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Summary and Analysis of Comments: Control of Emissions from Marine Diesel Engines

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EPA

U.S. Environmental Protection Agency
Office of Air and Radiation
Office of Mobile Sources
Engine Programs and Compliance Division

November 1999

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Introduction

On December 11, 1999, we published a Notice of Proposed Rulemaking (NPRM) for proposed emission standards and test procedures for new commercial marine diesel engines at or above 37 kilowatts (kW). In that notice, we proposed emission standards for new engines, beginning in 2004. We also proposed a compliance program with provisions for certification and production line testing, and recordkeeping and reporting requirements. The proposal also addressed exemptions, imports, and warranties.

We held a public hearing on the NPRM in Ann Arbor, Michigan on January 19, 1999. At that hearing, oral comments on the NPRM were received and recorded. A written comment period remained open until February 26, 1999. A complete list of organizations and individuals that provided comments on the NPRM is contained in the following table. Abbreviations for the organization names are also listed.

This Summary and Analysis of Comments contains a detailed summary of all comments we received on the NPRM as well as our analysis of each comment and response. The reader should also refer to the final rulemaking notice in the Federal Register as well as the Final RIA.

List of Commenters

Commenter	Abbreviation
Alaska Diesel Electric	ADE
American Bureau of Shipping	ABS
American Petroleum Institute	API
American Waterways Operators	AWO
Automotive Engine Rebuilders Association	AERA
Bluewater Network	BN
California Air Resources Board	California ARB
Carver Yachts	
Caterpillar	CAT
Chamber of Shipping of America	CSA
Crowley Marine Services, Inc.	
Cummins Engine Company	
Cummins Wärtsilä	CW
Electromotive Division/General Motors	EMD
Engine Manufacturers Association	EMA
Euromot	
Halliburton Energy Service	HES
Hatteras Yachts	
Hvide Marine, Inc.	
John Deere	
Lake Carriers' Association	LCA
MAN B&W Diesel, Inc.	
Manson Construction	
Manufacturers of Emission Controls Association	MECA
Mercury Marine	
National Marine Manufacturers Association	NMMA
Navistar	
Navy (Department of)	
Northeast States for Coordinated Air Use Management	NESCAUM
Oglebay Norton Company	ON
Port of Houston Authority	PHA
State and Territorial Air Pollution Program Administrators/ Association of Local Air Pollution Control Officials	STAPPA/ALAPCO
Tiara Yachts	
The Transportation Institute	TI
USS Great Lakes Fleet, Inc.	UGLF
Wärtsilä NSD	

CHAPTER 1 – Scope and Applicability

A. Scope of Application

1. Meaning of "New"

What We Proposed:

One key provision of this emission control program is the definition of those engines that must comply with the emission standards. In our notice, we proposed to use the approach set out in Section 213 of the Act and require that the standards cover all new marine diesel engines and new marine vessels that use those engines. We proposed to use the term "new" as it is used in our other nonroad programs. Under this definition, an engine is considered new until its legal or equitable title has been transferred or the engine has been placed into service. Because some marine diesel engines are made by modifying a highway or nonroad land-based engine that has already been installed on a vehicle or other piece of equipment, we also stated in the NPRM that a marine diesel engine is placed into service (i.e., used for its functional purposes) when it is installed on a marine vessel. In other words, a marine diesel engine made by converting, or marinizing, a used land-based engine will have to meet the standards once they take effect.

What Commenters Said:

Only Cummins commented on this proposal, recommending that we adopt our proposed requirement that any engine converted from a land-based application, clearly including locomotives, to a marine application be considered a new marine engine and thus subject to the rule's requirements applicable at the time the engine is converted.

Our Response:

We are finalizing the requirement for engines that have been used in non-marine applications to be certified to marine emission standards if they are installed on a vessel. This is achieved in the regulations with the definition of new marine engine, so we are not finalizing the definition of "placed into service" as "installed on a marine vessel."

2. Imported Engines

What We Proposed:

Consistent with our approach in other mobile source rules, we proposed that engines imported into the United States would be considered new engines and would be subject to these standards. EPA's definitions of "new," in this and other nonroad rules, generally tracks the Clean Air Act definition of new motor vehicle engine. We proposed an approach that is consistent with the Harmonized Tariff Schedule of the United States (HTSUS). HTSUS specifies that vessels used in international trade or commerce or vessels brought into the territory of the United States by nonresidents for their own use in pleasure cruising are admitted without formal customs consumption entry or payment of duty. This approach is consistent with the Treasury Department's ruling, which concluded that vessels coming into the United States temporarily as carriers of passengers or merchandise are not subject to customs entry or duty, but if brought into the United States permanently, they are to be considered and treated as imported merchandise. See *American Customs Brokerage Co., Inc., a/c Astral Corp. v. United States*, 375 F. Supp. 1360, 1366 (Cust. Ct. 1974). This means that engines installed on vessels flagged in another country that come into the United States temporarily will not be subject to the emission standards, because they are not imported and are therefore not new engines under Clean Air Act §§216(3) and 213(d).

What Commenters Said:

We received two comments on this issue. ABS noted that extending the definition of new to imported engines could create problems. Specifically, the original engine builder will not necessarily at the time of engine building or subsequently have undertaken the actions and submissions as required by 40 CFR Part 94. To comply with this requirement it would be necessary for the original engine builder to agree to undertake the obligations imposed by these regulations and to undertake the actions and submissions as would have been required had the engine been built in the U.S. Yet, it is unlikely that the engine builder will be prepared to provide this support. Under these circumstances it is possible that the only feasible option would be for operator to replace the engine. Even if the engine builder is prepared to provide the support necessary for importation, 40 CFR Part 94 would appear to require that a vessel not use those engines within U.S. waters until permitted by EPA. If the engine is imported "as installed" on a vessel, it is not clear how this would work. The vessel would have to be towed into the United States unless EPA is prepared to undertake the certification testing or inspections outside the United States.

Bluewater requested that we apply these standards to all vessels that enter U.S. waters on a regular basis as part of international commerce, particularly Category 3 vessels, and not just U.S.-flagged vessels. They noted that this is important because foreign-flagged vessels account for approximately 45 percent of Category 3 NOx emissions. Also, extension of the standards to all vessels that use U.S. ports would avoid imposing undue hardship on some U.S. vessel operators if they must achieve limits different from foreign-flagged competitors. Bluewater notes that regulating foreign-flagged vessels is not unprecedented— the Oil Pollution Act of 1990 requires that all vessels, both U.S.- and foreign-flagged, meet the U.S. double-hull requirement by 2015.

Our Response:

In most cases, imported engines will actually be new and imported as either loose engines for installation on vessels constructed in the United States or on new vessels that will be sold in the United States. Also, because of Jones Act restrictions on vessels that can be introduced for use in domestic waters, we expect the reflagging of existing vessels to U.S. registry to be rare. Therefore the concerns raised by ABS will not typically arise for imported marine engines. For those situations where this does occur, refer to Onboard Certification Testing in Chapter 7.

Bluewater, on the other hand, requests that we extend our requirements to foreign-flag vessels that enter U.S. waters. However, unlike The Oil Pollution Act of 1990, our authority under §213(a)(3) of the Clean Air Act is limited to nonroad engines that are considered new. We have defined "new marine engine" consistent with the definition of "new motor vehicle engine" in §216(3) and the directive under §213(d). Under this definition of "new marine engine," marine engines installed on foreign-flag vessels are not new unless or until the vessel is imported into the U.S. We look to the International Maritime Organization to set standards for the engines in foreign-flag vessels.

B. Remanufacturing and Rebuilding

What We Proposed:

We proposed to extend the land-based nonroad rebuild requirements to marine diesel engines. Under these requirements, rebuilders of engines subject to emission standards in this rule generally must, when rebuilding an engine, restore the engine to its original configuration from an emissions standpoint. This requirement is based on the statutory prohibition against tampering with regulated engines.

We requested comment on whether to treat engines already in the field as "new" when they are remanufactured to be like new engines. Emission standards would apply to these engines if we would consider them to be new.

We also proposed to treat engines as new if they were installed in a new vessel. We distributed at the public hearing and put in the docket a memo to solicit additional comment in an effort to clarify the definition of new vessels. The goal of the memo was to address situations where vessels would be built with recycled components (such as the hull), or where an old vessel would be modified or refurbished so extensively that it should qualify as a new vessel. We suggested that a vessel be considered new if over half its final value came from freshly manufactured components.

Finally, we proposed that any land-based engine converted to a marine engine would be considered a new marine engine for the purposes of our regulations, regardless of its age or condition.

What Commenters Said:

Rebuilders and engine manufacturers supported our proposed rebuilding requirements.

Industry respondents objected to treating remanufactured engines as new. They stated that it would be difficult to implement and enforce such a requirement, especially considering the diverse practices currently in place to maintain and overhaul engines. The American Waterways Operators pointed out that there are several factors driving an accelerated conversion to new vessels without regulating existing engines. STAPPA/ALAPCO and NESCAUM encouraged setting some requirement to get earlier emission reductions.

ABS recommended that we follow the IMO protocol of setting standards for engines that undergo significant modification.

Engine manufacturers agreed that we should treat remanufactured engines going into new vessels as new engines. Cummins supported the approach of defining new vessels as those whose value is at least 50 percent from new components. They also agreed that we should treat converted engines such as locomotives as new engines if they are being used in marine vessels for the first time. Bluewater is requesting that existing engines in vessels should be subject to standards too.

Several commenters noted the ambiguity of our references to rebuilding, remanufacturing, overhauling, and repowering. Some identified terms as synonymous where others recommended differentiation in meaning.

Our Response:

As supported by the comments, we are finalizing the proposed requirements that apply to rebuilding engines. We have described "rebuilding" as follows to clarify the scope of our rebuilding requirements:

> Engine rebuilding means to overhaul an engine or to otherwise perform extensive service on the engine (or on a portion of the engine or engine system). For the purpose of this definition, perform extensive service means to disassemble the engine (or portion of the engine or engine system), inspect and/or replace many of the parts, and reassemble the engine (or portion of the engine or engine system) in such a manner that significantly increases the service life of the resultant engine.

Our authority under Clean Air Act §213 is limited to engines that are considered new. As described in the proposed rule, we are aware of the obstacles to treating existing engines as new at the point of rebuild or remanufacture. The comments in favor of such standards did not address these fundamental questions given these outstanding issues. We are not at this point ready to adopt emission standards for remanufactured engines and are not including them in the definition of new engines.

Nevertheless, we are concerned that the gradual turnover to new vessels will cause a very slow introduction of new technologies. As new technologies become available to comply with MARPOL Annex VI standards and the EPA standards, we are hopeful that emission controls will improve even before they are required by our standards. Our early banking provisions add an incentive for this to occur.

To the extent that companies do not take advantage of opportunities to introduce emission control technologies, we may need to reconsider the importance of setting standards on remanufactured engines by treating them as new. In contrast, voluntary introduction and use of emission control technologies ahead of the regulatory schedule may confirm that a control program for these engines is not needed.

Rebuilding requirements apply when an engine subject to this rule is rebuilt or remanufactured to provide power for the same vessel. Note that this includes out-of-frame rebuilding, which is commonly referred to as remanufacturing. If the rebuilt or remanufactured marine engine is used to provide power for a different used vessel, our replacement engine provisions apply. If it is used to provide power to a new vessel, we treat the rebuilt or remanufactured engine as a new engine. Where the final rule sets requirements for rebuilt engines, these requirements apply equally to remanufactured engines, so there is no need to carefully distinguish these two processes in this final rule.

Even though the final rule does not generally treat remanufactured engines as new, we will treat any engine installed in a new marine vessel as a new engine, as we proposed. We will also finalize the definition of new vessels to include the threshold of 50 percent of the value coming from new components. This applies whether the engine is freshly manufactured, or whether it has already been in service on a vessel. We will also, as proposed, treat non-marine engines as new when they are installed in a marine vessel, regardless of the age or condition of the engine or vessel.

C. Replacement Engines

What We Proposed:

We proposed to treat replacement engines as we have under our other engine programs. Specifically, we proposed that whenever a compliant engine is removed from a vessel, the replacement engine would need to be a certified engine meeting the emission requirements that were in effect at the time the vessel was built, unless no compliant engine could meet the vessel's needs.

What Commenters Said:

Cummins Wärtsilä added a concern that it would be too easy for someone to claim a need for a noncompliant replacement engine.

EMA urged us to consider the engine build date, not the vessel build date, when considering which standards would apply to a new replacement engine. EMA further commented that vessels with paired propulsion engines need both engines to have identical operation; a replacement engine in this application could therefore not comply with emission standards.

The Lake Carriers Association commented that we allow noncompliant replacement engines "if desired by the owner."

Our Response:

We are finalizing the proposed provisions requiring replacement engines to be covered by a certificate of conformity. We agree that the engine build date for a replacement engine should determine which standards apply to it. The commenter provided no basis for allowing noncompliant replacement engines at the discretion of the owner. We believe that operators will generally be able to find replacement engines that are certified to meet applicable emission standards that also fulfill the desired function. We therefore see no reason to forego emission reductions from these engines.

If someone wants to produce a noncomplying replacement engine for one of an engine pair, as with any other replacement situation, he must show that no compliant engine has the physical or performance characteristics needed to propel the vessel. In case of engine pairs, we will only consider the request if there is reason to believe that the remaining engine of the pair will last much longer than the engine being replaced. If we approve the use of a noncompliant replacement engine for one of a pair of engines for engine matching purposes, we will not likely approve a subsequent, similar request for the second engine.

D. Engines Rated Below 37 kW

What We Proposed:

We requested comment on how to treat marine diesel engines rated below 37 kW. These engines are already subject to emission standards established in the rulemaking for land-based nonroad diesel engines. We suggested that there may be an advantage to combining all marine diesel engines under a single set of regulatory requirements.

What Commenters Said:

Only the Navy commented on this issue, recommending that we consolidate the smaller marine engines into 40 CFR Part 94.

Our Response:

We intend eventually to consolidate the smaller engines in a general marine diesel engine regulation. Consolidating existing requirements at this time into a single part of the Code of Federal Regulations without reopening those issues may, however, cause confusion. We will likely pursue the next tier of emission standards for all marine diesel engines together, to integrate any changes to the requirements for varying engines sizes in the most sensible way.

E. Definitions for Marine, Propulsion, and Auxiliary Engines

What We Proposed:

We proposed to use the definitions we finalized in our October 1998 rulemaking for land-based nonroad diesel engines.

- “marine engine” means a diesel engine that is installed or intended to be installed on a vessel. This definition does not include portable auxiliary engines for which the fueling, cooling, and exhaust systems are not integral parts of the vessel.

- “propulsion” means relating to an engine that moves a vessel through the water or directs the movement of a vessel.

- “auxiliary” means relating to a marine engine that is not a propulsion engine.

We requested comment on whether all auxiliary engines, both land-based and marine, should be subject to the requirements of 40 CFR Part 89 for land-based nonroad diesel engines.

What Commenters Said:

ABS requests that we clarify the status of engines fitted to equipment (generating sets, air compressors, etc.) temporarily placed on board.

LCA notes that the definition of propulsion engine is not consistent with marine industry definitions. In marine jargon, a propulsion engine is one that powers the propeller to drive the ship ahead or astern. All other engines would be called “auxiliary.” An auxiliary engine on a vessel is an integral part of that vessel, not “portable” as noted in the rules, and is a marine engine.

Our Response:

Under the proposed definition, these “temporary” engines do not qualify as marine engines and would therefore fall under the requirements of 40 CFR Part 89 for land-based nonroad diesel engines. This is consistent with our intent to include as marine engines only those engines that are designed specifically for operation onboard a vessel.

We understand the LCA comments to mean that only a vessel's main engine should be considered to be propulsion engines and all other engines, including engines powering bow thrusters, should be considered auxiliary engines. The practical significance of differentiating auxiliary and propulsion engines in the regulations is very small, since the final rule applies equally to propulsion and auxiliary engines in almost all cases. The only exceptions are the duty cycles, load factors for calculating emission credits, and the delayed implementation of not-to-exceed requirements for auxiliary engines.

Engines powering bow thrusters generally do not provide direct mechanical power to a fixed-pitch propeller, as is common for most propulsion engines. Rather, they typically generate electricity to power a variable-pitch propeller. If we would consider this an auxiliary engine, the manufacturer would need to choose between the C1 duty cycle (for variable-speed engines) and the D2 cycle (for constant-speed engines). We would expect engines powering bow thrusters normally to qualify as constant-speed engines. The E2 cycle would therefore apply if we consider this a propulsion engine. The primary difference between the D2 and E2 test modes is that the E2 duty cycle is weighted more toward high-load operation and does not include idle operation. We believe the E2 cycle best represents the operation of bow thrusters. It is therefore appropriate for the proposed definitions to treat bow thrusters as propulsion engines. Similarly, engines that act as electrical generators for both propulsion and auxiliary electrical power meet the definition of propulsion engines.

CHAPTER 2 – Exemptions and Exclusions

A. Recreational Engines

1. Exclusion of Recreational Engines

What We Proposed:

We excluded recreational engines from this rulemaking and are addressing them in a separate rulemaking, because we thought their operation in planing mode might impose design requirements on recreational boat builders. Our concern was that the proposed emission limits might require significant vessel redesign for these companies, which are often small businesses. We excluded them from this rulemaking to allow more time to evaluate the potential impact of emission standards on the recreational boat builders.

What Commenters Said:

Bluewater recommended that we not delay a rule for the recreational diesel category. According to Bluewater, there should be no space problem on these vessels and technologies to achieve more stringent limits are viable and economic.

Cummins submitted comments on the nature of a separate rulemaking for recreational marine engines. They recommended that all recreational marine engines, both CI and SI, be regulated separately but to the same degree of stringency. They also reminded us that a typical unregulated recreational diesel marine engine already produces lower HC+NOx emissions than a typical unregulated recreational gasoline marine engine. Finally, Cummins and Euromot recommended that we harmonize with the recreational marine rule that is nearing completion in Europe when we develop this recreational marine rule.

Our Response:

Because we did not propose standards for recreational engines, we cannot finalize standards for them at this time. We have been developing proposed standards for recreational engines and will be seeking comment on them in a separate rulemaking.

2. Definition of Recreational Engine and Vessel

What We Proposed:

To exclude them from the rule, we need to define recreational marine diesel engines are. We proposed the following definitions:

> Recreational marine engine means a propulsion marine engine that is intended by the manufacturer to be installed on a recreational vessel, and which is permanently labeled as follows: " THIS RECREATIONAL ENGINE DOES NOT COMPLY WITH FEDERAL MARINE ENGINE EMISSION REQUIREMENTS FOR NONRECREATIONAL VESSELS. INSTALLATION OF THIS ENGINE IN ANY NONRECREATIONAL VESSEL IS A VIOLATION OF FEDERAL LAW SUBJECT TO CIVIL PENALTY."
>
> Recreational vessel means a vessel being manufactured or operated primarily for pleasure, or being leased, rented or chartered to another for the latter's pleasure (except where the vessel is leased, rented, or chartered for more than six passengers). Vessels for hire which can carry more than six passengers, whether or not they ever actually do, are not recreational vessels. For this definition the term "operated primarily for pleasure," does not include vessels used solely for competition or used at any time in any other way to generate income or revenue in any way not associated with the hiring out of the vessel to other people for

their pleasure.

What Commenters Said:

Passenger Limit

We received a lot of comments on the proposed definition of recreational vessel, both regarding the limit on the number of passengers and the idea of a power cutoff.

We received several comments on our proposal to use Coast Guard's definition of recreational engine. These commenters, including Mercury Marine, Cummins, Hatteras, NMMA, Tiara Yachts, Carver Yachts, Caterpillar, and EMA, recommended that we use the definition contained in 46 U.S.C. 2101 instead. Their general argument is that, while the criteria of a vessel being for hire and passenger capacity have relevance in the Coast Guard definition for the sake of safety equipment, they are not relevant to engine performance requirements. As stated by Cummins, the performance requirements of recreational propulsion engines are the same whether a recreational vessel is for personal use or for hire, or whether the vessel can accommodate more than or fewer than six passengers. Therefore, a recreational vessel should be defined as "a vessel being manufactured or operated primarily for pleasure, or being leased, rented, or chartered to another for the latter's pleasure."

Hatteras went a step further and argued that the classification of a vessel as recreational should be determined by the manufacturer and be based on the intended use of the vessel. They were concerned that the proposed definition of recreational engine was a function of how the vessel is operated. Yet, the vessel manufacturer cannot know in advance how the vessel will actually be operated by the person who purchases it. NMMA and Tiara noted that some recreational vessels can end up being used for rental, charter, or leased purposes, even if that is not the initial intended use of the vessel at the point of sale and even though recreational boat builders do not have specific models that target that sector of the market. While Hatteras will not warranty a boat that is used for racing, rental, charter, military, or other commercial purposes, they cannot prevent the owner from using it that way. Hatteras also argues that it is a recreational vessel's performance characteristics that make it different from a commercial vessel, not the number of passengers it can carry or whether those passengers are paying customers. Carver Yachts commented that we must recognize that recreational boat manufacturers cannot be held liable for the nonrecreational use of a boat by a third party. Recreational boat manufacturers cannot control how the original owner (purchaser) uses the boat, much less how subsequent owners use the boat. Finally, Cummins also commented that, under the proposed definition of recreational vessel, personal recreational vessels could not be converted into charter vessels without engine repowering and the associated performance and weight risks.

EMA submitted a lengthy discussion of this issue. They commented that, under 46 U.S.C. 2101(25), a recreational vessel is defined as a vessel "being manufactured or operated primarily for pleasure, or leased, rented or chartered to another for the latter's pleasure." This definition is not dependent on the number of people that a recreational vessel might carry. Instead, 46 U.S.C. 2101(35) includes as "small passenger vessels" those vessels "less than 100 gross tons ... carrying more than 6 passengers, including at least one passenger for hire." Small passenger vessels are then subject to myriad Coast Guard requirements that are not otherwise applicable to recreational vessels. EMA was concerned that our proposal to consider "vessels for hire which can carry more than six passengers, whether or not they ever actual do" as not being recreational vessels would have the effect of including as small passenger vessels numerous recreational vessels that do not otherwise satisfy the federal definition of small passenger vessel. Those vessels are limited to vessels that do (not might) carry six or more passengers (with at least one for hire). EMA also asserts that the proposed definition would create an unworkable situation for engine manufacturers, since they cannot know whether a particular recreational vessel might or might not be able to carry more than six passengers at a time (whether or not it ever does). All manufacturers can know is whether the engine they manufacture is intended by them for installation on a recreational vessel, i.e. a vessel designed for pleasure and having the planing, power density and performance requirements that go along with it. Consequently, EMA suggests that we amend the definition of recreational vessel so it conforms with the established definition in 46 U.S.C. 2101(25).

Finally, Carver Yachts requested that we clarify a potential inconsistency in the definition of recreational vessel. Specifically, we proposed that "vessels used solely for competition or used at any time in any other way to generate income or revenue in any way not associated with the hiring out of the vessel to other people for their pleasure will not be considered recreational" for purposes of the proposed rule. We further proposed to narrow the definition of recreational to exclude recreational boats which ultimately are used for rental, charter or leased purposes if the boat is capable of carrying more than 6 passengers. Carver is concerned that the 6-passenger requirement would effectively redefine all recreational boats with marine diesel engines as non-recreational, since they are all capable of carrying more than 6 passengers.

Power Cutoff

Several commenters opposed the idea of a power cutoff for the recreational marine diesel engine exclusion. Both engine and vessel manufacturers asserted that a power cutpoint of 560 kW for recreational engines is unsound and unwarranted. The design and performance characteristics that separate commercial and recreational vessels center on power density and the use of a displacement hull as opposed to a planing hull, and not on the size of engine the vessel will use. Also, engine manufacturers produce recreational engines rated up to 2800 kW. If we were to require all large recreational vessels to be fitted with commercial-type engines or engines that otherwise compromised the required power densities for recreational planing operations, these boats would likely not get up on plane and so would be both unstable and unsafe. In addition, not all recreational vessels that use larger engines are custom built. For example, Hatteras stated that their yachts are designed for engines rated from 597 to 2230 kW. Yet, their vessels are not custom built. Tiara Yachts, Carver and Hatteras informed us that they use serially built fiberglass hulls that are subject to the same constraints as recreational vessels with smaller engines. NMMA noted that this is not uncommon throughout the industry. Thus, the justifications for treating smaller engines that are used in recreational vessels differently (planing; size and weight constraints) apply equally to their vessels and engines. Hatteras believes that engines should be designated as recreational based on the intended use of the engine in a recreational boat without regard to power or displacement. Consequently, commenters encouraged us not to impose any power cutoff for recreational engines—the only consideration should be whether or not they install the engine in a recreational vessel. Engine manufacturers also opposed capping the size of recreational diesel marine engines.

Our Response:

In general, commenters on this rule seem to agree with us that it is appropriate to distinguish between commercial and recreational marine engines for the purpose of establishing requirements under §213 of the Clean Air Act. Concern seems to focus on how we define which engines are subject to which set of standards. The request that we adopt an approach that is more in line with the Coast Guard approach is well taken. Therefore, we are revising our definitions as follows.

Consistent with our proposal, we are finalizing a definition of recreational marine engine as a propulsion engine that is intended by the manufacturer to be installed on a recreational vessel. To ensure that users will not install a recreational engine on a commercial vessel, we are requiring the following label language (in our proposed rulemaking for recreational marine engines, we will address any changes that would be appropriate or necessary for this label):

> THIS ENGINE IS CATEGORIZED AS A RECREATIONAL ENGINE UNDER 40 CFR Part 94, AND IS NOT SUBJECT TO THE EMISSION STANDARDS OF THAT PART. INSTALLATION OF THIS ENGINE IN ANY NONRECREATIONAL VESSEL IS A VIOLATION OF FEDERAL LAW SUBJECT TO CIVIL PENALTY.

It should be noted that there is no prohibition against installing a certified commercial marine engine on a recreational vessel. In fact, we encourage recreational vessel manufacturers to use certified engines whenever possible due to the beneficial impact on the environment. There is also no prohibition on installing an old marine engine in an old vessel.

We are revising our definition of recreational marine engine, in response to comments, to bring it more in line with the Coast Guard approach contained in 46 U.S.C. 2101. Specifically, we are defining recreational vessel as a vessel that is intended by the vessel manufacturer to be operated primarily for pleasure or leased, rented or chartered to another for the latter's pleasure. However, we continue to believe that it is necessary to put some boundaries on this definition, since certain vessels that are used for pleasure may have operating characteristics that are, in fact, similar to commercial marine vessels. For example, engines installed on excursion boats should be grouped with the commercial marine engines because they are used much more intensely (more hours, higher load) than engines on a similar vessel operated exclusively for one's own pleasure. Therefore, we are drawing on the Coast Guard's definition of passenger vessel to further delineate what will be considered to be a recreational vessel for the purposes of this rulemaking. Specifically, a vessel of less than 100 gross tones carrying more than 6 passengers will not be considered a recreational vessel, and a vessel of 100 gross tons or more carrying one or more passengers will not be considered a recreational vessel. For the purpose of defining a recreational vessel, a passenger will have the same meaning as that in given by 46 U.S.C. 2101(21), and generally means a person that pays to be on the vessel. Finally, a vessel that is used solely for competition will not be considered a recreational vessel.

A vessel will be considered a recreational vessel if the boat builder intends that the customer will operate the boat consistent with the recreational-vessel definition. Relying on the boat builder's intent is necessary since manufacturers need to establish a vessel's classification before it is sold, whereas the Coast Guard definitions apply at the time of use. The final definition therefore relies on the intent of the boat builder to establish that the vessel will be used consistent with the above criteria. If a boat builder manufactures a vessel for a customer who intends to use the vessel for recreational purposes, we will always consider that a recreational vessel regardless of how the owner (or a subsequent owners) actually uses it. To be able to verify that boat buyers don't abuse this provision, we would need to have some way of verifying the validity of the vessel manufacturer's original intent, for example, with written assurance from the buyer. We are not finalizing such a requirement in this final rule, but intend to address it when we propose emission standards for recreational marine engines.

3. Labeling

Our Proposal:

It is important to make sure that exempted recreational marine diesel engines do not go into commercial applications where we would require an engine certified to the commercial marine diesel engine standards. To prevent this, we proposed that manufacturers apply a label with the following statement to their recreational engines: THIS RECREATIONAL ENGINE DOES NOT COMPLY WITH FEDERAL MARINE ENGINE EMISSION REQUIREMENTS FOR NONRECREATIONAL VESSELS. INSTALLATION OF THIS ENGINE IN ANY NONRECREATIONAL VESSEL IS A VIOLATION OF FEDERAL LAW SUBJECT TO CIVIL PENALTY.

What Commenters Said:

Mercury Marine agrees that it is appropriate to label recreational engines to prevent their installation on commercial vessels. However, Mercury Marine recommended changing the label to read:

> *This engine is regulated under 40 CFR Part 94 and is categorized as a "Recreational Engine." Installation of this engine in any non-recreational vessel is a violation of federal law subject to civil penalty.*

EMA and NMMA do not support the use of a label to identify recreational engines, since the labeled recreational engine is not required to comply with emission limits. However, in the event we can demonstrate the significant need to label an unregulated engine, NMMA recommends alternative language identical to that submitted by Mercury Marine.

Our Response:

As noted in the preamble to our proposed rule, our intent is to make sure that boat builders and owners use the engine that corresponds to their vessel application once our standards take effect. We believe it is most effective to label the recreational engine, even though those engines are not subject to standards, because the prohibition concerns installing recreational engines on commercial vessels. If recreational engines were not labeled, boat builders and owners would have no way of knowing that the engine was limited to use in recreational vessels. There is no prohibition against using a commercial marine diesel engine on a recreational vessel. We are therefore finalizing the requirement to add a label to recreational engines.

We agree with the principle behind Mercury Marine's suggested alternative language. We have adjusted the suggested language, since we address recreational engines in 40 CFR Part 94, but we don't regulate their emission levels. In our proposed rulemaking for recreational marine engines we will address any changes that would be appropriate or necessary for the label language we are finalizing in this rulemaking.

4. Final definitions

We are adopting the following language in the final rule. These definitions are reproduced here for your convenience.

> Recreational marine engine means a propulsion marine engine that is intended by the manufacturer to be installed on a recreational vessel, and which is permanently labeled as follows: "THIS ENGINE IS CATEGORIZED AS A RECREATIONAL ENGINE UNDER 40 CFR Part 94, AND IS NOT SUBJECT TO THE EMISSION STANDARDS OF THAT PART. INSTALLATION OF THIS ENGINE IN ANY NONRECREATIONAL VESSEL IS A VIOLATION OF FEDERAL LAW SUBJECT TO CIVIL PENALTY."
>
> Recreational vessel means a vessel that is intended by the vessel manufacturer to be operated primarily for pleasure or leased, rented or chartered to another for the latter's pleasure. For this definition, the term "operated primarily for pleasure or leased, rented or chartered to another for the latter's pleasure" does not include the following vessels
>
> (1) Vessels of less than 100 gross tons that carry more than 6 passengers (as defined in this section).
> (2) Vessels of 100 gross tons or more that carry one or more passengers (as defined in this section).
> (3) Vessels used solely for competition.

Passenger has the meaning given in 46 U.S.C. 2101(21). This is generally a paying customer.

B. Competition exemption

What We Proposed:

We proposed to exempt marine diesel engines used solely for competition. Unlike other nonroad rules, we did not define "used solely for competition" based on physical features of the vessel, but solicited comment on this issue.

What Commenters Said:

Mercury Marine supported the idea that the racing exemption should be available to vessel used solely for racing. They noted that the racing exemption should be based on the use of the engine only, and should be interpreted literally, such that the exemption would apply only to engines that are, in fact, used solely for competition. NMMA also supports the proposal that engines be allowed to have emission controls modified or by-passed for racing purposes, should someone want to use them only for racing. If a boater chooses to race his recreational boat, but also uses the boat for non-racing purposes, NMMA agreed that he must meet any requirements that apply to recreational diesel marine engines.

Our Response:

We are addressing competition engines, also referred to as racing engines, in two ways. First, engines produced by the manufacturer specifically for competition are exempt from the requirements of the rule, subject to our approval of a request. These engines are not nonroad engines under the Clean Air Act, so none of the requirements of 40 CFR Part 94 apply, except for a requirement to label the engines. Second, someone can modify a certified engine for competition purposes. Normally we would prohibit making such changes to certified engines under the anti-tampering provisions. The final rule, however, exempts these engines from the anti-tampering provisions for engines that are used "solely for competition."

Engines or vessels used for amateur or occasional competition do not meet the competition criteria. Our review of an exemption request from a manufacturer should prevent abuse of this provision for engines that are originally produced for competition. There is, however, no approval step for someone who modifies engines for competition, so we will more clearly spell out criteria indicating whether the engine will be used solely for competition. Specifically, owners meeting all the following criteria will qualify for the competition exemption:

- The engine and vessel are designed and built to be used solely for competition. For example, we would not expect engines used solely for competition to have a lifetime until rebuild greater than about 10 hours.
- The vessel is registered with a nationally recognized organization that sanctions professional competitive events.

In addition, once an engine is modified for competition, the engine is no longer certified to the requirements of 40 CFR Part 94 and must therefore not be used in an application where we would require a certified engine.

C. National Security Exemption

What We Proposed:

We proposed to apply the national security exemption from the land-based nonroad program to marine engines.

What Commenters Said:

The Navy raised some concerns about the proposed national security exemption. Specifically, they requested that we clarify either in the rule language itself or in the preamble that the reference to armor or affixed weaponry in the automatic exemption is not meant to be exclusive, but would include vessels that have specialized electronic warfare equipment, special military sensors, or have been specifically designed to reduce their magnetic, electronic, infrared, or acoustic signatures to increase the vessels' military effectiveness. In addition, they recommend that vessels directly engaged in military combat support or military logistics operations should be included in the automatic exemption. This would ensure that vessels in direct support of national security missions including combat support, combat logistics, ocean surveillance and prepositioning of combat would also be exempt. These vessels detect submarines, chart unknown waters, provide hospital care for wounded combatants, transport tanks and helicopters to the war zone, and provide ammunition and oil in support of the Army, Air Force, Marines, and Navy. These ships sail with the Fleet when it deploys and play an integral role in DoD's war-fighting mission. Finally, the automatic exemption should be extended to such vessels that are owned, demise chartered, or time chartered for one year or more, by the U.S. Military Sealift command.

Our Response:

In response to the Navy's concerns, the final national security exemption regulation reflects the characteristics of their national security mission. Other agencies can also request an exemption provided the exemption is needed for them to fulfill a national security mission. Reflecting Executive Order No. 12856, we understand that the Navy, and all other branches of the government that qualify for the national security exemption, will do their best to comply with the emission standards finalized in this final rule.

D. Engine Dressing Exemption

What We Proposed:

We proposed to exempt certain marine engines produced from base engines that had already been certified to locomotive or land-based nonroad engine emission standards. This exemption would only be available if the engine would be bought and then marinized by a post-manufacture marinizer without being changed in a way that could affect emissions. We also proposed that this exemption be available only if the majority of engines (from all manufacturers) were not produced for marine application. We referred to this in the NPRM as the engine dresser or nonmarine-specific exemption. We proposed a requirement that anyone using this exemption notify us and their customers of their activities.

What Commenters Said:

EMA and EMD recommended that we also allow the base engine manufacturers to utilize the engine dressing exemption, rather than limiting it to companies we would otherwise call post-manufacture marinizers. EMA further suggested that we include certified highway engines as candidates for the dressing exemption.

EMA pointed out that the emission standard for some marine diesel engines is more stringent than the equivalent land-based nonroad or locomotive number, making the engine dressing provisions unavailable for those models.

Alaska Diesel requested we modify the conditions under which a manufacturer would be eligible for the engine dressing exemption. Specifically, they note that the only change they make to previously certified land-based nonroad engines is to replace the dry turbocharger with a water-jacketed turbocharger. The wet turbochargers they use are selected to approximate the charging characteristics of the original dry turbochargers as closely as possible. Further, the aftercooler assemblies on all of their engines so equipped are the same as those used in the certification process by the base engine manufacturer. Also, all of engine ratings currently offered by Alaska Diesel are equal to or less than the ratings certified for that engine by the base engine manufacturer. Consequently, while they change the engine more than the proposed dressing language would allow, the changes they make are not big enough to change the emissions profile of these machines to any significant degree.

California ARB agreed with the principle of exempting dressed engines, but wanted the base engine to be certified on the marine duty cycle.

Some commenters expressed a concern with our ability to define and enforce the limits of the engine dressing exemption. The Navy encouraged us to (1) require an engine label stating that the marinized engine has emission levels unchanged from the base engine, (2) test some dressed marine engines to confirm that emission levels are unchanged, and (3) use strong language to prevent “over-aggressive dressing.” EMA recommended that we set up an audit or other enforcement mechanism to oversee companies that use the dressing exemption.

Additional comments were related to liability in case problems develop or are discovered. EMA wants us to clarify that an engine dressing company needs to leave alone all engine aspects covered in the manufacturer’s application for certification (including control software).

AERA supports the proposed regulation that engine dressing should not be subject to certification requirements, provided that the dressers meet the seven criteria we described in the preamble to the proposed rule. However, neither the exemption nor the seven requirements are included in the proposed regulation text. AERA is concerned that EPA will presume that engine dressing companies are post-manufacture marinizers needing to certify their engines. Engine dressing companies would then need to rebut this presumption by making the showing set forth in the preamble. Thus AERA understood from the proposal that a company dressing marine engines could receive no advance assurance that their activities are exempt from the rule and they must modify any engines at their own risk and be subject to being penalized later if EPA decides they don’t qualify. AERA was concerned, moreover, that the requirements they must meet to qualify for this “exemption” will not be part of the rule; engine dressers would therefore not only proceed at their own risk, but standards under which they might qualify for exemptions will not be published as part of any regulation, may not be well known or understood by them, and would be subject to change by EPA at any time without notice or hearing. This would be too big a burden for these companies. AERA urges EPA to rectify this problem and include this exemption in the regulations of the final rule.

Alaska Diesel commented that failure of a dressed engine to meet applicable emission standards on an individual basis could be subrogated to the base engine manufacturer.

<u>Our Response</u>:

The goal of our engine dressing provisions is to eliminate the burden of certification and other compliance requirements where we have confidence that engines already certified to comparable standards from other programs will meet marine engine emission standards. Moreover, the certificate holder for the base engine continues to be liable, under the terms of the original certification, for the emissions performance of the dressed engine. We will nevertheless require, as we proposed, that a company certify dressed engines under 40 CFR Part 94 if the majority of engines produced are for marine application. This prevents a company taking advantage of the engine dressing exemption to produce marine diesel engines under, for example, a land-based nonroad diesel certificate, even though the engine might be used almost exclusively for marine application. Companies that produce engines qualifying for the engine dressing exemption will be exempt from the certification requirements and prohibited acts of 40 CFR Part 94. Minimal reporting and labeling requirements apply to these engines, as described below.

We are finalizing the proposed criteria to define the qualifications for engine dressing. In particular, we believe it is not possible to specify clearly when a marine, water-jacketed turbocharger sufficiently duplicates a replaced turbocharger such that emissions will not increase. Since intake air temperatures and pressures have an important effect on emissions, allowing turbocharger replacement without certification (or re-certification) could result in substantially increased engine emissions. We therefore consider changing to a water-jacketed turbocharger to be an engine modification that disqualifies a manufacturer from using the engine dressing exemption.

We agree with the engine manufacturers that they should be able to qualify for the engine dressing exemption if they meet the established criteria. The listed criteria should clearly preclude a company from making changes to the engine that would affect parameters included in the original certification. Base engine manufacturers utilizing the dressing exemption must submit marine-specific emission data on their dressed marine engines. In addition, we may request marine-specific data from the original engine manufacturer if another company is dressing their engines for marine application. We would use this data for oversight to determine the validity of the exemption. Except for this testing responsibility, the discussion of engine dressing applies equally whether an original engine manufacturer or a post-manufacture marinizer produces the marine engine. We therefore avoid referring to engine dressers, instead pointing to engine dressing as a practice that can exempt certain engines from marine engine requirements. The term marinizing may refer to marine engine production from base engine manufacturers and post-manufacture marinizers.

Heavy-duty highway engines are certified to a much different test cycle, which has in the past prevented us from accepting a highway engine certificate for nonroad applications for certification. Now that we are proposing to revise the standards and test procedures for these engines to control steady-state emissions, we can be more confident that they will adequately control emissions in a marine application. Thus, any certified heavy-duty highway, nonroad, or locomotive engine will be eligible for the dressing exemption.

Engine manufacturers may use averaging, banking, or trading to produce land-based engines that are certified with emission levels exceeding the comparable marine emission standard. These engines could not meet the proposed engine dressing criteria. Unlike an original engine manufacturer, a post-manufacture marinizer has no control over this. Engines produced under the dressing exemption must be certified to land-based standards that apply to that engine at the time the base engine manufacturer completes assembly of the engine. This is true regardless of whether the original engine was certified using emission credits under the ABT program. Similarly, our NTE provisions do not apply to dressed engines, unless NTE provisions are in place for the certified base engine.

Engines that qualify as dressed engines are exempt from the marine emission standards. We therefore will not treat these as regulated marine engines. If we find that a company with an engine dressing exemption does not, in fact, meet the criteria spelled out in the regulations, the engines are not exempt and we may pursue enforcement for selling uncertified marine engines and/or tampering with certified engines.

We are including in the final rule a requirement that dressing companies put a label on each exempted engine stating the name of the dressing company and the fact that the engine was marinized without affecting emission controls. This will make clear that the engine is acceptable for use in a marine vessel. In addition, dressing companies will need to give us minimal notification that they are modifying certified engines. This can be done once annually for a company's whole range of dressed marine engines.

In addition to the labeling requirement, we encourage engine manufacturers to inform companies dressing their engines of these requirements. This will not only aid us in educating affected companies, it may help protect engine manufacturers from exposure to liability if their engines are ever found in a marine vessel without proper documentation.

We believe that the dressing criteria are clear; however, we can take steps to ensure that the exemption is not abused. First, we can observe a dressing company's operations at any time to verify that their assembly or manufacturing procedures fall within the constraints of the dressing provisions. Also, we intend to review the appropriateness of this exemption before we set another tier of emission standards for these engines.

E. Other Exemptions and Exclusions

What We Proposed:

Consistent with our other rules, we proposed additional exemptions for certain kinds of marine diesel engines. These include the testing exemption, the manufacturer-owned exemption, the pre-certification exemption, the display exemption, and the export exemption.

What Commenters Said:

Several comments requested that we consider additional exemptions and exclusions for this emission control program.

EMA suggested that we include an additional exemption from the proposed commercial CI marine standards for those vessels that require the performance characteristics and operating capabilities of recreational vessels (planing speeds and high power densities) to fulfill their intended functions, such as patrol boats, fire boats, and emergency vessels. According to EMA, these vessels cannot perform their functions if they are required to install commercial CI marine engines, and so should be exempt from regulations that would have the effect of forcing the installation of mismatched engines. They have unique high performance requirements (certain of these unique engines must be able to operate even while upside down), are produced and utilized in very small volumes, and are operated generally less than 200 hours per year.

Mercury Marine made a similar comment, requesting that the definition of recreational marine engine be expanded to include sterndrive commercial diesel marine engines for much the same reason. They noted that sterndrives are used in commercial craft where significantly higher boat speeds are required. In these applications, sterndrive engines enable trimming of the propshaft angle to optimize performance over a wide range of operating conditions. It also permits moving the center of gravity of the vessel toward the transom, so that both the hull angle-of-attack and the propshaft angle may be optimized for maximum efficiency of both, and also permits planing of the boat at low speed despite the rearward center of gravity location. To do so, however, sterndrives must have power-to-weight ratios comparable to those for recreational CI marine engines. Consequently, commercial sterndrives should be included in the recreational CI marine grouping.

EMA, ABS, CSA and LCA also recommended that engines used solely for standby emergency purposes should be exempt from the requirements of the final rule. This is because the principal requirement of such engines is that they are simple and reliable. Engines of this type will have low service hours and will operate on gas oil. LCA also noted that emergency diesel generators on commercial vessels are required to supply quick power to critical items, such as steering, navigation lights, and communications. These engines must be simple, rugged, dependable, and easy to start under all conditions. CSA further noted that emergency equipment, including emergency diesel generators, are subject to strict design and performance criteria that ensure their readiness in the event of an emergency. CSA is concerned that the imposition of emissions controls on these engines could impair their performance if these criteria are not considered prior to their integration into the engine design.

EMA recommended that exemptions for both planing hull vessels and standby emergency engines also apply to marine diesel engines rated less than 37 kW.

Finally, Euromot requested that we consider an additional exemption for engines that manufacturers certify under MARPOL Annex VI. They suggested that these engines be exempt and not held for presumable non-compliance by any U.S. authority.

Our Response:

We are not extending an exemption to patrol boats, fire boats, and emergency vessels, or to other nonrecreational craft that use planing hulls or to sterndrive diesel engines used on commercial craft. The Final RIA and other parts of this document describe the several technological changes we anticipate manufacturers will use to comply with the new emission standards. None of these technologies has an inherent negative effect on the performance or power density of an engine. As with engines in land-based applications, we expect that manufacturers will be able to use the range of technologies available to maintain or even improve the performance capabilities of their engines.

We proposed to exclude recreational engines from this rulemaking and defer their standards to a separate rulemaking, not because they employ planing hulls but because their operation in planing mode might impose design requirements on recreational vessel manufacturers. Our concern was that the proposed emission limits might require significant vessel redesign on recreational vessel manufacturers, which are often small businesses. We therefore excluded them from this rule to allow more time to evaluate the potential impact of the proposed rule on the recreational vessel industry. As discussed in the Final RIA and in other parts of this document, we believe that engines meeting the emission standards in this final rule will be fully capable of powering planing hull vessels. We also do not believe that manufacturers of patrol boats, fire boats, and emergency vessels, or other nonrecreational craft that use planing hulls should be exempt from this rule. Furthermore, even though we don't set standards for recreational marine diesel engines in this rulemaking, we will pursue standards for these engines in a separate rulemaking, again requiring "the greatest degree of emission reduction achievable," considering the various statutory factors.

Instead of adopting different standards for light commercial engines, we have provided for manufacturers to base the useful life and deterioration factors on the documented hourly use of these engines over their lifetime. This may in some cases be much less than 10,000 hours of operation, which is the required value for other commercial engines. To prevent abuse of this provision, we won't approve any useful life less than 1,000 hours and we will require that the manufacturer display the certified useful life on the engine label.

We also do not believe it is necessary to extend an exemption to standby emergency engines. Commenters did not point out any technological reason that compliant engines would be incapable of meeting the performance needs of these engines. In fact, we believe that incorporating the design improvements from other current-model engines is the best way to ensure maximum reliability. Commenters noted in other areas that their propulsion engines too have a paramount need for dependable operation. The emission-related controls that will be used to meet the standard must be reliable for both emergency and non-emergency engines. Finally, we note that land-based emergency engines (such as fire trucks and standby generators) are not exempt from our emission control requirements in either highway or nonroad applications.

Finally, with regard to exempting engines that are certified according to MARPOL Annex VI, we must note that this will not be possible because the emission limits being finalized are different from those in that Annex, and so engines certified according to MARPOL Annex VI will not necessarily be in compliance with these emission limits. Also, our domestic program has an NTE requirement that is absent in the MARPOL program.

CHAPTER 3 – Duty-Cycle Emission Standards

The emission standards in the final rule apply to testing on the specified duty cycles and to testing according to the Not-to-Exceed provisions. The standards in section 94.8(a) are generally referred to as the duty-cycle emission standards. We refer to the standards in 94.8(e) as the Not-to-Exceed standards.

A. Timing and Stringency of Emission Standards

Summary of Proposal:

We proposed to divide marine diesel engines into three broad categories. Category 1 ranged from engines with rated power as low as 37 kW up to engines with per-cylinder displacement up to 5 liters. These engines are generally derived from or use the same technology as land-based nonroad diesel engines. We proposed to further subdivide Category 1 engines to align the emission standards as much as possible with land-based nonroad diesel requirements for different engine sizes. Marine engines are often calibrated for widely varying power ratings for different applications or are bolted together. We proposed to convert the land-based power groupings into comparable displacement-based groups as the best way to preserve consistency between rulemakings for these widely varying marine configurations.

We proposed to define Category 2 engines as those ranging from 5 to 20 liters per cylinder. Many of these engines are derived from or use the same technology as locomotive engines. We proposed that Category 3 engines were those models with per-cylinder displacement greater than 20 liters per cylinder. Most or all of these engines are used in vessels involved in international operations.

We proposed two tiers of standards (Tier 2 and Tier 3) for Category 1 and Category 2 commercial marine diesel engines. Under our proposal, the Tier 3 standards would be subject to a technology review. We did not propose to regulate Category 3 engines under this rule; however, these engines will be subject to MARPOL Annex VI standards. The proposed standards and the associated starting dates are presented in Table 2-1.

Table 2-1
Proposed Engine Emission Standards

Subcategory (liters/cylinder)	Tier	Starting Date	HC+NOx (g/kW-hr)	CO (g/kW-hr)	PM (g/kW-hr)
power ≥ 37 kW 0.5 ≤ disp. < 0.9	2 3	2004 2008	7.2 4.0	5.0 5.0	0.40 subject to review
0.9 ≤ disp. < 1.2	2 3	2004 2008	7.2 4.0	5.0 5.0	0.30 subject to review
1.2 ≤ disp. < 1.5	2 3	2004 2008	7.2 4.0	3.5 3.5	0.20 subject to review
1.5 ≤ disp. < 2.0	2 3	2004 2008	7.2 4.0	3.5 3.5	0.20 subject to review
2.0 ≤ disp. < 2.5	2 3	2004 2008	7.2 4.0	3.5 3.5	0.20 subject to review
2.5 ≤ disp. < 5.0	2 3	2006 2010	7.2 5.0	3.5 3.5	0.20 subject to review
5.0 ≤ disp. < 20 (Category 2)	2 3	2006 2010	7.2 5.0	2.0 2.0	0.27 subject to review

We based our proposed standards on the emission reductions expected using a combination of land-based nonroad technology and marine aftercooling. For the proposed Tier 2 standards, this technology included some utilization of electronic controls, engine modifications, improved fuel injection systems, turbocharging, and separate-circuit aftercooling. For the proposed Tier 3 standards, the technology included further penetration of electronic controls as well as common rail fuel injection, and exhaust gas recirculation.

Summary of Comments:

1. Technological Feasibility

EMA took issue with what it believes is an incorrect premise of the rule—that most CI marine engines are "marinized" derivative versions of land-based nonroad engines and that the standards for land-based and marine CI engines can be the same if manufacturers are given time to implement the "marinization" process. EMA stated that marinization involves complicated development work that often can result in in-cylinder changes to the engine. In addition, CI marine engines do not have access to the equivalent engine cooling technologies as do land-based CI engines, and so are at a fundamental disadvantage in pursuing land-based emission control strategies. Consequently, CI marine engines can only approach, but not attain, the limits achievable by land-based nonroad CI marine engines. The marine engine emission limits must therefore be less stringent than those for their land-based counterparts. In addition, this error is compounded by proposed requirements that go beyond the nonroad limits, including certification on the E3 instead of the C1 duty cycle, the requirement that testing be performed without correction for ambient conditions, the requirement that high sulfur test fuels be utilized without sufficient correction factors and the requirement that all CI marine engine emissions must comply with an upper limit throughout a mandated NTE zone over the full range of the engine's operating conditions. These requirements impose a more onerous requirement on marine engines than on their land-based counterparts. They will require engine manufacturers to design and implement emission control strategies that meet emission standards under the most extreme, worst-case scenarios, even though this may rarely or never occur in real-world marine operations. Consequently, the standards and the requirements proposed in the NPRM are neither feasible nor reasonable, and must be amended.

EMA, Caterpillar, and Mercruiser shared their belief that Tier 2 nonroad technology is not entirely transferrable to marine applications. They all commented that seawater aftercooling would not be appropriate for commercial applications because of durability and maintenance problems associated with bringing ambient water directly into the aftercooler. EMA also commented that separate-circuit aftercooling is not as effective as air-to-air aftercooling. They also stated that operators today are not ordering engines with separate-circuit aftercooling, which shows that it is too expensive. Caterpillar and EMA stated that using jacket-water aftercooling would not gain the same level of cooling for marine as is possible using air-to-air aftercooling on nonroad engines. EMA stated that marine engines have 35 percent higher NOx emissions and higher PM than their nonroad counterparts due to this difference in cooling, power loss from the turbocharger to the cooling system, and higher power densities. EMA also challenged the data in the Draft Regulatory Impact Analysis from the low-emission demonstration engines used in Santa Barbara. They commented that much of the data only includes NOx emissions and does not show the trade-off between NOx and PM emissions. EMA also commented that it is difficult to introduce new technology because the industry is fragmented with a large number of small-volume boat builders.

EMA and Caterpillar also commented on Tier 3 technology transfer from nonroad. EMA stated that common rail fuel injection would not be effective on marine engines due to high loads. Caterpillar considers exhaust gas recirculation to be unrealistic for marine engines until it has been applied to land-based nonroad applications.

Engine manufacturers commented generally that the Tier 3 standards should be included in a subsequent rule. They stated that the technology necessary for these levels has not yet been determined for land-based engines, and it would be premature to project Tier 3 levels for commercial marine engines at this time. They stated that this is especially true for engines greater than 560 kW where no land-based engine is subject to Tier 3 standards.

NESCAUM supports the proposed Tier 2 and Tier 3 standards. They stated that reductions from Category 2 are especially important. They also commented that we should consider aftertreatment when setting Tier 3 standards. The Manufacturers of Emission Controls Association also supports the proposal and believes that aftertreatment should be considered for the Tier 3 standards.

The American Bureau of Shipping commented that overly effective aftercooling can lead to intake air temperatures that are low enough to cause condensation in the intake manifold. They agreed that lower temperatures can reduce NOx, but too much cooling can increase NOx by lengthening the ignition delay period. Crowley agreed with us that the marine environment provides a greater potential for cooling. However, they stated that today’s tugs often do not have enough space to add more channel coolers for separate-circuit aftercooling or the high power engines in these vessels. The Lake Carriers Association and Oglebay Norton both commented that retrofits for enhanced aftercooling could cost $100,000 per engine if dry dock costs are considered.

EMD commented that locomotive technology doesn’t necessarily transfer readily to Category 2 marine applications and that they are not sure that the locomotive standards are feasible. They stated that electronic injection does not bring any benefits for steady-state operation beyond that of a well calibrated mechanical system. They commented that common rail fuel injection provides benefits primarily at low power, where marine engines do not often operate. Also, they commented that increased injection pressure limits spray penetration in Category 2 marine engines due to the size of the combustion chambers. EMA added that NOx is inherently high for slower speed engines because there is more time for NOx to form and because increased volume to surface area ratios increase NOx. Manufacturers also stated that not all Category 2 marine engines are derived from locomotive engines so that these engines would not necessarily have locomotive technology that can be directly transferred.

LCA questions EPA’s statement that emission reduction strategies for locomotives can also be applied to Category 2 marine diesel engines because the majority of Category 2 marine diesel engines are derivatives of locomotive engines. LCA provided information showing that there are 314 marine diesel engines used on Great Lakes vessels. Of these, 79 are main propulsion diesels, 60 are Category 2, locomotive derivatives, and 158 are Category 2, not locomotive derivative. LCA also asserts that having access to water and providing access to that water for cooling are two different things. Using seawater to cool engines on a ship would be very difficult and expensive due to the cramped location of the engine itself and the machinery, piping, and structure of the existing aftercoolers.

CSA does not believe that the transfer of technology between locomotive and marine applications is as simple as we suggested in the proposed rule.

MECA commented that aftertreatment could be used on diesel marine engines for significant reductions. They stated the selective catalytic reduction can achieve reductions of 50 percent PM, 80 percent HC, and 70-90 percent NOx. MECA commented that particulate filters could be used to offset the negative effects of timing retard on PM. Also they said that oxidation catalysts could be used to reduce PM by 30 percent provided that low sulfur fuel (less than 500 parts per million) were used. STAPPA/ALAPCO commented that Category 3 engines should have to meet tighter standards and that selective catalytic reduction has been proven to reduce NOx by 90 percent. Bluewater commented that combined gas and steam turbine electric machinery should be considered as a control technology.

Engine manufacturers commented that testing on the E3 marine duty cycle results in higher emissions than testing on the C1 nonroad duty cycle.

2. Category definitions

Commenters generally approved of the use of per-cylinder displacement to differentiate engines. EMA and Cummins noted further that the cutpoints to divide Category 1 engines into subgroups were reasonable.

HES would like to see fewer divisions of categories and intended use groups when this action is finalized. At minimum, they would like to see the exact same categories as those already promulgated in the land-based nonroad engine categories. This would simplify their burdens, as they deal with both land-based and marine applications for essentially the same types of engines. Also, a unit may be in an off-shore application on one job and the next job it will be used in a land-based application.

The principal area of comment on the displacement thresholds was related to defining the upper end of Category 2 engines, which are the largest engines subject to EPA standards. MARPOL standards apply in lieu of EPA standards for Category 3 engines. Several commenters pointed out that there are many Category 2 engines that are not derived from locomotive applications. Cummins Wärtsilä selected a threshold of 600 kW, above which the majority of engines are not derived from locomotives and therefore use totally different technology. Cummins, Caterpillar, Wärtsilä, and the Lake Carriers Association also shared that many Category 2 engines are capable of operating on heavy fuel, which greatly increases the difficulty of controlling emissions. The commenters argued that these engines should therefore only be subject to MARPOL requirements.

Euromot supports the use of per-cylinder displacement as a criterion to distinguish engine groupings. However, they note that there are unique marine engines with comparable displacement to land-based engines but with different design and operating characteristics. Specifically, some marine engines use low-quality fuels, like residual fuel and heavy fuel oil. Because it is not possible to determine in advance which fuel the engine will use, Euromot suggests that all marine engines regardless of displacement, but with a rated speed less than or equal to 1600 rpm, be treated as Category 3 engines (i.e., subject only to the MARPOL Annex VI program).

Similarly, LCA notes that Category 3 engines are not used solely in ocean-going applications; there are 19 Category 3 engines in operation on the Great Lakes. In addition, new or repowered vessels would use residual fuel-burning Category 2 and Category 3 engines. LCA also questions EPA’s assertion that “because of the extensive use of Tier 2 technologies on Category 3 engines, the opportunities for emission reductions are not as extensive as they are for smaller engines.” LCA asserts that many Category 2 engines are designed and built to run on residual fuels, and some are in operation on the Great Lakes. Further, all owners consider using residual fuels when they look at the economic factors of selecting engines. LCA therefore recommends that all engines on a ship equipped with a Category 3 main engine, and any engine that burns residual fuel, be regulated under MARPOL Annex VI.

EMA and EMD assert that the engine categorization scheme proposed by EPA is seriously flawed and will put domestic manufacturers at a significant competitive disadvantage in international markets. Instead of the three categories proposed by EPA, EMA and EMD suggest only two categories: (1) engines less than 5 L/cyl should be subject to technologically feasible EPA emission standards and requirements, and (2) engines at or above 5 L/cyl should be subject to standards and requirements equivalent to those established by the IMO protocols. EMA asserts this alternative scheme is reasonable because U.S. manufacturers produce fewer than 40 engines at or above 5 L/cyl for sale in the U.S. on an annual basis. This scheme would also create an even playing field for larger U.S.-built engines sold for use in the international marketplace.

Caterpillar pointed to its 3600 Series engine as an example of an "IMO-class" engine capable of operating on heavy-fuel that was not able to meet the proposed Tier 2 emission standards. They cited baseline emission data showing the need for significant emission reductions to reach MARPOL emission levels.

Bluewater Network recommends that EPA extend Category 2 up to a higher value of 25 or 30 L/cyl instead of 20 L/cyl. This is because tugboat engines are already approaching the 20 L/cyl limit, and engine manufacturers may therefore produce engines intended to circumvent the effect of the proposed rule for Category 2. EPA should also note that some tugboats use residual fuel, not distillate diesel fuel.

Cummins recommended that the rule apply to all commercial engines between 37kW and 19.9 L/cyl, and to recreational auxiliary engines between 37 kW and 19.9 L/cyl, as we proposed.

Caterpillar recommended subdividing Category 2 engines and Category 1 engines over 2.5 L/cyl into more groupings with gradually increasing emission standards with engine size. The main advantage of this approach was to minimize any unintended competitiveness effects for similar engine models that happen to fall on different sides of a displacement cutoff. They recommended drawing lines at 2.5, 4, 8, and 17 liters per cylinder.

In later comments, EMA and Caterpillar proposed drawing lines to group engines at 3, 15, 20, and 25 L/cyl, with EPA standards applying to engines up to 30 L/cyl. Each of these groups would have different emission levels, with gradually increasing NOx+HC levels for bigger engines. They cited multiple reasons for this, including (1) the difficulty for larger engines to control emissions, (2) the potential for market distortions from having big step changes in emission standards, and (3) the possibility of high-emitting large-displacement engines displacing smaller, cleaner-burning engines. They requested that engines over 3 L/cyl be treated as Category 2 engines because these engines have very low sales volumes, they overlap with locomotive power ratings (and are sometimes used as locomotive engines), and they benefit little from highway engine technology transfer. They further recommended that engines below 15 L/cyl, but with rated power above 3300 kW be subject to the same standards as engines between 20 and 25 L/cyl. This was based on experience showing that harbor tow and inland river vessels have a practical upper limit of about 3300 kW due to propellor sizing limitations.

3. Level and timing of standards

EMA takes issue with the genesis of this rulemaking. After describing the history of the rule, EMA notes the limits proposed in the 1998 NPRM are very different from the 1994 rulemaking in that EPA is proposing to omit promulgating any Tier 1-type standards for CI marine engines and instead is proposing to proceed directly to far more stringent Tier 2 limits. As a result, the CI marine engine industry, unlike other industries previously regulated by EPA, would be forced to shift from operating without emission regulations to operating under stringent regulations in a single step. Crowley agreed that Tier 1 standards are probably not cost-effective given that most marine diesel engines already meet Tier 1-type standards.

EMA commented that the proposed Tier 2 standards would be infeasible and cost-prohibitive. EMA stated that for the smallest engines, the marine HC+NOx standard would be four percent lower than for nonroad. Caterpillar stated that using the same level for nonroad and commercial marine would be more stringent for commercial marine. They suggested that less stringent standards be put into place for engines over 2.5 L/cyl. Caterpillar suggested NOx-only standards of 8.2 g/kW-hr for 4-8 L/cyl and 85 percent of the MARPOL standard for 8-17 L/cyl. Cummins stated that the 10-12 percent increase in the proposed Tier 2 marine standard compared to the Tier 2 nonroad standard is not enough to account for the differences between marine and land-based engines. EMD commented that the MARPOL standard would result in meaningful NOx reductions, and at worst, we should not have commercial marine standards that are more stringent than the locomotive levels.

EMA commented that the CO emission standards were too stringent, especially for large engines. Caterpillar submitted emission data showing that baseline CO emission levels were above the proposed emission standards.

Cummins also suggested EPA could impose appropriate PM standards in 2000, then follow up later with Tier 2 requirements for Category 2 that lag those for Category 1.

American Waterways Operators stated that we should work with manufacturers to ensure that the commercial marine standards are no more stringent than for nonroad engines. Crowley commented that they believe it would be better for engine manufacturers to offer a single clean-technology engine than produce separate clean and dirty models; however, the standards should be based on technology that is practical, reliable, cost-effective, and easy to maintain.

California's Air Resources Board supports the proposal and believes that we should set tighter standards for PM which follow the lead of the land-based Tier 3 standards. Bluewater Network also called for tighter PM standards stating that a level of 0.14 g/kW-hr PM would be appropriate in conjunction with fuel sulfur level control. They commented that we should be investigating PM-2.5 as well as PM-10.

STAPPA/ALAPCO stated that we should be working for more stringent standards for NOx, HC, CO, and PM for Category 3 in the long term.

HES would like to see the same limits for marine engines as are applicable to nonroad engines.

ABS requests that the starting date of the requirements be clarified as to whether it relates to keel laying, as defined in MARPOL Annex VI, delivery date, or some other date.

Manufacturers commented that they need more lead time for the standards. Caterpillar stated that they need a lead time of two years for engines below 2.5 L/cyl and three years for engines greater than 2.5 L/cyl beyond the land-based standards. Cummins stated that they need a two-year lead time beyond the starting dates for land-based nonroad emission standards. EMA commented that manufacturers would need a two-year lead time for standards based on land-based nonroad and four years if the standards were more stringent. EMD stated that they need lead time beyond the starting dates for the locomotive emission standards.

Caterpillar recommended emission levels to correspond with their recommended engine grouping scheme. Table 2-2 shows their proposed emission standards. They also provided emission data showing baseline PM emission levels between 0.6 and 0.7 g/kW-hr from heavy-fuel-capable engines operating on distillate fuel. This is significantly higher than EPA's 0.3 g/kW-hr estimate for PM emissions from uncontrolled locomotive-derived engines. Caterpillar also provided emission data showing that CO emissions from uncontrolled engines were in many cases near 5 g/kW-hr.

Table 2-2
Caterpillar's Proposed Category 2 Emission Standards

Liters/cylinder	NOx+HC g/kW-hr	PM g/kW-hr	CO g/kW-hr
3-15	7.8	0.27	3.5
15-20	8.7	0.5	5.0
20-25	9.8	0.5	5.0
25-30	11.0	0.5	5.0

Analysis of Comments:

1. Technological Feasibility

The transfer of technology from land-based nonroad and locomotive engines is an important factor in our determination that the marine Tier 2 emission standards are feasible. Except for selected models from a small number of foreign manufacturers, marine diesel engine models also serve in land-based applications. Sales of land-based versions of these engines are usually much greater than those of the marine counterpart versions, so manufacturers typically focus their primary technology development efforts on their land-based products. Manufacturers then modify these engines for use in marine engines. These changes can be very extensive, but they rarely involve basic R&D for new technologies. We therefore stand by our statement that most marine diesel engines are “marinized” derivative versions of land-based nonroad engines.

The numerical emission standards in this final rule are all greater than or equal to the comparable emission standard for the counterpart land-based engines. There are two broad areas of concern when adapting the emission standards for the marine engines. First, we can expect emission levels to be somewhat different on the different duty cycle, even with no changes to the engine. Second, the engine changes in the marinization process may affect emission levels. These concerns, which we address in the following paragraphs, are central to the question of whether the standards for land-based and marine diesel engines should be the same. An additional issue relates to the need for corrections to account for the effect of varying fuel properties and ambient conditions on measured emission levels; we address this in Chapter 4.

a. Duty cycle effects

Emission data on several engines help us quantify the effect of the duty cycle; the data are presented in the Final RIA. The data show that NOx+HC emissions are approximately the same when measured on the C1 duty cycle (for land-based nonroad diesel engines) or the E3 duty cycle (for commercial marine diesel engines). This suggests that emission levels determined using either duty cycle are roughly equivalent. A similar comparison for PM and CO shows that measured emissions from an engine are lower by at least 30 percent on the E3 duty cycle compared with the C1 duty cycle. Auxiliary marine engines are tested using the same duty cycles as for land-based nonroad engines, so emission levels for those engines are not different for marine testing. Locomotive engines are tested under a duty cycle that is specific to locomotive operation, but this operation follows the same pattern as the E3 duty cycle. Comparison of emission levels from uncontrolled locomotive and marine engines shows that the duty cycle seems to have little effect on emission levels. We therefore do not believe that the marine duty cycles call for relaxing emission standards relative to the counterpart engine emission standards, especially for PM and CO emissions.

b. Marinization effects

Evaluating the effect of marinization technologies and processes on emissions is more complex. Manufacturers often make several changes to marinize the base engine, especially for Category 1 engines. In general, this would include at least changing to a water-jacketed turbocharger and recalibrating the fueling rates across the range of engine operation (including reprogrammed electronics, if applicable). Marinizing often includes changing the specified heat rejection rates to take into account the different engine cooling and aftercooling dynamics resulting from the use of seawater as the heat sink (especially for separate-circuit aftercooling). Manufacturers claimed that these changes cause a 35 percent increase in emissions, but provided no more than a general description of technologies as a basis for this figure.

There is no reason to believe that emissions would be consistently or inherently higher for marine engines than the land-based engines from which they are derived. Recalibrating an engine’s fuel rates is necessary to ensure proper performance for the range of operation expected in the new application. This is very similar to adapting a calibration to a new land-based nonroad application. For example, if manufacturers want to use an engine developed for construction equipment and use it in a forklift, they would need to adust the calibration to ensure that the engine has sufficient power and response for the very different range of operation. This will have an effect on emissions, but it is not clear what that effect would be. Just as we don’t make allowance for different applications and their associated calibrations within the land-based nonroad rulemaking, we don't believe it is necessary or appropriate to expect higher emissions from a marine calibration. For both land-based and marine applications, the changes needed to adapt an engine for a different application can generally be managed as a calibration change to tune the engine for operation at different combinations of speeds and loads and diffferent degrees of transient operation. These changes should not involve fundamental changes that affect the basic emission control capability of the engines.

Engine manufacturers cited high power density as one particular reason that marine engines have higher emissions than counterpart land-based models. Manufacturers often increase power output from a given engine by increasing the amount of fuel burned per combustion cycle. The fuel flow can be increased without a corresponding increase in air flow, but this quickly leads to high particulate and smoke emissions and an unacceptable compromise in engine durability. The alternative is to increase the air flow by increasing the boost capability of the turbocharger or increasing the cooling capacity of the aftercooler, or both. These systems can be optimized to achieve power at the expense of emission controls. Manufacturers, however, have many years of experience in balancing these technology changes to achieve good simultaneous control of NOx and PM emissions. We believe that manufacturers can also optimize their marine engines for emissions without significant sacrifices in performance.

The variable in the marinizing process that has the greatest effect on emissions is the temperature of the intake air. Turbocharging and especially aftercooling technologies are therefore central to the discussion of controlling emissions from marine diesel engines. We agree that raw-water aftercooling is not appropriate for most commercial applications. Commenters, however, generally did not comment on separate-circuit aftercooling, which was the basis of our proposal. We agree that marine diesel engines do not have the same engine cooling technologies as the land-based engines. Comparing land-based and marine cooling systems requires an evaluation of the equation governing convective heat transfer:

$$q = h \bullet A \bullet \Delta T$$

The heat transferred, q, is governed by three variables: the convection coefficient, h; the surface area, A, over which two fluids are in thermal contact; and the temperature difference between the two fluids. In marine and most land-based nonroad engines, the "coolant" fluid circulates in a closed loop between the engine (and/or aftercooler) and a heat exchanger to remove heat from the engine (and/or aftercooler). This fluid is usually ethylene glycol or, in the case of some Category 2 engines, water. The second fluid, which acts as the heat sink, is ambient air for land-based systems and ambient water for marine systems. Land-based engines with air-to-air aftercooling avoid the need for an intermediate coolant fluid for the aftercooler by transferring heat from the intake air directly to the ambient air in a single heat exchanger. Removing this coolant loop provides an advantage for cost and simplicity of design, but it does not necessarily change the effectiveness of the aftercooler.

The temperature term does not play a significant role in differentiating land-based and marine systems, since water temperatures are usually somewhere between average high and low temperatures for a given day. Also, seasonal temperature variations are much greater than any inherent differences in the applications. This leaves consideration of the convection coefficient and the surface area.

The convection coefficient is not easily quantified, but some fundamental principles are clear. First, a fluid flowing past heat exchanger surfaces is more effective than quiescent fluids. This accounts for the greater cooling potential for highway trucks compared with nonroad applications. Second, water is a much more effective cooling fluid than air. To illustrate, heat transfer coefficients range from 10 to 200W/m^2-K for forced air convection, while they range from 50 to 10,000 W/m^2-K for forced water convection.[1] This suggests that a comparable degree of flow results in a five-fold increase in cooling capability for water-based systems.

Marine engines with an internal heat exchanger have a water pump that regulates the flow of cooling water. For vessels with external channel or keel coolers, the degree of flow varies considerably. The speed of these vessels largely determines the flow rate past the heat exchanger surfaces. External cooling is generally used for vessels

[1]Basic Heat Transfer, F. Kreith and W. Black, Harper and Row, 1980, p. 15.

operating at slow or medium speeds where the extra drag is not a problem. Flow rates for channel and keel coolers therefore are typically substantial, though less than for highway trucks. Convection coefficients for marine cooling should be much greater than for land-based nonroad engines. The high flow rates associated with high-speed truck operation may be enough to cause convection coefficients for highway and marine applications to be comparable. Note also that all trucks spend some time at much slower speeds.

The surface area of the heat exchanger is another important variable for comparison. Land-based applications depending on air cooling have the advantage that a finned radiator allows for a large effective surface area in a relatively small volume. This is essential, since trucks, locomotives, and most nonroad equipment have a very limited space for installing heat exchanger hardware. Marine vessels with internal heat exchangers have the option of adding expanding the surface area by simply increasing the volume of the unit. This is not as difficult as for land-based applications, because water-based systems are so compact, and because vessels generally have much less severe space constraints than land-based applications.

Marine vessels with external heat exchangers have two options. Vessels have traditionally had channel coolers, which are U-shaped steel sections that are welded directly to the hull. The engine coolant loses heat as it flows through these channels. We are aware that hulls with channel cooling may not have enough surface area to accommodate the additional heat-rejection rates of separate-circuit aftercooling. The current trend toward increasing use of keel cooling, however, provides an alternative. Keel coolers typically route the coolant through relatively thin-wall copper-nickel alloy sections. The thermal mass of these systems is so much less that they allow a much higher rate of heat transfer than channel coolers. Keel cooler units accordingly occupy roughly 20 times less hull area than channel coolers with equivalent cooling capacity. These systems are so compact that it is possible at a reasonable cost to bring coolant temperatures down to within 5° C of the ambient water temperature. Also, because they are so much smaller, keel coolers can be placed in a variety of positions on the hull (or recessed in the hull) to avoid damage or durab ility problems. Keel coolers have the further advantage of adding dramatically less weight to the vessel. We believe that the new emission standards will accelerate the trend toward keel cooling.

We agree that adding a water-jacketed cooling system to a land-based turbocharger to reduce surface temperatures will change the performance of the turbocharger in a way that can affect emissions. An alternative approach, however, is to replace the dry turbocharger with a different water-jacketed model that compensates for the cooling effect. Alaska Diesel confirmed our belief that it is possible to design a water-cooled turbocharger to closely approximate the charging characteristics of the original dry turbocharger.

We believe that Tier 2 locomotive emission control technology can be effectively applied to derivative marine engines. Both engine applications are mostly steady-state and operate only under a portion of the engine power curve. Locomotives operate at notch positions while marine engines operate along a propeller curve. The primary technology difference between marine and locomotive engines is the cooling potential. Locomotives rely on heat banks on their top surface, which are limited in space and efficiency. Marine engines have access to ambient water with no comparable space constraints, so they can easily achieve the same temperature specifications and heat rejection specifications as locomotive engines and aftercoolers, as described above. The duty cycles and engine technologies for locomotive engines and derivative marine models are so similar that these marine engines can meet the same emission levels without requiring additional measures. The feasibility of the final Tier 2 standards therefore does not rely on the use of electronic controls beyond the manufacturers' use of electronics in their locomotive engines. Similarly, manufacturers' concerns about the limitations of increasing fuel injection pressure and the inherent higher emissions from slower engines do not apply uniquely to marine engines. We have taken these concerns into account by setting the Category 2 emission standards for these engines at the same level as the locomotive engine standards. The feasibility of controlling emissions from Category 2 engines that are not derived from locomotives is described in the next section.

We believe the above discussion demonstrates that the unique features of marine cooling systems make marine engines as capable, or more capable, than land-based engines to achieve the degree of cooling and aftercooling needed to reduce NOx emissions to the required levels. Furthermore, other emission control hardware poses no unique obstacles that would prevent a marine engine from achieving the same level of control as counterpart land-based engines. We therefore believe that marinized versions of land-based engines are capable of achieving the same degree of emission control as the base engines.

c. Emission data

The emission data on marine engines in the Final RIA include several engines that have already achieved emissions levels below the proposed Tier 2 HC+NOx standards. Though not all the engines were tested for PM (including those tested in Santa Barbara), at least two of the tested engines were very close to the proposed Tier 2 standards for both NOx+HC and PM. Most of the tested engines, ranging from 120 to 575 kW, used the kind of technologies we expect manufacturers to use to meet Tier 2 standards. These engines are used in a wide variety of propulsion and auxiliary applications. These technologies and emission levels are representative of the whole range of Category 1 engines up to 2.5 L/cyl. This was done more than five years before the Tier 2 land-based nonroad standards start. Given the four to six years of remaining lead time, we believe that manufacturers can duplicate this effort for the remaining engine models.

Category 1 engines under 2.5 L/cyl share a lot of similarities because manufacturers can readily transfer technologies from highway engines to the similar-size land-based nonroad diesel engines. Category 1 engines over 2.5 L/cyl do not have a counterpart highway engine, so technology transfer to these engines is not as direct as for the smaller engines. These engines are also sold in very low sales volumes. Our conclusion for the similar land-based engines was to set the emission standards at the same level as the smaller engines, but to allow additional time to transfer the technology and amortize the costs from the previous tier of standards. For the same reasons, we believe these engines, given sufficient lead time, are capable of meeting the same emission standards as engines under 2.5 L/cyl.

d. Other issues

In cases where separate-circuit aftercooling would overcool the engine intake air, a thermostat could be used to limit the cooling water flow when the system temperature gets too low.

The fact that operators are not already ordering separate-circuit systems may show that the performance and fuel economy improvements are alone not compelling enough, but that is different than showing that the technology is not a viable and cost-effective emission-control technology. Manufacturers did not comment on our estimated costs to upgrade systems to separate-circuit aftercooling. We continue to believe that this technology, especially with its inherent benefit of improved fuel consumption, provides a cost-effective means to reduce emissions from marine engines.

We did not propose to require that existing vessels and engines be retrofitted with Tier 2 emission control technology, as suggested by the Lake Carriers Association and Oglebay Norton.

We agree with the commenters who believe that Tier 3 standards should be addressed at a later date. This will allow us to learn from the application of Tier 3 technology to land-based nonroad diesel engines. Also, it will give us time to consider emission control strategies such as aftertreatment.

We are interested in any data on the application of gas turbine technology or aftertreatment to commercial marine engines, including the possible effects that fuel composition may have on aftertreatment effectiveness. If this technology proves to be feasible and cost-effective for commercial marine engines, we will consider it in the future. We hope that manufacturers offer Blue Sky Series engines to prove out some of these technologies.

In conclusion, we believe that technologies are available in the near term to comply with the Tier 2 emission standards on the specified duty cycles. We address the feasibility of meeting NTE requirements in Chapter 4. Furthermore, advances in these and other technologies show promise for greater reductions in the future.

2. Category definitions

Commenters generally supported the displacement-based subdivisions for Category 1 engines, especially for engines up to 2.5 L/cyl. By setting a common starting date and adopting the same NOx+HC and CO standards for most Category 1 engines, we have reduced the number of Category 1 subdivisions. The remaining distinctions for starting dates and PM emission standards apply to engine groups that are divided consistent with the land-based nonroad diesel requirements.

We do not believe it is appropriate to treat engines between 3 and 5 L/cyl as Category 2 engines. While some of these engines will be designed and certified as locomotive engines, we expect all these models to be designed and certified to the land-based nonroad diesel emission standards. The numerical standards for land-based nonroad diesel engines are lower than those for locomotive engines. As described above, we acknowledge that these engines have no counterpart highway engines and that some of their design characteristics may constrain the transfer of low-emission technologies. At the same time, it is clear that the emission standards for the land-based nonroad engines reflect this challenge with an unusually long lead time to reach levels less stringent than those required for highway engines. Consistent with the land-based nonroad rulemaking, we believe manufacturers need significant lead time for these engines. Given enough time, however, we believe manufacturers can achieve the same level of emission control as the rest of the Category 1 marine engines, as described in the previous section.

As described above, we believe locomotive-level emission standards are feasible for most Category 2 marine engines. The comments have made it clear, however, that locomotive-derived engines do not cover the whole power range of Category 2 engines. The biggest locomotive-derived engine available today for marine application has a rated power of around 3000 kW. Most or all engines with a higher rated power are capable of operating on heavy-fuel, whether they fall in Category 2 or Category 3.

This raises two concerns. First, there is a possibility that the proposed Tier 2 emission standards would not be feasible for any engine models in the upper end of the proposed Category 2. Where there is no alternative choice of a complying engine, the proposed standards in that case might limit the range of options for some boat builders. Second, if there is a void in the availability of compliant engines in the upper end of Category 2, there is a possibility that this need will be filled by higher-emitting Category 3 engines. The Lake Carriers Association highlights this concern by pointing out that Category 3 propulsion engines are operating in Great Lakes vessels alongside Category 2 propulsion engines.

To address these concerns, we have concluded that the best approach is to expand Category 2 and divide it into subcategories with gradually increasing emission standards for larger engines. We are confident that engines between 5 and 15 L/cyl can comply with the locomotive-level emission standards and meet the power needs for this segment of the market. Dividing this displacement range for gradually increasing emission standards is therefore not appropriate.

We agree with commenters that the current range of marine engine models over 15 L/cyl have design constraints that limit their ability to control emissions. Since engines under 15 L/cyl may not be capable of providing adequate propulsion power for all vessels in this size range, we believe the best approach is to accommodate the technology constraints of these engines by setting emission standards less stringent than for locomotive-derived engines. These standards reflect the reduced capability of controlling emissions from engines designed to operate on heavy fuel (and the need to reduce emissions from a higher baseline level).

Engines models between 15 and 20 L/cyl are in a somewhat transitional category. These engines are sometimes used in harbor and inland river applications alongside locomotive-derived engines. Higher-power models are used in coastal and open-sea operations alongside engines with much larger per-cylinder displacement. Locomotive engine designs are planned for this size range, extending up to about 4500 kW, but it is not clear if these engines will be made available for marine application. In the Tier 2 time frame, we therefore believe it is appropriate to set emission standards based on what is achievable for the engines currently available. If it appears that these larger locomotive engines will become available as marine engines in the future, we would need to reconsider this approach to take into account the emission-control capabilities of these engines.

The manufacturers' suggestion to use 3300 kW as a threshold to separate this transitional Category of engines is helpful. Engines under this power rating should be expected to more closely approximate the engine operating characteristics of the competing locomotive-derived engines for fuel consumption, engine lifetime, and emissions performance. For these engines rated above 3300 kW, we would similarly expect them to approximate the operating characteristics of the competing bigger, slower-speed oceangoing engines.

There are several marine engine models available worldwide with per-cylinder displacement between 20 and 30 liters. Very few of these engines are currently installed in vessels that are flagged and used in the United States. In the final rule we expand Category 2 to include engines up to 30 L/cyl. We subdivide the Category with graduated emission standards for 20 to 25 L/cyl and 25 to 30 L/cyl engines reflecting the emission control capability of those engines. This should prevent high-emission engines from displacing smaller engines in common applications.

Setting emission standards at MARPOL levels for locomotive-derived engines would not be an appropriate exercise of discretion for setting the emission standards under §213 of the Clean Air Act. The greatest population of Category 2 engines is dominated by locomotive-derived engines. Some heavy-fuel capable engines less than 15 L/cyl have comparable power ratings, but these engines are rarely used in the domestic U.S. market. The economies of scale from relatively high-volume locomotive production and the lower cost of the simpler fuel system prevent widespread use of heavy-fuel capable engines. As described above, we recognize that engines capable of burning heavy fuels may not be able to achieve the same degree of emission control as distillate-only engines. To the extent that these two kinds of engines compete directly for installation in a given application, setting less stringent emission standards for heavy-fuel capable engines would provide an incentive to use the dirtier engines, leading to an increase in emissions. We believe there is no technological or cost reason that vessels would need to use the heavy-fuel capable engines in an application where a distillate-only engine is satisfactory. We therefore believe it is appropriate to set a single emission standard for all engines between 5 and 15 L/cyl.

For similar reasons, we are not exempting smaller auxiliary engines on vessels with a Category 3 engine. Commenters did not question the feasibility of achieving the same degree of emission control from these engines. Having different emission requirements apply to different engines on a vessel does not pose problems significant enough to compel less stringent emission standards and does not make these emission standards unachievable. We are not prepared to provide an exemption that would provide a competitive advantage to these higher-emitting engines.

Heavy fuel (or residual fuel) is fundamentally different than the distillate fuel used for testing and most in-use operation. We therefore treat it as an alternative fuel. To ensure proper control of in-use emissions, our regulations require manufacturers to certify an engine using test fuel representative of in-use fuel. If manufacturers produce their engines with sufficient hardware to be capable of operating on heavy fuel, they should submit test data with their application for certification showing that they meet the emission standards using both distillate and heavy fuel . The Clean Air Act prohibits removing or rendering inoperative elements of design in regulated engines. If operators add fuel heating and filtering equipment and other hardware to make a certified engine capable of operating on heavy fuel, we would likely consider that to be making the emission control system inoperative. We are requiring a statement on the engine label for engines that can be modified to operate on heavy fuel to discourage operators from making this modification.

Manufacturers will need to decide whether to produce their exported engines to MARPOL emission levels or the cleaner EPA levels. This is no different than for other highway or nonroad engines. Also, any foreign engine manufacturer choosing to sell marine engines into the U.S. market will need to make the same decision for the engines they market to the non-U.S. market. While we agree that there is a small number of engines involved, these few engines have a disproportionately large effect on total emission levels because of their size and operating characteristics. Furthermore, our assessment of the economic impact of meeting the new emission standards shows that the costs involved are reasonable and do not alter our conclusion that the standards in the final rule are justified under §213(a)(3) and (4) of the Act.

3. Level and timing of standards

We disagree with EMA's assessment that we are adopting a large reduction in emissions as the first step in emission standards for these engines. However, the MARPOL limits serve effectively as a Tier 1 program, which mimics the limits we originally proposed for these engines in 1994. Manufacturers are producing engines today that meet or are very close to meeting those limits, so it would not be appropriate to create a regulatory program with those limits. Such a program would impose a considerable compliance burden with very small, if any, emission benefits.

We don't believe that the MARPOL Annex VI NOx standard would result in meaningful reductions in NOx for most Category 1 and 2 marine engines. For Category 1 engines it would result in a negligible NOx reduction, because the 9.8 g/kW-hr standard is so close to the baseline emission level of about 10 g/kW-hr. The NOx standard for Category 2 engines varies with rated speed, but is in all cases higher than for Category 1 engines. On average, as described in the Final RIA, we estimate that the MARPOL limits will result in a reduction of about 15 percent NOx for Category 2. We have received (and placed in the docket) baseline data confirming manfucturers' claims that some Category 2 engines need substantial emission reductions to meet the MARPOL limits. Because MARPOL doesn't cover HC, CO, or PM, these pollutants would not be controlled and some or all of them would likely increase with decreasing NOx levels. As described in the preamble and elsewhere in this document, we are relying on the MARPOL limits before our standards start and are therefore not setting emission standards for any pollutants for these engines before our Tier 2 standards take effect.

We recognize that, in the short term, manufacturers will need time to gain knowledge associated with effectively applying land-based nonroad technology to commercial marine engines. This is why we proposed a NOx+HC standard for Category 1 engines that is more than 10 percent higher than the land-based nonroad limit on average. As requested in the comments, we have adjusted the NOx+HC standard for engines smaller than 0.9 L/cyl to match the standard for the counterpart land-based nonroad engines. The feasibility discussion above shows that an equivalent numerical standard does not imply a more stringent requirement for marine engines. The Tier 2 standards therefore meet the constraints suggested by the American Waterways Operators and Crowley for consistency with nonroad requirements and operators' performance needs. As discussed in the Final RIA, some marine engines are already demonstrating that land-based nonroad technology can be used in marine applications for significant emission reductions.

We took into account the relatively aggressive schedule for implementing the marine standards in selecting the Tier 2 emission levels for this final rule. We recognize that manufacturers need time to effectively transfer technologies to their marine engines in a way that allows them to optimize the marine engines for low emissions. Specifically, we agree with the commenters that the emission standards for marine engines should not start before the comparable standards take effect for the land-based counterpart engines. At the same time, we consider the time before the land-based standards take effect as an opportunity for manufacturers to anticipate applying control technologies to the marine engines. With more time to meet land-based emission standards, manufacturers have a greater opportunity to coordinate the simultaneous development of their marine engines. Thus, the later the land-based emission standards apply, the less important is the need for an extended time after implementation of the nonroad standards to allow sufficient time for the marine standards. Furthermore, the level of the marine emission standards generally is set to ensure that there will be no need for extensive marine engine development beyond the performance of land-based engines.

We have simplified the starting dates for the different Category 1 engine groups compared with the highly staggered approach for land-based nonroad diesel engines. The Tier 2 emission standards for all engines between 0.9 and 2.5 L/cyl start in the 2004 model year (no emission standards start before 2004). This allows three full years beyond the counterpart land-based nonroad engines in some cases, but we need to accommodate the limitations of post-manufacturer marinizers to comply with emission standards without an excessive cost burden from certifying a large number of engine families. The regulations allow a one- or two-year delay after land-based nonroad standards before the marine emission standard applies for the rest of these engines. We understand the need to follow land-based designs by developing multiple ratings of marine engines to meet emission standards. In general, we set the level of the standard to avoid the need for extensive marine engine development beyond the performance of land-based engines. Engine manufacturers can therefore in some cases develop their marine engines in conjunction with their land-based engines. The lead time relative to the date of this final rule is therefore another important parameter. We believe the lead time before and after the start of nonroad diesel standards together provides adequate time to certify these marine engines to Tier 2 standards. The request for 2- and 3-year lead time beyond land-based standards does not recognize the significant potential to use the years before implementation of the land-based emission standards to transfer technologies, test marine calibrations, and otherwise make progress toward complying with emission standards. Averaging, banking, and trading provides additional flexibility in planning an orderly transition of a company's whole product line to meet Tier 2 standards.

Engines under 0.9 L/cyl start in 2005 and Category 1 engines over 2.5 L/cyl start in 2007. Both of these dates are delayed one year beyond what we proposed to address the manufacturers' concerns for having time to transfer the technology to their marine engines. For the smaller engines, this is appropriate because of the small number of engine models involved. For the larger engines, this is appropriate because of the time manufacturers have to coordinate the marine and land-based nonroad engine development.

As described above, the final rule includes an expanded set of Category 2 engines, with differing standards for subcategories. Engines between 5 and 15 L/cyl are almost all locomotive-derived engines with relatively little constraint on applying locomotive emission-control technology to the marinized engines. We are therefore establishing numerical standards for NOx+HC and PM emissions that are equivalent to the locomotive standards. This is less stringent than we proposed, but we believe it would be too costly to achieve emission levels that are more stringent than locomotive levels in the Tier 2 time frame. This is largely because of the limited sales volume for marine engines compared with their locomotive counterparts.

Table 2-3 shows the arrangement of standards for the bigger Category 2 engines. As described above, it is appropriate for these engines to have an emission standard that is numerically less stringent than for the locomotive-derived engines. While these engines have some unique design constraints relative to locomotive-derived engines, the anticipated Tier 2 technologies applied to these engines can achieve emission levels below the MARPOL Annex VI limits. Emission data on an 18 L/cyl engine show varying emission levels with different emission control strategies. An engine with no emission controls emitted 18 to 20 g/kW-hr NOx on the D2 cycle (PM was not measured). Applying sufficient controls to meet MARPOL limits reduced these emissions to 12 g/kW-hr NOx+HC and 0.46 g/kW-hr PM. Finally, applying extensive timing retard resulted in emission levels of 8 g/kW-hr NOx+HC and 0.61 g/kW-hr PM. Operation with this degree of timing retard increased fuel consumption by 8 percent.

For these engines with rated power over 3300 kW, the test data support the intermediate standard suggested by Caterpillar. The several years of lead time provide opportunity to optimize control technologies and calibrations, but achieving a level of 8 g/kW-hr NOx+HC would likely prevent these engines from being competitive on the oceangoing market. The level of 9.8 g/kW-hr NOx+HC provides a reasonable balance considering the costs of deploying emission control technologies. As described above, the engines between 15 and 20 L/cyl with rated power under 3300 kW participate predominantly alongside locomotive-derived engines in inland operations. For these engines, we believe that manufacturers will be able to develop emission-control technologies to the point that they can comply with an 8.7 g/kW-hr NOx+HC level (with compliance margin), without incurring a prohibitive increase in fuel consumption.

We recognize that there is relatively little data to establish an appropriate emission standard for engines between 20 and 30 L/cyl. This is especially difficult for these engines, since many times none of them are sold in the U.S. in a given year. The engines between 20 and 25 L/cyl are very similar to the engines between 15 and 20 L/cyl with rated power over 3300 kW, so the same standard should apply to those engines. Absent specific data for engines over 25 L/cyl, we believe the best approach is to calculate a common degree of additional stringency beyond MARPOL levels. The 9.8 g/kW-hr NOx+HC standard is about 15 percent more stringent than the levels dictated by the MARPOL NOx curve for (at 1000 rpm). Engines between 25 and 30 L/cyl are more likely to operate at 720 rpm. A 15 percent reduction from MARPOL NOx limits calls for a NOX+HC standard of 11 g/kW-hr. We believe this emission standard is achievable for these engines.

We intend to re-evaluate this scheme for grouping Category 2 engines and will also carefully consider the appropriate level of emission standards for these engines for the next tier of standards. Our conclusions for dividing Category 2 engines depends on our understanding of the technologies in use in today's unregulated marketplace. Over time we will learn more about these engines. Also, emission standards may cause some shift in the distribution of engine technologies for different size engines. These changes may affect our judgment about what level of emission reduction is achievable for Category 2 engines, especially those over 15 L/cyl.

We are finalizing our proposed PM emission levels for engines between 5 and 15 L/cyl. As with NOx+HC emissions, we believe that locomotive-derived engines will be able to achieve the same level of control for PM emissions. Again, there is little test data to establish achievable emission control levels for the larger Category 2 engines. We estimate that the engines with counterpart land-based engines will reduce PM emissions by about 35 percent to reach Tier 2 emission levels (see Chapter 5 of the Final RIA). Applying this same percentage reduction to the baseline emission level supplied by Caterpillar would result in a Tier 2 emission standard of 0.5 g/kW-hr, which aligns with their recommended target. We therefore believe that this is the appropriate standard for these engines. For PM too, we intend to carefully re-evaluate the appropriate level of the standard before setting the next tier of emission standards.

All the Category 2 emission standards start in the 2007 model year. This allows two years after the locomotive standards start for engines between 5 and 15 L/cyl. As described above, we expect a high degree of commonality between locomotive and marine engine designs, manufacturers will be able to complete their efforts to complete the effort to design, test, and certify their marine engine calibrations within a two-year period. We do not expect any of the bigger Category 2 engines to be certified to the locomotive standards. So, the 2007 starting date is not based on technology transfer, but on the lead time required to pursue emission controls that exceed the requirements of the MARPOL Annex VI NOx limits. The emission data described above show that manufacturers have already made substantial progress toward meeting the Tier 2 limits. The seven years of lead time gives them opportunity to complete the development and testing effort for the whole range of these engine models.

The lead time for Category 2 engines and Category 1 engines over 2.5 L/cyl includes consideration of the need, not just to do research to reach the target emission level, but also to do the development work to apply technologies to a wide range of engine calibrations. The 2007 date is designed to allow successive development of the whole range of engine calibrations, which means that many engines can be certified ahead of that schedule. We expect manufacturers to focus their initial development and certification work on their highest-volume calibrations. Early banking of emission credits may therefore provide an substantial additional help in easing the transition to complying with the Tier 2 standards with early banking credits. This would be similar to adopting a phase-in schedule for these engines, except that early banking leaves the manufacturer more flexibility to plan the roll-out of the range of engine models.

In response to the ABS question, the starting date for these standards refers to the date the engine is manufactured. This follows the same approach we use in all of our other engine emission control programs, which are based on date of manufacture, or the engine's model year. This approach is different from that used in the MARPOL Annex VI NOx requirements, which ties the starting date to the time the vessel is constructed, as defined by the point at which the keel is laid or the vessel is at a similar stage of construction, or the date the engine undergoes a major conversion.

In addition to the direct responsibilities for engine manufacturers, we include in the regulations various prohibited acts that apply to boat builders. We generally want to prevent equipment manufacturers from selling new equipment with noncompliant engines after the starting date for new emission standards. We have adapted this approach for marine construction to disallow the use of noncompliant engines in boats where the keel is laid (or a similar stage of construction) after the starting date for the new emission standards. We maintain some flexibility to transition to new emission standards with normal inventory management, but we do not allow stockpiling as a strategy to delay implementation of emission standards.

As described in our proposal, we intend for the CO emission standard to serve as a cap on uncontrolled emission levels to prevent manufacturers from increasing CO emission levels as they control other emission constituents. he data we have gathered shows that the appropriate level for marine engines is 5 g/kW-hr. This applies to all Category 1 and Category 2 engines.

All the Tier 2 standards and starting dates are presented in Table 2-3.

Table 2-3
Final Engine Emission Standards and Dates

Category	Displacement (liters/cylinder)	Starting Date	NOx+THC (g/kW-hr)	PM (g/kW-hr)	CO (g/kW-hr)
1	power ≥ 37 kW disp. < 0.9	2005	7.5	0.40	5.0
	0.9 ≤ disp. < 1.2	2004	7.2	0.30	5.0
	1.2 ≤ disp. < 2.5	2004	7.2	0.20	5.0
	2.5 ≤ disp. < 5.0	2007	7.2	0.20	5.0
2	5.0 ≤ disp. < 15	2007	7.8	0.27	5.0
	15 ≤ disp. < 20, and power < 3300 kW	2007	8.7	0.50	5.0
	15 ≤ disp. < 20, and power ≥ 3300 kW	2007	9.8	0.50	5.0
	20 ≤ disp. < 25	2007	9.8	0.50	5.0
	25 ≤ disp. < 30	2007	11.0	0.50	5.0

B. Voluntary Standards

What We Proposed:

We proposed to set target emission levels to define a threshold for manufacturers to earn a designation as a low-emitting (or "Blue Sky Series) engine. To maximize the potential for other groups to create incentive programs, without double-counting, we did not allow manufacturers to earn marketable credits for their Blue Sky Series engines.

What Commenters Said:

MECA strongly supported the voluntary standards and agreed with preventing manufacturers to earn emission credits for these engines. They would like to see voluntary standards also for remanufactured engines. They would like us to establish incentives. Finally, they suggested adding a recognition of different qualifying emission levels to reflect the range of improvement available from different control technologies.

Mercury argued in favor of earning emission credits from Blue Sky Series engines. STAPPA and NESCAUM recommended letting manufacturers decide whether to keep emission credits or to make them available to others. Finally, Alaska Diesel suggested that we allow the Blue Sky designation for adding exhaust aftertreatment to a certified engine.

Bluewater Network recommended that we adopt a policy similar to that in Sweden, in which ports charge lower port fees for vessels equipped with selective catalytic reduction.

Our Response:

Several factors are involved in developing a successful program of voluntary standards. First and most importantly, the program should avoid complexity as much as possible to prevent confusion and avoid administrative disincentives to participation. Second, there should be a clear qualifying threshold that presents a significant challenge beyond the mandatory emission standards. Third, recognition of levels of control that go beyond the minimum required to qualify as a low-emitting engine are desirable but must be balanced with the need for simplicity.

In keeping with the need to create a simple and manageable program, we believe it is best to establish a single qualifying threshold for the Blue Sky Series engines. We are not at this time formalizing a plan to recognize a level of emission control going beyond the single qualifying level. Successful implementation of a simple program is seen as a necessary first step before addressing the possibility of multiple levels of voluntary standards or indexed controls. In the near term, even with only one level of voluntary standards, engine manufacturers will have some incentive to design a system that will qualify as a Blue Sky Series engine through the transition to more stringent emission standards. Notwithstanding this initial simplicity of the federal program, states or other organizations may do well to design incentive programs that include recognition of varying degrees of superior emission control levels.

We continue to believe that granting federal emission credits to engine manufacturers for Blue Sky Series engines would not be appropriate. This is consistent with the conclusion we reached for land-based nonroad diesel engines. While federal emission credits for the engine manufacturer would create an incentive for the early development of clean technology, this would send an improper message that the environment is benefitted when in fact the emission reductions from these engines may be offset by increased emissions from other engines using those credits. Also, allowing ABT credits for Blue Sky engines could create a situation of credit double counting. We believe there may be some merit in shifting an emission credit program from engine manufacturers to equipment manufacturers or users. We also believe, however, that states or other groups are best positioned to manage a credit program that would recognize the potential for emission reductions from Blue Sky Series engines. The input from Bluewater Network illustrates a good example of how state or local authorities can provide incentives for buying low-emitting engines.

We believe that it is not realistic to expect a company to certify remanufactured engine families, even to voluntary levels, if we don't set up a program to require emission controls for these engines. If someone wants to market a low-emitting remanufactured engine, we would suggest aiming for the Tier 2 emission levels. Short of engine family certification, states may be able to provide incentives for adopting emission-control technologies or achieving some level of emission control for remanufactured engines.

CHAPTER 4 – Not-To-Exceed Standards and Related Provisions

What We Proposed:

To ensure that emission reductions are occurring during actual vessel operation, we proposed a "not-to exceed" (NTE) emission standard. The NTE standard, in conjunction with the other standards, is intended to ensure in-use emissions reductions through an objective standard and an easily implemented test procedure that can be employed in an in-use test program. For a furthe discussion, see the December 11, 1998 proposal (63 FR 68505). We proposed that testing could be done at any point within an NTE zone, which is defined by the power curve of the engine up to rated speed. Within the NTE zone, we proposed that the emission standards be 1.25 times the applicable standards (or family emission limits) for all of the regulated pollutants. We also asked for comment on whether a split NTE zone with different caps would make more sense for mechanically controlled engines which are only capable of a fixed injection timing.

In our proposed concept, any operation that could reasonably be expected to be seen in use, including transient operation, could be performed within the NTE zone during testing. In addition, we proposed that acceleration associated with bringing a vessel to plane also be eligible for inclusion in NTE testing, regardless of whether it falls within the NTE zone. To ensure that short transients do not give unfairly high results, we proposed that the emissions sampling period must be at least 30 seconds.

We proposed that the NTE standards apply under all atmospheric conditions, and that no corrections be allowed within specified ranges of ambient air temperature (13-35°C) and humidity (7.1-10.7 g water/kg dry air). We also proposed that ambient water temperature must be within the range of 5-32°C during NTE testing. Finally, under the proposal there would be no correction for fuel sulfur level from 0.05 to 0.4 weight percent, and no NTE testing with fuel sulfur levels above 0.8 weight percent.

What Commenters Said:

1. Effect on stringency of standards

Marine engine manufacturers generally opposed our proposed NTE provisions. They argued that the NTE provisions increased the stringency of the other emission standards and would result in the need for more emission control equipment than we projected would be required to meet these standards. The argued that reducing emissions at the most challenging points would force them to apply a greater degree of emission control technology than they would need to comply only with the emission standards corresponding to the E3 duty cycle. Based on their own test data, Mercury Marine stated that the NTE requirements would more than double the stringency of the standards. Navistar stated that a manufacturer would have to design to 40-70 percent below the standards to account for in-use power measurement uncertainties, wide ambient condition range and the 1.25 multiplier proposed for NTE testing. Caterpillar commented that the NTE provisions should only apply to NOx and that CO correlates with fuel consumption so that there is a natural incentive to minimize CO.

Manufacturers also stated that we had not demonstrated the feasibility of the proposed NTE requirements and that they impose a tremendous burden for a questionable environmental benefit. They said that the undefined nature of the test requirement results in an infinite number of operating points and transient conditions to control and test for, and that even a large amount of testing would not give them certainty of meeting the requirements under all possible scenarios. This uncertainty increases the burden of the NTE requirements.

Both Cummins and John Deere noted that land-based nonroad engines are not subject to NTE requirements. Cummins stated that we had not taken this fact into account when we used nonroad technology as the basis for establishing the feasibility of the proposed marine standards. John Deere stated that, because marine engine technology lags behind that of land-based nonroad engines by at least two years, the marine NTE proposal is premature. John Deere suggested that the marine NTE program should come only after such a program is established for land-based nonroad engines.

2. Shape of NTE zone

Manufacturers expressed concern about the shape of the NTE zone. Caterpillar suggested that the NTE zone should be limited to above 75 percent power because this is where commercial engines operate. Several manufacturers commented that the NTE zone contained a lot of operating areas away from the prop curve which would not be seen in actual use. They stated that this would result in the need to control emissions in operating areas that wouldn't be seen in use, thus raising the burden without corresponding real world benefits. EMA commented that the flat map approach would limit the stringency of future standards by requiring excessive reductions in operating modes that do not represent the real world at the expense of further reductions in actual operating modes. EMA also suggested that we need to limit testing to those areas of the engine operating map that the manufacturer recommends to the user for the particular application, stating that a manufacturer should not be held liable for engine operation outside of what it recommends for the application. Finally, Caterpillar and EMA commented that we should not allow NTE testing in a laboratory setting. Lab testing, they argued, would require costly emission reductions in those engine operating areas that would not be seen in-use, resulting in increased burden and cost with no associated emission benefit.

3. NTE cap of 1.25 times the family emission limit

Manufacturers expressed concern about the 1.25 emission limit. Manufacturers stated that the "flat map" (the use of a single 1.25 multiplier throughout the entire NTE zone) was not appropriate and resulted in increased stringency without corresponding benefits. ABS and Caterpillar both commented that emissions increase at low speeds and loads. Caterpillar suggested that the multiplier would need to be as high as 3.0 at lower speeds and loads, or that the NTE zone should be limited to operation above 75 percent power, since this is where commercial engines operate. In later comments, Caterpillar suggested caps of 1.7, 3.7, and 11 for NOx+HC, PM, and CO, respectively. They also suggested dividing the subzones based on engine speed rather than power. Euromot commented that single-mode measurement variability, compared to the cycle average, would result in the need to design for excessive safety margins, especially for HC and PM at low loads.

4. Inclusion of transient operation

Caterpillar and Mercury Marine both stated that there is little transient operation in real world operation, and that to require that transient operation be included in NTE testing would increase the burden on manufacturers without any corresponding emission benefits. ABS commented that both the ability to measure transient emissions and the ability to comply with the transient requirements are questionable. ABS suggested that we include a specific transient sequence in our NTE requirements. Mercury Marine commented that, in addition to the burden of complying with the transient requirements, there is additional burden of test equipment required for transient testing. Also, the test equipment required for transient testing requires dry exhaust. Mercury Marine stated that their engines would have to be redesigned from their current wet exhaust configuration to have dry exhaust to do in-use testing. Such a redesign, Mercury Marine stated, would require changes to the exhaust manifold as well as engine recalibration, and could have safety and noise implications. Finally, Cummins commented that different pollutants react differently to transient operation, thus making a single 1.25 multiplier inappropriate for all pollutants.

5. Ambient conditions without correction

Manufacturers generally opposed our proposal to require compliance over a wide range of ambient conditions without the use of correction factors. They stated that such a requirement increased the stringency of the standards by 10 to 20 percent, and thus their burden, without any real benefits. Cummins argued that we did not demonstrate the feasibility of the standards over the full range of ambient conditions. EMA commented that the lack of correction factors would mean that an engine's pass/fail determination would be more dependent on ambient conditions than the engine's ability to control emissions. They also commented that high intake air temperatures decrease the density of the charge air, which decreases the degree of boost from the turbocharger, which can affect control of PM emissions. EMA and Euromot suggested that we adopt ISO correction factors, at least until we can develop some that are more representative of current engine designs. EMD commented that without a standard reference condition, the data from different tests cannot be compared and that manufacturers must show their engines comply under all conditions.

6. In-use fuel effects

Both ABS and Cummins commented on the issue of fuel composition. ABS suggested that we should allow correction for fuel sulfur and nitrogen content, especially since the use of residual fuels is a possibility. Cummins stated that we have not taken into account the full range of in use fuels in setting our NTE requirements.

7. Practicality of NTE testing

EMA and Mercury Marine commented that we need to establish specific criteria such as procedures and test equipment for NTE testing. EMA suggested that such criteria must include a provision that excludes from NTE testing any engines that are not properly maintained and used, arguing that manufacturers should not be held liable for treatment of engines outside their control. ABS questioned whether in use testing would be done during normal operation, or whether a special trip would be required for the testing, and also argued that, since different measurement equipment would be used during certification and NTE testing, we should allow for measurement variability. Mercury Marine stated that in use testing is not viable because removing engines from vessels for testing is not practical, and no portable emissions measurement system has been proven to be accurate and reliable. Caterpillar commented that field testing needs to be performed cooperatively with the engine manufacturers and the EPA to develop measurement techniques and testing protocol.

8. Mechanically controlled engines

John Deere commented that the NTE requirements should not apply to engines with mechanical injection timing. John Deere argued that it is not possible for such engines to have the kinds of defeat devices that we are concerned about. Also, they lack the timing flexibility to meet the NTE requirements without being designed to extremely low, potentially unattainable emission levels in some operating modes. Manufacturers argued that mechanically controlled engines have no ready means to determine power output in use, making in use testing difficult.

In later comments, Caterpillar and EMA suggested that we exclude engines over 15 L/cyl from NTE requirements. They based this on the fact that none of these engines are electronically controlled and there is little data from which to draw conclusions about the range of emissions over the NTE zone.

9. Harmonization

Euromot commented that our NTE proposal went against the principle of harmonization. Also, ABS suggested that our proposal was contrary to IMO provisions, where test repeatability is an important factor. ABS stated that the proposed NTE requirements are severe because they do not apply to non-U.S. ships, Category 3 engines and auxiliary engines.

10. Alternative approaches

Caterpillar stated that we should postpone the NTE requirements and develop suitable procedures cooperatively with the engine manufacturers. EMA commented that we either need to abandon NTE altogether or generate supporting data and adjust the standards accordingly. EMA stated its belief that the E3 duty cycle standards in conjunction with defeat device language should meet our objectives.

Both Caterpillar and EMA suggested that NTE requirements be limited to NOx emissions, but for different reasons. Caterpillar suggested that PM and HC cannot be accurately measured in the field, while EMA suggested that the desire for improved fuel economy would only impact NOx emissions.

EMA and Euromot both suggested an alternative NTE program. This alternative would include a smaller NTE zone, as well as ambient condition correction factors. Under their proposal we would specify three points within the NTE zone that the manufacturer would have to test at. The emission limit would be 1.10 times the speed-interpolated emissions levels of the adjacent E3 test points.

In later comments, EMA offered a proposal for a modified approach to the proposed NTE program. Under this proposal, we would not enforce the NTE requirements until the appropriateness of the NTE zones and limits were demonstrated with test data. Under this approach, manufacturers would agree to collect data under the NTE zone and share it with us. As a part of this alternative approach, EMA reiterated its earlier comments on the inclusion of transient operation, ranges of ambient conditions, and PM sampling in the NTE requirments.

11. Legal authority

Both Navistar and EMA challenged our legal authority for the NTE program. EMA simply stated that we have no legal authority for requiring manufacturers to perform an in-use testing program. Navistar stated that the NTE program is not legal under the Clean Air Act, arguing that our proposed NTE program is based on absolute emissions, rather than average emissions as required by the Act. Further, Navistar stated that our only authority to issue standards for these engines is section 213(a) of the Act, and this is not the authority we used. Navistar argued that the NTE requirement amounts to a second, more stringent, standard and that we cannot circumvent the requirements of section 213(a) by disguising new standards as test procedures.

12. State and local enforcement benefits

California ARB, STAPPA/ALAPCO and NESCAUM all expressed support for our NTE proposal. STAPPA/ALAPCO and NESCAUM both commented that it would provide the basis of credible enforcement programs at the state and local levels.

Our Response:

1. Effect on stringency of standards

With any standard we set, our goal is to achieve control of emissions over the broad range of in-use operation and ambient conditions, not to just reduce emissions over a specific operating cycle under laboratory conditions. No single test procedure can cover all real world operations. For instance the E3 duty cycle only contains four operating points which are based on an assumed propeller curve. Meeting the duty-cycle emission standard alone does not provide assurance that emission reductions will be achieved in use, especially for engines that do not operate on the assumed propeller curve. The NTE concept provides objective design criteria while still covering a wide range of conditions that would be seen by marine engines in use. In this context, the defeat device prohibition is an important supplement to both the NTE standards and the steady-state duty-cycle standards.

As described in Section 3 below, the same technology that can be used to meet the standards over the E3 duty cycle can be used to meet the NTE caps in the NTE zone. We therefore do not expect these standards to cause commercial marine engines to need more advanced technology than is used by the nonroad engines from which they are derived. We do not believe the NTE concept results in a large amount of additional testing, because these engines should be designed to perform as well in use as they do over the steady-state four-mode certification test. However, our cost analysis accounts for some additional testing, especially in the early years, to provide manufacturers with assurance that their engines will meet the NTE requirements.

Mercruiser supplied us with data showing the effects of the worst-case parameters in the proposed NTE concept on a marine engine that uses electronically controlled fuel management but is not designed for emission control. This data shows a wide variability in emissions in the proposed NTE zone, especially when a range of ambient conditions are considered. Southwest Research Institute has collected emission data on a similar engine under contract with EPA. This uncontrolled engine showed much less sensitivity to operational or temperature variation. The SwRI data, available in the docket and discussed in the Final RIA, show that the inherent variability of emissions over the range of operating and ambient conditions is consistent with the NTE standards in the final rule. In any case, neither of these engines were calibrated for emission control. Manufacturers can use the anticipated control technologies, with calibration adjustments as needed, to reduce emissions over the broad range of operation expected from in-use engines.

Navistar commented that the combination of power measurement uncertainty, wide ambient conditions range, and a 1.25 cap would cause them to design engines 40-70 percent below the standards. Power measurement uncertainty is an in-use measurement issue. We would account for any error in measurement during testing in the field; therefore, this does not affect the stringency of the standards. The ambient conditions and NTE cap are discussed in more detail below. Caterpillar claimed that CO should not be included in the NTE zone because manufacturers already have an incentive to minimize CO. By the same argument, we believe that it will be straightforward for manufacturers to design engines which are well below the NTE cap for marine engines, especially given that the CO standard is just a cap and not a technology-forcing requirement.

We believe the NTE standards, in combination with the steady-state duty-cycle standards, are necessary and appropriate ways to ensure the in-use benefits of the standards. The NTE requirements, along with the defeat device requirement, will help to ensure that engines will be designed for low emissions under all real-world conditions.

The NTE provisions involve consideration of appropriate ambient conditions, operating ranges, and emission limits. We asked for comment on these parameters in the NPRM and these comments are summarized above. As a result of these comments, we made some changes to the proposed NTE concept. Our analysis of the comments and the changes we made are discussed below.

2. Shape of NTE zone

We do not consider it reasonable to limit the NTE zone to operation above 75 percent power only. The E3 test procedure suggests that 30-50 percent of operation is below this cut-off. In addition, we believe that most of the lower power operation would be in ports and near shore where it likely has a larger effect on air pollution problems affecting public health or welfare. Therefore, we believe that emission control from low-power operation is important.

Operational data we have collected on a planing hull and a displacement hull vessel indicates that real world operation is not constrained to the cubic propeller curve.[2] In fact, some of the operation at speeds greater than 63 percent of rated extends beyond the NTE zone. This supports our concept of expanding the NTE zone beyond the cubic propeller curve.

We recognize that, in some rare occasions, there could be engines that are not designed to operate in some portion of the NTE zone. This is why we proposed to allow manufacturers to petition to adjust the size and shape of the NTE zone for certain engines if they can show us that the engine will not see operation outside of the revised NTE zone in use. For example, this may be the case for Category 2 engines over 15 L/cyl, as described for mechanically controlled engines, below. In addition, if a manufacturer designs an engine for operation outside of the NTE zone, we proposed that the manufacturer would be responsible for notifying us so that their NTE zone can be modified appropriately for that engine. We believe that laboratory testing is appropriate. We have designed the NTE zone to cover areas of operation that can reasonably be expected to be seen in use, subject to case by case changes for specific engine families, as discussed above.

3. NTE cap of 1.25 times the family emission limit

According to the emission data presented in the Final RIA for uncontrolled engines, about half of the engines are below 1.25 times the E3 average for all four of the E3 modes for HC+NOx and for PM. However, these data show that emissions are higher on a brake-specific basis at lower power than at higher power. For this reason, we think it is reasonable to split the NTE zone into two regions with different caps. Using a cap of 1.50 below 45 percent of rated power, and a cap of 1.20 above 45 percent power, about two-thirds of the uncontrolled baseline engines meet the limit across the E3 modes for HC+NOx and for PM. To be consistent with this rationale, the caps for propulsion engines certified to the C1 or E2 duty cycles would be the same above and below 45 percent power. Because baseline CO levels

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[2]"Data Collection and Analysis of Real-World Marine Diesel Transient Duty-Cycles," EPA memo from Matt Spears to Mike Samulski, October 15, 1999 (EPA Docket A-97-50, document IV-B-2).

are low compared to the proposed CO limit, the NTE cap should not be a limiting design factor. Given the lead time for the NTE standards and the application of emission control technology such as electronically controlled fuel management, we believe that manufacturers can comply with this requirement on all their engines.

The greatest challenge in meeting the Tier 2 emission limits will be to reduce NOx emissions. We therefore divided the subzones primarily based on the maps we have for NOx emissions. The data show a relatively constant NOx level with increasing speed around the 45 percent power line, which supports the use of power to separate subzones. The data for PM and CO show different trends across the NTE zone, which we could use to support dividing the zone at some constant speed. The PM and CO data also show a different degree of variation of emission levels across the zone. With enough information and experience we could attempt to devise an approach that would carefully balance the primary and NTE emission standards into tailored subzones for each pollutant. The data available today, however, support the conclusion that engines will be able to comply with all the Tier 2 requirements at the levels we are finalizing. In some cases, the primary emission standard is controlling and the NTE caps serve to prevent unexpected variations. In other cases, we are aware that the NTE caps may be controlling, especially for certain pollutants in certain areas of engine operation. We expect to learn better over the coming years how emissions vary under different operating conditions. We may conclude in a future rulemaking that it will be appropriate for that tier of emission standards to adopt an NTE approach that differentiates the individual pollutants.

The principal emission control technologies anticipated for complying with the marine Tier 2 emission standards are described in detail in Chapters 3 and 4 of the Final RIA. These technologies provide the manufacturers with tools that can be used together to reduce emissions. Even without emission standards, engine manufacturers need to conduct sufficient development with each of their engine ratings to be sure that engines perform properly throughout the anticipated in-use operating range. Integrating the emission-control technologies into the engine design enables the manufacturer to make engines that perform well in use with the additional feature of reduced emissions. Some of these technologies can be manipulated to achieve a greater or lesser degree of emission control at different operating points. For example, a manufacturer may be able to adjust the turbocharger mapping to increase boost pressure at an operating point where PM emissions are unacceptably high. Also, as described in the cost analysis in the Final RIA, manufacturers can use timing retard selectively to reduce NOx emissions in those areas where it is most difficult to meet the emission standard. This would most likely be necessary at lower loads, where manufacturers have a greater ability to retard timing without compromising overall fuel consumption values. We therefore believe that manufacturers will not need to add technologies to comply with the NTE standards that they will not already be adopting to comply with the duty-cycle standards.

For some engines, especially electronically controlled engines, manufacturers may prefer to control their emissions to a flat cap. For these engines we will allow manufacturers the option of certifying to a flat cap of 1.25 times the family emissions level.

4. Inclusion of transient operation

We developed six transient marine cycles based on data collected from diesel engines used on vessels. Based on these cycles we observed variation in emissions for testing performed by SwRI on one engine: HC+NOx = -3 to +16 percent, PM = -46 to +18 percent and CO = 13 to 224 percent. It is unclear how much of this variation in emissions was due to transient operation and how much was due to the relationship between emissions and operational mode that would be seen under steady-state testing. Through the use of electronic controls, especially for fuel management, we believe that variation in emissions due to transient operation can be controlled.

Equipment exists to sample NOx emissions during in-use transient operation. Although this equipment is new, we fully expect this technology to be proven reliable well before 2004. Emissions could be sampled from a wet exhaust using a probe upstream of where the water and exhaust mix. Sampling PM under transient operation in-use is more difficult and we are unclear on when this sort of equipment will be viable for in-use compliance programs. However, transient NTE testing could still be performed in a laboratory with a dilution tunnel. We recognize the costs that would be associated with removing an engine from a vessel for laboratory testing. At the same time, we are aware that a small degree of transient operation is likely when attempting to conduct steady-state testing onboard a vessel. We believe this is acceptable for a valid steady-state test. The regulations therefore limit NTE testing to “nominally steady-state” conditions.

Regardless of transient testing feasibility and costs, it is unlikely that transient operation is necessary under the NTE concept to ensure that emissions reductions from commercial marine engines are achieved in use. We designed the NTE zones to contain the operation near an assumed propeller curve that the steady-state cycles are intended to represent. We believe that the vast majority of commercial marine operation in the NTE zone is steady-state. For planing vessels, we believe that the transient operation as a vessel comes to plane generally is along the torque curve and would not be within the NTE zone. However, we do not have enough data to reliably say where under the torque curve marine engines operate during transient operation. Also, we do not believe that the NTE zone should be extended at this time to include areas an engine may see during transient operation but would never see during steady-state operation. For this reason, we do not believe that adding transient operation to the NTE requirements for commercial marine engines is necessary at this time. We would revise our opinion in the future if we were to see evidence that in-use emissions were increased due to insufficient emission control under transient operation.

Under the new emission standards, manufacturers must nevertheless design their engines to control emissions during transient operation, even without a transient element to the NTE zone. The defeat device provisions established for highway and nonroad engines apply to marine diesel engines in addition to the NTE requirements. A design in which an engine met the standard at the steady-state test points, but the effectiveness of the emission control system was reduced by an auxiliary emission control device during transient operation, would be considered defeating the standard (subject to certain limited exceptions, identified in the definition of defeat device in 40 CFR 94.2).

5. Ambient conditions without correction

Our goal with the range of ambient conditions is to ensure real world emission control over a broad range of conditions. Although test-to-test repeatability can be valuable in developing engines, this is not the goal of the NTE provision. Several manufacturers commented that the proposed range of ambient conditions affects the stringency of the proposed standards. We expect that ambient air temperature and humidity, in the ranges we proposed, only have small effects on emissions compared to ambient water temperature for turbocharged and aftercooled engines, especially for NOx emissions. In the final rule, we lower the maximum water temperature limit for NTE testing without correction. The resulting upper limit in water temperature results in cooling water temperatures close to the reference condition recommended by SAE. Similarly, we adjusted the air temperature range to account for marine conditions. With this modifications, we believe the ambient conditions included in the NTE zone without correction are reasonable. We describe the rationale for the final ambient condition ranges below.

Water temperature – We agree that a water temperature range extending to 32°C is too high. The warmest water temperatures seen by commercial vessels operating in the U.S. would not likely exceed 27°C. We believe that it is reasonable to expect marine engines to comply with the emission standards when operating at water temperatures of 27°C. The standardized aftercooler medium temperature recommended by SAE J1937 for laboratory testing is 20 to 30°C. With separate-circuit aftercooling, manufacturers should be able to stay within or close to this range.

We recognize that some vessels are built only to operate in cold water, such as fishing vessels intended to operate in Alaska. These vessels will often use a channel or keel cooler with no more capacity for cooling than needed to operate in cold water. In these cases, we believe that in-use testing in warm water would be inappropriate, provided that the owner is clearly made aware in writing that the vessel is not designed to operate in warmer climates.

We still think that the lower water temperature limit of 5°C is appropriate. Marine engines operate in the U.S. in water at temperatures near freezing. Therefore, if we limited the lower temperature, this would reduce the engine-days eligible for in-use testing. Marine engine manufacturers can use a simple thermostat to reduce the cooling water flow to the aftercooler to prevent over-cooling of the charge air. Therefore, we do not believe that the lower end of the temperature range affects the ability of the marine engines to comply with the NTE requirements.

Ambient air temperature – Similarly, we acknowledge that peak ambient air temperatures over water will be less than over land, due to the cooling effect of the water. We have relied on 35° C as a temperature representing a hot summer day where ozone formation is most prevalent. As described in the recent proposal for heavy-duty highway engines, the proposed temperature range encompasses the conditions exhibited by most days on which an exceedance of the ozone NAAQS is observed.[3] In addition, recent EPA analyses concluded that the "typical" ozone nonattainment day exhibits a maximum temperature between 90 and 95 degrees Fahrenheit. (See 61 FR 54852, October 22, 1996). Testing engines for emissions without correction to these conditions would therefore provide environmental protection during hot and humid conditions typical of ozone exceedance days.

While this applies to land-based engines, we acknowledge that cooler ambient air temperatures would occur on a day high ambient air temperatures over land. Thus a lower peak ambient air temperature is appropriate. We believe a range of 13 to 30°C is appropriate for ambient air temperature over water. We are also aware, however, that marine engines sometimes draw their intake air from an engine compartment or engine room such that intake air temperatures are substantially higher than fresh air temperatures. We are therefore retaining 35° C as the upper end of the specified range for engines that don't draw their intake air from the outdoor ambient. Lower inlet air temperatures would enhance turbocharger performance and reduce the heat rejection need of the aftercooler, providing some benefit for NOx and PM emissions. This corresponds with the improved power and fuel consumption at lower intake air temperatures.

Test data show that aftercooler performance is not nearly as sensitive to air temperature as it is to cooling water temperature. SwRI ran a marine engine at rated speed with two different inlet air temperatures and varied the cooling water temperature between the two tests to maintain a constant charge air temperature into the cylinder. Although the inlet air temperature increased by 20°C, the cooling water temperature only had to be decreased by 0.5°C. At the same time, the effect of varying temperatures on turbocharger performance and the corresponding effect on PM emissions is not well understood. We intend to re-evaluate this issue in the future with the benefit of additional data on marine temperatures, its effect of on emissions, and the degree to which marine engines draw heated intake air from engine compartments or engine rooms.

Humidity – The range of 7.1 to 10.7 g water/kg dry air reflects average humidity levels seen in the U.S. According to the humidity correction equation in 40 CFR Part 89, an engine designed for a humidity level in the middle of this range would only see a NOx variance of ± 3 percent when compared to either side of the range. This is a small effect on NOx compared to the cap for the NTE zone. For testing with humidity outside this range, we would allow the measured NOx to be corrected back into this range.

6. In-use fuel effects

Most, if not all, residual fuels would be excluded from NTE testing because we proposed only to include fuels with a sulfur content of 0.03-0.8 percent by weight (wt%). To be consistent with the requirements for land-based nonroad (0.03-0.4 wt%) and locomotive (0.2-0.4 wt%), we are allowing PM measured using fuels with sulfur contents of 0.4-0.8 wt% to be corrected to the level that would have been measured if a fuel with a sulfur level of 0.4 wt% were used.

In the nonroad rule, we agreed to only use fuel with sulfur levels up to 0.2 wt% for engines over 37 kW subject to Tier 2 standards for our testing. Because Category 1 marine engines are mostly derived from land-based nonroad engines, we believe it is appropriate to extend this provision to Category 1 marine engines for the period during which they rely on land-based engines operating at Tier 2 emission levels. In the future effort to set marine Tier 3 emission levels, we will revisit the appropriate range of fuel properties for in-use testing in the context of the emission standards we set at that time.

7. Practicality of NTE testing

Before manufacturers produce engines, they certify that their engines will meet all the standards that apply, including the standards based on duty-cycle testing and the broader Not-to-Exceed standards, throughout the useful life of the engines. We are interested in testing in-use engines to confirm that they are emitting within these standards. We

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[3] "Ambient Temperatures Associated With High Ozone Concentrations," EPA memo from Mark Wolcott to Charles Gray, September 6, 1984 (Docket A-97-50, document IV-B-4)..

could do this testing one of two ways. First, we could remove the engine from the vessel and test it on a laboratory dynamometer, much like the manufacturer's certification testing. This would be the most direct way to determine if an engine continues to meet the certification standards after the engine has been installed on a vessel. However, the cost of removing and testing engines this way would be extremely high and a ship operator may be unwilling to allow us to remove the engine from service for emission testing.

Onboard testing is a second type of in-use emission measurement. Being able to conduct emission testing onboard the vessel can make in-use testing more accessible since onboard testing eliminates the need for engine removal and minimizes the disruption of normal vessel operations. The goal is for us to accurately assess the emission performance of these engines when they are in service. We may use onboard emission testing to identify and hold manufacturers responsible for noncompliance with the emission standards (including the Not-to-Exceed limits). The Clean Air Act authorizes us to pursue an emission-related recall if we determine that a substantial number of engines, when properly maintained and used, do not conform to the regulations throughout their useful life. Noncompliance relates to meeting the emissions levels under the associated test procedures, as defined in the regulations. In-use testing results may provide credible and probative information relevant to making such a determination. We also recognize that the level of accuracy and precision of in-use testing is one of the key factors to take into account when making any such evaluation or determination of compliance. We believe such systems and procedures would provide a significant benefit to both the agency and the industry.

We've defined the NTE zones, limits, and ranges of ambient conditions and test fuels. NTE testing would be performed over typical in-use operation that is nominally steady-state. This could be performed in the laboratory, on a vessel performing normal work, or on a trip made specifically for the testing. We are not setting specific criteria for onboard test equipment because of the quickly evolving nature of this equipment. However, we consider the equipment accuracy for laboratory testing to be the benchmark for in-use testing. As in-use measurement improves in the future, we expect this to be less of an issue.

Under 207(c) of the Clean Air Act, manufacturers are not liable for noncompliance caused by improper maintenance in use. Therefore, if an engine was improperly maintained, we could only consider its emission levels for the purposes of section 202(c) if it was relevant to determining the emission levels of properly maintained engines.

8. Mechanically controlled engines

We recognize that meeting a flat emissions level within the NTE zone will be more difficult for mechanically controlled engines than for electronically controlled engines. At lower power, emissions are likely to be higher than at higher power for an engine with a fixed injection timing if that engine is optimized to operate near rated power. We believe that splitting the NTE zone with a higher cap at low power addresses this concern.

We agree that there would be some error in measuring or inferring power from an in-use marine engine. It is possible to measure speed and torque from the engine on a vessel; however, this would be difficult and expensive for torque measurements. Electronically controlled engines generally have the ability to calculate power based on engine and ambient variables. During a test, this calculated value can be used to determine brake-specific emissions. For mechanically controlled engines, power would have to be inferred using fuel consumption and a map of fuel consumption under the power curve developed in a laboratory. Because the fuel map is based on laboratory conditions, it may be different under in-use conditions. We would consider any error in measuring or calculating power when making a determination of compliance.

The NTE provisions should apply for all propulsion engines subject to Tier 2 emission standards, including those over 15 L/cy. The caps that apply over the NTE zones are based on data developed from mechanically controlled engines, so we don't expect substantially different emissions behavior from the larger engines. In fact, data supporting the NTE caps includes data from the Caterpillar 3600 series, which has 18.4-liter cylinders. Sales of bigger engines are so infrequent that the vessels and propulsion systems can be designed specifically for a particular engine. For example, the propeller for each vessel can be carefully sized so the engine manufacturer knows that the engine will operate in a narrow range around the desired propeller-demand curve. We would therefore expect the engine manufacturer to exercise the flexibility to define an NTE zone that is narrower than what we specify in the regulations. In practice, this can limit the engine manufacturer's responsibility to ensuring that the engine complies with the emission standards and NTE caps over the E3 propeller curve and a narrow band around those points.

9. Harmonization

Although the European Union is not proposing NTE requirements, we believe this sort of program is necessary and appropriate to ensure that emissions reductions are achieved in use. We are harmonizing requirements to the extent possible by using similar duty cycles and test procedures. The NTE provisions in the final rule are an essential tool for us to achieve our Clean Air Act mandate to achieve emission reductions from these engines.

10. Alternative approaches

We have gathered additional data since the NPRM which support the NTE requirements we are finalizing. We believe that, due to the constrained size of the NTE zone and the caps above the standard, the manufacturers can comply with the NTE requirements with the same technologies needed for the duty-cycle standards. The constrained size ensures that the same emissions control technology used over the four-mode steady-state duty cycle can be used to reduce emissions over the entire NTE zone. The caps allow for modal variation above and below the average so that the average emissions do not necessarily need to be reduced to meet the NTE requirements.

Although the NTE requirements can help prevent the use of certain types of defeat devices, it is primarily intended to help ensure that the standards are met over a wide range of operating conditions. The defeat device prohibition is designed to ensure that emissions controls are employed during real world operation and not just under laboratory or test procedure conditions. However, the defeat device prohibition is not a quantified standard and does not have an associated test procedure, so it does not have the clear objectivity and ready enforceability of a numerical standard and test procedure. This was discussed in the NPRM (63 FR 68529, December 11, 1998).

We believe the NTE program is appropriate for all of the regulated constituents because our goal is to gain real world reductions in each. Also, there are tradeoffs in designing for NOx versus PM reductions; controlling NOx only could lead to increases in PM emissions. We believe that in-use testing will advance in the coming years such that measurement errors will be further reduced. In any case, we would consider the quality of the emission measurements in any compliance determinations.

We appreciate EMA and Euromot's efforts to work with us in defining NTE requirements. The operational data we collected on four commercial marine engines suggests, however, that much of the operation seen by these vessels would occur outside of the narrow zone suggested by EMA. Also, basing the cap on the modal emissions only could result in the emissions at some modes being much higher than the standard. This would especially be a problem for an engine that spends most of its time in these high emission zones when in nonattainment areas. We believe that the cap of 1.5 times the average at power levels below 45 percent of rated provides enough headroom to account for increases in brake-specific emissions at low power.

It will be valuable for research and development purposes for manufacturers to have an opportunity to collect more data before we implement the NTE requirements. For this reason, we believe it is appropriate for the NTE requirements to begin in 2007 for all sizes of commercial marine engines (2010 for post-manufacture marinizers). This provides three extra years of lead time for the design of most Category 1 marine engines. The 2010 starting date for post-manufacture marinizers is appropriate considering that the marinizer works with another manufacturer's base engines and needs to conduct testing with more limited resources. We don't believe that an additional three years beyond 2007 is necessary for larger engines, because manufacturers of these engines will already have seven years of lead time to collect data.

Manufacturers have agreed that they will collect and submit emission data from the NTE zone in their applications for certification before 2007. We believe that many of the low-emission engine models will be produced before the standards go into place because manufacturers often stagger their production dates to even out their workload. This is especially true for engines with a large number of calibrations requiring extensive laboratory time to develop and validate compliance with emission standards. Our early banking program adds an incentive for manufacturers to gain this early experience. When manufacturers collect data from engines that are certified early, it will also be an opportunity to learn how to comply with NTE requirements across the range of test parameters.

11. Legal authority

We are required by section 213(a)(3) of the Clean Air Act to set standards which will "achieve the greatest degree of emission reduction achievable," considering relevant statutory factors. These standards apply to the useful life of the engine, as determined by us under section 213(a)(3). Section 206, made applicable to marine engine standards in section 213(d), authorizes us to prescribe compliance testing and certification procedures. Other compliance and enforcement provisions are also based on section 213(d). As explained in the preamble to the final rule, in the Final RIA, and elsewhere in this document, we believe the combination of elements in the final rule, including the duty-cycle emission standards, not-to-exceed provisions, certification requirements, and other compliance provisions, together satisfy and are authorized by these statutory provisions. We believe we have authority under the Clean Air Act to set standards to control emissions from new marine engines and vessels over the broad range of in-use speed and load combinations that can occur on a vessel, achieving real-world emission reductions, rather than just controlling emissions under limited laboratory conditions. Our authority for the not-to-exceed standards and test procedures thus is the same as our authority for the duty-cycle standards and test procedures.

In response to the comment that we did not make various findings before imposing an in-use testing program involving manufacturers, we note that although we have authority to do so under the Clean Air Act, this final rule does not impose any in-use testing requirements on manufacturers. Instead, we are requiring manufacturers to meet certification and production line testing requirements under sections 213 and 206 of the Clean Air Act. Our authority to establish standards and related test procedures that apply to in-use engines is discussed above. Our authority to conduct in-use testing is the same for marine diesel engines as for other nonroad or on-highway programs, and is not subject to the kind of findings discussed in the comments. Further, in response to the comment that we are contravening section 207(b), we reply that we are not exercising authority either to establish a state inspection and maintenance program or to impose a warranty under section 207(b). The NTE provisions involve federal emissions standards and their related test procedures, under our authority to set standards and test procedures in sections 213 and 206. We have not exercised our authority under section 207 to establish state inspection and maintenance tests, or to require the related warranty under section 207(b). Section 207 does not limit our authority under sections 213 and 206, the basis for our adoption of the NTE provisions.

In response to Navistar's comments, the Clean Air Act does not require standards to be based on averages, but rather allows us to set standards both based on averages, as in our duty cycle emission standards, and not based on averages, as in our NTE standards. Further, we agree that our NTE standards are emission standards, with associated test procedures, under section 213(a) and (d) of the Act.

12. State and local enforcement benefits

We agree that the NTE standards will be valuable as an enforcement tool at the state and local as well as federal levels.

13. General conclusions

We are finalizing the proposed NTE requirements with five primary changes:

- The cap of 1.25 times the E3 average is changed to 1.20 at powers in the NTE zone at or above 45 percent of rated and 1.50 below 45 percent of rated.

- The maximum ambient water temperature for NTE testing is reduced from 32 to 27°C.

- The maximum ambient air temperature for NTE testing is reduced from 35 to 30°C for engines that draw intake air from outside the engine compartment or engine room.

- Transient operation is not included.

- The NTE requirements do not begin until the 2007 model year (2010 for post-manufacture marinizers), regardless of the implementation date of the standards.

CHAPTER 5 – Other Requirements and Provisions

A. Smoke Standards

What We Proposed:

We did not propose any smoke standards or test procedures for two reasons. First, we did not consider smoke to be a concern both because the operators of vessels generally desire low smoke levels and thus purchase engines with smoke controls and because the proposed PM standards would serve to limit smoke emissions. Second, there is currently no suitable smoke test procedure available for CI marine engines.

What Commenters Said:

EMA and Wärstilä both supported the lack of a smoke requirement. EMA pointed to the lack of a test procedure, as well as a lack of equipment to measure smoke in exhaust that exists below the water line. Wärstilä stated that a smoke limit is not feasible because smoke emissions are significantly impacted by fuel quality, which varies greatly.

STAPPA/ALAPCO and NESCAUM both commented in favor of a smoke standard. They stated that Category 1 and 2 engines emit considerable smoke and result in nuisance complaints to air quality agencies. They also stated that new technologies, such as remote sensing, hold promise for in-use testing, and that we should establish certification smoke standards and test procedures. Finally, NESCAUM stated that we should use the ISO 8178-9 test procedure for Category 1 CI marine if we adopt it for land-based nonroad engines, and we should use the locomotive test for Category 2 engines.

Our Response:

We continue to believe that setting smoke standards for commercial CI marine engines is premature at this time for the reasons outlined in the proposal. There is currently no appropriate test procedure for measuring smoke emissions from these engines. Existing land-based test procedures include lugging operation, which is not generally seen in marine engine operation. We also believe that the PM standards will serve to limit smoke emissions. However, by not adopting smoke requirements at this time we are not committing never to do so. Should smoke emissions from commercial CI marine engines prove to be a problem after these regulations take effect, we would take action at that time to develop an appropriate remedy.

In all likelihood, those engines that are currently generating nuisance complaints are older or poorly maintained engines. Further, our in-use maintenance requirements should prevent smoke emissions from regulated engines due to poor maintenance.

B. Alternative Fuels

What We Proposed:

We proposed that these standards would apply to marine diesel engines, without regard to the type of fuel used. Since we are not aware of any alternative-fueled marine engines that are currently being sold into the U.S. market, we did not propose extensive special provisions to address alternative-fueled engines. We did propose alternate forms of the hydrocarbon standards to address the potential for natural gas-fueled and alcohol-fueled engines. These alternate forms follow the precedent set in previous rulemakings to make the standards similar in stringency and environmental impact. Natural gas-fueled engines would be required to comply with nonmethane hydrocarbon (NMHC) plus NOx standards instead of total hydrocarbon (THC) plus NOx standards. Similarly, alcohol-fueled engines would be required to comply with total hydrocarbon equivalent (THCE) plus NOx standards instead of total hydrocarbon (THC) plus NOx standards.

What Commenters Said:

ABS stated that alternative-fueled engines running on LNG or sewage sludge should be certified on distillate fuel. They argued that this was necessary because of fuel availability concerns.

Our Response:

The Clean Air Act directs EPA to require manufacturers to demonstrate compliance with emission standards using test fuel representative of actual in-use fuels. Engine manufacturers generally produce engines that operate on distillate diesel fuel, which led us to specify ranges of fuel properties for a "representative" test fuel. If an engine manufacturer designs an engine intending for that engine to use a different fuel, the manufacturer has an obligation to include test data in the application for certification showing compliance with the emission standards on that fuel. If the fuel is available enough for the manufacturer to design engines, it is available enough to conduct emission testing.

For engines to operate on natural gas or sewage sludge, we would expect to see extensive changes to fuel systems and other emission-related components. Our anti-tampering provisions therefore don't allow this practice without emission test data showing that the engine's emissions do not increase while operating on the different fuel. We also address this issue in Chapter 3 for heavy fuel.

C. Useful Life and Warranty

What We Proposed:

We proposed that engines be required to comply with the standards for a useful life period that ends when either an engine-hour limit is reached, or after ten calendar years, whichever occurs first. We proposed that the minimum hour limits would be 10,000 hours for Category 1, and 20,000 hours for Category 2. We also proposed that manufacturers warrant emission-related components for at least the first half of the useful life period.

What Commenters Said:

Cummins Wärtsilä argued that manufacturers cannot warrant the in-use emissions of their engines because they cannot control in-use maintenance which dramatically affects emissions. EMA argued that marine engine useful life and warranty should be less than for similar land-based nonroad engines. They also suggested that we should specify useful life in terms of both time and use. Caterpillar argued that the proposed useful life is too long for heavy-fuel engines. They stated that useful life should account for load factor and fuel quality. Mercury stated that the proposed useful life and warranty periods are too long for engines derived from recreational engines.

Our Response:

As noted in the NPRM, we based our proposed useful life values on the expectation that marine engines are typically operated for five years before they are rebuilt, and on estimated typical usage rates of 2,000 hours per year for Category 1 and 4,000 hours per year for Category 2. This approach was generally supported by manufacturers' recommendations for periods between engine overhauls, which account for in-use variability in load factors and fuel quality. Published maintenance schedules call for engine overhauls anywhere from 15,000 to 40,000 hours for marine diesel engines. Manufacturers did not dispute our basis for selecting useful life values. Therefore, we are finalizing the minimum useful life specifications as proposed.

In response to Mercury's comment, we are establishing provisions to address useful life for high-performance light-commercial engines, though we are not modifying the proposed general minimum useful life specification. These engines have lower usage rates and will therefore exceed the ten-year useful life period before they reach 10,000 hours. They are also designed to be overhauled after less than 10,000 accumulated hours. We are therefore finalizing provisions allowing us to make exceptions to the minimum useful life for such engines. In no cases, however, will we allow a useful life value less than 1,000 hours. We expect that manufacturers requesting this special provision will provide us information demonstrating that the engines will experience such significant performance problems (e.g., increased fuel consumption, decreased reliability) if operated beyond the shorter useful life period that owners will rarely operate these engines longer than the specified shorter useful life.

Under our warranty provisions, manufacturers are required to warrant that engines are designed to meet emissions in use with proper maintenance, and that the engines are free from defect. Manufacturers are not required to warrant emissions with improper maintenance.

D. Averaging, Banking and Trading

What We Proposed:

We proposed an emissions averaging, banking and trading (ABT) program which would allow the certification of one or more engine families within a given manufacturer's product line at emission levels above the applicable standards, provided that the increased emissions are offset by one or more engine families certified at levels below the applicable standards. The proposed program would also allow for the banking of credits for use in future model years as well as the trading of credits to other manufacturers.

The proposed program is voluntary and only available for HC+NOx and PM emissions. We proposed that an engine family could not generate credits on one pollutant while using credits on another. The proposed credit calculations were based on sales-weighted average power, production volume and useful life. We proposed that the credits have an infinite life, with no discounting over time. Finally, we proposed several restrictions on credit generation and usage, including no early credit generation, no exchange of credits across engine categories or standard tiers, and no exchange of credits between land-based and marine engine families.

What Commenters Said:

Most of the comments we received on the proposed ABT program concerned the restrictions we proposed on credit generation and usage. EMD argued that easing the transition to more stringent standards is a major use of credits, particularly for products that are about to be discontinued, and that a prohibition against cross-tier credits exchanges renders the ABT program meaningless. EMA supported the concept of an ABT program, but said that the proposed restrictions serve to severely limit credit life and undermine the program's utility. The restrictions EMA opposed included the lack of a mechanism for early credit generation, the prohibition on cross-tier and cross-Category credit exchanges, and the prohibition on the use of credits generated on marine engines for their land-based counterparts.

EMA argued that the ABT program should be environmentally neutral and disagreed with our statement that the ABT program allows us to finalize standards more stringent than would otherwise be appropriate. EMA stated that it is this mistake in ABT philosophy that led to the restrictions that we proposed.

EMA made a specific recommendation on how we should allow early credit generation. EMA suggested that we allow early credits to be generated relative to levels of 1.15 times the Tier 2 standards three years early, 1.08 times the Tier 2 standards two years early, and the Tier 2 standards one year early.

In contrast to the concerns expressed by industry, California ARB supported the proposed ABT program, and offered no specific recommendations to change it. Finally, NESCAUM stated that we shouldn't allow Blue Sky engines to generate ABT credits in addition to participating in the Blue Sky program.

Our Response:

In the proposal, we outline the specific reasons why we proposed restrictions on cross-Category credit exchanges and credit exchanges between marine and land-based engine families. While comments took issue with these restrictions, they did not address or refute the rationale we used to propose them. In the absence of compelling arguments refuting our rationale, we believe that it is most appropriate to largely retain these restrictions on credit exchanges, between marine categories and between marine and land-based engine families. While we understand that such restrictions make the ABT program less useful to manufacturers than it would be in the absence of those restrictions, we believe that our rationale for the restrictions is sound and that an ABT program with restrictions still provides significantly more flexibility than no ABT program at all. We do, however, believe there is room to be more flexible with respect to the exchange of credits between marine categories without compromising the integrity of the standards. Our rationale for restricting cross-Category credit exchanges was based on a concern that a single low emitting Category 2 engine could be used to generate credits for a number of Category 1 engines. However, this would not be a concern in the reverse situation (where Category 1 engine credits would be used toward compliance of a Category 2 engine). Therefore, we will allow credits generated on Category 1 engines to be used for compliance of Category 2 engines, but not allow credits generated on Category 2 engines to be used for the compliance of Category 1 engines.

To account for the likelihood that Category 2 engines will undergo more rebuilds in their lifetime than Category 1 engines, we will discount any Category 1 engine credits by 25 percent if they are used for Category 2 engine compliance. This is to ensure that the in-use emissions impacts of such an exchange are neutral by offsetting the likely longer service life of a larger engine compared to a smaller one. We chose 25 percent under the assumption the Category 1 engines would typically undergo 2 rebuilds whereas Category 2 engines would undergo three rebuilds, resulting in Category 2 engines having one more "lifetime" than Category 1 engines.

Although we proposed a restriction on cross-tier credit exchanges, we are not adopting Tier 3 standards in this action. Thus, there is no need to evaluate the appropriateness of such a restriction here. We do note that by not adopting Tier 3 standards (along with a restriction on cross-tier credit exchanges) we have eliminated EMA's concern that a restriction on cross-tier credit exchanges would serve to severely limit credit life. However, we do expect to propose Tier 3 standards for commercial CI marine engines in the future. During that process we will evaluate the appropriateness of cross-tier credit exchanges in the context of both the stringency of any proposed Tier 3 standards as well as the availability of credits from Tier 2 engines.

We believe that early banking of credits has some value to ease the transition to the new Tier 2 standards. This is especially true for the larger Category 1 and Category 2 engines, which are required to meet the standards in 2007. Allowing early banking would give manufacturers of those engines an opportunity to gain experience with those engines prior to the effective date of the not-to-exceed requirements. Also, most marine engines being regulated here are derived from land-based engines, and since the lead time we are providing for marine engines is in most cases a year after the implementation of land-based nonroad Tier 2 standards, we believe that early banking of emission credits will allow for a smoother implementation of the marine standards. However, there are already some commercial CI marine engines which meet the proposed Tier 2 standards, and for this reason we proposed no option for early banking. We are still concerned about the ability of engines to generate early credits without any modifications to reduce emissions but, as mentioned, believe that early banking has some value to ease the transition to the new Tier 2 standards. We do not believe that EMA's suggestion that engines be allowed to generate early credits relative to levels above the Tier 2 standards is appropriate for all engine families, especially given that some engines already meet the Tier 2 standards. However, we do believe that it is appropriate to allow for the early generation of credits in cases where genuine emission reductions occur prior to the standards' start date.

Effective immediately, early credit generation is available for all Category 1 and 2 commercial CI marine engines. Credits will be generated relative to the actual Tier 2 standards and will be undiscounted. However, if a manufacturer believes it should be allowed to generate credits relative to an engine family's pre-control emission levels (rather than the Tier 2 standards), it can choose to develop engine family-specific baseline emission levels. Credits will then be calculated relative to the manufacturer-generated baseline emission rates, rather than the Tier 2 standards. Engine manufacturers that are not post-manufacture marinizers generate baseline emission rates by testing three engines from the family for which the baseline is being generated, with the baseline calculated as the average of the three engines. Under this option, engines mut still meet the Tier 2 standards for all pollutants to generate credits, but the credits will be calculated relative to the generated baseline rather than the Tier 2 standards. Any credits generated between a measured baseline and the Tier 2 levels will be discounted by reducing the measured baseline value by 10 percent. This is to account for the variability of testing in-use engines to establish the baseline due to differences in hours of use and maintenance practices.

Some early banking provisions apply uniquely to post-manufacture marinizers. In recognition of their small size, more difficult resource constraints and general reliance on engine manufacturers to produce base engines, additional flexibility is warranted to ease the transition to these rules. Therefore, post-manufacture marinizers may establish a measured baseline by testing a single engine. Consistent with the provisions of §94.209(a), the baseline established by this single engine may be used for broadened engine families, provided the marinizer starts with certified land-based engines. Also, they may certify an engine under the early banking program with an engine that does not meet the Tier 2 emission standards. However, since this program is only intended to ease the transition to full compliance with these standards and rules, the credits will only be available to post-manufacture marinizers through the 2007 model years.

We received no comments on our proposed upper limits for FELs. Thus, we are adopting the proposed upper limits for Tier 2 FELs. Because we are not finalizing Tier 3 standards at this time, we are not including FELs upper limits for Tier 3 standards in this rule.

We agree that engines participating in the Blue Sky engine program should not also be allowed to generate ABT credits, as described in the next section.

CHAPTER 6 – Category 3 Engines

A. NOx Limits

What We Proposed:

Category 3 engines are very large marine diesel engines, typically used for propulsion purposes on ocean-going vessels. In our discussion of the proposed regulatory approach for these engines, we noted that the special characteristics of these engines and the fuels they use suggest that the appropriate emission limits for Category 3 engines would be based on a limited set of engine technologies (for example, injection rate shaping but not necessarily extensive timing retard). Standards that reflect this level of control would be very similar to those adopted by the International Maritime Organization in 1997. These standards, which address only NOx emissions, are contained in Regulation 13 of Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) Because the MARPOL Annex VI NOx limits would likely be implemented independently of any Clean Air Act requirement, we were concerned that it would be unnecessary to adopt the same program under the Clean Air Act. Therefore, we did not propose Category 3 emission limits in our NPRM. Instead, we indicated that we expect U.S. vessel owners to begin installing engines certified to the MARPOL Annex VI limits beginning with the effective date set in Annex VI (January 1, 2000) following the procedures applicable to the Annex. We requested comment on this approach, as well as on how to ensure that vessel owners begin installing compliant engines beginning with ships constructed on or after January 1, 2000. Finally, we requested comment on whether we should consider addition emission limits for PM, since the Annex does not contain a PM requirement.

What Commenters Said:

The Transportation Institute, ABS, and CSA supported relying on the MARPOL Annex VI limits. The Transportation Institute noted that the use of these limits will help maintain a level playing field and equitable competitiveness in this area for all oceangoing vessels, regardless of flag. While STAPPA and ALAPCO agreed with our strategy for the short term, they were not as supportive for the long term and recommended that we continue to work with the international community to set more meaningful standards in the future

Most commenters also recommended that we should use the international process if we want to pursue additional limits for other pollutants or more stringent standards in the long term. However, ABS questioned the need to set CO and HC standards at this time. They noted that, according to the Lloyd's Register Exhaust Emission Research Programme, CO emissions from these engines is around 1.6 g/kW-hr, significantly lower than the levels proposed for Category 1 and 2 engines even at the Tier 3 levels. Therefore, ABS concluded that it does not appear to be necessary to add CO limits and noted that the Lloyds' Register study also indicates that HC levels from Category 3 engines are relatively low.

One commenter, Bluewater, was strongly opposed to our proposed approach for Category 3 engines. Bluewater believes that EPA has failed in its mandate under Section 213 of the Clean Air Act to establish standards for NOx and other pollutants emitted from Category 3 vessels operating in U.S. waters, despite the fact that Category 3 vessels are very significant contributors to SOx, NOx, CO, HC, and PM emissions. Bluewater noted that Annex VI has not gone into effect due to lack of ratification by Contracting Parties and is unlikely to do so. Consequently, according to Bluewater, IMO has in fact been ineffective in regulating ship emissions and thus the full burden of establishing standards is back on EPA. Bluewater is also concerned that deferring to IMO renders Section 113 and 304 of the Act unenforceable. Bluewater also stated that our rationale for choosing the MARPOL Annex VI limits is without merit. Our reasons, the special fuels used by these engines and their international use, argue for setting more stringent standards now according to Bluewater. More stringent limits can be achieved by using technologies such as SCR, EGR, the HAM technique, and freshwater injection systems. These technologies, which were inappropriately set aside by EPA, can achieve NOx emissions as low as 2 g/kW-hr. Bluewater strongly recommends that EPA rely on these technologies to finalize stringent new limits for Category 3 engines. Bluewater recommends the following approach: a 17 percent reduction in NOx emission to be achieved by 2000, followed by a 30 percent reduction by 2002, 50 percent by 2004, 70 percent by 2006, and 90 percent by 2008. A technology review in 2005 will ensure that the final two targets are appropriate. Bluewater also notes that EPA will also need to set limits for HC, CO, PM, and SOx limits even if it chooses to finalize the MARPOL Annex VI limits.

Our Response:

We continue to believe that the MARPOL Annex VI approach is the most appropriate for Category 3 engines. As we noted in the NPRM, the appropriate emission limits for Category 3 engines under the Clean Air Act are those that were adopted in MARPOL Annex VI. These standards reflect the special fuel used in these engines and we continue to believe that the use of residual fuel places constraints on the degree of emission reduction achievable from these engines. Residual fuel has a high viscosity and density, which affects ignition quality, and its content is highly variable because of its nature as a residual product and the lack of regulatory specifications. This means that ship engineers must have the ability to adjust engine operating parameters to adapt to the characteristics of the fuel they are currently using. It also means that engine manufacturers cannot effectively use timing controls as a strategy to meet engine NOx emission limits.

While Bluewater is correct in asserting that new technologies such as SCR, EGR, the HAM technique, and freshwater injection systems can achieve deep emission reductions, we believe that it is premature to set standards that would require the use of these technologies at this time. Much research work must still be done before we understand the implications of using these technologies, especially to understand if they will require special fuels or fuel handling, and how ship operators will need to adjust their operating procedures. Unlike smaller marine engines, operators must constantly adjust and tune Category 3 engines while the vessel is underway to accommodate a variety of fuel characteristics and operating conditions, including the condition of the sea. Manufacturers must build their engines to accommodate these adjustments, so imposing an emission limit that could constrain these necessary operating flexibilities without fully understanding the implications is not appropriate at this time.

At the same time, EPA intends to pursue more stringent emission limits through the International Maritime Organization, where we can take advantage of the knowledge and expertise of the international shipping community as we continue to pursue air quality improvements from this group of marine diesel engines. Future standards will likely include HC, CO, and PM controls (SOx emissions are already addressed through fuel sulfur controls). It should be noted that the Swedish program currently underway will yield important information about the viability of some of these new technologies and will help us as we continue to consider appropriate emission limits for these engines.

With regard to Bluewater's comment that the status of ratification or entry into force of MARPOL Annex VI compels us to conclude that the IMO approach is ineffective and that we must therefore bear the full burden of setting emission limits for Category 3 marine diesel engines, we believe it is too early to make this conclusion. The MARPOL Annex VI limits are designed such that vessel owners must install compliant engines on vessels constructed on or after a specific date: January 1, 2000. By including this date in Regulation 13, the standards can be enforced against these vessels once the Annex goes into effect. Consequently, vessel owners are expected to comply with the requirements because otherwise they may face compliance and liability problems after U.S. ratification or the Annex goes into force internationally. Bringing engines into compliance at that time may involve retrofitting or replacing noncomplying engines. Ship owners may also be required to remove their vessels from service while these issues are resolved. Owners of vessels that are not operated internationally but that will be subject to the MARPOL survey requirements after Annex VI goes into effect for the United States should be aware that they may be required to demonstrate compliance with the Annex VI NOx limits when they apply for their International Air Pollution Prevention (IAPP) certificate. Owners of vessels that are operated internationally may also be required to demonstrate compliance with the MARPOL limits after the Annex goes into effect, both because they will be required to have an IAPP and because they may be subject to port state controls. For all of these reasons, we expect ship owners to begin purchasing compliant engines for installation on ships constructed on or after January 1, 2000, and to bring engines into compliance when they undergo a major conversion after that date. It is also expected that vessel classification societies and vessel insurers will encourage vessel owners to comply with the limits regardless of the status of ratification of the Annex. ABS and others confirmed this understanding in their comments.

For these reasons, we believe it is more appropriate to wait a reasonable period to see if the Annex will enter into force for the United States and/or to ascertain the extent to which ship owners are complying with the limits before we adopt a duplicate program under the Clean Air Act. For example, we can reconsider this issue as part of a future consideration of Tier 3 standards for Category 1 and Category 2 diesel marine engines.

To encourage vessel owners to purchase MARPOL Annex VI compliant engines prior to the date the Annex goes into force for the United Sates, we have developed a voluntary certification program that will allow engine manufacturers to obtain a Statement of Voluntary Compliance to the MARPOL Annex VI NOx limits. This voluntary approach to the MARPOL Annex VI emission limits depends on the assumption that manufacturers will produce MARPOL-compliant engines before the emission limits go into effect internationally. Engine manufacturers can use the voluntary certification program mentioned above to obtain a Statement of Voluntary Compliance to the MARPOL NOx limits. If, however, manufacturers continue to sell engines with emissions above MARPOL levels or if the Annex is not ratified by the United States or does not go into effect internationally, we will revisit the need to adopt the MARPOL Annex VI NOx limits under the Clean Air Act.

B. Compliance With the NOx Limits

What We Proposed:

Because adopting the MARPOL Annex VI NOx limits as part of this rule would be redundant when MARPOL is ratified and could potentially require engine manufacturers to obtain two kinds of certificates, one pursuant to 40 CFR Part 94 and another pursuant to the compliance program set up as part of MARPOL implementation, we did not propose to adopt the same program under the Clean Air Act. In other words, the requirements would be voluntary until it goes into force for the United States. We did not expect this to lead to noncompliance prior to that time since the Annex VI NOx requirements are retroactive to all vessels constructed on or after January 1, 2000, and all engines that undergo a major conversion on or after January 1, 2000. We asked for comment on how to ensure that US. Vessels owners comply with the Annex before its ratification by the United States and its entry into force.

What Commenters Said:

ABS informed us that engines are expected to be fully compliant with the MARPOL NOx limits by January 1, 2000, irrespective of the progress of ratification. They noted that builders of engines used in merchant ships, those most likely to be using Category 3 engines, are currently working to be in a position to supply compliant engines prior to the January 1, 2000 threshold date. Due to the severe problems associated with changing even an auxiliary engine on a merchant ship, together with the associated cost implications (the cost of the new engine, limited value of the removed engine, shipyard costs, and off-hire costs), ABS stated its opinion that shipowners will insist in newbuilding or conversion contracts that all engines which fall within the scope of MARPOL Annex VI, either by virtue of the date the ship is constructed or the engine undergoes a major modification, will be supplied in compliant condition.

LCA suggested that, to ensure compliant engines are used beginning January 1, 2000, EPA can rely on existing Coast Guard certification to ensure that U.S. vessel owners begin installing Category 3 engines beginning with ships constructed on or after January 1, 2000. Vessels used by LCA members are required by federal law to be inspected annually and can only operate with a valid Certification of Inspection (COI) issued by the U.S. Coast Guard. Without a Air Emission Certificate as mandated under Annex VI, the Coast Guard will not issue a COI and the vessel cannot operate. In the event of an engine replacement after the year 2000, U.S. Coast Guard and Classification Surveyors will be involved with the changes and federal law will require proper engine certification.

Our Response:

Ensuring compliance with the Annex VI NOx limits for Category 3, as well as the interim voluntary NOx limits for all categories of marine diesel engines, continues to be a concern. However, we agree with the commenters that it is reasonable to expect engine manufacturers to produce these engines and vessel owners to install them on vessels constructed on or after January 1, 2000. This is because once the Annex goes into effect the Regulation 13 requirements will be enforceable back to any vessel constructed on or after that date. Otherwise, vessel owners could face potentially expensive retrofit requirements once the Annex becomes enforceable. To facilitate this process, we have set up a voluntary program to give engine builders a statement of voluntary compliance with the MARPOL Annex VI NOx limits. Vessel classification societies and vessel insurers are also expected to encourage vessel owners to comply with the limits regardless of the status of ratification of the Annex. If, however, after some reasonable period we find that ship owners are not using compliant engines or if the Annex continues to remain unratified, we will revisit reconsider whether it is necessary to develop a mandatory compliance program for these engines.

C. PM Limits

What We Proposed:

We did not propose PM limits for Category 3 engines. This is because residual fuels used in Category 3 engines are not regulated, and variability in its content would make it difficult to choose an appropriate limit. Also, there is currently no PM test for engines using residual fuel. However, we asked for comment on the desirability of setting a PM limit and, if it is desirable, what the limit should be.

What Commenters Said:

As noted above, most commenters recommended that we use the international process to set additional limits, including PM limits, for Category 3 engines. Bluewater commented that we cannot defer PM controls for Category 3 engines simply because the high sulfur content of marine fuel prevents an appropriate emission test, especially since we noted that one way to reduce PM emissions is for vessel operators to switch fuels in or near port areas. Bluewater also encouraged us to consider engine-based approaches to reduce PM emissions from these engines, such as PM traps, scrubbers, oxidation catalysts, and pulsed-power aftertreatment. Bluewater suggested a strategy that would phase-in a standard of 0.14 over a 3-year period. This level is commensurate with today's European recreational marine diesel engine levels. Bluewater also noted that because it will be several years before we can regulate PM 2.5 emissions, it is urgent to reduce PM 10 loadings from the marine diesel category. In the meantime, Bluewater recommended that we continue to study PM 2.5 and to ensure that monitoring is conducted near port terminal operations.

Our Response:

Since proposing our marine diesel engine emission control program, we learned that the PM limit we quoted for the EU rule, 0.14 g/kW-hr, was incorrect. This standard was rectified in a subsequent version of their draft program, and is 1.0 g/kW-hr. We are concerned that even adopting this limit, however, would be inappropriate at this time. This is primarily because we do not have test data for these very large engines that would support such a standard. Also, we do not believe it is suitable to set a standard for very large (up to 90,000 kW) engines on the basis that much smaller diesel engines will be required to meet it. Since we also do not have enough information at this time to set appropriate standards or to devise a test procedure for engines of this size, regardless of whether the engine is tested on residual or distillate fuel, we will not finalize a PM standard for Category 3 engines in this rule.

At the same time, we remain concerned about PM emissions from these engines, and will continue to monitor this problem both internationally and domestically. We continue to be interested in obtaining data on PM emissions from these ships and information about technologies that can be used to reduce these emissions. We also plan to use the international process to explore appropriate PM emission limits for these engines. In the meantime, states and local areas can explore operating controls such as fuel switching, described below, to achieve some control of PM emissions from these vessels.

D. Operational Controls

What We Proposed:

In our proposal, we noted that states and local areas can takes steps to reduce the contribution of Category 3 engines to ozone levels by restricting the use of residual fuel in or near port regions. Residual fuel can increase NOx emissions by 20 to 50 percent and PM emissions by 1000 percent (±250 percent) compared to marine distillate fuel.

This is because residual fuel has high viscosity and density, which affects ignition quality, and it typically has high ash, sulfur and nitrogen content in comparison to marine distillate fuel. Because of the potential air quality effects from fuel switching, we sought comment on whether ports and states could in fact effectively employ such a strategy for example as a condition on use of ports.

What Commenters Said:

LCA recommended against this approach for local NOx control. They noted that ship operators need uniformity and standardization of laws for the marine industry, and each state producing their own requirements would complicate things for ship operators.

The Port of Houston Authority described several obstacles that would prevent port authorities from using such a strategy. Specifically, PHA noted that they lack the authority to enforce or condition the use of the port to ocean going ships that comply with environmental requirements, including emission standards. The port would have to be given that authority under state law. PHA's enabling statutes and the Texas Clean Air Act are silent as to enforcement powers and no implied power exists since environmental powers are not necessary to satisfy the Port's statutory purposes. Since such powers are outside the agency's scope of authority, the Port currently cannot regulate these activities. Even if the port were able to resolve this issue, such regulation may violate the Commerce Clause or the Foreign Affairs Clause. In addition, not all the facilities along the Houston Ship Channel are operated by PHA. Some are operated privately. In addition to not being able to enforce in private ports, any action by the PHA that "discourages" use of the ship channel and/or port facilities by non complying vessels would have a negative impact upon the relationship between PHA and the companies that operate there (shipping companies and tenants). Finally, tracking the vessels that use these ports would impose a huge administrative burden. Consequently, PHA strongly urges EPA not to involve port authorities in operational controls for marine vessels.

ABS recommends that if fuel switching in near coastal waters is required, this should be pursued by seeking to declare such areas as SOx Emission Control Areas under MARPOL Annex VI. Alternatively, ports could declare oil fuel sulfur limits or to adopt an incentive scheme similar to that implemented by the Swedish Administration.

Bluewater noted that, according to information obtained from British Petroleum America, marine distillate fuel and residual oil actually have a similar sulfur content and that both of these products for sale on both the U.S. Gulf and the U.S. East Coast have a sulfur content of 3.7 to 4 percent. Therefore, EPA has erred by stating that distillate fuel has lower sulfur content and lower sulfur/PM emissions than residual fuel. Therefore, for fuel switching programs, vessel operators should use #2 diesel.

Finally, Bluewater recommended that we establish a uniform set of standards for the use of ship-based power during shore side hoteling operations, due to the environmental justice considerations raised by increased localized emissions in ports. Otherwise, states may be forced to develop a confusing hodge-podge of regulations ranging from none at all to extremely stringent regulations. This will needlessly confuse ship operators and provide unequal and uneven benefits for port-based communities. Bluewater also questions whether EPA considered hoteling and other shore-based emissions in its inventory calculations.

Our Response:

We take note of the potential obstacles to local and state application of fuel switching requirements. However, this may still be a viable strategy for those ports with appropriate authority that are seeking additional NOx control. Areas that are interested in these controls should note Bluewater's comment that it may be advantageous to require the use of #2 diesel, or a similar land-based diesel distillate fuel, instead of marine distillate. At the same time, however, it should be noted that the sulfur content of fuel is not expected to have much impact on NOx emissions for the technologies involved here. However, the use of #2 diesel may provide additional benefits for areas in need of additional SOx control.

With regard to hotelling requirements, rulemaking under section 213 of the Clean Air Act is limited to emission standards for new marine diesel engines. We believe at this time that operational controls for vessels in ports are more appropriately developed by states or localities, including ports.

E. Sulfur Controls

What We Proposed:

We did not propose any sulfur controls as part of this rulemaking.

What Commenters Said:

Bluewater recommended that we establish maximum sulfur limits on marine distillate fuels (380c, 180c and #2). These limits will promote the NOx and PM benefits and will also reduce acid rain. In addition, sulfur limits will avoid any increase in sulfur content of marine fuel due to the sulfur controls in other EPA fuel control programs. Bluewater expressed a concern that oil industry may dispose of excess sulfur in their marine fuels.

Bluewater recommends that we adopt an immediate standard of maximum 1.0 percent sulfur, with a phase-in of decreasing sulfur standards approaching 0.25 percent at the end of an 8-year period. The current IMO MARPOL Annex VI requires a maximum of 1.5 percent sulfur content of fuel for vessels operating in the Baltic States. This should also be expanded to Category 1 and Category 2 engines, to be consistent across engines. For these smaller engines, the limits should be the same as for on-road fuel: 0.05, or 500 ppm. EPA should also extend the new sulfur limits to be proposed in its 1999 NPRM for land-based fuel to marine engines.

Bluewater suggests that a least-cost method of compliance would be for ship owners to expand the two fuel tank system currently in use by many Category 3 vessels to provide cleaner fuel for use in starting their engines. Bluewater noted its belief that it is currently within EPA's mandate to establish the development of such systems as a State's condition to use of ports. Expanding the two fuel tank system will also have the benefit of reducing the risk in oil spills and encouraging vessel operators to use shoreside power while hotelling to reduce fuel costs. With regard to the enforcement, Bluewater suggests that remote sensing could be used to determine if a ship is using the appropriate fuel. Because this method is not fully developed at this time, however, Bluewater recommends a two-part approach to enforcement: spot sampling of fuels in secondary clean-fuel tanks when vessel arrive portside and establishing mandatory reporting guidelines to states for port bunkering operators to provide fuel logs to the State and EPA listing the volume of low sulfur fuel purchased by each vessel by month and year. Fuel purchases can then be correlated with the number of port entries to verify if a vessel operator may be violating the low-sulfur fuel requirements.

With regard to concerns that ships will avoid U.S. ports if more stringent limits are imposed for ships that use our ports, Bluewater said their analysis suggests that such displacement will not occur based simply on the extra fuel costs of using a 1 percent sulfur grade fuel. For example, a typical vessel with a 10,000 hp engine, operating at 75 percent load uses 1.05 metric ton/hr. Assuming it switches to #2 diesel for one hour entering port and another hour departing port, the fuel cost difference is only $110. This is not a significant cost for a vessel this size. In fact, according to Bluewater, transportation shifting is likely to be minimal, even in response to more stringent NOx limits for C3 engines due to the greater cost of compliant engines. This is because any significant displacement would occur only if there were no net increase in costs to the rail or truck industries due to other EPA rulemakings. Bluewater asserts that, in fact, the economic effects to the U.S. transportation industry should be neutral since alternate forms of domestic freight would still be required.

Our Response:

Because we did not propose any diesel fuel controls, we cannot finalize any requirements at this time. It should be noted, however, that MARPOL Annex VI contains a 4.5 percent limit for the sulfur content of marine diesel fuel and sets up a process to designate special sulfur control areas, called SOx Emission Control Areas. Ships must use low sulfur fuel (1.5 percent sulfur content) when operating in these special areas.

F. Other Fuel Controls

What Commenters Said:

Bluewater notes that there is evidence that vessel crews are dumping used waste and lube oils into fuel tanks. This can result in increased toxic emissions. Bluewater urges EPA to address such concerns within this rule, to the full extent of its authority.

Our Response:

Because we did not propose any diesel fuel controls, we cannot finalize any requirements to restrict this practice at this time. We are nevertheless concerned about the Category 3 engines burning fuel with very high sulfur levels. As we consider the need to reduce emissions from these engines in the future, we will look more carefully at the possibility of addressing in-use fuel quality for these engines. However, it should be noted that MARPOL Annex VI places some limits on this practice by specifying that only sludge oil generated during the normal operation of a ship by be incinerated onboard. It also prohibits ships from incinerating these substances while the ship is inside ports, harbors, and estuaries (Regulation 16.5).

G. Special Limits for Certain Vessels

What Commenters Said:

As an additional control strategy, Bluewater urges us to consider requiring cruise ships, RO/ROs and other vessels to use combined gas and steam turbine electric machinery (COGES), which are cleaner than conventional diesel engines. This technology could leapfrog past diesel engines as a power source on marine vessels, and result in greatly reduced NOx, SOx, and PM emissions. At the very least, a separate standard for cruise vessels promoting this technology should be established.

Our Response:

Because we did not propose the program described by Bluewater, we cannot finalize it at this time. While we are interested in obtaining data on this emission control strategy, we would use it to inform a decision on emission limits for all marine diesel engines in a particular Category and not those used in particular applications.

H. Limits – Adjustable Parameters

What We Proposed:

Category 3 engines are designed to allow ship engineers to perform engine adjustments in response to the fuel being used, sea conditions, and other conditions. The MARPOL Annex VI certification procedures reflect this practice, by allowing engines to be certified for a range of adjustable parameters as long as the range is specified in advance and the engine will remain in compliance within that entire range. In our NPRM, we requested comment on whether it is necessary to develop supplemental provisions to prevent tampering with the engine outside that range or in such a way that will increase emissions.

What Commenters Said:

ABS notes that the NOx Code allows adjustable parameters only for engine groups. Since it is impractical to consider tamper proof options on such engines, control can only reasonably be undertaken through vessel surveys and, possibly, port state control inspections. With electronic controls on these engines, the question of operating outside the approved ranges can be more easily controlled. These systems are not as easy to circumvent as mechanical systems, and records of adjustment can be recorded without outside intervention. Thus, electronic systems can be expected to provide a high level of confidence as regards performance between scheduled surveys. LCA stated that they believe the Annex VI and NOx Code survey and inspection requirements will address this concern, and the U.S. Coast Guard and classification societies will ensure compliance with those requirements.

Our Response:

Because the adjustable parameters are an important feature of these engines, and because the NOx Technical Code provides for surveys and inspections to ensure that engine parameters are not adjusted outside their certified range, we will not adopt additional anti-tampering requirements at this time. However, we will revisit this issue in the future if industry practices suggest that the survey and inspection procedures are not adequate to prevent setting adjustable parameters outside their certified range.

I. Category 1 and Category 2 Engines on Foreign Trade Vessels

What We Proposed:

EPA proposed to allow Category 1 and Category 2 engines installed on vessels operated in foreign trade to meet the MARPOL Annex VI limits instead of the domestic limits if the ship owner can demonstrate to the Administrator's satisfaction that the vessel will spend less than 25 percent of its operating time within 320 nautical kilometers (200 nautical miles) of U.S. territory. EPA requested comment on whether this special provision is necessary, how best to define the group of vessels that can benefit from the provision while ensuring that those vessels that operate primarily in the United States meet the domestic emission limits, and whether ships that operate solely between the United States, Mexico, the Bahamas, and Canada should be able to benefit from this provision.

What Commenters Said:

CSA supported this provision, but suggested that it should apply regardless of trade route. In other words, the exemption should apply to all Category 1 and 2 engines when they are installed for auxiliary uses aboard vessels with Category 3 propulsion systems. They suggest that the benefits of applying the proposed limits to some vessels engaged in foreign travel would pale in comparison to the certification and enforcement complexities surrounding vessels where one engine was regulated under Annex VI while the others were regulated under different EPA regulations. ABS was more detailed in their comments, noting that this approach creates a situation in which the Category 1 and Category 2 engines on a vessel that is not exempt but not solely engaged in voyages within US controlled waters will need to comply with two quite different sets of emission control regulations: both EPA's requirements and MARPOL Annex VI. The potential complications arising from the application of these two sets of regulations is in terms of both the different limit values applied but also the means by which compliance is demonstrated. ABS also notes that this requirement means that the Category 1 and 2 auxiliary engines on a vessel with a Category 3 propulsion engine will have to meet more stringent emission limits even though the propulsion engine has higher fuel consumption on an annual basis. They also note, however, that this may be legitimate considering the fact that it is the auxiliary engines that will be running which the ship is in port or offshore waiting berth.

ABS warned us that the dual requirements may lead engine manufacturers to build engines with a larger bore/stroke engines with fewer cylinders, essentially making all engines supplied to U.S. flag vessels Category 3 engines. ABS also questions whether non-US manufacturers will continue to provide engines to the U.S. market as a result of the more stringent requirements. Non-US manufacturers may also be disinclined to provide data and support required to satisfy the importation requirements. This could affect non-US built tonnage into the Military Sealift Command and other US agencies. ABS also noted that operating time of the vessel needs to be defined for the purpose of determining whether the vessel will spend less than 25 percent of total operating time within 320 nautical kilometers of U.S. territory.

Finally, Navy raised the concern that requiring Category 1 and Category 2 engines on board U.S. flagged vessels to meet the stringent domestic requirements may place U.S. flagged vessels at a competitive disadvantage to foreign flagged vessels. Navy recommends that we assess alternatives which would treat all vessels equally regardless of registry or as a minimum avoid any differentiation which imposes an undue hardship on U.S. flagged vessels.

Our Response:

The proposed flexibility that would allow Category 1 and Category 2 engines onboard vessels that are engaged in foreign trade to meet the MARPOL Annex IV NOx requirements instead of the domestic requirements is intended to address a particular circumstance in which these engines will be used. Specifically, many Category 1 and Category 2 engines used onboard vessels engaged in foreign trade are used for auxiliary purposes. These engines are essential for the smooth functioning of the vessel, since they are used to generate electricity for navigational equipment, maneuvering equipment, and crew services. Repairing these engines may be difficult in certain foreign ports, which may cause a ship owner to incur significant downtime costs to have a replacement part or a new engine delivered to a foreign port. Consequently, we continue believe that tying this flexibility to the amount of time a ship spends within easy distance of the United States is appropriate. Because we received no other comments on whether it is preferable to tie this flexibility to another period of operation within 200 nautical miles of the United States, and because we believe the emission limits being finalized in today's action will not reduce the reliability or durability of these engines, we will finalize the 75 percent requirement.

The mere fact that engines onboard vessels that do not qualify for the foreign trade flexibility will have to meet two sets of requirements is not sufficient to extend this flexibility to all vessels engaged in foreign trade. The domestic limits are not expected to make operations more complex or confusing for operators of these vessels since they will be supplied with the paperwork that will allow them to receive their Engine International Air Pollution Prevention certificate under the MARPOL program. They will simply be certified to a different set of standards. Engine manufacturers can apply for an EIAPP at the same time as they demonstrate compliance with the national standards.

We are not convinced that this flexibility will lead engine manufacturers to build engines with a larger bore/stroke engines with fewer cylinders, essentially making all engines supplied to U.S. flag vessels Category 3 engines. There would be a power/density penalty associated with such a strategy, which limits the ability of manufacturers to carry such a strategy through their entire product line. We also are not convinced that such a strategy would be cost effective for engine manufacturers, especially since the land-based counterparts of these engines will have to meet even more stringent limits. The engine changes associated with these standards are not so burdensome to make a complete redesign attractive. They are also not so onerous as to lead engine manufacturers to cease production for the U.S. domestic market.

Finally, with regard to the Navy comment, we do not believe that requiring Category 1 and 2 engines on some vessels engaged in foreign trade will lead to competitiveness issues. This is because the costs associated with compliant engines are small, both in terms of new engine costs and operating costs.

J. Mutual Recognition of Engine Certificates under MARPOL Annex VI

What We Proposed:

We neither proposed nor requested comment on mutual recognition of engine certificates. This is the process whereby the United States would accept engine certificates from other countries to demonstrate compliance with the MARPOL Annex VI limits.

What Commenters Said:

Cummins raised a concern about the lack of mutual recognition provisions with regard to engine certificates issued by various states under the MARPOL Annex VI program. Cummins notes that while U.S. and European countries do not accept each others' emission certificates for highway or nonroad engines because their respective requirements are different, there appears to be no valid reason for one not to accept the others' certificate for a common international regulations such as MARPOL Annex VI NOx requirements. At the extreme, this situation could force engine manufacturers to obtain IMO certificates from each of the 156 IMO countries. Therefore, Cummins recommends that EPA immediately take the necessary steps to resolve the IMO reciprocity issue to where some realistic degree of mutual recognition is achieved without jeopardizing air quality.

Our Response:

The issue of mutual recognition of MARPOL Annex VI engine certificates is only of indirect relevance to this rulemaking. This is because, as proposed in the NPRM and finalized in today's action, the MARPOL Annex VI limits are not mandatory under this national program. Instead, engine manufacturers are encouraged to provide compliant engines between January 1, 2000, and the effective dates of the emission limits finalized in today's action, as evidenced by a Statement of Compliance issued by EPA. After the domestic limits go into effect, however, engine manufacturers will be required to obtain an EPA statement of conformity for any Category 1 or Category 2 engine entered into commerce in the United States. This certificate can only be issued by EPA, since it demonstrates compliance with our domestic standards.

Cummins' comment refers to the broader question of the regime set up in the NOx Technical Code, in which countries are not required to automatically recognize each other's engine certificates. Cummins is concerned that the lack of mutual recognition means they must obtain an engine certificate from the government of every country in which they sell engines. This is an artifact of the MARPOL Convention, which gives the state under whose authority the ship is entitled to operate (its flag state) the authority to certify the engines on that ship. This situation is not unlike the one Cummins faces for selling its land-based nonroad engines: each country certifies the engines offered for sale in its country. The only difference between the land-based nonroad situation and the diesel marine situation is that there is ostensibly harmonized numerical emission limits for diesel marine engines. As became apparent during the MARPOL negotiations, however, there is a concern that not all countries apply the same degree of thoroughness to their domestic certification processes. Without a truly uniform certification process among countries, there is a risk that engines that are certified to a particular numerical standard do not actually achieve that standard. A mutual recognition system would make it very difficult for a country to refuse entry to engines that do not, in fact, meet the emission limits. Therefore, it was deemed preferable to allow countries to decide whether they want to enter into a system of mutual recognition and, if so, with which other countries.

At the same time, we make note of Cummins' concern and will pursue this issue in the context of our implementing strategy for MARPOL Annex VI. In the meantime, however, it should be noted that the existence of mutual recognition agreements among other countries may reduce the number of certificates needed by a manufacturer that sells engines abroad. For example, if the EU countries enter into a mutual recognition agreement, Cummins will have to obtain a certificate from only one European country. The other EU countries should accept that certificate even if they do not accept an EPA certificate.

CHAPTER 7 – Compliance

A. Certification

What We Proposed:

We proposed a certification program for Category 1 engines based largely on the existing program for land-based nonroad engines, and for Category 2 engines based largely on the existing program for locomotive engines. We proposed that engines which are expected to have similar emission characteristics throughout their useful lives can be grouped into a single engine family for certification purposes. Within that engine family the manufacturer would only have to test the highest emitting (worst-case) engine configuration for certification purposes. We requested comment on whether we should allow testing on a single cylinder development engine for Category 2. We proposed that manufacturers determine the rate of emissions deterioration for each engine family and apply the deterioration factor to the test data to determine compliance with the standards. We proposed to require a separate certificate of conformity for each engine family each model year, with provisions for carryover of certification data from one model year to the next if there are no changes to the engine family which would affect emissions between model years.

What Commenters Said:

The only comments specific to our proposed certification provisions were provided by ABS. ABS noted that the concept of "model year" is unusual in the marine industry, and questioned at what point an engine is "manufactured" to determine its model year (such as the date of order, completion of manufacture, installation in vessel). ABS also requested that the concept of model year be clarified as it applies to imported engines. ABS suggested that we use a different term than engine family to denote engine configurations grouped for certification, noting that our proposed definition differs from those in the IMO NOx technical code and ISO 8178. ABS commented that our proposal to require the worst-case emitter from any engine family to be tested could result in one engine family based on NOx, another based on PM, and so on. Also, in conjunction with our proposed model year definition, ABS argued that some engine families could be comprised of a single engine. Finally, ABS questioned whether single cylinder development engines could adequately replicate a complete engine given likely differences in turbocharging and exhaust characteristics between the two.

Response to Comments:

1. Model Year and Certificate Coverage

The concept of model year we are using in this regulation is the same as is used in the other mobile source rules. It generally means the calendar year in which the final assembly of the marine engine occurs, but the definition allows the manufacturer to establish the model year based on its annual new engine production period. The model year is restricted to contain January 1 of the named year, to begin no earlier than January 2 of the previous year, and to end no later than December 31 of the named year. If the manufacturer has no annual production period (as may be the case for some manufacturers in the marine industry) the model year means the calendar year. We are finalizing this concept, but are modifying the proposed language to make it more clear. This definition applies to both imported and domestic engines.

The certificate of conformity only covers engines which are fully manufactured, excluding dressing the engine for installation into a vessel, within the period of the model year. As previously stated, the model year must end no later than December 31 of the named year. Consequently, engines covered by a certificate of conformity must be fully built by December 31 of the named year. These engines, if covered by a certificate of conformity, may be installed in vessels which are assembled after December 31 of the named year. If the engines are assembled in a foreign location, the engines may be imported into the United States after December 31, provided they have a certificate of conformity and a corresponding engine label showing that it meets the requirements that apply to it based on its date of production. See Onboard Certification Testing in Chapter 7 for treatment of imported vessels.

2. Engine Families and Testing

We have previously adopted the engine family approach to certification to minimize the certification burden. However, we have always placed restrictions on which engines can be placed into a single engine family to ensure that the certification emission data from the test engine are sufficiently representative of the engines in the family. We continue to believe that the proposed regulations appropriately balance these two conflicting goals, even though it may result in some engine families being comprised of a single engine, as ABS indicated. The direction for defining engine families under MARPOL is very similar to our approach. There are small differences that could lead to differing conclusions under the two programs, but both MARPOL and EPA regulations allow flexibility in establishing families, which should avoid any practical inconsistency.

We have consistently used the term “engine family” in the various nonroad and highway heavy-duty engine rules. Many of the engines certified under these other rulemakings will also be demonstrating compliance with the land-based nonroad or locomotive requirements on the basis of “engine family”. Changing to another name for this grouping term for this rule would cause unnecessary confusion for these manufacturers complying with multiple rules. Consequently, we are finalizing the proposed language calling this grouping an “engine family”.

We proposed that only the worst-case engine be selected for testing so that only one engine needs to be tested within an engine family. The Administrator may select an additional engine under the provisions of §94.217 (c) after the manufacturer has made its selection which would result in two engines being tested, but we expect to reserve the application of this requirement to unusual situations. In making the selection of worst-case, the manufacturer should consider the proximity of each engine’s expected emissions over the its useful life for each constituent with the applicable standards. The engine producing the regulated constituent which is closest to the applicable standards compared to all other regulated constituents (i.e., most likely to fail an emission standard) should be chosen as the “worst-case” engine. A separate "worst-case" determination is not made for each regulated constituent.

In some cases it may not be practical to test a complete engine. To obtain approval for single-cylinder testing the manufacturer must rely on approval under the special test procedures. This requires a demonstration “that it is equivalent to the specified test procedures”. We will address the concern that single-cylinder testing may not be appropriate in some cases by evaluation of the individual situations under §94.27.

B. Production Line Testing

<u>What We Proposed</u>:

We proposed a production line testing (PLT) program to ensure that production engines actually meet the emission standards they were certified as meeting. Under the proposed PLT program a manufacturer would be required to emission test a percentage of its annual production at the conclusion of the production process or assembly line. We proposed that each manufacturer would have to test one percent of its Category 1 and Category 2 engines per year, with the test engines being randomly selected and representative of annual production. We proposed that no Category 1 testing be required if a manufacturer’s Category 1 sales were less than 100, but requested comment on whether we should apply a cumulative total approach whereby a test would be required when a manufacturer’s Category 1 production reached 100 engines regardless of whether all 100 were produced in the same model year. We proposed that a minimum of one engine test be required for a manufacturer’s Category 2 production, regardless of total sales. We did not propose a maximum number of tests for either category.

In the event that any engine tested under the proposed PLT program failed the test by exceeding the emission standard for any pollutant, the manufacturer would be required to test two more engines of the production from the next two days or the next fifteen engines produced in that engine family. If the average of the three test results was greater than the standard for any pollutant the manufacturer has failed the PLT for that engine family. EPA could suspend or revoke a manufacturer’s certificate of conformity with 15 days of the failure. Regardless of the outcome of the testing, we proposed that any engine failing an individual test under the PLT program be required to be brought into compliance with the standards.

We proposed to allow a manufacturer to submit for our approval a plan for an alternative PLT program that would better suit its needs. Such a request would be required to include an explanation for the need of an alternative, as well as details such as sample size and engine selection criteria, and provisions regarding what constitutes a failure of an engine family under the alternative plan. This provision was included in the preamble to the proposal, but was inadvertently left out of the regulatory text.

The proposed PLT program was developed in place of our traditional selective enforcement audit (SEA) approach due to the low production volumes of commercial CI marine engines. However, we also proposed that we retain the authority to do an SEA of a manufacturer's production.

<u>What Commenters Said</u>:

EMA opposed our proposal to have a PLT program and still retain the right to do an SEA. EMA supported adopting the SEA program for land-based nonroad engines in 40 CFR Part 89 instead of the proposed PLT program. EMA suggested that, as an alternative, manufacturers could elect to participate in the PLT program, and that electing to do so would preclude SEA unless we have reason to doubt compliance (such as a failed PLT). EMA also said that we must propose for comment any SEA program we intend to apply to commercial CI marine engines.

EMA stated that the PLT sample size should be one percent of a given engine family, not one percent of total sales for the category. EMA pointed out that section 94.505(a)(1) of the proposed regulatory text sets the required sample size for each engine family as one percent of the annual sales for all engine families. EMA argued that under this approach a manufacturer with several engine families would have a much higher testing burden than a different manufacturer with the same total production but spread over fewer engine families. EMA also requested that we make clear that, for purposes of determining sample size, only sales of engines certified according to the commercial CI marine regulations would be considered. It argued that we should limit the number of tests required for a given engine family to five (unless a failure occurs), stating that for some large engine families the number of required tests could be as high as 15. EMA argued that this would be far more testing than actually required to demonstrate compliance with the standards. EMA also requested that no testing be required for any engine family with projected production volumes below 100, regardless of category, citing prohibitive costs.

EMA said that we should establish a PLT program that is the same as the land-based nonroad engine program for those engines that are derived from land-based nonroad engines. Likewise, EMA stated that the PLT program for locomotive-derived engines should be the same as the locomotive PLT program. EMA did not explain why this approach would be more appropriate than our proposal. Finally, EMA took exception to our statement that every single engine must meet the applicable standards, regardless of whether or not the average of three test results shows a PLT failure. EMA argued that there are engines that will not meet the standards, and that it is appropriate to ensure that, on average, the standards are being met.

In late comments, EMA requested that we allow manufacturers to use alternate sampling plans, at the approval of the Administrator. In those comments, EMA also supported our proposal to allow for up to 300 hours of service on engines to be tested in the PLT program prior to their actual testing.

ABS pointed out that, due to the low production volumes of commercial CI marine engines, there would be very little PLT testing performed. Thus, ABS stated, in the case of an engine failing a PLT test, there may not be another engine to test. Under these circumstances, ABS argued, we should allow the failing engine to be rebuilt, adjusted, or modified and then retested to determine compliance.

California ARB generally supported our proposed PLT program. They commented in favor of the cumulative total approach whereby a test would be required when a manufacturer's Category 1 production reached 100 engines regardless of whether all 100 were produced in the same model year, provided that the model had not changed significantly in subsequent years.

Our Response:

The Clean Air Act gives us the authority to require or conduct SEA testing, so it would not be appropriate to waive this authority. The PLT requirements in this final rule don't affect our ability to do SEA testing if we see the need to conduct an audit. EMA's suggestion to limit SEA testing to situations where there is reason to doubt compliance is consistent with our approach. We only expect to exercise our SEA authority in cases where we have reason to expect that a manufacturer may be out of compliance. We therefore believe that this approach is appropriate and will not result in undue burden. We would also take into account the specific circumstances, such as the volume of production and practicality of conducting SEA type testing, before exercising such authority. We believe that the Act authorizes us to require or conduct SEA testing regardless of whether we have specific regulations in effect. Should we decide to perform an SEA, we would use the SEA program for land-based nonroad engines (40 CFR Part 89, subpart F) for guidance.

We agree with EMA that one percent of total production is too high of a sampling rate for each engine family. Although our proposed regulatory text was written this way, the preamble stated that the sampling rate was to be one percent of total production, to be spread evenly over all production. We are finalizing the rule consistent with the preamble language from the proposal, so that the total number of tests for all engines combined will be one percent of total production. This approach seems to address EMA's concern about the difference in testing burden between manufacturers with different numbers of engine families. We do not believe that it is appropriate to use EMA's suggested sampling rate of one percent of each engine family. Given the small sales volumes of commercial CI marine engines, it is likely that many engine families would never be subject to production line testing under this approach. If we require, as proposed, that the sampling rate be one percent of total production for a given Category and that the testing be spread out among all production it is much more likely that, over time, most engine families would be subject to production line testing. Thus, we are adopting the sampling plan as proposed in the preamble where the sampling rate will be one percent of a manufacturer's total production for a given category, and that the tests be spread out over all production to in such a way as to be representative of annual production. We agree with EMA that for the purposes of determining sample size, only engines certified according to the provisions of this part and sold in the U.S. should be included in the production volume estimate. Thus, as EMA requested, we are making this explicit in the final regulatory text.

Given the sampling rate we are adopting, and the typical production volumes of these engines, we believe that a manufacturer generally won't be faced with having to perform more than five tests on a given engine family. This would only seem likely in cases where a manufacturer has fairly high production volumes and a very few engine families. Furthermore, there is no statistical reason for capping the number of tests for each engine family. We believe the one percent sampling rate sufficiently limits the testing burden for these engines.

We do not believe that EMA's proposal to use the land-based nonroad engine SEA program for Category 1 engines and the locomotive PLT program for Category 2 engines is appropriate. There is no PLT program for land-based nonroad engines, only an SEA program. For reasons outlined in the proposal (primarily low production volumes) we believe that a traditional SEA program will not work well in this segment. The PLT program for locomotives was designed specifically for the locomotive segment where the market consists almost exclusively of moderate volumes of a very small number of engine families. We believe that the engine sampling provisions contained in the locomotive PLT program would not work as well for the marine market, because the marine Category 2 market is smaller than the locomotive market and has more engine families. Thus, we are adopting the PLT program largely as proposed, with the modifications discussed elsewhere in this section.

We set the levels of the standards considering cost, technology availability, and potential for emissions reductions as for other mobile source programs. The standards are set such that each engine is subject to and must meet those standards. No good reason was given by EMA to change this approach. If we were to require compliance on average, as EMA has suggested, we would likely set the standards at levels more stringent than those we are adopting. Therefore, we will require, as proposed, that any engine which fails a production line test must be brought into compliance and retested to demonstrate compliance. This is consistent with PLT programs for other mobile source categories. We note that a PLT failure (as opposed to a single engine failing a PLT test) addresses a different issue - whether the certificate of conformity should be revoked for the entire engine family.

Our intent was to explicitly allow for alternative PLT programs at the request of a manufacturer and approval of the Administrator. As previously mentioned, we discussed our intent to propose this provision, but inadvertently left it out of the regulatory text. We are including this provision in the final regulatory text. We also agree with EMA's comment in support of the allowance for up to 300 hours of service accumulation, and are finalizing that provision as proposed.

We do not believe that, as ABS suggested, there may be a problem with not having another engine to test in the event of a PLT failure. ABS suggested that this might occur in cases where production volumes are extremely low. Given the PLT sampling rates and the fact that the tests are to be performed on a sample which is representative of actual production, we do not believe that such low volume engine families will be tested very often. Nonetheless, if such a situation does occur, we believe that it would be better to test the next engine produced in that engine family regardless of how long it takes. If there are no more produced in that family for that model year, then the production volumes are so low that there will be little or no negative environmental impact, especially since the original failing engine must be brought into compliance regardless of whether another engine is tested. Regardless, we maintain the authority to direct the models tested if we do not believe that engine selection adequately represents actual production.

When considering whether to adopt a cumulative total approach for Category 1 engines whereby a test would be required when a manufacturer's Category 1 production reached 100 engines regardless of whether all 100 were produced in the same model year, we considered the advantages of such an approach in terms of likely emission benefits in light of the disadvantages. We concluded that the likely burden this would place on smaller volume manufacturers combined with the difficulty in tracking cumulative production over successive model years outweigh any benefit from such an approach. Thus, we are not adopting a provision to require that total production be monitored cumulatively over more than one model year to determine when a Category 1 engine manufacturer would have to do a PLT. Rather, we are adopting the proposed requirement that PLT is triggered when a manufacturer's Category 1 production volume reaches 100 engines in a given model year.

C. Enforcement

What We Proposed:

We proposed an enforcement program which is similar to most current mobile source enforcement programs. In general, we proposed that manufacturers be liable for the emissions performance of their engines throughout their useful lives. We also proposed that we have authority to test certified engines in use and, on the basis of such testing, require manufacturers to remedy any nonconformities.

What Commenters Said:

ABS commented that the manufacturer retaining liability for an engine's in use emissions performance is contrary to current marine practice, where the owner assumes all responsibility once it takes delivery. ABS also questioned whether enforcement actions such as remediation and voiding of certificates would be taken considering the implications and costs of vessel being taken out of service. Finally, ABS commented that poor fuel quality, which is outside of a manufacturer's control, could result in engine wear that could cause noncompliance. ABS implied that it would not be appropriate to hold the manufacturer liable under such circumstances.

PHA commented that it did not have the resources or legal authority to do any enforcement on fuel quality within the port areas under its control. Finally, LCA stated its preference that the U.S. Coast Guard enforce emissions regulations under MARPOL Annex VI.

Our Response:

We are promulgating these rules under section 213 of the Clean Air Act which requires that the standards apply to the useful life of the engines, as determined by the Administrator, and that the standards are subject to sections 206, 207, 208, and 209, with such modifications of the applicable regulations implementing such sections as the

Administrator deems appropriate, and shall be enforced in the same manner as standards prescribed under section 202. In turn, section 207 of the Act establishes provisions for an in-use testing and a recall program. Consequently, the standards which are finalized today must be enforceable in-use under the provisions of Section 207 of the Act. This rule reasonably implements these statutory requirements. Under the rules, manufacturers have the responsibility to meet standards in use and EPA may order recalls of nonconforming engines in appropriate circumstances.

Section 207 of the Act limits recalls to situations where "a substantial number of any class or Category of vehicles or engines, although properly maintained and used, do not conform to the regulations prescribed under section 202." Consequently, misuse or improper maintenance of the engine may make it ineligible for evaluation as a test engine for an in-use testing program. We agree with ABS and Carver, that in some extreme situations, the duty cycle experienced by the engine or the fuel type used may cause the engine to be ineligible for use in a recall test fleet if we determine that these parameters constitute misuse or improper maintenance.

D. Adjustable Parameters

What We Proposed:

We proposed that owners of Category 2 engines with adjustable features keep their engines adjusted within the range specified by the manufacturers for compliance with the emission standards.

What Commenters Said:

ABS and LCA stated that EPA should establish MARPOL recording requirements for adjustable parameters.

Our Response:

We share the concern raised by the commenters regarding adjustable parameters. However, we do not agree that it is necessary at this time to adopt the MARPOL recordkeeping requirements for domestic vessels. We will monitor this issue and will establish recordkeeping requirements in the future if necessary.

E. Onboard Certification Testing

What We Proposed:

We did not address onboard certification testing in our proposal.

What Commenters Said:

Although no one submitted formal written comments on this issue, we were asked during our outreach efforts if EPA would permit onboard certification testing as provided in the MARPOL Annex VI NOx Technical Code.

Our Response:

To do onboard certification testing, someone would need to buy and install the engine before it is certified, which we do not allow under our domestic compliance programs. Also, for new Category 1 and Category 2 engines entered into commerce in the United States, our certification requirements call for manufacturers to submit data and information. The data include emission testing data from specified laboratory procedures. Our normal certification process therefore doesn't allow for emission testing onboard a vessel. These engines are fully capable of being tested in a lab, as evidenced by the fact that their land-based counterparts are all laboratory tested.

A situation may arise, however, in which an uncertified engine is imported into this country on an existing (i.e., not newly constructed) vessel. Consistent with other EPA programs, the final rule requires that we treat this as a new marine engine, subject to the relevant provisions of 40 CFR Part 94. Because it may not be possible to remove the engine to perform a laboratory test, EPA will allow an exception to this requirement for that special case. The vessel owner will need to apply to EPA for this exemption, and upon approval by EPA, will be able to do an onboard certification test. This testing may be done with an alternative procedure such as the MARPOL Annex VI NOx Technical Code Chapter 5 requirements, as modified by EPA for that particular situation. Regardless of the procedure, the engine will need to comply with the EPA emission standards that apply to engines for the date that the engine was originally manufactured.

Note that, while the MARPOL Annex VI NOx Technical Code permits onboard certification testing, that testing must be performed in accordance with the full test bed requirements of Chapter 5 of that document. Certification testing may not be done using the simplified onboard testing method, which is reserved for confirmation of compliance at periodical and intermediate surveys, confirmation of precertified engines for initial certification surveys, recertification of an engine that failed its initial certification and was subsequently fitted with a NOx reducing device, or to recertify an engine that has been adjusted outside the accepted range of its adjustable parameters.

CHAPTER 8 – Test Procedures

A. Duty Cycles and Sampling Procedures

What We Proposed:

We proposed that marine engines be tested using test procedures developed for land-based nonroad engines. Specifically, we proposed that Category 1 engines be tested using the test procedures in 40 CFR Part 89, and that Category 2 engines be tested using the test procedures in 40 CFR Part 92. Both of these test procedure specifications are for steady-state testing. They would apply for all gaseous (THC, NMHC, THCE, NOx, and CO) and particulate emissions. We also proposed to retain the authority to allow modifications to these procedures to ensure accurate testing. To allow in-use testing, we proposed specifications for an exhaust emissions sampling port that would be required on all engines.

What Commenters Said:

Wärtsilä NSD, Cummins Wärtsilä and Euromot stated that EPA should use ISO 8178. CSA stated that EPA should use MARPOL procedures. Wärtsilä stated that EPA should set NMHC instead of THC standards because of the growing number of gas engines, and to be consistent with Part 89. California ARB supports the proposed test procedures.

Caterpillar wants EPA to allow manufacturers to determine where to put the exhaust sampling port. ABS also expressed concern about our specifications for the sampling port. EMA stated that manufacturers should not be responsible for the sampling port because they do not generally provide exhaust systems with the engines when they sell them.

Crowley stated that tug operation is transient.

Our Response:

In specifying the proposed test procedures for marine engines, we sought to maximize consistency with other nonroad programs in 40 CFR Parts 89 and 92. This is because most commercial marine engines in the U.S. are derivations of engines that are regulated under 40 CFR Parts 89 and 92. The test procedures from these EPA programs sections are very similar to those specified in ISO 8178, with a few important differences. First, the ISO procedures correct measured emissions to a narrow set of reference testing conditions to minimize variability in measured emission values. This is in conflict with our goal generally to ensure to control of emissions over the wide range of engine operation and ambient conditions that the engine can reasonably be expected to encounter in use. The narrow set of ISO reference testing conditions is also in conflict with the not-to-exceed emission standards in this final rule, which specifically requires manufacturers to control emissions in a zone of engine operation over defined ranges of test conditions that are wider. Second, the ISO procedures allow wide discretion for manufacturers to set important test parameters such as rated speed and fuel properties. We describe in Chapter 8 why it is important to define an explicit procedure to determine an objective value for an engine's rated speed and to establish a range of test fuel properties (especially sulfur). Third, an ISO committee is in the process of making various corrections to the calculations and sampling and analysis procedures currently specified in 8178. We look forward to contributing to any efforts to improve these deficiencies in the ISO procedures.

We proposed THC standards largely to facilitate in-use testing. Measuring THC involves substantially simpler test procedures than measuring NMHC. Moreover, diesel engines have very low methane emissions, which results in THC and NMHC measurements being very similar. With respect to natural gas engines, we will allow them to comply with NMHC + NOx standards instead of THC + NOx standards.

We agree with Caterpillar that manufacturers should be allowed to determine where to place the sampling port for in-use emission testing. We will only require that it be designed such that it allows for emission measurements that are equivalent with those made using the proposed sampling port. Moreover, for engines that do not include exhaust systems when sold, the manufacturer is only responsible for specifying the sampling port to the vessel manufacturer, just as it would do for the cooling system or other features that affect emissions. In these cases, any failure of the vessel manufacturer to comply with these specifications would be considered tampering.

Finally, we agree that many marine engine applications can be transient in nature. However, we have determined that most operation is steady-state for a typical marine engine. Therefore, we are not including transient operation in our current test procedures. Nevertheless, we will continue to monitor this issue and may specify transient test procedures at a later date.

B. Definition of Rated Speed (Maximum Test Speed)

What We Proposed:

To ensure that a manufacturer's declared rated speed is representative of actual engine operating characteristics, and is not improperly used to influence the parameters under which their engines are certified, we proposed a new definition of engine rated speed. We proposed to define rated speed as the single point on an engine's maximum-power versus speed curve that lies farthest away from the zero-power, zero-speed point on a normalized maximum power versus speed curve. We also proposed a specific procedure for determining the rated speed under this definition.

What Commenters Said:

EMA stated that the rated speed should be the speed at which rated power is delivered, and should be determined by the manufacturer. EMA cited several concerns with our proposed approach. EMA commented that our proposed procedure might result in a rated speed above the speed at which maximum power is achieved, resulting in an E3 test cycle which does not represent the actual propeller curves the engine would have in use. EMA further stated that a lug curve is not relevant to marine engines. Such engines typically run either at constant speed and variable power, or along a propeller curve, and never up to some maximum torque versus speed as a highway engine would. Determining a lug curve could also damage a marine engine, since maximum power is typically well above the manufacturer's rated speed. Getting to the speed associated with maximum power could result in overspeeding and damaging the turbocharger. Finally, EMA argued that a number of practical factors go into the setting of the rated speed by the manufacturer and that, given that propellers are selected to achieve maximum power and fuel economy based on the engine's rated speed and power, a manufacturer should be the one to determine the rated speed based on these practical considerations.

EMD supplemented EMA's comments by stating that a manufacturer's rated power will not lie on the lug curve, but at a point below it so that a power transient won't "bog" the engine down. EMA also stated that manufacturers will continue to set their rated speed for purposes of commerce using the practical criteria that EMA discussed. These two things combined, EMD commented, would result in an engine that would, in real world applications, operate on a curve shifted from the curve that contains the EPA test points. This real world curve could conceivably be outside the not-to-exceed zone altogether. EMD suggested that we prevent this by requiring, through regulation or spot-checking of installations, that the rated speed of an engine as installed and operating is the same as that chosen for certification.

Navistar commented that our proposed definition of rated speed is not based on real world engine operating characteristics. Navistar stated that the proposal does not distinguish between engine types, including highway, land-based nonroad and marine. As a result, manufacturers would be left to comply with a not-to-exceed requirement that is not based on real world operating conditions.

Our Response:

EMD correctly stated that our proposed definition of rated speed might return a speed higher than the speed at which an engine develops its highest power. That was intentional in the proposal because a high torque-rise engine has a particularly low speed at which it develops its highest power, and by defining rated speed at that low speed, a significant high-load area of the torque versus speed map is left untested. This area happens to be an area in which engines are likely to operate because diesel engines operate most efficiently at high speed-high load conditions. This is also a region where, depending upon engine design, either NO_x or PM limits might be exceeded. In addition, extensive testing of our proposed definition indicates that the definition never returns a speed at which power is less than 90 percent of the maximum power of the engine. Furthermore, for engines that do not have a high torque-rise, our proposed definition of rated speed is within 1 percent of an engine's maximum power speed.

EMD also expressed concern that our proposed definition of rated speed might be counter-effective with respect to the not-to-exceed (NTE) provisions in the NPRM. To clarify, we specifically proposed the rated speed definition to maximize the testable area within the NTE zone, which lies within the torque versus speed area under the lug curve. Any other definition of rated speed, and especially one that allows individual manufacturers to arbitrarily declare rated speed, might not maximize the testable area under the lug curve. EMD expressed concern over the proposed definition of rated speed with respect to electrical power generation. We recognize that electrical power generation limits an engine to operating exclusively at a single, constant speed. In this special case the engine's rated speed is that constant speed. In cases where a single engine model might be installed in different configurations, we would expect manufacturers to certify the worst-case configuration for complying with the emission standards (see Chapter 7, Section A). This may occur if more than one constant engine speed might be expected, such as when coupled to generators with different numbers of poles, or different output frequencies.

EMD indicated concern that our proposed rated speed definition might cause an engine to "bog" with no hope of recovery. Our proposed definition can only provide even more of a speed cushion (or torque-rise margin) to prevent "bogging", which only occurs *below* peak-torque speed. However, because Category 2 engines are designed with little or no torque rise, we are allowing that *rated power* be defined as the power at which maximum test speed (i.e. rated speed) is defined, but multiplied by a factor of 0.9. EPA has confirmed that manufacturers of Category 2 engines typically use this factor of 0.9 to provide a sufficient torque margin at rated speed. This torque margin is used instead of "torque rise" to overcome brief transient torque demands, which can exceed the maximum torque demand at steady-state.

Finally, EMD pointed out that if we define an NTE zone by using our proposed definition of rated speed, it is possible that an actual engine in service might operate only partially inside or entirely outside of the resulting NTE zone. We believe that using EMD's approach of allowing an engine manufacturer to declare a rated speed can only increase the likelihood of this possibility in comparison to our proposal. Neither we nor any engine manufacturer has complete control over how an engine might be operated in use. An engine manufacturer might publish application guidelines that include performance curves, service ratings, and rated speeds, but neither we nor an engine manufacturer has direct control over many of the factors that determine a marine engine's in-use operating range of speeds and loads. These uncontrolled factors include:

1. Vessel hull form and size.
2. Hull condition including modifications, repairs, fouling, and tolerable damage.
3. Selection of propeller type, size, or pitch.
4. Condition of propeller.
5. Ambient conditions including waves and wind.
6. Additional loads such as cargo, towing loads, or cast fishing nets

However, an engine manufacturer has complete control over an engine's lug curve and an engine's speed governor characteristics, which completely define the upper bounds of speed and load under which an engine might possibly operate. Therefore, the manufacturer has complete control of an engine's rated speed under the proposed definition, but the manufacturer must now design the engine's rated speed into the lug curve and governor droop characteristics instead of picking a rated speed that may not be accurate. Thus, the proposed definition of rated speed ensures that an engine will never operate above or beyond the steady-state points of the certification test cycle or the NTE zone. This is especially the case with the adjustment for rated power for Category 2 engines. Furthermore, because our proposed definition of rated speed utilizes a manufacturer's selection of lug curve and governor droop, it naturally maximizes the NTE area under the bounds of these curves. This in turn maximizes the effectiveness of the NTE requirements. EMD suggested that we should allow manufacturers to declare rated speed and then perform "spot checks" to ensure compliance. This alternative increases the potential for compliance actions, which would otherwise not occur under our proposal. Furthermore, because of the uncontrolled factors listed above, an engine "spot-check" is not likely to result in an effective compliance action because a difference in in-use observed rated speed versus a manufacturer's rated speed might be attributable to one or more of these factors.

EMD reiterated that our proposed definition reduces the effectiveness of the proposed rule and that engine manufacturers should be granted the latitude to declare rated speed themselves. We do not agree with these comments for the reasons detailed above.

EMA commented that engines likely will be matched to vessels so that the propeller curve intersects the lug curve at maximum power, which might sometimes be at a lower speed than our proposed definition of rated speed. First, for engines that do not have a high torque-rise, the speed at which maximum power occurs and the proposed rated speed coincide within 1 percent. For high torque-rise engines where the proposed rated speed is higher, it is just as likely that the propeller curve might intersect that point versus the maximum power point. Not only has it been shown that this point is always above 90 percent maximum power, but also there might be design considerations that would cause boat builders to intersect the proposed rated speed instead of the manufacturers rated speed. These design considerations might include benefits of operating the engine at a higher speed, which would allow for more available torque rise and possibly better fuel economy. The enhanced torque-rise is advantageous especially for planing vessels or vessels whose load varies frequently due to maneuvering, fishing, or adverse sea conditions. A higher propeller curve and lug curve intersection speed also might be selected so that a more cost-effective or higher-performing propeller can be utilized for the specific hull and engine combination. In the case of high torque-rise engines, the boat builder has more latitude to select an intersection speed, and the engine manufacturer, therefore, is not in a strong position to declare exactly what the in-use rated speed will be. We recognized this and therefore proposed a rated speed definition that is always above 90 percent maximum power and that always will maximize the testable area under the lug curve, which will maximize the NTE zone.

EMA stated that the idea of a lug curve is a "foreign concept to most marine engines." To the contrary, we found over 100 published lug curves of marine engines on manufacturers' websites.[4] Furthermore, marine engine lug curve information is essential to match engines to planing hulls. Planing hull vessels require a sufficiently steep lug curve to get up onto plane before the operation of the engine falls back to the propeller curve. We have collected speed and load data on planing vessels in-use and have demonstrated this to be the case. The lug curve information is also required to effectively match a propeller to an engine. Without lug curve data, it is impossible to accurately determine the maximum output of a propeller when shafted to a specific engine. Lug curve information is essential to effectively select a marine engine that matches a propeller and hull combination.

EMA indicated that the manufacturer sets rated speed to avoid critical vibrations, to maintain a sufficient power stroke rate for a given mean effective pressure to generate sufficient power, to match turbocharger characteristics, and to ensure compatibility with specific applications. Every one of these factors still can be resolved because the manufacturer can design the engine's lug curve and governor droop so that our proposed definition of rated speed coincides with that of the manufacturer's desired rated speed.

EMA indicated that some marine engines might catastrophically fail if tested to determine rated speed by our proposed definition. Since our proposed definition only requires that an engine will be operated along its lug curve and governor droop, we would like to request a specific list of engine models in which the manufacturer-designed curves do not safely prevent dangerous operation. We intend to submit any such list to the US Coast Guard for investigation because we believe that, if these engines exist, they are not sufficiently safe to be operated in U.S. waters. Furthermore, we have modified the proposal such that an engine only needs to be run along a limited portion of the lug curve around the point of maximum power. Specifically, the engine must operate from 90 percent of maximum power (below rated speed) through maximum power to the point at which the engine generates 75 percent of maximum power (at or above

[4]"Data Collection and Analysis of Real-World Marine Diesel Transient Duty-Cycles," EPA memo from Matt Spears to Mike Samulski, October 15, 1999 (EPA Docket A-97-50, document IV-B-2).

rated speed). Manufacturers may generate this data traversing the lug curve in either direction. We believe that all marine engines can be safely operated over this segment of the lug curve to determine an engine's rated speed.

EMA explained the economic pitfalls of selecting either too large or too small a propeller for a given engine and that a boat builder makes this selection based on rated power and rated speed. We agree with EMA on this point. We do not intend to cause miscommunication between engine manufacturers and boat builders. In fact we believe that engine manufacturers should provide as much accurate information about their engines to boat builders as possible. EMA did not explicitly comment that boat builders might become confused between our rated speed and the speed at which maximum horsepower occurs. To account for this, we have changed the nomenclature to clarify that our proposed rated speed is merely a defined speed that only has to be used for the purpose of testing an engine's emissions. The final regulations refer to "maximum test speed" and "maximum power at maximum test speed."

Navistar claimed that an engine manufacturer presently declares rated speed based on real-world operating characteristics. We do not believe that engine manufacturers can determine with certainty how their engines are applied in- use. Refer to our previous response to EMD's comments for a list of important determining factors that neither we nor engine manufacturers can control. Again, engine manufacturers can control the characteristics of an engine's lug curve and governor droop, which determine the maximum operating speed and load of an engine. We expect that engine manufacturers will design these performance curves to limit an engine's speed and load so that we can be assured that emissions remain within a specified limit, even in-use. Our proposed rated speed maximizes the NTE zone under the lug curve, therefore it maximizes the NTE zone's effectiveness by maximizing the likelihood that real-world operating conditions will fall within the NTE zone. Contrary to Navistar claims, engine manufacturers will not be "left in the anomalous position of having to design engines to satisfy an NTE test that is not based on real-world operating conditions." Rather, we are adopting a definition of rated speed that ensures that all engine manufacturers will be responsible for emissions over a maximum area under an engine's lug curve, and therefore all manufacturers will be responsible for emissions over a maximum area of real-world operation.

EMA concluded, "Thus, the rated speed of an engine simply should be what the engine manufacturer says it is." We wholly disagree with this conclusion because our required certification test cycle and NTE zone are entirely defined by an engine's rated speed. We do not believe that it would be a fair or equitable policy to allow manufacturers to declare how their individual engines should be tested. Instead, our proposed rated speed provides a single definition of rated speed, with which every engine manufacturer equitably complies.

C. Crankcase Measurement

What We Proposed:

We proposed to require that marine engines be built with closed crankcases to eliminate crankcase emissions, with one exception. We proposed to allow turbocharged engines to be built with open crankcases, provided the crankcase ventilation system is designed to allow crankcase emissions to be measured. For engines with open crankcases, we would require crankcase emissions to be either routed into the exhaust stream to be included in the exhaust measurement, or to be measured separately and the measured mass added to the measured exhaust mass. For other engines, we proposed to allow manufacturers to close the crankcase by permanently routing the crankcase gases into the exhaust. This proposal was consistent with our previous regulation of crankcase emissions from such diverse sources as highway engines, locomotives and passenger cars.

What Commenters Said:

Caterpillar opposes measuring crankcase emissions in use. They argue that it may cause a malfunction.

LCA stated that our proposed requirement would conflict with the requirement from ABS that crankcase ventilation pipes must be "led to the weather and fitted with a flame screen." EMA stated that crankcase emissions from naturally aspirated engines should not be routed into the exhaust.

Our Response:

We are not requiring crankcases of turbocharged engines to be permanently closed and sealed. Rather, we are requiring that these engines be designed to allow crankcase emissions to be measured. Closing the crankcase is simply one option for complying with this requirement. We have no evidence to dispute Caterpillar's statement that measuring crankcase emissions from current engines may cause a malfunction. However, this problem can be corrected in future engines by adjusting the design to prevent the problem. This is not an inherent feature of marine diesel engines, but rather a design feature of the electronics that can be bypassed or eliminated.

Our requirement to be able to measure crankcase emissions does not necessarily involve any change to the way engines route crankcase vapors, so there is no conflict with ABS requirements. A manufacturer could arrange for measurement of crankcase vapors in the existing vent configuration, or simply route these vapors into the exhaust stream. The crankcase vaports could also be vented in the existing configuration, then routed temporarily into the exhaust stream for measurement.

We agree with EMA that crankcase emissions from naturally aspirated engines should not be routed into the exhaust. Naturally aspirated highway diesel engines have had closed crankcases for years (with crankcase gases routed into the intake air stream), and there is no reason that the same technology will not work as well with marine engines.

D. Fuel Specifications

What We Proposed:

We proposed specifications for test fuels that are consistent with the specifications used for land-based nonroad engines, except that the marine specifications allow for higher sulfur levels. (Note: since the proposed regulations allow for PM correction for testing conducted with fuel sulfur levels over 0.4 weight percent, these fuel specifications are practically equivalent to the land-based specifications.) We proposed no regulation of in-use fuel quality.

What Commenters Said:

Bluewater Network stated that EPA should regulate in-use fuel quality for both propulsion and auxiliary engines. MECA stated that low sulfur fuel would allow the use of catalytic technology to lower PM emissions by 30 percent. STAPPA/ALAPCO and NESCAUM urged EPA to require the use of low sulfur fuel to allow NOx-reducing technologies such as SCR.

Cummins stated that EPA must consider in-use fuel quality in determining feasibility of NTE standards.

ABS stated that EPA's test fuel specifications are not appropriate because the specified flashpoint is below the level specified by international regulations.

Our Response:

Regulation of in-use marine fuels is beyond the scope of what we proposed in this rulemaking. We don't believe that compliance with the Tier 2 emission standards will require the use of catalytic technologies, and thus, we believe that the standards will be feasible without the use of low-sulfur fuel. We may reconsider the need for regulating in-use fuel quality when we review the technical feasibility and appropriateness of land-based nonroad diesel Tier 3 standards.

We agree that fuel quality can affect the feasibility of the standards such as the NTE standards, and have considered fuel effects in determining the feasibility of the new emission standards (see Chapter 4). For engines without catalytic aftertreatment, adverse fuel effects on emissions durability are likely to be the result of corrosion, and thus are also likely to be associated with adverse fuel effects on fuel consumption, reliability and performance. We expect manufacturers to design their engines and establish their recommended maintenance schedules to minimize fuel effects on emissions durability.

We believe our flashpoint specification is acceptable since it is only specifies a minimum level (54° C). Thus fuels with higher flashpoints may be used. In addition, we also allow other fuels to be used where such fuels are demonstrated to be more representative.

E. Allowable Maintenance

What We Proposed:

We proposed allowable maintenance specifications that would limit the amount of maintenance a manufacture could perform during service accumulation for determining emission deterioration rates. The proposed specifications were taken from the recently finalized Part 89 nonroad regulations.

What Commenters Said:

EMA and LCA stated that EPA is not in a position to specify maintenance intervals. Crowley stated that they did not object to the proposed maintenance intervals.

Our Response:

We are not specifying intervals for in-use maintenance. Engine manufacturers will generally be allowed to specify to their customers whatever maintenance they believe is necessary for proper operation of their engines. They may not, however, condition the emission warranty on performing maintenance more frequent than that specified by the regulations. The primary purpose of our minimum maintenance intervals, however, is to prevent engine manufacturers from conducting excessive maintenance during service accumulation for durability testing.

CHAPTER 9 – Environmental and Economic Impacts

A. Cost Analysis

What We Proposed:

For the proposed rule, we presented a detailed analysis estimating the costs of complying with the standards.

What Commenters Said:

EMA commented that the unreasonable stringency of the proposed standards made them infeasible and cost-prohibitive. This was noted as especially difficult because of the high cost burden with such a small number of sales.

Alaska Diesel explained that small businesses would have particular difficulties absorbing the costs of complying with the emission standards.

Haliburton Energy Services related their observation that increased costs escalate as the product moves from the original manufacturer to its eventual final sale to the end user. A $1,000 cost increase in manufacturing can lead to a $10,000 to $24,000 increase in the cost of finished equipment.

Mercury Marine referred to a cost analysis with such high estimated costs that the emission standards would have a cost-effectiveness of greater than $18,000 per ton of NOx+HC reduction.

Our Response:

Our analysis of costs reflects the technology and low sales volumes of the marine engine market. The resulting cost estimates showed that cost increases would be less than 3 percent of the price of a new vessel. We believe this is not cost-prohibitive. No commenter suggested any changes in the methodology or specific inputs to this analysis, so we continue to believe that these costs represent a reasonable burden for meeting emission standards.

We are aware that the burden of complying will be greater for small businesses. For that reason we are adopting provisions to simplify the requirements for these companies, as described in the preamble to the final rule. While small businesses still need to meet the requirements of the final rule, we believe that the simplified approaches will effectively relieve the burden for these companies.

The analysis incorporates a cost markup on the first sale of the engine to reflect overhead and profit for the manufacturer. As described in the Final RIA, we don't believe that vessel builders will have any additional expense to install a compliant engine relative to current practice. This comes primarily from the predominance of custom building in the commercial marine industry. This rule does not impose any additional costs on equipment manufacturers or distributors; unanticipated pricing strategies therefore do not change the reasonableness of the costs of the final rule.

Mercury Marine's analysis was based almost exclusively on the cost impact of controlling emissions from spark-ignition engines, with no attempt to adapt the analysis to commercial marine diesel engines. We were therefore unable to modify the proposed analysis to reflect this information.

B. Emissions Inventory

What We Proposed:

For Category 1 engines we estimated the emissions inventories by summing estimated engine populations in different applications and power ranges in conjunction with estimated average power, load factors, annual usage rates and emission factors. Category 2 and 3 engine emission inventories were developed separately for U.S. flagged and foreign flagged vessels. For U.S. flagged vessels we used ship registry data in conjunction with estimates of daily fuel consumption, fuel specific emission factors, and usage data. Foreign vessel inventories were developed based on cargo movements and waterways data.

What Commenters Said:

Bluewater Network commented that our emissions inventory estimates are somewhat different than those in EPA's Notice of Proposed Finding published February 8, 1999. Bluewater Network also commented that it believes we underestimated Category 2 emissions by assuming that Category 2 engines use only #2 diesel fuel.

LCA took issue with our general statement that per source emission reductions will be outpaced by emission increases due to economic expansion. LCA pointed out that the number of ships in the Great Lakes marine industry has steadily declined and that most efforts are directed at reducing fuel consumption and increasing efficiency.

NMMA and Mercury Marine both commented that they believe our Category 1 recreational emissions inventories are too high. They commented that this was primarily due to an overestimate of annual hours of use for recreational engines.

Our Response:

The discrepancy between the inventories in our CI marine proposal and in the Notice of Proposed Finding can be traced to a mistake that was made in the Notice of Proposed Finding. The CI marine inventory in that document is erroneous and has been corrected in the Final RIA.

The emission factors that were used as a basis for the Category 2 baseline inventories were reported by Lloyd's Register Engineering Services and did, in fact, include data on engines that used heavy fuel. Thus, Bluewater Network's assertion that Category 2 emissions were underestimated due to an assumption that all Category 2 engines use #2 diesel fuel is not accurate.

We do not disagree with LCA's assessment of the Great Lakes marine industry. However, the statement in the preamble concerning emission increases due to economic expansion was a general one which applied to emission sources in general. We believe that, while there may be specific exceptions to this, in general we do expect that the emission increases due to economic expansion will outpace per source reductions. The purpose of that statement was simply to show that further emission reductions (even among sources whose population is not expected to grow significantly) are needed nationally to continue making progress in meeting air quality goals.

We based our recreational inventories based on annual use data supplied to us by EMA. In the absence of additional data on use rates we will continue to use the information supplied by EMA. However, we are addressing recreational engine emissions in a separate rulemaking action. If NMMA and Mercury Marine wish to develop and submit additional use data we will consider it in the context of that rulemaking effort.

CHAPTER 10 – Other Issues

A. Post-Manufacture Marinizers

Post-manufacture marinizers are those companies that buy complete, or nearly complete, engines from engine manufacturers for conversion to a marine engine. Many of these are small businesses. We proposed some provisions that would be specific to these companies.

1. Defining worst-emitter

What We Proposed:

We proposed a provision for marinizers to reduce their testing burden by combining all their engine models into a single family for certification. The marinizer would then test the one engine model representing the worst-emitting configuration and base the certification of all its engines on the one test engine.

What Commenters Said:

Alaska Diesel raised a concern about the marinizer provision that would allow combining all of their engines into one large engine family for certification purposes. They note that some of their machines are used only for electric power generation, while some are used for power generation and propulsion. A "worst emitter" that is only used for power generation should not be considered as a representative of propulsion engines as well. In addition, the emissions profile of a generator set engine could be significantly different than the emissions profile of the same engine when it is in service as a propulsion engine. Therefore, marinizers may be forced to split into subfamilies as generator set, fixed pitch propulsion, variable pitch and waterjet engines to provide valid criteria for certification.

Alaska Diesel also requested some clarification of how to make the single engine family concept work, in terms of "rules of thumb" for establishing the worst emitter, test procedures that will allow at least a ballpark estimation of emissions levels, and what to do in the event of an emissions test failure. Alaska Diesel also noted that the single family concept would preclude the use of the ABT program for these engines. They wanted to know if there is an option for multiple families to be generated and, if so, what are the advantages and disadvantages of such a system.

Our Response:

We depend on manufacturers accepting liability for the highest-emitting engines in a family as the only way to be sure that all the engines covered by a certificate of conformity comply with the emission standards. We understand that the proposed provision for marinizers to combine very different engine models into a single, all-encompassing engine family makes this more difficult than in other programs. We can suggest some guidelines for identifying worst-emitter engines without the expense of conducting a full emission test on each engine calibration of each model.

Marinizers can utilize low-cost equipment and a simple procedure to routinely measure parts per million (ppm) levels of gaseous pollutants. We expect that every company operates most or all production engines for quality control 5purposes, probably with a small number of fixed cycles. Measuring for NOx emissions during that time provides an additional diagnostic for engine performance, and should provide a good benchmark for comparing emission levels across the product line. Measured ppm NOx readings should correlate closely with NOx emission levels from a full certification test. Conversely, the lowest measured NOx emissions (or highest CO emissions) are an indication of the worst PM emitter. This strategy should provide a lot of information at very low cost. If a post-manufacture marinizer certifies using a single engine family under this provision, it needs to send in test data only from a single duty cycle on a single engine, but it remains liable for all pollutants on all engines in the family, with any applicable duty cycle.

As described in Chapter 7, in making the selection of worst-case, the manufacturer should consider the proximity of each engine's expected emissions over the its useful life for each constituent with the applicable standards. The engine producing the regulated constituent which is closest to the applicable standards compared to all other regulated constituents (i.e., most likely to fail an emission standard) should be chosen as the “worst-case” engine. A separate "worst-case" determination is not made for each regulated constituent.

This guidance suggests a possible means by which a post-manufacture marinizer can limit the testing burden in the effort to certify broad engine families where it may not be apparent which engine to test. If this does not address a marinizer’s concerns, the remaining alternative is to certify each engine family, using the standard engine-family definition.

A marinizer wanting to generate emission credits would have to certify all engines to a level below the emission standard, or would have to subdivide the engines into more than one family. Subdividing engine families would defeat the purpose of allowing combined engine families. Moreover, because of the smaller sales volumes and product offerings for marinizers, we do not expect them to significantly benefit from the averaging, banking, and trading program.

2. Catalysts

What Commenters Said:

Alaska Diesel requested that we provide some specific provisions to consider engine emission control systems such as catalytic converters and soot traps, and how they might be applied to bring engine emissions levels to acceptable levels, or potentially well below those levels.

Our Response:

Catalysts might be added to engines before or after the engines are certified to meet the requirements of Part 94. Certified engines may be modified for higher engine-out HC levels to make the catalyst work, but final emission levels should be significantly lower. There are a variety of possible scenarios that call for differing treatment.

If an engine is already marine-certified, someone else adding a catalyst, but not making other changes that could increase emissions, would be subject to anti-tampering provisions, but would not need to recertify the engine. This means that someone may add a catalyst as long as there is a basis for showing that emissions will not increase as a result of the change.

If an engine is not marine certified, an engine manufacturer or marinizer would need to certify it to the requirements of 40 CFR Part 94. The engine could be in a new engine family or could be part of a bigger engine family, as described above. The certifier would not necessarily need test data on that engine for certification if it is part of a bigger engine family, but would be liable for emissions of all pollutants for the full useful life of that engine.

A company could add a catalyst as part of marinizing an engine with a land-based certificate and still use the engine dressing exemption only by meeting all the dressing criteria. This includes not doing anything to increase emissions, so manipulating engine-out HC levels would call for full marine certification. There are two possible options for someone manipulating engine-out HC levels on an engine. First , recertifying the engine to marine emission standards is acceptable. Second, if the engine already has a marine certificate, you may choose not to recertify the engine if you have data showing that the engine’s net emission of each pollutant have not increased as a result of the changes.

3. Importing uncertified base engines.

We finalized the nonroad diesel rule with no allowance to import uncertified nonroad engines that will be changed into a marine engine. We recognize there may be a legitimate need to import these engines to produce unregulated marine engines. The regulations now include a provision for post-manufacture marinizers to import these engines.

4. Conversion Kits

What Commenters Said:

Although no one submitted formal written comments on this issue, we learned during our outreach efforts of at least one company who produces conversion kits, to convert existing land-based diesel engines to marine diesel engines, by providing a water-cooled manifold and new bell housing to accept a marine transmission. This person wanted to know how this rule will affect his business.

Our Response:

As noted earlier in this Summary and Analysis of comments, all new marine diesel engines must be certified as meeting these domestic emission limits beginning with their starting date. A land-based diesel engine that is converted to a marine application is considered to be a "new" marine diesel engine for the purpose of this emission control program, and it will have to be certified as meeting the emission limits before it can be sold for marine purposes. Consequently, converters who use these kits to convert land-based diesel engines must either certify the converted engines or be classified as an engine dresser pursuant to the engine dresser provisions contained in our final rule. Meeting the engine dressing criteria will be contingent on whether or not the kit modifies the engine in any way that may affect engine emissions and on whether the base engine was already certified to at least as stringent a level of control. Manufacturers of the kits are encouraged to inform these converters of this fact whey then purchase the kit. If there is sufficient interest in the future, we may adopt an alternative program in which we certify conversion kits, as we currently do for our urban bus program.

B. Energy, Noise, and Safety

What We Proposed:

In the Draft Regulatory Impact Analysis we stated that we did not expect the proposed regulations to result in any safety issues because we expected that manufacturers would only use proven technologies adapted from land-based nonroad and highway applications. In the proposal we determined that noise and energy impacts also did not affect our conclusion that the emission standards were feasible and appropriate.

What Commenters Said:

Crowley stated that it is important that engine designs not sacrifice reliability for reduced emissions, pointing out that reliability enables safe operation. EMD stated that engine failures could be a safety issue, pointing out that an engine failure would result in loss of vessel control that could result in property or environmental damage.

We received no comments on our assessment of that the new emission standards would have little or no effect on energy and noise concerns.

Our Response:

We agree that the final emission standards for commercial CI marine engines should in no way compromise their reliability and thus, their safety. We note that, while both Crowley and EMD suggested that reliability should not be compromised, neither suggested that the proposed standards would result in reduced reliability. We continue to believe that manufacturers will use only proven technologies adapted from land-based nonroad and highway applications, and that reliability and safety will not be compromised as a result of the standards.

C. Aftermarket Parts

What We Proposed:

We did not propose specific requirements regarding aftermarket parts.

What Commenters Said:

EMD argued that manufacturers should not be responsible for the emissions performance of engines using aftermarket parts, and that we should require certification of aftermarket parts. LCA wants to be sure that aftermarket parts remain available. EMA commented that manufacturers should not be liable for emission failures caused by another manufacturer's aftermarket parts.

Our Response:

We recognize LCA's concern about the availability of aftermarket parts, and do not intend for this rulemaking to result in any competitive disadvantage for aftermarket parts suppliers. However, we also share EMD's concern about the potential for adverse emission impacts caused by faulty replacement parts. At this time, we believe that these conflicting concerns are best balanced by the anti-tampering provisions in the regulations. An engine owner choosing to use non-OEM replacement parts is expected to have a reasonable basis for believing that the parts will not degrade the emissions performance of the engine. Thus, engine owners would also be prohibited from using parts known to adversely impact the emissions performance of the engine. We will monitor this issue to be sure that anti-tampering provisions adequately address this concern.

D. Environmental Justice

What We Proposed:

We proposed no special provisions for different treatment in any individual regions, areas, or neighborhoods. The proposed emission standards would apply nationwide regardless of location.

What Commenters Said:

Bluewater Network called on us to analyze marine emissions (especially particulate matter) for potential effects on low-income and minority neighborhoods near commercial ports. This was noted as an additional reason for controlling sulfur levels in marine fuel. Bluewater also stated that we failed to provide for adequate public participation of affected communities.

Our Response:

By setting technology-forcing emission standards, we are taking an important step toward reducing emissions in all areas, including low-income and minority neighborhoods. For the purposes of this rulemaking, we believe it is not necessary to perform an analysis of impacts on individual communities or to provide for additional public participation. We are not regulating fuel sulfur levels for the reasons in the Chapter 6 discussion of fuel specifications.

E. Prohibited Acts - Tampering

What We Proposed:

EPA proposed to prohibit a person from removing or rendering inoperative a device or element of design installed on or in an engine in compliance with regulations under this part, or to set any adjustable parameter to a setting outside of the range specified by the manufacturer, as approved in the application for certification by the Administrator.

What Commenters Said:

ABS noted that this requirement would appear to require an engine to meet the requirements of 40 CFR Part 94 at all times, including those times when it is outside U.S. waters.

Our Response:

It is true that our anti-tampering provisions have the practical effect of preventing engine changes even when engines and vessels are outside of U.S. waters. We find the implications of the ABS comment unclear, in that it implies that ship engineers will adjust engines out of compliance once a ship exits U.S. domestic waters. While we are aware that ship engineers modify engine parameters to meet the requirements of specific sea conditions or, in the case of Category 3 engines, fuel characteristics, this can be done in the context of the emission control requirements since both MARPOL Annex VI and this domestic emission control program allow manufacturers to certify engines with adjustable parameters. Engine certified in this way are required to meet the requirements over the full range of adjustments. We believe it is very important for engines to stay in compliance at all times, not only because of the environmental benefits but also because it is not clear if there are emissions impacts of adjusting engines in and out of compliance at the U.S. domestic waters frontier.

At the same time, we are aware that there are situations in which it may be critical for safety reasons to disable an engine's emission control system or adjust it outside of compliance parameters. In these situations, we will allow the engine to be brought temporarily out of compliance. However, we will also require that the engine is brought back into compliance as soon as possible after the emergency is over.

We address additional issues related to tampering under the Engine Dressing Exemption in Chapter 2 and under Post-Manufacture Marinizers in this Chapter.

F. Preemption

What We Proposed:

We did not propose any specific provisions relating to preemption of state requirements for commercial CI marine engines.

What Commenters Said:

Manson Construction asked whether state controls beyond the federal controls adopted by EPA would be preempted.

Our Response:

The preemption of state and local emission controls is addressed in section 209 of the Clean Air Act and in 40 CFR Part 85, Subpart Q. The regulations generally preempt state and local emission standards and other requirements for new and used nonroad engines (including commercial CI marine engines), but also allow states to obtain a waiver from this provision. Refer to 40 CFR Part 85, Subpart Q for more information about these requirements.

G. Competitiveness

What We Proposed:

We proposed to set emission standards for Category 1 and Category 2 marine diesel engines on U.S.-flagged commercial vessels.

What Commenters Said:

AWO, the Chamber of Shipping, Crowley, and the Lake Carriers Association commented that we should not do anything to provide a competitive advantage to locomotive or highway transport relative to marine. They raised the possibility of total emissions increasing if the cost of buying or operating new low-emitting marine engines would shift freight to less efficient modes.

The Lake Carriers Association, the Transportation Institute, and EMA commented that domestic operators are competing with foreign-flagged carriers who may see a competitive advantage over U.S.-flagged operations because they do not need to use engines meeting EPA emission standards.

The Bluewater Network emphasized that technology-forcing standards for Category 3 engines would potentially cause a small shift to other modes of transport, but that the overall costs associated with low-emission engines were small enough that there should not be a great effect.

The USS Great Lakes Fleet commented that setting standards that depart from international requirements could limit the availability of compliant engine models. They related that the engines currently available on their vessels are constructed worldwide, with the observation that these engines would not likely be redesigned for the relatively small U.S. market. The Lake Carriers Association added similarly that there are no licensed engine builders in the U.S. and none that have expertise in designing and building marine diesel engines, which forces them to look to the international market for their engines.

Our Response:

We present a full analysis of the economic impacts of the new emission standards in the Final RIA. The commenters did not agree or disagree with the estimates in the Draft RIA. Based on our assessment of the costs associated with low-emitting engines, we do not believe there will be any effect on any company's ability to operate in a competitive market. The estimated cost increase for new engines is at most 3 percent of the price of a new vessel and is usually much less. The new emission standards apply to new engines and do not affect vessels or engines already placed into service, so companies incur these costs gradually as they modernize their fleet. Furthermore, companies amortize the cost of purchasing vessels over several years, so any calculation of cost increase per ton of freight or hour of operation would be a very small number.

Some new engines meeting emission standards may have an increase in fuel consumption. Here too, under the scenarios considered in the Final RIA, any increase in costs will be dwarfed by the expenses for maintaining a crew and operating all the systems onboard the vessel.

We agree that no U.S.-based companies produce Category 3 engines and that engine availability may be an issue for setting domestic emission standards for these engines. For Category 2 engines, however, there are manufacturers that intend to supply engines across the whole range of power ratings that would be affected by the new emission standards.

H. Defect Reporting

What We Proposed:

We proposed to require engine manufacturers to report to us if they become aware of a significant number of emission-related defects. For Category 1 engines, a significant number would mean a defect occurring in 25 or more engines. For Category 2 engines, a significant number would mean a defect occurring in 10 or more engines.

What Commenters Said:

ABS commented that engine manufacturers may not become aware of all emission-related defects, and that the trigger levels may never be reached due to low production volumes.

Our Response:

We recognize that manufacturers may not become aware of all emission-related defects. Nevertheless, we continue to believe that there is value in having manufacturers report the defects of which they do become aware. On the other hand, we believe that it could become burdensome to require manufactures to report every defect. The numbers chosen represent a compromise, and are the same as those used for the comparable land-based programs (i.e., 25 engines for general land-based nonroad engines, and 10 engines for locomotives). It is also important to emphasize that these limits apply to the occurrence of the same defect, and are not constrained by engine family or model year. For example, if a manufacturer becomes aware of an emission-related defect in a specific fuel injector design that has been used in three different engine families for four model years, then the manufacturer must report the defect if the combined number of occurrences in the three families and four model years exceeds the specified limit. Thus, these requirements can be meaningful for engine families with small annual production volumes.

I. Gas Turbine Engines

What We Proposed

We requested comment on whether gas turbine engines should be included in this emission control program

What Commenters Said

ABS noted that gas turbines represent only an extremely limited portion of the power units installed in merchant ships. In terms of the pollutants covered by this control program, gas turbines are not significant emitters. As NOx emissions are reduced to below 5 g/kW-hr, it would then be appropriate to consider including gas turbines. At that time, it will be necessary to determine how to measure their emissions, however, since there is currently no global approach.

Our Response:

We will consider regulation of gas turbine marine engines in a later rulemaking.

J. Classified Information

What We Proposed

We proposed to take our conventional approach for handling confidential business information.

What Commenters Said

The Navy requested that we make an explicit accommodation for classified military information that may fall under the reporting requirements of the final rule.

Our Response:

The provisions in the final rule regarding disclosure of information restrict how we release documents to the public. Therefore, expanding these provisions to restrict access to classified information would only serve to regulate EPA staff. This is not needed, because the statutory requirements regulating disclosure of classified information already apply. In any case involving classified information, we intend to fully comply with these requirements.

K. Miscellaneous Issues

In an appendix to their comments, EMA submitted 12 pages of specific comments on the proposed regulatory text. Many of these comments that requested only clarification or other minor revision were incorporated into the final regulations and are not discussed further here. The others are discussed briefly here, or are discussed elsewhere in this document.

Comment: EMA suggested that we change our definition of compression-ignition (CI) to include natural gas-fueled engines that are derived from CI engines, but use throttles and/or spark plugs.

Response: We believe that the proposed definition of compression-ignition does include natural gas-fueled engines. This is because the definition only requires that an engine be significantly similar to the theoretical Diesel cycle. We intended this language to cover a broad range of engines, not simply traditional diesel-fueled engines. The part of the definition that states that the non-use of a throttle is indicative of a CI engine is intended only as general guidance; it does not mean that an engine using a throttle over part of its operating range cannot be considered a CI engine. In fact, all of the natural gas-fueled marine engines that we are currently aware of (even those which are partially throttled) are sufficiently similar to the theoretical Diesel cycle to be considered compression-ignition.

Comment: EMA commented that it did not understand the use of the phrase "or other control feature that reduces the efficiency of the emission control system" in the definition of "defeat device".

Response: We included the phrase "or other control feature that reduces the efficiency of the emission control system" in the definition of "defeat device" to clarify that Section 203(a)(3)(B) broadly prohibits features in engine controls that would make emission controls less effective under in-use conditions than they are under testing conditions. This language was used for the same reasons in the locomotive regulations of 40 CFR Part 92.

Comment: EMA requested clarification regarding whether we intended to exclude auxiliary engines from the definition of "recreational".

Response: We are excluding auxiliary engines from the definition of "recreational" because we believe that the vessel manufacturer issues related to propulsion engines on recreational vessels do not apply to auxiliary engines, and manufacturers do not make special noncommercial auxiliary engines for recreational vessels. Therefore, we will treat all diesel auxiliary engines the same.

Comment: EMA stated that the definition of "specific emissions" is incorrect because the units of specific emissions are unit mass per unit work.

Response: The definition of "specific emissions" is correct, because it merely states that they are based on observed power. The actual measurements are made by measuring the steady-state emission rate (g/hr) and dividing by the measured the steady-state engine power output (kW). Thus, while the denominator of the specific emissions has units of work (kW-hr), specific emissions are actually determined on the basis of observed power, rather than work.

Comment: EMA requested clarification of §94.6(b).

Response: That paragraphs states that "the point at which an engine or vessel becomes subject to the regulations of this part is determined by the definition of new marine engine and new marine vessel". It does not state that the engine is only subject to the regulations when it is new. The purpose of this paragraph is to refer the reader to provisions in the regulations that affect applicability, but which might not be obvious to the reader.

Comment: EMA stated that §94.7(c) is inconsistent with §94.205(a)(1).

Response: We agree and are removing from §94.205(a)(1) everything except a cross-reference to §94.7(c).

Comment: EMA stated that we do not specify what fuel parameters need to be reported under §94.108(a)(3) and (b)(2). They also stated that others rules do not require reporting of fuel properties.

Response: EMA is incorrect in stating that we do not require reporting of fuel properties in other rules. In fact, we require it in all other mobile source rules. The manufacturer is required to report those properties for which there are specifications in the regulations.

Comment: EMA asked why we are not allowing fuel sulfur correction for engines with aftertreatment.

Response: We are not allowing the correction to be used for engines with aftertreatment because the correction equation is valid only for engines without aftertreatment. We are not aware of any correction equation that is generally valid for engines with aftertreatment.

Comment: EMA opposed some of the requirements in §94.203(d) to provide information in the application because it is burdensome, not required by other rules, and may contain confidential information. They also opposed the requirement in §94.213(b) to provide information about the engine coding system.

Response: These requirements are essentially the same as are required for locomotives. The proposed marine regulations also contain the same language (§94.203(g)) as the locomotive regulations that allow us to modify the requirements to allow manufacturers to provide less information in the application. Thus, the regulations provide us the flexibility to avoid making the application unnecessarily burdensome. Our proposed certification procedure also allows for special treatment of confidential business information.

Comment: EMA opposes the inclusion of combustion cycle as an engine family discriminator for Category 2 engines.

Response: We included combustion cycle as an engine family discriminator for Category 2 engines to be consistent with the locomotive certification program. Inclusion of combustion cycle will not affect the certification process.

Comment: EMA commented on the criteria for using special and alternate test procedures under §94.207. They stated that the different requirements were confusing.

Response: EMA mistakenly assumed that special and alternate test procedures are the same. In fact, they are very different. Special test procedures are specified by us, where the normal test procedures cannot be used. They would generally differ from normal test procedures in some fundamental respect. Use of special test procedures is relatively rare. Alternate test procedures, on the other hand, must be "shown to yield equivalent results." Alternate test procedures, which are relatively common, generally differ from the specified test procedures only with respect to the equipment used.

Comment: EMA commented on §94.211(a)(2) stating that we should specify the recordkeeping required for maintenance performed by engine owners.

Response: The purpose of this requirement is to make sure that engine owners are fully aware of the requirements upon which manufacturers will condition their emission warranty. We believe that this is best determined by the manufacturer, subject to our approval for reasonableness.

Comment: EMA commented that we should not limit the applicability of §94.211(e)(2)(ii) to Category 2 engines.

Response: We included that provision, which allows for more frequent maintenance during service accumulation, for Category 2 engines because we believe that the otherwise specified maintenance intervals may not appropriate for engines derived from locomotives. The specified intervals are the same as those that apply to general nonroad engines under Part 89. Thus, since most Category 1 marine engines are derived from nonroad engines regulated under Part 89, we are confident that the specified maintenance intervals are appropriate for them. Category 2 marine engines, on the other hand, are generally derived from locomotive engines regulated under Part 92, which does not contain specifications for maintenance intervals or service accumulation.

Comment: EMA commented that we should allow a tolerance of 50 hours for the maintenance intervals of §94.211(e)(3) and (4).

Response: We do not believe that this is necessary because the regulations merely specify minimum intervals. Thus, a manufacturer that needs such tolerance can target maintenance at 1550 hours to be sure that it complies with the 1500-hour minimum.

Comment: EMA argued that we should allow credits to be traded in the same year as they are generated.

Response: We do not allow credits to be traded in the same year as they are generated because the credit program is based on actual end-of-year sales. Allowing otherwise would increase the likelihood that there would be credit shortfalls at the end of the year because of inaccurate projection of engines sales.

L. Additional Changes from the Proposal

Most of the changes in the final rule are directly in response to the comments we received. We identified a few additional changes that were necessary for a variety of reasons, as described in the following paragraphs.

The text of 40 CFR Part 89 for land-based nonroad engines exempts marine engines from the requirements of that part. This final rule is changing the definition of marine engines to include those that are "intended" to be installed on a marine vessel. This is necessary to allow post-manufacture marinizers to import loose engines for marinizing. We also corrected an inadvertent error in the definition of new from 40 CFR Part 89.

We are including additional flexibility for compliance with locomotive emission standards by allowing the possibility of an alternate program for production line testing.

The final rule includes additional exemptions. The manufacturer-owned exemption allows a company to do development work on an engine, provided the engine is not sold or used in revenue-generating service. We are also including an exemption for incomplete marine engines, which allows a post-manufacture marinizer to import an uncertified base engine for marinizing in a way that complies with emission standards. Once emission standards apply, a marinizer importing such engines must already have a certificate showing that the engine is part of a certified engine family. The regulations also obligate the marinizer to modify all the imported engines to comply with the requirements of 40 CFR Part 94.

The requirements for engine labeling include five additional items. All the additional labeling information is needed to aid in enforcing the requirements of this final rule. First, the final rule requires that any Blue Sky Series engines include identifying information on the label; this is consistent with the provisions for land-based nonroad engines. Second, manufacturers need to identify the range of duty cycles that apply to an engine family to help us know if an engine has a valid certificate for each particular configuration or application. Third, engines that can be modified to run on heavy fuel, but are not certified to meet the emission standards on heavy fuel, must have a label saying that it is not acceptable to modify the engine for this alternate fuel. Fourth, engines that qualify for the foreign-trade exemption need a label identifying them as exempt. Finally, imported engines that are exempt from 40 CFR Part 94 for any reason must have a label showing which exemption applies; this will help importers avoid difficulties with customs inspections.

The rebuild requirements now make a distinction between people who conduct a rebuild and those who simply install rebuilt engines. The proposed rule would have placed all the responsibilities for repair, recordkeeping, etc. on someone who installed the rebuilt engine without doing the maintenance or service.