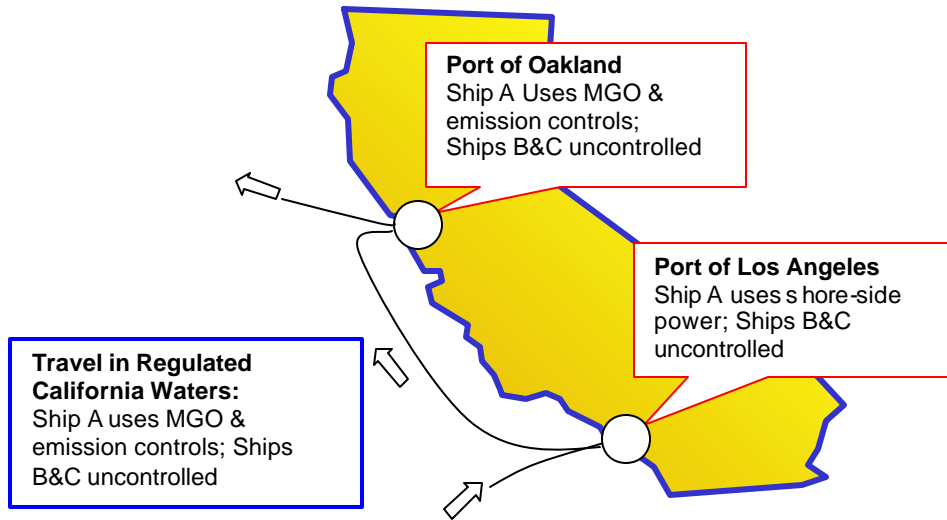


Table 9: Annual Emissions Summary under ACE Plan

Ship "A" Annual Emissions with Marine Gas Oil @ 25 CA visits/50 port calls					
Operating Mode	Time per visit or port call (hrs)	Annual Time in mode (hrs)	Power (kW)	PM Emission Factor (g/kW-hr)	PM Emissions (pounds)
Transiting	30 hrs/trip	750	1,000	0.20	330
Maneuvering	2 hrs/port call	100	3,000	0.20	132
Hotelling (auxiliary engines)	50 hrs/port call	1,250	1,200	0.20	661
Hotelling (shore-side power)	50 hrs/port call	1,250	1,200 (grid)	0.013	43
Total					1,166
Ship "B+C" Annual Emissions with Heavy Fuel Oil @ 4 visits/8 total CA port calls					
Operating Mode	Time per visit or port call (hrs)	Annual Time in Mode (hrs)	Power (kW)	PM Emission Factor (g/kW-hr)	PM Emissions (pounds)
Transiting	30 hrs/trip	120	1,000	1.5	396
Maneuvering	2 hrs/port call	16	3,000	1.5	158
Hotelling	50 hrs/port call	400	1,200	1.5	1,586
Total					2,140
Grand Total					3,306

VIII. Contact Information

Below are important addresses and phone numbers to obtain additional information regarding CHE ACPs and ocean-going vessel ACEs.

Websites:

Cargo handling equipment regulatory documents:

<http://www.arb.ca.gov/regact/cargo2005/cargo2005.htm>

Ocean-going ship auxiliary engine regulatory documents:

<http://www.arb.ca.gov/regact/marine2005/marine2005.htm>

Electronic version of this guidance document:

<http://www.arb.ca.gov/maritime> or <http://www.arb.ca.gov/cargo>

E-mail list server for cargo handling equipment and/or ocean-going ship auxiliary engines:

<http://www.arb.ca.gov/listserv/listserv.php>

Staff:

	<u>Name</u>	<u>Phone</u>	<u>E-mail</u>
Cargo handling equipment:	Lisa Williams	916.327.1498	lwilliam@arb.ca.gov
Ocean-going vessels:	Paul Milkey	916.327.2957	pmilkey@arb.ca.gov

Mailing Address for ACP and ACE Applications:

Executive Officer
ACP/ACE Application
Attn: SSD, Emissions Assessment Branch
Air Resources Board
1001 "I" Street
Sacramento, CA 95814

Appendix A

Zero-Hour Emission Rates for Cargo Handling Equipment

		(g/hp-hr)	(g/hp-hr)			
HP	Year	NOx	PM	*NOTE:		
50	1987	6.90	0.76		50	- Implies 25-50 hp
50	1998	6.90	0.76		120	- Implies 51-120 hp
50	2003	5.55	0.60		175	- Implies 121-175 hp
50	2004	5.10	0.43		250	- Implies 176-250 hp
50	2005	4.95	0.38		500	- Implies 251-500 hp
50	2007	4.88	0.35		750	- Implies 501-750 hp
50	2020	4.80	0.32		9999	- Implies >751 hp
120	1987	13.00	0.84			
120	1997	8.75	0.69			
120	2003	6.90	0.69			
120	2004	5.64	0.39			
120	2005	5.22	0.29			
120	2007	5.01	0.24			
120	2020	2.89	0.19			
175	1969	14.00	0.77			
175	1971	13.00	0.66			
175	1979	12.00	0.55			
175	1984	11.00	0.55			
175	1987	11.00	0.55			
175	1996	8.17	0.38			
175	2002	6.90	0.38			
175	2003	5.26	0.24			
175	2004	4.72	0.19			
175	2006	4.44	0.16			
175	2020	2.45	0.14			
250	1969	14.00	0.77			
250	1971	13.00	0.66			
250	1979	12.00	0.55			
250	1984	11.00	0.55			
250	1987	11.00	0.55			
250	1995	8.17	0.38			
250	2002	6.25	0.15			
250	2003	5.00	0.12			
250	2004	4.58	0.11			
250	2006	4.38	0.11			
250	2020	2.45	0.11			
500	1969	14.00	0.74			
500	1971	13.00	0.63			
500	1979	12.00	0.53			
500	1984	11.00	0.53			
500	1987	11.00	0.53			
500	1995	8.17	0.38			
500	2000	6.25	0.15			
500	2001	4.95	0.12			
500	2002	4.51	0.11			
500	2004	4.29	0.11			
500	2005	4.00	0.11			
500	2020	2.45	0.11			
750	1969	14.00	0.74			
750	1971	13.00	0.63			
750	1979	12.00	0.53			
750	1984	11.00	0.53			
750	1987	11.00	0.53			
750	1995	8.17	0.38			
750	2001	6.25	0.15			
750	2002	4.95	0.12			
750	2003	4.51	0.11			
750	2005	4.29	0.11			
750	2020	2.45	0.11			
9999	1969	14.00	0.74			
9999	1971	13.00	0.63			
9999	1979	12.00	0.53			
9999	1984	11.00	0.53			
9999	1987	11.00	0.53			
9999	1999	8.17	0.38			
9999	2005	6.25	0.15			
9999	2006	4.95	0.12			
9999	2007	4.51	0.11			
9999	2009	4.29	0.11			
9999	2020	4.08	0.11			

Appendix B

Reference to Approved Test Methods

Below are references to Air Resources Board (ARB), United States Environmental Protection Agency (U.S. EPA), and International Organization for Standardization (ISO) approved test methods:

Title 13, California Code of Regulations, section 2423, "Exhaust Emission Standards and Test Procedures – Off-Road Compression Ignition Engines."

Code of Federal Regulations (CFR) 40, Part 89, "Control of Emissions from New and In-Use Nonroad Engines."

ISO 8178 Test Procedures: ISO 8178-1: 1996(E) ("ISO 8178 Part 1"); ISO 8178-2: 1996(E) ("ISO 8178 Part 2"); and ISO 8178-4: 1996(E) ("ISO 8178 Part 4").