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Control of Emissions of Air Pollution From Locomotive Engines and Marine Compression-Ignition Engines Less Than 30 Liters per Cylinder; Proposed Rule

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 92, 94, 1033, 1039, 1042, 1065 and 1068

[EPA–HQ–OAR–2003–0190; FRL–8285–5]

RIN 2006–AM06

Control of Emissions of Air Pollution From Locomotive Engines and Marine Compression-Ignition Engines Less Than 30 Liters per Cylinder

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule.

SUMMARY: Locomotives and marine diesel engines are important contributors to our nation's air pollution today. These sources are projected to continue to generate large amounts of particulate matter (PM) and nitrogen oxides (NO_X) emissions that contribute to nonattainment of the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$ and ozone across the United States. The emissions of PM and ozone precursors from these engines are associated with serious public health problems including premature mortality, aggravation of respiratory and cardiovascular disease, aggravation of existing asthma, acute respiratory symptoms, chronic bronchitis, and decreased lung function. In addition, emissions from locomotives and marine diesel engines are of particular concern, as diesel exhaust has been classified by EPA as a likely human carcinogen.

EPA is proposing a comprehensive program to dramatically reduce emissions from locomotives and marine diesel engines. It would apply new exhaust emission standards and idle reduction requirements to diesel locomotives of all types—line-haul, switch, and passenger. It would also set new exhaust emission standards for all types of marine diesel engines below 30 liters per cylinder displacement. These include marine propulsion engines used on vessels from recreational and small fishing boats to super-yachts, tugs and Great Lakes freighters, and marine auxiliary engines ranging from small gensets to large generators on ocean-going vessels. The proposed program includes a set of near-term emission standards for newly-built engines. These would phase in starting in 2009. The near-term program also contains more stringent emissions standards for existing locomotives. These would apply when the locomotive is remanufactured and would take effect as soon as certified remanufacture systems are available (as early as 2008), but no later than 2010 (2013 for Tier 2 locomotives). We are requesting comment on an alternative under consideration that would apply a similar requirement to existing marine diesel engines when they are remanufactured. We are also proposing long-term emissions standards for newly-built locomotives and marine diesel engines based on the application of high-efficiency catalytic aftertreatment technology. These standards would phase in beginning in 2015 for locomotives and 2014 for marine diesel engines. We estimate PM reductions of 90 percent and NO_X reductions of 80 percent from engines meeting these standards, compared to engines meeting the current standards.

We project that by 2030, this program would reduce annual emissions of NO_X and PM by 765,000 and 28,000 tons, respectively. These reductions are estimated to annually prevent 1,500 premature deaths, 170,000 work days lost, and 1,000,000 minor restricted-activity days. The estimated annual monetized health benefits of this rule in 2030 would be approximately $12 billion, assuming a 3 percent discount rate (or $11 billion assuming a 7 percent discount rate). These estimates would be increased substantially if we were to adopt the remanufactured marine engine program concept. The annual cost of the proposed program in 2030 would be significantly less, at approximately $600 million.

DATES: Comments must be received on or before July 2, 2007. Under the Paperwork Reduction Act, comments on the information collection provisions must be received by OMB on or before May 3, 2007.

ADDRESSES: Submit your comments, identified by Docket ID No. EPA–HQ–OAR–2003–0190, by one of the following methods:

- *www.regulations.gov*: Follow the on-line instructions for submitting comments.
- *Fax:* (202) 566–1741
- *Mail:* Air Docket, Environmental Protection Agency, *Mailcode:* 6102T, 1200 Pennsylvania Ave., NW., Washington, DC 20460. In addition, please mail a copy of your comments on the information collection provisions to the Office of Information and Regulatory Affairs, Office of Management and Budget (OMB), *Attn:* Desk Officer for EPA, 725 17th St., NW., Washington, DC 20503.
- *Hand Delivery:* EPA Docket Center, (EPA/DC) EPA West, Room 3334, 1301 Constitution Ave., NW, Washington DC, 20004. Such deliveries are only accepted during the Docket's normal hours of operation, and special arrangements should be made for deliveries of boxed information.

Instructions: Direct your comments to Docket ID No. EPA–HQ–OAR–2003–0190. EPA's policy is that all comments received will be included in the public docket without change and may be made available online at *http://www.regulations.gov*, including any personal information provided, unless the comment includes information claimed to be Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Do not submit information that you consider to be CBI or otherwise protected through *http://www.regulations.gov* or e-mail. The *http://www.regulations.gov* Web site is an ''anonymous access'' system, which means EPA will not know your identity or contact information unless you provide it in the body of your comment. If you send an e-mail comment directly to EPA without going through *http://www.regulations.gov* your e-mail address will be automatically captured and included as part of the comment that is placed in the public docket and made available on the Internet. If you submit an electronic comment, EPA recommends that you include your name and other contact information in the body of your comment and with any disk or CD–ROM you submit. If EPA cannot read your comment due to technical difficulties and cannot contact you for clarification, EPA may not be able to consider your comment. Electronic files should avoid the use of special characters, any form of encryption, and be free of any defects or viruses. For additional information about EPA's public docket visit the EPA Docket Center homepage at *http://www.epa.gov/epahome/dockets.htm*. For additional instructions on submitting comments, go to section I.A. of the **SUPPLEMENTARY INFORMATION** section of this document, and also go to section VIII.A. of the Public Participation section of this document.

Docket: All documents in the docket are listed in the *http://www.regulations.gov* index. Although listed in the index, some information is not publicly available, e.g., CBI or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, will be publicly available only in hard copy. Publicly available docket materials are available either electronically in *http://www.regulations.gov* or in hard copy at the EPA–EQ–OAR–2003–0190 Docket, EPA/DC, EPA West, Room 3334, 1301 Constitution Ave., NW., Washington, DC. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566–1744, and the telephone number for the EPA–EQ–OAR–2003–0190 is (202) 566–1742.

Hearing: Two hearings will be held, at 10 a.m. on Tuesday, May 8, 2007 in Seattle, WA, and at 10 a.m. on Thursday, May 10, 2007 in Chicago, IL. For more information on these hearings or to request to speak, see section VIII.C. ''WILL THERE BE A PUBLIC HEARING.''

FOR FURTHER INFORMATION CONTACT: John Mueller, U.S. EPA, Office of Transportation and Air Quality, Assessment and Standards Division (ASD), Environmental Protection Agency, 2000 Traverwood Drive, Ann Arbor, MI 48105; *telephone number:* (734) 214–4275; *fax number:* (734) 214–4816; *e-mail address: Mueller.John@epa.gov*, or Assessment and Standards Division Hotline; telephone number: (734) 214–4636.

SUPPLEMENTARY INFORMATION:

General Information

♦ *Does This Action Apply to Me?*

♦ Locomotive

Entities potentially regulated by this action are those which manufacture, remanufacture and/or import locomotives and/or locomotive engines; and those which own and operate locomotives. Regulated categories and entities include:

Category	NAICS Code [1]	Examples of potentially affected entities
Industry	333618, 336510	Manufacturers, remanufacturers and importers of locomotives and locomotive engines.
Industry	482110, 482111, 482112	Railroad owners and operators.
Industry	488210	Engine repair and maintenance.

[1] North American Industry Classification System (NAICS).

This table is not intended to be exhaustive, but rather provides a guide for readers regarding entities likely to be regulated by this action. This table lists the types of entities that EPA is now aware could potentially be regulated by this action. Other types of entities not listed in the table could also be regulated. To determine whether your company is regulated by this action, you should carefully examine the applicability criteria in 40 CFR sections 92.1, 92.801, 92.901, 92.1001, 1065.1, 1068.1, 85.1601, 89.1, and the proposed regulations. If you have questions, consult the person listed in the preceding **FOR FURTHER INFORMATION CONTACT** section.

♦ Marine

This proposed action would affect companies and persons that manufacture, sell, or import into the United States new marine compression-ignition engines, companies and persons that rebuild or maintain these engines, companies and persons that make vessels that use such engines, and the owners/operators of such vessels. Affected categories and entities include:

Category	NAICS Code [1]	Examples of potentially affected entities
Industry	333618	Manufacturers of new marine diesel engines.
Industry	33661 and 346611	Ship and boat building; ship building and repairing.
Industry	811310	Engine repair, remanufacture, and maintenance.
Industry	483	Water transportation, freight and passenger.
Industry	336612	Boat building (watercraft not built in shipyards and typically of the type suitable or intended for personal use).

[1] North American Industry Classification System (NAICS).

This table is not intended to be exhaustive, but rather provides a guide for readers regarding entities likely to be regulated by this action. This table lists the types of entities that EPA is now aware could potentially be regulated by this action. Other types of entities not listed in the table could also be regulated. To determine whether your company is regulated by this action, you should carefully examine the applicability criteria in 40 CFR 94.1, 1065.1, 1068.1, and the proposed regulations. If you have questions, consult the person listed in the preceding **FOR FURTHER INFORMATION CONTACT** section.

♦ *Additional Information About This Rulemaking*

♦ Locomotive

The current emission standards for locomotive engines were adopted by EPA in 1998 (see 63 FR 18978, April 16, 1998). This notice of proposed rulemaking relies in part on information that was obtained for that rule, which can be found in Public Docket A–94–31. That docket is incorporated by reference into the docket for this action, OAR–2003–0190.

♦ Marine

The current emission standards for new commercial marine diesel engines were adopted in 1999 and 2003 (see 64 FR 73300, December 29, 1999 and 66 FR 9746, February 28, 2003). The current emission standards for new recreational marine diesel engines were adopted in 2002 (see 67 FR 68241, November 8, 2002). The current emission standards for marine diesel engines below 37 kW (50 hp) were adopted in 1998 (see 63 FR 56967, October 23, 1998). This notice of proposed rulemaking relies in part on information that was obtained for those rules, which can be found in Public Dockets A–96–40, A–97–50, A–98–01, A–2000–01, and A–2001–11. Those dockets are incorporated by reference into the docket for this action, OAR–2003–0190.

♦ Other Dockets

This notice of proposed rulemaking relies in part on information that was obtained for our recent highway diesel and nonroad diesel rulemakings, which can be found in Public Dockets A–99–06 and A–2001–28 (see also OAR 2003–

0012).[1 2] Those dockets are incorporated by reference into the docket for this action, OAR–2003–0190.

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I. Overview

This proposal is an important step in EPA's ongoing National Clean Diesel Campaign (NCDC). In recent years, we have adopted major new programs designed to reduce emissions from highway and nonroad diesel engines.[3] When fully implemented, these new programs would largely eliminate emissions of harmful pollutants from these sources. This Notice of Proposed Rulemaking (NPRM) sets out the next step in this ambitious effort by addressing two additional diesel sectors that are major sources of air pollution nationwide: locomotive engines and marine diesel engines below 30 liters per cylinder displacement.[4] This addresses all types of diesel locomotives— line-haul, switch, and passenger rail, and all types of marine diesel engines below 30 liters per cylinder displacement (hereafter collectively called ''marine diesel engines.''). These include marine propulsion engines used on vessels from recreational and small fishing boats to super-yachts, tugs and Great Lakes freighters, and marine auxiliary engines ranging from small gensets to large generators on ocean-going vessels.[5]

Emission levels for locomotive and marine diesel engines remain at high levels—comparable to the emissions standards for highway trucks in the early 1990s—and emit high level of pollutants that contribute to unhealthy air in many areas of the U.S. Nationally, in 2007 these engines account for about 20 percent of mobile source NO_X emissions and 25 percent of mobile source diesel $PM_{2.5}$ emissions. Absent new emissions standards, we expect overall emissions from these engines to remain relatively flat over the next 10 to 15 years due to existing regulations such as lower fuel sulfur requirements and the phase-in of locomotive and marine diesel Tier 1 and Tier 2 engine standards but starting in about 2025 emissions from these engines would begin to grow. Under today's proposed program, by 2030, annual NO_X emissions from locomotive and marine diesel engines would be reduced by 765,000 tons and $PM_{2.5}$ and 28,000 tons. Without new controls, by 2030, these engines would become a large portion of the total mobile source emissions inventory constituting 35 percent of mobile source NO_X emissions and 65 percent of diesel PM emissions.

We followed certain principles when developing the elements of this proposal. First, the program must achieve sizeable reductions in PM and NO_X emissions as early as possible. Second, as we did in the 2007 highway diesel and clean nonroad diesel programs, we are considering engines and fuels together as a system to maximize emissions reductions in a highly cost-effective manner. The groundwork for this systems approach was laid in the 2004 nonroad diesel final rule which mandated that locomotive and marine diesel fuel comply with the 15 parts per million sulfur cap for ultra-low sulfur diesel fuel (ULSD) by 2012, in anticipation of this rulemaking (69 FR 38958, June 29, 2004). The costs, benefits, and other impacts of the locomotive and marine diesel fuel regulation are covered in the 2004 rulemaking and are not duplicated here. Lastly, we are proposing standards and implementation schedules that take full advantage of the efforts now being expended to develop advanced emissions control technologies for the highway and nonroad sectors. As discussed throughout this proposal, the proposed standards represent a feasible progression in the application of advanced technologies, providing a cost-effective program with very large public health and welfare benefits.

The proposal consists of a three-part program. First, we are proposing more stringent standards for existing locomotives that would apply when they are remanufactured. The proposed remanufactured locomotive program would take effect as soon as certified remanufacture systems are available (as early as 2008), but no later than 2010 (2013 for Tier 2 locomotives). We are also requesting comment on an alternative under consideration that would apply a similar requirement to existing marine diesel engines when

[1 2] Control of Air Pollution From New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, 66 FR 5002 (January 18, 2001); Control of Emissions of Air Pollution From Nonroad Diesel Engines and Fuel, 69 FR 38958 (June 29, 2004).

[3] See 65 FR 6698 (February 10, 2000), 66 FR 5001 (January 18, 2001), and 69 FR 38958 (June 29, 2004) for the final rules regarding the light-duty Tier 2, clean highway diesel (2007 highway diesel) and clean nonroad diesel (nonroad Tier 4) programs, respectively. EPA has also recently promulgated a clean stationary diesel engine rule containing standards similar to those in the nonroad Tier 4 rule. See 71 FR 39153. See also *http://www.epa.gov/diesel/* for information on all EPA programs that are part of the NCDC.

[4] In this NPRM, ''marine diesel engine'' refers to compression-ignition marine engines below 30 liters per cylinder displacement unless otherwise indicated. Engines at or above 30 liters per cylinder are being addressed in separate EPA actions, including a planned rulemaking, participation on the U.S. delegation to the International Maritime Organization's standard-setting work, and EPA's new Clean Ports USA Initiative (*http://www.epa.gov/cleandiesel/ports/index.htm*).

[5] Marine diesel engines at or above 30 l/cyl displacement are not included in this program. See Section III.E, below.

they are remanufactured. Second, we are proposing a set of near-term emission standards, referred to as Tier 3, for newly-built locomotives and marine engines, that reflect the application of technologies to reduce engine-out PM and NO_X. Third, we are proposing longer-term standards, referred to as Tier 4, that reflect the application of high-efficiency catalytic aftertreatment technology enabled by the availability of ULSD. These standards phase in over time, beginning in 2014. We are also proposing provisions to eliminate emissions from unnecessary locomotive idling.

Locomotives and marine diesel engines designed to these proposed standards would achieve PM reductions of 90 percent and NO_X reductions of 80 percent, compared to engines meeting the current Tier 2 standards. The proposed standards would also yield sizeable reductions in emissions of nonmethane hydrocarbons (NMHC), carbon monoxide (CO), and hazardous compounds known as air toxics. Table I–1 summarizes the PM and NO_X emission reductions for the proposed standards compared to today's (Tier 2) emission standards or, in the case of remanufactured locomotives, compared to the current standards for each tier of locomotives covered.

TABLE I.–1.—REDUCTIONS FROM LEVELS OF EXISTING STANDARDS

Sector	Proposed standards tier	PM	NO_X
Locomotives	Remanufactured Tier 0	60%	15–20%
	Remanufactured Tier 1	50	
	Remanufactured Tier 2	50	
	Tier 3	50	
	Tier 4	90	80
Marine Diesel Engines [a]	Remanufactured Engines [b]	25–60	up to 20
	Tier 3	50	20
	Tier 4	90	80

[a] Existing and proposed standards vary by displacement and within power categories. Reductions indicated are typical.
[b] This proposal asks for comment on an alternative under consideration that would reduce emissions from existing marine diesel engines. See section VII.A(2).

Combined, these reductions would result in substantial benefits to public health and welfare and to the environment. We project that by 2030 this program would reduce annual emissions of NO_X and PM by 765,000 and 28,000 tons, respectively, and the magnitude of these reductions would continue to grow well beyond 2030. We estimate that these annual emission reductions would prevent 1,500 premature mortalities in 2030. These annual emission reductions are also estimated to prevent 1,000,000 minor restricted-activity days, 170,000 work days lost, and other quantifiable benefits. All told, the estimated monetized health benefits of this rule in 2030 would be approximately $12 billion, assuming a 3 percent discount rate (or $11 billion assuming a 7 percent discount rate). The annual cost of the program in 2030 would be significantly less, at approximately $600 million.

A. What Is EPA Proposing?

This proposal is a further step in EPA's ongoing program to control emissions from diesel engines, including those used in marine vessels and locomotives. EPA's current standards for newly-built and remanufactured locomotives were adopted in 1998 and were implemented in three tiers (Tiers 0, 1, and 2) over 2000 through 2005. The current program includes Tier 0 emission limits for existing locomotives originally manufactured in 1973 or later, that apply when they are remanufactured. The standards for marine diesel engines were adopted in 1998 for engines under 37 kilowatts (kW), in 1999 for commercial marine engines, and in 2002 for recreational marine engines. These various Tier 1 and Tier 2 standards phase in from 1999 through 2009, depending on engine size and application. The most stringent of these existing locomotive and marine diesel engine standards are similar in stringency to EPA's nonroad Tier 2 standards that are now in the process of being replaced by Tier 3 and 4 standards.

The major elements of the proposal are summarized below. We are also proposing revised testing, certification, and compliance provisions to better ensure emissions control in use. Detailed provisions and our justifications for them are discussed in sections III and IV and in the draft Regulatory Impact Analysis (RIA). Section VII of this preamble describes a number of alternatives that we considered in developing this proposal, including a more simplistic approach that would introduce aftertreatment-based standards earlier. Our analysis shows that such an approach would result in higher emissions and fewer health and welfare benefits than we project will be realized from the program we are proposing today. After evaluating the alternatives, we believe that our proposed program provides the best opportunity for achieving timely and very substantial emissions reductions from locomotive and marine diesel engines. It best takes into account the need for appropriate lead time to develop and apply the technologies necessary to meet these emission standards, the goal of achieving very significant emissions reductions as early as possible, the interaction of requirements in this proposal with existing highway and nonroad diesel engine programs, and other legal and policy considerations.

Overall, this comprehensive three-part approach to setting standards for locomotives and marine diesel engines would provide very large reductions in PM, NO_X, and toxic compounds, both in the near-term (as early as 2008), and in the long-term. These reductions would be achieved in a manner that: (1) Is very cost-effective, (2) leverages technology developments in other diesel sectors, (3) aligns well with the clean diesel fuel requirements already being implemented, and (4) provides the lead time needed to deal with the significant engineering design workload that is involved. We are asking for comments on all aspects of the proposal, including standards levels and implementation dates, and on the alternatives discussed in this proposal.

(1) Locomotive Emission Standards

We are proposing stringent exhaust emissions standards for newly-built and remanufactured locomotives, furthering the initiative for cleaner locomotives started in 2004 with the establishment of the ULSD locomotive fuel program, and adding this important category of engines to the highway and nonroad diesel applications already covered under EPA's National Clean Diesel Campaign.[6]

In the Advance Notice of Proposed Rulemaking (ANPRM) for this proposal (69 FR 39276, June 29, 2004), we suggested a program for comment that would bring about the introduction of high-efficiency exhaust aftertreatment to this sector in a single step. Although it has taken longer than expected to develop, the proposal we are issuing today is far more comprehensive than we envisioned in 2004. Informed by extensive analyses documented in the draft RIA and numerous discussions with stakeholders since then, this proposal goes significantly beyond that vision. It sets out standards for locomotives in three steps to more fully leverage the opportunities provided by both the already-established clean fuel programs, and the migration of clean diesel technology from the highway and nonroad sectors. It also addresses the large and long-lived existing locomotive fleet with stringent new emissions requirements at remanufacture starting in 2008. Finally, it sets new requirements for idle emissions control on newly-built and remanufactured locomotives.

Briefly, for newly-built line-haul locomotives we are proposing a new Tier 3 PM standard of 0.10 grams per brake horsepower-hour (g/bhp-hr), based on improvements to existing engine designs. This standard would take effect in 2012. We are also proposing new Tier 4 standards of 0.03 g/bhp-hr for PM and 1.3 g/bhp-hr for NO_X, based on the evolution of high-efficiency catalytic aftertreatment technologies now being developed and introduced in the highway diesel sector. The Tier 4 standards would take effect in 2015 and 2017 for PM and NO_X, respectively. We are proposing that remanufactured Tier 2 locomotives meet a PM standard of 0.10 g/bhp-hr, based on the same engine design improvements as Tier 3 locomotives, and that remanufactured Tier 0 and Tier 1 locomotives meet a 0.22 g/bhp-hr PM standard. We also propose that remanufactured Tier 0 locomotives meet a NO_X standard of 7.4 g/bhp-hr, the same level as current Tier 1 locomotives, or 8.0 g/bhp-hr if the locomotive is not equipped with a separate loop intake air cooling system. Section III provides a detailed discussion of these proposed new standards, and section IV details improvements being proposed to the applicable test, certification, and compliance programs.

In setting our original locomotive emission standards in 1998, the historic pattern of transitioning older line-haul locomotives to road- and yard-switcher service resulted in our making little distinction between line-haul and switch locomotives. Because of the increase in the size of new locomotives in recent years, that pattern cannot be sustained by the railroad industry, as today's 4000+ hp (3000+ kW) locomotives are poorly suited for switcher duty. Furthermore, although there is still a fairly sizeable legacy fleet of older smaller line-haul locomotives that could find their way into the switcher fleet, essentially the only newly-built switchers put into service over the last two decades have been of radically different design, employing one to three smaller high-speed diesel engines designed for use in nonroad applications. In light of these trends, we are establishing new standards and special certification provisions for newly-built and remanufactured switch locomotives that take these trends into account.

Locomotives spend a substantial amount of time idling, during which they emit harmful pollutants and consume fuel. Two ways that idling time can be reduced are through the use of automated systems to stop idling locomotive engines (restarting them on an as-needed basis), and through the use of small low-emitting auxiliary engines to provide essential accessory power. Both types of systems are installed in a number of U.S. locomotives today for various reasons, including to save fuel, to help meet current Tier 0 emissions standards, and to address complaints from railyard neighbors about noise and pollution from idling locomotives.

We are proposing that idle control systems be required on all newly-built Tier 3 and Tier 4 locomotives. We also propose that they be installed on all existing locomotives that are subject to the proposed remanufactured engine standards, at the point of first remanufacture under the proposed standards, unless already equipped with idle controls. We are proposing that automated stop/start systems be required, but encourage the use of auxiliary power units by allowing their emission reduction to be factored into the certification test program as appropriate.

Taken together, the proposed elements described above constitute a comprehensive program that would address the problems caused by locomotive emissions from both a near-term and long-term perspective, and do so more completely than would have occurred under the concept described in the ANPRM. It would do this while providing for an orderly and cost-effective implementation schedule for the railroads, builders, and remanufacturers.

(2) Marine Engine Emission Standards

We are also proposing emissions standards for newly-built marine diesel engines with displacements under 30 liters per cylinder (referred to as Category 1 and 2, or C1 and C2, engines). This would include engines used in commercial, recreational, and auxiliary power applications, and those below 37 kW (50 hp) that were previously regulated separately in our nonroad diesel program. As with locomotives, our ANPRM described a one-step marine diesel program that would bring about the introduction of high-efficiency exhaust aftertreatment in this sector. Just as for locomotives, our subsequent extensive analyses (documented in the draft RIA) and numerous discussions with stakeholders since then have resulted in this proposal for standards in multiple steps, with the longer-term implementation of advanced technologies focused especially on the engines with the greatest potential for large PM and NO_X emission reductions.

The proposed marine diesel engine standards include stringent engine-based Tier 3 standards for newly-built marine diesel engines that phase in beginning in 2009. These are followed by aftertreatment-based Tier 4 standards for engines above 600 kW (800 hp) that phase in beginning in 2014. The specific levels and implementation dates for the proposed Tier 3 and Tier 4 standards vary by engine sub-groupings. Although this results in a somewhat complicated array of emissions standards, it will ensure the most stringent standards feasible for each group of newly-built marine engines, and will help engine and vessel manufacturers to implement the program in a cost effective manner that also emphasizes early emission reductions. The proposed standards and implementation schedules, as well as their technological feasibility, are described in detail in section III of this preamble.

We are also requesting comment on an alternative we are considering to address the considerable impact of emissions from large marine diesel

[6] We are not proposing any change to the current definition of a ''new locomotive'' in 40 CFR § 92.2. The terms ''new locomotive'', ''new locomotive engine'', ''freshly manufactured locomotive'', ''freshly manufactured locomotive engine'', ''repower'', ''remanufacture'', ''remanufactured locomotive'', and ''remanufactured locomotive engine'' all have formal definitions in 40 CFR 92.2. In this notice, the term ''newly-built locomotive'' is synonymous with ''freshly manufactured locomotive''.

engines installed in vessels currently in the fleet. We have in the past considered but not finalized a program to regulate such engines as ''new'' engines at the time of remanufacture, similar to the approach taken in the locomotive program. We are again considering such a program in the context of this rulemaking and are soliciting comments on this alternative.

Briefly summarized, it would consist of two parts. In the first part, which could begin as early as 2008, vessel owners and rebuilders would be required to install a certified emissions control system when the engine is remanufactured, if such a system were available. Initially, we would expect the systems installed on remanufactured marine engines to be those certified for the remanufactured locomotive program, although this alternative would not limit the program to only those engines. Eventually manufacturers would be expected to provide systems for other large engines as well. In the second part, to take effect in 2013, marine diesel engines identified by EPA as high-sales volume engine models would have to meet specified emissions standards when remanufactured. The rebuilder or owner would be required to either use a system certified to meet the standards or, if no certified systems were available, to either retrofit an emission reduction technology for the engine that demonstrates at least a 25 percent reduction or to repower (replace the engine with a new one). The alternative under consideration is described in more detail in section VII.A(2). We request comment on the elements of this alternative as well as other possible approaches to achieve this goal, with the view that EPA may adopt a remanufacture program in the final rule if appropriate.

B. Why Is EPA Making This Proposal?

(1) Locomotives and Marine Diesels Contribute to Serious Air Pollution Problems

Locomotive and marine diesel engines subject to today's proposal generate significant emissions of fine particulate matter ($PM_{2.5}$) and nitrogen oxides (NO_X) that contribute to nonattainment of the National Ambient Air Quality Standards for $PM_{2.5}$ and ozone. NO_X is a key precursor to ozone and secondary PM formation. These engines also emit hazardous air pollutants or air toxics, which are associated with serious adverse health effects. Emissions from locomotive and marine diesel engines also cause harm to public welfare, including contributing to visibility impairment and other harmful environmental impacts across the US.

The health and environmental effects associated with these emissions are a classic example of a negative externality (an activity that imposes uncompensated costs on others). With a negative externality, an activity's social cost (the cost borne to society imposed as a result of the activity taking place) exceeds its private cost (the cost to those directly engaged in the activity). In this case, as described below and in Section II, emissions from locomotives and marine diesel engines and vessels impose public health and environmental costs on society. However, these added costs to society are not reflected in the costs of those using these engines and equipment. The market system itself cannot correct this externality because firms in the market are rewarded for minimizing their production costs, including the costs of pollution control. In addition, firms that may take steps to use equipment that reduces air pollution may find themselves at a competitive disadvantage compared to firms that do not. To correct this market failure and reduce the negative externality from these emissions, it is necessary to give producers the signals for the social costs generated from the emissions. The standards EPA is proposing will accomplish this by mandating that locomotives and marine diesel engines reduce their emissions to a technologically feasible limit. In other words, with this proposed rule the costs of the transportation services produced by these engines and equipment will account for social costs more fully.

Emissions from locomotive and marine diesel engines account for substantial portions of the country's ambient $PM_{2.5}$ and NO_X levels. We estimate that today hese engines account for about 20 percent of mobile source NO_X emissions and about 25 percent of mobile source diesel $PM_{2.5}$ emissions. Under today's proposed standards, by 2030, annual NO_X emissions from these diesel engines would be reduced by 765,000 tons and $PM_{2.5}$ emissions by 28,000 tons, and those reductions would continue to grow beyond 2030 as fleet turnover to the clean engines is completed.

EPA has already taken steps to bring emissions levels from light-duty and heavy-duty highway, and nonroad diesel vehicles and engines to very low levels over the next decade, as well as certain stationary diesel engines also subject to these standards, while the emission levels for locomotive and marine diesel engines remain at much higher levels—comparable to the emissions for highway trucks in the early 1990s.

Both ozone and $PM_{2.5}$ contribute to serious public health problems, including premature mortality, aggravation of respiratory and cardiovascular disease (as indicated by increased hospital admissions and emergency room visits, school absences, lost work days, and restricted activity days), changes in lung function and increased respiratory symptoms, altered respiratory defense mechanisms, and chronic bronchitis. Diesel exhaust is of special public health concern, and since 2002 EPA has classified it as likely to be carcinogenic to humans by inhalation at environmental exposures.[7] Recent studies are showing that populations living near large diesel emission sources such as major roadways,[8] rail yards, and marine ports [9] are likely to experience greater diesel exhaust exposure levels than the overall U.S. population, putting them at greater health risks. We are currently studying the size of the U.S. population living near a sample of approximately 60 marine ports and rail yards, and will place the information in the docket upon completion prior to the final rule.

Today millions of Americans continue to live in areas that do not meet existing air quality standards. Currently, ozone concentrations exceeding the 8-hour ozone NAAQS occur over wide geographic areas, including most of the nation's major population centers. As of October 2006 there are approximately 157 million people living in 116 areas (461 full or partial counties) designated as not in attainment with the 8-hour ozone NAAQS. These numbers do not include people living in areas where there is a potential that the area may fail to maintain or achieve the 8-hour ozone NAAQS. With regard to $PM_{2.5}$ nonattainment, EPA has recently finalized nonattainment designations

[7] U.S. EPA (2002) Health Assessment Document for Diesel Engine Exhaust. EPA/600/8–90/057F. Office of Research and Development, Washington DC. This document is available electronically at *http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=29060*.

[8] Kinnee, E.J.; Touman, J.S.; Mason, R.; Thurman, J.; Beidler, A.; Bailey, C.; Cook, R. (2004) Allocation of onroad mobile emissions to road segments for air toxics modeling in an urban area. Transport. Res. Part D 9: 139–150.

[9] State of California Air Resources Board. Roseville Rail Yard Study. Stationary Source Division, October 14, 2004. This document is available electronically at: *http://www.arb.ca.gov/diesel/documents/rrstudy.htm* and State of California Air Resources Board. Diesel Particulate Matter Exposure Assessment Study for the Ports of Los Angeles and Long Beach, April 2006. This document is available electronically at: *http://www.arb.ca.gov/regact/marine2005/portstudy0406.pdf*.

(70 FR 943, Jan 5, 2005), and as of October 2006 there are 88 million people living in 39 areas (which include all or part of 208 counties) that either do not meet the $PM_{2.5}$ NAAQS or contribute to violations in other counties. These numbers do not include individuals living in areas that may fail to maintain or achieve the $PM_{2.5}$ NAAQS in the future.

In addition to public health impacts, there are public welfare and environmental impacts associated with ozone and $PM_{2.5}$ emissions which are also serious. Specifically, ozone causes damage to vegetation which leads to crop and forestry economic losses, as well as harm to national parks, wilderness areas, and other natural systems. NO_X and direct emissions of $PM_{2.5}$ can contribute to the substantial impairment of visibility in many part of the U.S., where people live, work, and recreate, including national parks, wilderness areas, and mandatory class I federal areas. The deposition of airborne particles can also reduce the aesthetic appeal of buildings and culturally important articles through soiling, and can contribute directly (or in conjunction with other pollutants) to structural damage by means of corrosion or erosion. Finally, NO_X emissions from diesel engines contribute to the acidification, nitrification, and eutrophication of water bodies.

While EPA has already adopted many emission control programs that are expected to reduce ambient ozone and $PM_{2.5}$ levels, including the Clean Air Interstate Rule (CAIR) (70 FR 25162, May 12, 2005) and the Clean Air Nonroad Diesel Rule (69 FR 38957, June 29, 2004), the Heavy Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements (66 FR 5002, Jan. 18, 2001), and the Tier 2 Vehicle and Gasoline Sulfur Program (65 FR 6698, Feb. 10, 2000), the additional $PM_{2.5}$ and NO_X emission reductions resulting from the standards proposed in this action would assist states in attaining and maintaining the Ozone and the $PM_{2.5}$ NAAQS near term and in the decades to come.

In September 2006, EPA finalized revised $PM_{2.5}$ NAAQS standards and over the next few years the Agency will undergo the process of designating areas that are not able to meet this new standard. EPA modeling, conducted as part of finalizing the revised NAAQS, projects that in 2015 up to 52 counties with 53 million people may violate either the daily, annual, or both standards for $PM_{2.5}$ while an additional 27 million people in 54 counties may live in areas that have air quality measurements within 10 percent of the revised NAAQS. Even in 2020 up to 48 counties, with 54 million people, may still not be able to meet the revised $PM_{2.5}$ NAAQS and an additional 25 million people, living in 50 counties, are projected to have air quality measurements within 10 percent of the revised standards. The locomotive and marine diesel $PM_{2.5}$ reductions resulting from this proposal will be needed by states to both attain and maintain the revised $PM_{2.5}$ NAAQS.

State and local governments are working to protect the health of their citizens and comply with requirements of the Clean Air Act (CAA or ''the Act''). As part of this effort they recognize the need to secure additional major reductions in both diesel $PM_{2.5}$ and NO_X emissions by undertaking numerous state level actions,[10] while also seeking Agency action, including the setting of stringent new locomotive and marine diesel engine standards being proposed today.[11] The emission reductions in this proposal will play a critical part in state efforts to attain and maintain the NAAQS through the next two decades.

While the program we are proposing today will help many states and communities achieve cleaner air, for some areas, the reductions will not be large enough or early enough to assist them in meeting near term ozone and PM air quality goals. More can be done, beyond what we are proposing today, to address the emissions from locomotive and marine diesel engines. For example, as part of this proposal we are requesting comment on a concept to set emission standards for existing large marine diesel engines when they are remanufactured. Were we to finalize such a concept, it could provide substantial emission reductions, beginning in the next few years, from some of the large legacy fleets of dirtier diesel engines.

At the time of our previous locomotive rulemaking, the State of California worked with the railroads operating in southern California to develop and implement a corollary program, ensuring that the cleanest technologies are expeditiously introduced in these areas with greatest air quality improvement needs. Today's proposal includes provisions, such as streamlined switcher locomotive certification using clean nonroad engines, that are well-suited to encouraging early deployment of cleaner technologies through the development of similar programs.

In addition to regulatory programs, the Agency has a number of voluntary programs that partner government, industry, and local communities together to help address challenging air quality problems. The EPA SmartWay program has initiatives to reduce unnecessary locomotive idling and to encourage the use of idle reduction technologies that can substantially reduce locomotive emissions while reducing fuel consumption. EPA's National Clean Diesel Campaign, through its Clean Ports USA program, is working with port authorities, terminal operators, and trucking and rail companies to promote cleaner diesel technologies and strategies today through education, incentives, and financial assistance for diesel emissions reductions at ports. Part of these efforts involves voluntary retrofit programs that can further reduce emissions from the existing fleet of diesel engines. Finally, many of the companies operating in states and communities suffering from poor air quality have voluntarily entered into Memoranda of Understanding (MOUs) designed to ensure that the cleanest technologies are used first in regions with the most challenging air quality issues.

Together, these approaches can augment the regulations being proposed today helping states and communities achieve larger reductions sooner in the areas of our country that need them the most. The Agency remains committed to furthering these programs and others so that all of our citizens can breathe clean healthy air.

(2) Advanced Technology Solutions

Air pollution from locomotive and marine diesel exhaust is a challenging problem. However, we believe it can be addressed effectively through the use of existing technology to reduce engine-out emissions combined with high-efficiency catalytic aftertreatment technologies. As discussed in greater detail in section III.D, the development of these aftertreatment technologies for

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[10] Two examples of state and local actions are: California Air Resources Board (2006). Emission Reduction Plan for Ports and Goods Movements, (April 2006). Available electronically at *www.arb.ca.gov/gmp/docs/finalgmpplan090905.pdf*; Connecticut Department of Environmental Protection. (2006). Connecticut's Clean Diesel Plan, (January 2006). See *http://www.dep.state.ct.us/air2/diesel/index.htm* for description of initiative.

[11] For example, see letter dated September 23, 2006 from Northeast States for Coordinated Air Use Management to Administrator Stephen L. Johnson; September 7, 2006 letter from Executive Officer of the California Air Resources Board to Acting Assistant Administrator William L. Wehrum; August 9, 2006 letter from State and Territorial Air Pollution Program Administrators and Association of Local Air Pollution Control Officials (and other organizations) to Administrator Stephen L. Johnson; January 20, 2006 letter from Executive Director, Puget Sound Clean Air Agency to Administrator Stephen L. Johnson; June 30, 2005 letter from Western Regional Air Partnership to Administrator Stephen L. Johnson.

highway and nonroad diesel applications has advanced rapidly in recent years, so that very large emission reductions in PM and NO_X (in excess of 90 and 80 percent, respectively) can be achieved.

High-efficiency PM control technologies are being broadly used in many parts of the world, and in particular to comply with EPA's heavy-duty truck standards now taking effect with the 2007 model year. These technologies are highly durable and robust in use, and have also proved extremely effective in reducing exhaust hydrocarbon (HC) emissions. However, as discussed in detail in section III.D, these emission control technologies are very sensitive to sulfur in the fuel. For the technology to be viable and capable of controlling an engine's emissions over the long term, we believe it will require diesel fuel with sulfur content capped at the 15 ppm level.

Control of NO_X emissions from locomotive and marine diesel engines can also be achieved with high-efficiency exhaust emission control technologies. Such technologies are expected to be used to meet the stringent NO_X standards included in EPA's heavy-duty highway diesel and nonroad Tier 4 programs, and have been in production for heavy duty trucks in Europe since 2005, as well as in many stationary source applications throughout the world. These technologies are also sensitive to sulfur.

Section III.D discusses additional engineering challenges in applying these technologies to newly-built locomotive and marine engines, as well as the development steps that we expect to be taken to resolve the challenges. With the lead time available and the assurance of ULSD for the locomotive and marine sectors in 2012, as provided by our 2004 final rule for nonroad engines and fuel, we are confident the proposed application of advanced technology to locomotives and marine diesels will proceed at a reasonable rate of progress and will result in systems capable of achieving the proposed standards on the proposed schedule.

(3) Basis for Action Under the Clean Air Act

Authority for the actions promulgated in this documents is granted to the Environmental Protections Agency (EPA) by sections 114, 203, 205, 206, 207, 208, 213, 216, and 301(a) of the Clean Air Act as amended in 1990 (CAA or ''the Act'') (42 U.S.C. 7414, 7522, 7524, 7525, 7541, 7542, 7547, 7550 and 7601(a)).

EPA is promulgating emissions standards for new marine diesel engines pursuant to its authority under section 213(a)(3) and (4) of the Clean Air Act (CAA). EPA is promulgating emission standards for new locomotives and new engines used in locomotives pursuant to its authority under section 213(a)(5) of the CAA.

CAA section 213(a)(3) directs the Administrator to set NO_X, VOCs, or carbon monoxide, standards for classes or categories of engines that contribute to ozone or carbon monoxide concentrations in more than one nonattainment area, like marine diesel engines. These ''standards shall achieve the greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available for the engines or vehicles, giving appropriate consideration to cost, lead time, noise, energy, and safety factors associated with the application of such technology.''

CAA section 213(a)(4), authorizes the Administrator to establish standards to control emissions of pollutants which ''may reasonably be anticipated to endanger public health and welfare,'' where the Administrator determines, as it has done for emissions of PM, that nonroad engines as a whole contribute significantly to such air pollution. The Administrator may promulgate regulations that are deemed appropriate, taking into account costs, noise, safety, and energy factors, for classes or categories of new nonroad vehicles and engines which cause or contribute to such air pollution, like diesel marine engines.

Finally, section 213(a)(5) directs EPA to adopt emission standards for new locomotives and new engines used in locomotives that achieve the ''greatest degree of emissions reductions achievable through the use of technology that the Administrator determines will be available for such vehicles and engines, taking into account the cost of applying such technology within the available time period, the noise, energy, and safety factors associated with the applications of such technology.'' Section 213(a)(5) does not require any review of the contribution of locomotive emissions to pollution, though EPA does provide such information in this proposal. As described in section III of this Preamble and in Chapter 4 of the draft RIA, EPA has evaluated the available information to determine the technology the will be available for locomotives and engines proposed to be subject to EPA standards.

EPA is also acting under its authority to implement and enforce both the marine diesel emission standards and the locomotive emissions standards. Section 213(d) provides that the standards EPA adopts for both new locomotive and marine diesel engines ''shall be subject to sections 206, 207, 208, and 209'' of the Clean Air Act, with such modifications that the Administrator deems appropriate to the regulations implementing these sections. In addition, the locomotive and marine standards ''shall be enforced in the same manner as [motor vehicle] standards prescribed under section 202'' of the Act. Section 213(d) also grants EPA authority to promulgate or revise regulations as necessary to determine compliance with, and enforce, standards adopted under section 213.

As required under section 213(a)(3), (4), and (5) we believe the evidence provided in section III.D of this Preamble and in Chapter 4 of draft RIA indicates that the stringent emission standards proposed today for newly-built and remanufactured locomotive engines and newly-built marine diesel engines are feasible and reflect the greatest degree of emission reduction achievable through the use of technology that will be available in the model years to which they apply. We also believe this may be the case for the alternative identified for existing marine engines in section VII.A(2) of this preamble. We have given appropriate consideration to costs in proposing these standards. Our review of the costs and cost-effectiveness of these standards indicate that they will be reasonable and comparable to the cost-effectiveness of other emission reduction strategies that have been required. We have also reviewed and given appropriate consideration to the energy factors of this rule in terms of fuel efficiency as well as any safety and noise factors associated with these proposed standards.

The information in section II of this Preamble and Chapter 2 of the draft RIA regarding air quality and public health impacts provides strong evidence that emissions from marine diesel engines and locomotives significantly and adversely impact public health or welfare. EPA has already found in previous rules that emissions from new marine diesel engines contribute to ozone and carbon monoxide (CO) concentrations in more than one area which has failed to attain the ozone and carbon monoxide NAAQS (64 FR 73300, December 29, 1999). EPA has also previously determined that it is appropriate to establish standards for PM from marine diesel engines under section 213(a)(4), and the additional information on diesel exhaust carcinogenicity noted above reinforces this finding. In addition, we have already found that emissions from nonroad engines as a whole significantly contribute to air pollution that may reasonably be anticipated to endanger public welfare due to regional haze and visibility impairment (67 FR 68241, Nov. 8, 2002). We propose to find here, based on the information in section II of this preamble and Chapters 2 and 3 of the draft RIA that emissions from the new marine diesel engines likewise contribute to regional haze and to visibility impairment.

The PM and NO_X emission reductions resulting from the standards proposed in this action would be important to states' efforts in attaining and maintaining the Ozone and the $PM_{2.5}$ NAAQS in the near term and in the decades to come. As noted above, the risk to human health and welfare would be significantly reduced by the standards proposed today.

II. Air Quality and Health Impacts

The locomotive and marine diesel engines subject to today's proposal generate significant emissions of particulate matter (PM) and nitrogen oxides (NO_X) that contribute to nonattainment of the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$ and ozone. These engines also emit hazardous air pollutants or air toxics which are associated with serious adverse health effects. Finally, emissions from locomotive and marine diesel engines cause harm to the public welfare, contribute to visibility impairment, and contribute to other harmful environmental impacts across the U.S.

By 2030, the proposed standards are expected to reduce annual locomotive and marine diesel engine $PM_{2.5}$ emissions by 28,000 tons; NO_X emissions by 765,000 tons; and volatile organic compound (VOC) emissions by 42,000 tons as well as reductions in carbon monoxide (CO) and toxic compounds known as air toxics.[12]

We estimate that reductions of $PM_{2.5}$, NO_X, and VOC emissions from locomotive and marine diesel engines would produce nationwide air quality improvements. According to air quality modeling performed in conjunction with this proposed rule, if finalized, all 39 current $PM_{2.5}$ nonattainment areas would experience a decrease in their 2020 and 2030 design values. Likewise all 116 mandatory class I federal areas would see improvements in their visibility. This rule would also result in substantial nationwide ozone benefits. The air quality modeling conducted for ozone estimates that in 2020 and 2030, 114 of the current 116 ozone nonattainment areas would see improvements in ozone air quality as a result of this proposed rule.

A. Overview

From a public health perspective, we are concerned with locomotive and marine diesel engines' contributions to atmospheric levels of particulate matter in general, diesel $PM_{2.5}$ in particular, and various gaseous air toxics, and ozone. Today, locomotive and marine diesel engine emissions represent a substantial portion of the U.S. mobile source diesel $PM_{2.5}$ and NO_X emissions accounting for approximately 20 percent of mobile source NO_X and 25 percent of mobile source diesel $PM_{2.5}$. These proportions are even higher in some urban areas. Over time, the relative contribution of these diesel engines to air quality problems is expected to increase as the emission contribution from other mobile sources decreases and the usage of locomotives and marine vessels increases. By 2030, without further emissions controls beyond those already adopted for these engines, locomotive and marine diesel engines nationally will emit more than 65 percent of the total mobile source diesel $PM_{2.5}$ emissions and 35 percent of the total mobile source NO_X emissions.

Based on the most recent data available for this rule, air quality problems continue to persist over a wide geographic area of the United States. As of October 2006 there are approximately 88 million people living in 39 designated areas (which include all or part of 208 counties) that either do not meet the current $PM_{2.5}$ NAAQS or contribute to violations in other counties, and 157 million people living in 116 areas (which include all or part of 461 counties) designated as not in attainment for the 8-hour ozone NAAQS. These numbers do not include the people living in areas where there is a significant future risk of failing to maintain or achieve either the $PM_{2.5}$ or ozone NAAQS. Figure II–1 illustrates the widespread nature of these problems. This figure depicts counties which are currently designated nonattainment for either or both the 8-hour ozone NAAQS and $PM_{2.5}$ NAAQS. It also shows the location of mandatory class I federal areas for visibility.

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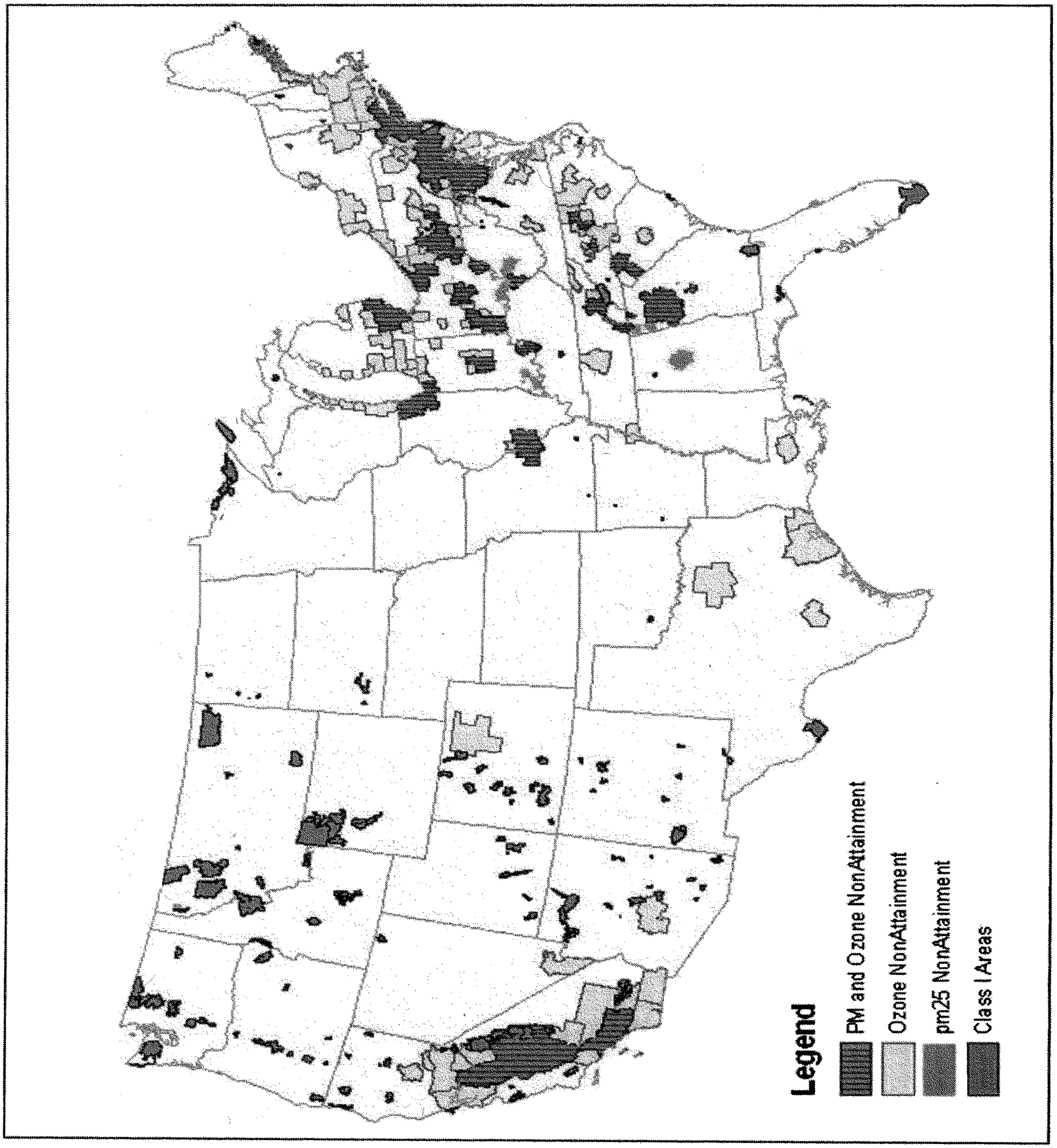
[12] Nationwide locomotive and marine diesel engines comprise approximately 3 percent of the nonroad mobile sources hydrocarbon inventory. EPA National Air Quality and Emissions Trends Report 1999. March 2001, Document Number: EPA 454/R–0–004. This document is available electronically at:*http://www.epa.gov/air/airtrends/aqtrnd99/.*

Figure II-1 Air Quality Problems are Widespread



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The engine standards proposed in this rule would help reduce emissions of PM, NO_X, VOCs, CO, and air toxics and their associated health and environmental effects. Emissions from locomotives and diesel marine engines contribute to PM and ozone concentrations in many, if not all, of these nonattainment areas.[13] The engine standards being proposed today would become effective as early as 2008 making the expected $PM_{2.5}$, NO_X, and VOC inventory reductions from this rulemaking critical to states as they seek to either attain or maintain the current $PM_{2.5}$ or ozone NAAQS.

Beyond the impact locomotive and marine diesel engines have on our nation's ambient air quality the diesel exhaust emissions emanating from these engines are also of particular concern since diesel exhaust is classified as a likely human carcinogen.[14] Many people spend a large portion of time in or near areas of concentrated locomotive or marine diesel emissions, near rail yards, marine ports, railways, and waterways. Recent studies show that populations living near large diesel emission sources such as major roadways,[15] rail yards [16] and marine ports [17] are likely to experience greater diesel exhaust exposure levels than the overall U.S. population, putting them at a greater health risk. We are currently studying the size of the U.S. population living near a sample of approximately 60 marine ports and rail yards, and will place that information in the docket upon completion prior to the final rule. The diesel $PM_{2.5}$ reductions which occur as a result of this proposed rule would benefit the population near these sources and also assist state and local governments as they work to meet the NAAQS.

In the following three sections we review important public health effects linked to pollutants emitted from locomotive and marine diesel engines first describing the human health effects and the current and expected future ambient levels of direct or indirectly caused pollution. Following the discussion of health effects, we will discuss the modeled air quality benefits which are estimated to result from regulating these engines. We also discuss a number of other welfare effects associated with emissions from diesel engines. These effects include visibility impairment, ecological and property damage caused by acid deposition, eutrophication and nitrification of surface waters, environmental threats posed by polycyclic organic matter (POM) deposition, and plant and crop damage from ozone.

Finally, in section E we describe the locomotive and marine engine emission inventories for the primary pollutants affected by the proposal. We present current and projected future levels of emissions for the base case, including anticipated reductions from control programs already adopted by EPA and the States, but without the controls proposed today. Then we identify expected emission reductions from nonroad locomotive and marine diesel engines. These reductions would make important contributions to controlling the health and welfare problems associated with ambient PM and ozone levels and with diesel-related air toxics.

Taken together, the materials in this section describe the need for tightening emission standards from both locomotive and marine diesel engines and the air quality and public health benefits we expect as a result of this proposed rule. This section is not an exhaustive treatment of these issues. For a fuller understanding of the topics treated here, you should refer to the extended presentations in Chapter 2 of the Draft Regulatory Impact Analysis (RIA) accompanying this proposal.

B. Public Health Impacts

(1) Particulate Matter

The proposed locomotive and marine engine standards would result in significant reductions of primary $PM_{2.5}$ emissions from these sources. In addition, locomotive and marine diesel engines emit high levels of NO_X which react in the atmosphere to form secondary $PM_{2.5}$, ammonium nitrate. Locomotive and marine diesel engines also emit SO_2 and HC which react in the atmosphere to form secondary $PM_{2.5}$ composed of sulfates and organic carbonaceous $PM_{2.5}$. This proposed rule would reduce both the directly emitted diesel PM and secondary PM emissions.

(a) Background

Particulate matter (PM) represents a broad class of chemically and physically diverse substances. It can be principally characterized as discrete particles that exist in the condensed (liquid or solid) phase spanning several orders of magnitude in size. PM is further described by breaking it down into size fractions. PM_{10} refers to particles generally less than or equal to 10 micrometers (µm). $PM_{2.5}$ refers to fine particles, those particles generally less than or equal to 2.5 µm in diameter. Inhalable (or ''thoracic'') coarse particles refer to those particles generally greater than 2.5 µm but less than or equal to 10 µm in diameter. Ultrafine PM refers to particles less than 100 nanometers (0.1 µm). Larger particles tend to be removed by the respiratory clearance mechanisms (e.g. coughing), whereas smaller particles are deposited deeper in the lungs.

Fine particles are produced primarily by combustion processes and by transformations of gaseous emissions (e.g., SO_X, NO_X and VOCs) in the atmosphere. The chemical and physical properties of $PM_{2.5}$ may vary greatly with time, region, meteorology, and source category. Thus, $PM_{2.5}$, may include a complex mixture of different pollutants including sulfates, nitrates, organic compounds, elemental carbon and metal compounds. These particles can remain in the atmosphere for days to weeks and travel through the atmosphere hundreds to thousands of kilometers.

The primary $PM_{2.5}$ NAAQS includes a short-term (24-hour) and a long-term (annual) standard. The 1997 $PM_{2.5}$ NAAQS established by EPA set the 24-hour standard at a level of 65 µg/m³ based on the 98th percentile concentration averaged over three years. (This air quality statistic compared to the standard is referred to as the ''design value.'') The annual standard specifies an expected annual arithmetic mean not to exceed 15 µg/m³ averaged over three years. EPA has recently finalized $PM_{2.5}$ nonattainment designations for the 1997 standard (70 FR 943, Jan 5, 2005).[18] All areas currently in nonattainment for

[13] See section II.B.(1)(d) and II.B.(2)(d) for a summary of the impact emission reductions from locomotive and marine diesel engines will have on air quality in current $PM_{2.5}$ and ozone nonattainment areas.

[14] U.S. EPA (2002) Health Assessment Document for Diesel Engine Exhaust. EPA/600/8–90/057F. Office of Research and Development, Washington, DC. This document is available electronically at *http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=29060.*

[15] Kinnee, E.J.; Touma, J.S.: Mason, R.; Thurman, J.; Beidler, A.; Bailey, C.; Cook, R. (2004) Allocation of onroad mobile emissions to road segments for air toxics modeling in an urban area. Transport. Res. Part D 9:139–150; also see Cohen, J.; Cook, R; Bailey, C.R.; Carr, E. (2005) Relationship between motor vehicle emissions of hazardous pollutants, roadway proximity, and ambient concentrations in Portland, Oregon. Environ. Modeling & Software 20: 7–12.

[16] Hand, R.; Di, P; Servin, A.; Hunsaker, L.; Suer, C. (2004) Roseville Rail Yard Study. California Air Resources Board. [Online at *http://www.arb.ca.gov/diesel/documents/rrstudy.htm*]

[17] Di P.; Servin, A.; Rosenkranz, K.; Schwehr, B.; Tran, H. (April 2006); Diesel Particulate Matter Exposure Assessment Study for the Ports of Los Angeles and Long Beach. State of California Air Resources Board. This document is available electronically at:*http://www.arb.ca.gov/regact/marine2005/portstudy0406.pdf.*

[18] US EPA, Air Quality Designations and Classifications for the Fine Particles ($PM_{2.5}$) National Ambient Air Quality Standards, December 17, 2004. (70 FR 943, Jan 5. 2005) This document is also available on the web at: *http://www.epa.gov/pmdesignations/.*

$PM_{2.5}$ will be required to meet these 1997 standards between 2009 and 2014.

As can be seen in Figure II–1 ambient $PM_{2.5}$ levels exceeding the 1997 $PM_{2.5}$ NAAQS are widespread throughout the country. As of October 2006 there were approximately 88 million people living in 39 areas (which include all or part of 208 counties) that either do not meet the 1997 $PM_{2.5}$ NAAQS or contribute to violations in other counties. These numbers do not include the people living in areas where there is a significant future risk of failing to maintain or achieve the $PM_{2.5}$ NAAQS.

EPA has recently amended the NAAQS for $PM_{2.5}$ (71 FR 61144, October 17, 2006). The final rule, signed on September 21, 2006 and published in the **Federal Register** on October 17, 2006, addressed revisions to the primary and secondary NAAQS for PM to provide increased protection of public health and welfare, respectively. The level of the 24-hour $PM_{2.5}$ NAAQS was revised from 65 μg/m³ to 35 μg/m³ to provide increased protection against health effects associated with short-term exposures to fine particles. The current form of the 24-hour $PM_{2.5}$ standard was retained (e.g., based on the 98th percentile concentration averaged over three years). The level of the annual $PM_{2.5}$ NAAQS was retained at 15 μg/m³, continuing protection against health effects associated with long-term exposures. The current form of the annual $PM_{2.5}$ standard was retained as an annual arithmetic mean averaged over three years, however, the following two aspects of the spatial averaging criteria were narrowed: (1) The annual mean concentration at each site shall be within 10 percent of the spatially averaged annual mean, and (2) the daily values for each monitoring site pair shall yield a correlation coefficient of at least 0.9 for each calendar quarter.

With regard to the secondary $PM_{2.5}$ standards, EPA has revised these standards to be identical in all respects to the revised primary standards. Specifically, EPA has revised the current 24-hour $PM_{2.5}$ secondary standard by making it identical to the revised 24-hour $PM_{2.5}$ primary standard and retained the annual $PM_{2.5}$ secondary standard. This suite of secondary $PM_{2.5}$ standards is intended to provide protection against PM-related public welfare effects, including visibility impairment, effects on vegetation and ecosystems, and material damage and soiling.

The 2006 standards became effective on December 18, 2006. As a result of the 2006 $PM_{2.5}$ standard, EPA will designate new nonattainment areas in early 2010. The timeframe for areas attaining the 2006 PM NAAQS will likely extend from 2015 to 2020.

Table II–1 presents the number of counties in areas currently designated as nonattainment for the 1997 $PM_{2.5}$ NAAQS as well as the number of additional counties which have monitored data that is violating the 2006 $PM_{2.5}$ NAAQS. In total more than 106 million U.S. residents, in 257 counties are living in areas which either violate either the 1997 $PM_{2.5}$ standard or the 2006 $PM_{2.5}$ standard.

TABLE II–1.—FINE PARTICLE STANDARDS: CURRENT NONATTAINMENT AREAS AND OTHER VIOLATING COUNTIES

	Number of counties	Population [a]
1997 $PM_{2.5}$ Standards: 39 areas currently designated	208	88,394,000
2006 $PM_{2.5}$ Standards: Counties with violating monitors [b]	49	18,198,676
Total	257	106,595,676

[a] Population numbers are from 2000 census data.

[b] This table provides an estimate of the counties violating the 2006 $PM_{2.5}$ NAAQS based on 2003–05 air quality data. The areas designated as nonattainment for the 2006 $PM_{2.5}$ NAAQS will be based on 3 years of air quality data from later years. Also, the county numbers in the summary table includes only the counties with monitors violating the 2006 $PM_{2.5}$ NAAQS. The monitored county violations may be an underestimate of the number of counties and populations that will eventually be included in areas with multiple counties designated nonattainment.

EPA has already adopted many emission control programs that are expected to reduce ambient $PM_{2.5}$ levels and as a result of these programs, the number of areas that fail to achieve the 1997 $PM_{2.5}$ NAAQS is expected to decrease. Even so, EPA modeling projects that in 2015, with all current controls, up to 52 counties with 53 million population may not attain some combination of the current annual standard of 15 μg/m³ and the revised daily standard of 35 μg/m³, and that even in 2020 up to 48 counties with 54 million population will still not be able to attain either the annual, daily, or both the annual and daily $PM_{2.5}$ standards.[19] This does not account for additional areas that have air quality measurements within 10 percent of the 2006 $PM_{2.5}$ standard. These areas, although not violating the standards, would also benefit from the additional reductions from this rule ensuring long term maintenance of the PM NAAQS.

States have told EPA that they need the reductions this proposed rule would provide in order to meet and maintain both the current 1997 $PM_{2.5}$ NAAQS and the 2006 $PM_{2.5}$ NAAQS. Based on the final rule designating and classifying $PM_{2.5}$ nonattainment areas, most $PM_{2.5}$ nonattainment areas will be required to attain the 1997 $PM_{2.5}$ NAAQS in the 2009 to 2015 time frame, and then be required to maintain the NAAQS thereafter. The emissions standards for engine remanufacturing being proposed in this action would become effective as early as 2008, but no later than 2010, and states would rely on these expected $PM_{2.5}$ reductions to help them to either attain or maintain the 1997 $PM_{2.5}$ NAAQS. In the long term, the emission reductions resulting from the proposed locomotive and marine diesel engine standards would be important to states efforts to attain and maintain the 2006 $PM_{2.5}$ NAAQS.

(b) Health Effects of $PM_{2.5}$

Scientific studies show ambient PM is associated with a series of adverse health effects. These health effects are discussed in detail in the 2004 EPA Particulate Matter Air Quality Criteria Document (PM AQCD) for PM, and the 2005 PM Staff Paper.[20 21 22] Further discussion of health effects associated

[19] Final RIA PM NAAQS, Chapter 2: Defining the $PM_{2.5}$ Air Quality Problem. October 17, 2006.

[20] U.S. EPA (1996) Air Quality Criteria for Particulate Matter, EPA 600–P–95–001aF, EPA 600–P–95–001bF. This document is available in Docket EPA–HQ–OAR.

[21] U.S. EPA (2004) Air Quality Criteria for Particulate Matter (Oct 2004), Volume I Document No. EPA600/P–99/002aF and Volume II Document No. EPA600/P–99/002bF. This document is available in Docket EPA–HQ–OAR.

[22] U.S. EPA (2005) Review of the National Ambient Air Quality Standard for Particulate Matter: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper. EPA–452/R–05–005. This document is available in Docket EPA–HQ–OAR.

with PM can also be found in the draft RIA for this proposal.

Health effects associated with short-term exposures (hours to days) to ambient PM include premature mortality, increased hospital admissions, heart and lung diseases, increased cough, adverse lower-respiratory symptoms, decrements in lung function and changes in heart rate rhythm and other cardiac effects. Studies examining populations exposed to different levels of air pollution over a number of years, including the Harvard Six Cities Study and the American Cancer Society Study, show associations between long-term exposure to ambient $PM_{2.5}$ and both total and cardio respiratory mortality.[23] In addition, a reanalysis of the American Cancer Society Study shows an association between fine particle and sulfate concentrations and lung cancer mortality.[24] The locomotive and marine diesel engines, covered in this proposal contribute to both acute and chronic $PM_{2.5}$ exposures. Additional information on acute exposures is available in Chapter 2 of the draft RIA for this proposal.

These health effects of $PM_{2.5}$ have been further documented in local impact studies which have focused on health effects due to $PM_{2.5}$ exposures measured on or near roadways.[25] Taking account of all air pollution sources, including both spark-ignition (gasoline) and diesel powered vehicles, these latter studies indicate that exposure to $PM_{2.5}$ emissions near roadways, dominated by mobile sources, are associated with potentially serious health effects. For instance, a recent study found associations between concentrations of cardiac risk factors in the blood of healthy young police officers and $PM_{2.5}$ concentrations measured in vehicles.[26] Also, a number of studies have shown associations between residential or school outdoor concentrations of some constituents of fine particles found in motor vehicle exhaust and adverse respiratory outcomes, including asthma prevalence in children who live near major roadways.[27] [28] [29] Although the engines considered in this proposal differ with those in these studies with respect to their applications and fuel qualities, these studies provide an indication of the types of health effects that might be expected to be associated with personal exposure to $PM_{2.5}$ emissions from large marine diesel and locomotive engines. The proposed controls would help to reduce exposure, and specifically exposure near marine ports and rail yard related $PM_{2.5}$ sources.

Recently, new studies [30] from the State of California provide evidence that $PM_{2.5}$ emissions within marine ports and rail yards contribute significantly to elevated ambient concentrations near these sources. A substantial number of people experience exposure to locomotive and marine diesel engine emissions, raising potential health concerns. Additional information on marine port and rail yard emissions and ambient exposures can be found in section.B.3 of this preamble.

(c) $PM_{2.5}$ Air Quality Modeling Results

Air quality modeling performed for this proposal shows that in 2020 and 2030 all 39 current $PM_{2.5}$ nonattainment areas would experience decreases in their $PM_{2.5}$ design values. For areas with $PM_{2.5}$ design values greater than 15 µg/m^3 the modeled future-year $PM_{2.5}$ design values are expected to decrease on average by 0.06 µg/m^3 in 2020 and 0.14 µg/m^3 in 2030. The maximum decrease for future-year $PM_{2.5}$ design values in 2020 would be 0.35 µg/m^3 and 0.90 µg/m^3 in 2030. The reductions are discussed in more detail in Chapter 2 of the draft RIA.

The geographic impact of the proposed locomotive and marine diesel engine controls in 2030 on $PM_{2.5}$ design values (DV) in counties across the US, can be seen in Figure II–2.

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[23] Dockery, DW; Pope, CA III: Xu, X; et al. 1993. An association between air pollution and mortality in six U.S. cities. N Engl J Med 329:1753–1759.

[24] Pope Ca, III; Thun, MJ; Namboodiri, MM; Docery, DW; Evans, JS; Speizer, FE; Heath, CW. 1995. Particulate air pollution as a predictor of mortality in a prospective study of U.S. adults. Am J Respir Crit Care Med 151:669–674.

[25] Riekider, M.; Cascio, W.E.; Griggs, T.R..; Herbst, M.C.; Bromberg, P.A.; Neas, L.; Williams, R.W.; Devlin, R.B. (2003) Particulate Matter Exposures in Cars is Associated with Cardiovascular Effects in Healthy Young Men. Am. J. Respir. Crit. Care Med. 169: 934–940.

[26] Riediker, M.; Cascio, W.E.; Griggs, T.R.; *et al.* (2004) Particulate matter exposure in cars is associated with cardiovascular effects in healthy young men. Am. J. Respir. Crit. Care Med. 169: 934–940.

[27] Van Vliet, P.; Knape, M.; de Hartog, J.; Janssen, N.; Harssema, H.; Brunekreef, B. (1997). Motor vehicle exhaust and chronic respiratory symptoms in children living near freeways. Env. Research 74: 122–132.

[28] Brunekreef, B., Janssen, N.A.H.; de Hartog, J.; Harssema, H.; Knape, M.; van Vliet, P. (1997). Air pollution from truck traffic and lung function in children living near roadways. Epidemiology 8:298–303.

[29] Kim, J.J.; Smorodinsky, S.; Lipsett, M.; Singer, B.C.; Hodgson, A.T.; Ostro, B. (2004). Traffic-related air pollution near busy roads: The East Bay children's respiratory health study. Am. J. Respir. Crit. Care Med. 170: 520–526.

[30] State of California Air Resources Board. Roseville Rail Yard Study. Stationary Source Division, October 14, 2004. This document is available electronically at: *http://www.arb.ca.gov/diesel/documents/rrstudy.htm* and State of California Air Resources Board and State of California Air Resources Board. Diesel Particulate Matter Exposure Assessment Study for the Ports of Los Angeles and Long Beach, April 2006. This document is available electronically at: *ftp://ftp.arb.ca.gov/carbis/msprog/offroad/marinevess/documents/portstudy0406.pdf.*

Figure II-2 Impact of Proposed Locomotive/Marine controls on annual $PM_{2.5}$ Design Values (DV) in 2030

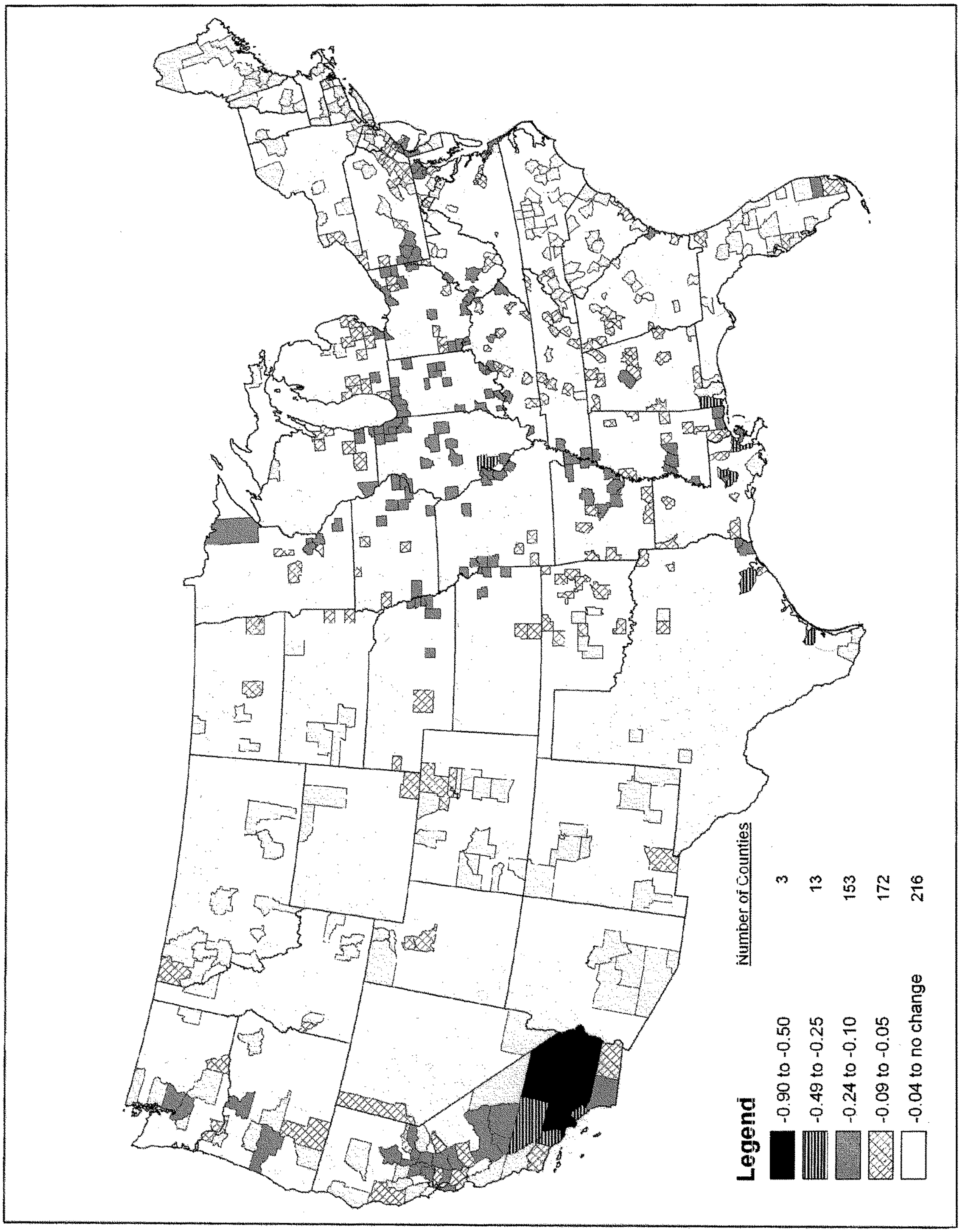

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Figure II–2 illustrates that the greatest emission reductions in 2030 are projected to occur in Southern California where 3 counties would experience reductions in their $PM_{2.5}$ design values of −0.50 to −0.90 μg/m³. The next level of emission reductions would occur among 13 counties geographically dispersed in the southeastern U.S., southern Illinois, and southern California. An additional 325 counties spread across the U.S. would see a decrease in their $PM_{2.5}$ DV ranging from −0.05 to −0.24 μg/m³.

(d) PM Air Quality Modeling Methodology

A national scale air quality modeling analysis was performed to estimate future year annual and daily $PM_{2.5}$ concentrations and visibility for this proposed rule. To model the air quality benefits of this rule we used the Community-Scale Air Quality (CMAQ) model. CMAQ simulates the numerous physical and chemical processes involved in the formation, transport, and destruction of ozone and particulate matter. In addition to the CMAQ model, the modeling platform includes the emissions, meteorology, and initial and boundary condition data which are inputs to this model. Consideration of the different processes that affect primary directly emitted and secondary PM at the regional scale in different locations is fundamental to understanding and assessing the effects of pollution control measures that affect PM, ozone and deposition of pollutants to the surface. A complete description of the CAMQ model and methodology employed to develop the future year impacts of this proposed rule are found in Chapter 2.1 of the draft RIA.

It should be noted that the emission control scenarios used in the air quality and benefits modeling are slightly different than the emission control program being proposed. The differences reflect further refinements of the regulatory program since we performed the air quality modeling for this rule. Emissions and air quality modeling decisions are made early in the analytical process. Chapter 3 of the draft RIA describes the changes in the inputs and resulting emission inventories between the preliminary assumptions used for the air quality modeling and the final proposed regulatory scenario. These refinements to the proposed program would not significantly change the results summarized here or our conclusions drawn from this analysis.

(2) Ozone

The proposed locomotive and marine engine standards are expected to result in significant reductions of NO_X and VOC emissions. NO_X and VOC contribute to the formation of ground-level ozone pollution or smog. People in many areas across the U.S. continue to be exposed to unhealthy levels of ambient ozone.

(a) Background

Ground-level ozone pollution is formed by the reaction of volatile organic compounds (VOCs) and nitrogen oxides (NO_X) in the atmosphere in the presence of heat and sunlight. These two pollutants, often referred to as ozone precursors, are emitted by many types of pollution sources, such as highway and nonroad motor vehicles and engines, power plants, chemical plants, refineries, makers of consumer and commercial products, industrial facilities, and smaller ''area'' sources.

The science of ozone formation, transport, and accumulation is complex.[31] Ground-level ozone is produced and destroyed in a cyclical set of chemical reactions, many of which are sensitive to temperature and sunlight. When ambient temperatures and sunlight levels remain high for several days and the air is relatively stagnant, ozone and its precursors can build up and result in more ozone than typically would occur on a single high-temperature day. Ozone also can be transported from pollution sources into areas hundreds of miles upwind, resulting in elevated ozone levels even in areas with low local VOC or NO_X emissions.

The highest levels of ozone are produced when both VOC and NO_X emissions are present in significant quantities on clear summer days. Relatively small amounts of NO_X enable ozone to form rapidly when VOC levels are relatively high, but ozone production is quickly limited by removal of the NO_X. Under these conditions NO_X reductions are highly effective in reducing ozone while VOC reductions have little effect. Such conditions are called ''NO_X-limited.'' Because the contribution of VOC emissions from biogenic (natural) sources to local ambient ozone concentrations can be significant, even some areas where man-made VOC emissions are relatively low can be NO_X-limited.

When NO_X levels are relatively high and VOC levels relatively low, NO_X forms inorganic nitrates (i.e., particles) but relatively little ozone. Such conditions are called ''VOC-limited.'' Under these conditions, VOC reductions are effective in reducing ozone, but NO_X reductions can actually increase local ozone under certain circumstances. Even in VOC-limited urban areas, NO_X reductions are not expected to increase ozone levels if the NO_X reductions are sufficiently large.

Rural areas are usually NO_X-limited, due to the relatively large amounts of biogenic VOC emissions in many rural areas. Urban areas can be either VOC- or NO_X-limited, or a mixture of both, in which ozone levels exhibit moderate sensitivity to changes in either pollutant.

Ozone concentrations in an area also can be lowered by the reaction of nitric oxide with ozone, forming nitrogen dioxide (NO_2); as the air moves downwind and the cycle continues, the NO_2 forms additional ozone. The importance of this reaction depends, in part, on the relative concentrations of NO_X, VOC, and ozone, all of which change with time and location.

The current ozone National Ambient Air Quality Standards (NAAQS) has an 8-hour averaging time.[32] The 8-hour ozone NAAQS, established by EPA in 1997, is based on well-documented science demonstrating that more people were experiencing adverse health effects at lower levels of exertion, over longer periods, and at lower ozone concentrations than addressed by the previous one-hour ozone NAAQS. The current ozone NAAQS addresses ozone exposures of concern for the general population and populations most at risk, including children active outdoors, outdoor workers, and individuals with pre-existing respiratory disease, such as asthma. The 8-hour ozone NAAQS is met at an ambient air quality monitoring site when the average of the annual fourth-highest daily maximum 8-hour average ozone concentration over three years is less than or equal to 0.084 ppm.

Ozone concentrations exceeding the level of the 8-hour ozone NAAQS occur over wide geographic areas, including most of the nation's major population centers.[33] As of October 2006 there are approximately 157 million people living in 116 areas (which include all or part

[31] U.S. EPA Air Quality Criteria for Ozone and Related Photochemical Oxidants (Final). U.S. Environmental Protection Agency, Washington, D.C., EPA 600/R– 05/004aF–cF, 2006. This document may be accessed electronically at: *http://www.epa.gov/ ttn/naaqs/standards/ ozone/s_o3_cr_cd.html.*

[32] EPA's review of the ozone NAAQS is underway and a proposal is scheduled for May 2007 with a final rule scheduled for February 2008.

[33] A listing of the 8-hour ozone nonattainment areas is included in the draft RIA for this proposed rule.

of 461 counties) designated as not in attainment with the 8-hour ozone NAAQS. These numbers do not include the people living in areas where there is a future risk of failing to maintain or achieve the 8-hour ozone NAAQS.

EPA has already adopted many emission control programs that are expected to reduce ambient ozone levels. These control programs are described in section I.B.(1) of this preamble. As a result of these programs, the number of areas that fail to meet the 8-hour ozone NAAQS in the future is expected to decrease.

Based on recent ozone modeling performed for the CAIR analysis,[34] which does not include any additional local ozone precursor controls, we estimate that in 2010, 24 million people are projected to live in 37 Eastern counties exceeding the 8-hour ozone NAAQS. An additional 61 million people are projected to live in 148 Eastern counties expected to be within 10 percent of violating the 8-hour ozone NAAQS in 2010.

States with 8-hour ozone nonattainment areas will be required to take action to bring those areas into compliance in the future. Based on the final rule designating and classifying 8-hour ozone nonattainment areas (69 FR 23951, April 30, 2004), most 8-hour ozone nonattainment areas will be required to attain the 8-hour ozone NAAQS in the 2007 to 2013 time frame and then be required to maintain the 8-hour ozone NAAQS thereafter.[35] We expect many of the 8-hour ozone nonattainment areas will need to adopt additional emission reduction programs. The expected NO_X and VOC reductions from the standards proposed in this action would be important to states as they seek to either attain or maintain the 8-hour ozone NAAQS.

(b) Health Effects of Ozone

The health and welfare effects of ozone are well documented and are assessed in EPA's 2006 ozone Air Quality Criteria Document (ozone AQCD) and EPA staff papers. [36 37 38]

Ozone can irritate the respiratory system, causing coughing, throat irritation, and/or uncomfortable sensation in the chest. Ozone can reduce lung function and make it more difficult to breathe deeply, and breathing may become more rapid and shallow than normal, thereby limiting a person's activity. Ozone can also aggravate asthma, leading to more asthma attacks that require a doctor's attention and/or the use of additional medication. Animal toxicological evidence indicates that with repeated exposure, ozone can inflame and damage the lining of the lungs, which may lead to permanent changes in lung tissue and irreversible reductions in lung function. People who are more susceptible to effects associated with exposure to ozone include children, the elderly, and individuals with respiratory disease such as asthma. There is also suggestive evidence that certain people may have greater genetic susceptibility. People can also have heightened vulnerability to ozone due to greater exposures (e.g., children and outdoor workers).

The recent ozone AQCD also examined relevant new scientific information which has emerged in the past decade, including the impact of ozone exposure on such health effect indicators as changes in lung structure and biochemistry, inflammation of the lungs, exacerbation and causation of asthma, respiratory illness-related school absence, hospital admissions and premature mortality. In addition to supporting and building further on conclusions from the 1996 AQCD, the 2006 AQCD included new information on the health effects of ozone. Animal toxicological studies have suggested potential interactions between ozone and PM with increased responses observed to mixtures of the two pollutants compared to either ozone or PM alone. The respiratory morbidity observed in animal studies along with the evidence from epidemiologic studies supports a causal relationship between acute ambient ozone exposures and increased respiratory-related emergency room visits and hospitalizations in the warm season. In addition, there is suggestive evidence of a contribution of ozone to cardiovascular-related morbidity and non-accidental and cardiopulmonary mortality.

EPA typically quantifies ozone-related health impacts in its regulatory impact analyses (RIAs) when possible. In the analysis of past air quality regulations, ozone-related benefits have included morbidity endpoints and welfare effects such as damage to commercial crops. EPA has not recently included a separate and additive mortality effect for ozone, independent of the effect associated with fine particulate matter. For a number of reasons, including (1) advice from the Science Advisory Board (SAB) Health and Ecological Effects Subcommittee (HEES) that EPA consider the plausibility and viability of including an estimate of premature mortality associated with short-term ozone exposure in its benefits analyses and (2) conclusions regarding the scientific support for such relationships in EPA's 2006 Air Quality Criteria for Ozone and Related Photochemical Oxidants (the CD), EPA is in the process of determining how to appropriately characterize ozone-related mortality benefits within the context of benefits analyses for air quality regulations. As part of this process, we are seeking advice from the National Academy of Sciences (NAS) regarding how the ozone-mortality literature should be used to quantify the reduction in premature mortality due to diminished exposure to ozone, the amount of life expectancy to be added and the monetary value of this increased life expectancy in the context of health benefits analyses associated with regulatory assessments. In addition, the Agency has sought advice on characterizing and communicating the uncertainty associated with each of these aspects in health benefit analyses.

Since the NAS effort is not expected to conclude until 2008, the agency is currently deliberating how best to characterize ozone-related mortality benefits in its rulemaking analyses in the interim. For the analysis of the proposed locomotive and marine standards, we do not quantify an ozone mortality benefit. So that we do not provide an incomplete picture of all of the benefits associated with reductions in emissions of ozone precursors, we have chosen not to include an estimate of total ozone benefits in the proposed RIA. By omitting ozone benefits in this proposal, we acknowledge that this analysis underestimates the benefits associated with the proposed standards. For more information regarding the quantified benefits included in this analysis, please refer to Chapter 6 of this RIA.

[34] Technical Support Document for the Final Clean Air Interstate Rule Air Quality Modeling. This document is available in Docket EPA–HQ–OAR–2003–0190.

[35] The Los Angeles South Coast Air Basin 8-hour ozone nonattainment area will have to attain before June 15, 2021.

[36] U.S. EPA Air Quality Criteria for Ozone and Related Photochemical Oxidants (Final). U.S. Environmental Protection Agency, Washington, D.C., EPA 600/R–05/004aF–cF, 2006. This document may be accessed electronically at:*http://www.epa.gov/ttn/naaqs/standards/ozone/s_o3_cr_cd.html.*

[37] U.S. EPA (1996) Review of National Ambient Air Quality Standards for Ozone, Assessment of Scientific and Technical Information. OAQPS Staff Paper First Draft. EPA–452/R–96–007. This document is available electronically at: *http:www.epa.gov/ ttn/naaqs/ standards/ ozone/ s_o3_ cr_sp. html.*

[38] U.S. EPA (2006) Review of the National Ambient Air Quality Standards for Ozone, Policy Assessment of Scientific and Technical Information. OAQPS Staff Paper Second Draft. EPA–452/D–05–002. This document is available electronically at: *http:www.epa.gov/ttn/naaqs/standards/ozone/s_o3_cr_sp.html.*

(c) Air Quality Modeling Results for Ozone

This proposed rule would result in substantial nationwide ozone benefits. The air quality modeling conducted for ozone as part of this proposed rulemaking projects that in 2020 and 2030, 114 of the current 116 ozone nonattainment areas would see improvements in ozone air quality as a result of this proposed rule.

Results from the air quality modeling conducted for this rulemaking indicates that the average and population-weighted average concentrations over all U.S. counties would experience broad improvement in ozone air quality. The decrease in average ozone concentration in current nonattainment counties shows that the proposed rule would help bring these counties into attainment. The decrease in average ozone concentration for counties below the standard, but within ten percent, shows that the proposed rule would also help those counties to maintain the standard. All of these metrics show a decrease in 2020 and a larger decrease in 2030, indicating in four different ways the overall improvement in ozone air quality. For example, in nonattainment counties, on a population-weighted basis, the 8-hour ozone design value would decrease by 0.29 ppb in 2020 and 0.87 ppb in 2030.

The impact of the proposed reductions has also been analyzed with respect to those areas that have the highest design values at or above 85 ppb in 2030. We project there would be 27 U.S. counties with design values at or above 85 ppb in 2030. After implementation of this proposed action, we project that 3 of these 27 counties would drop below 85 ppb. Further, 17 of the 27 counties would be at least 10 percent closer to a design value of less than 85 ppb, and on average all 27 counties would be about 30 percent closer to a design value of less than 85 ppb.

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Figure II-3 Impact of Proposed Locomotive/Marine controls on annual Ozone Design Values (DV) on U.S. Counties in 2030

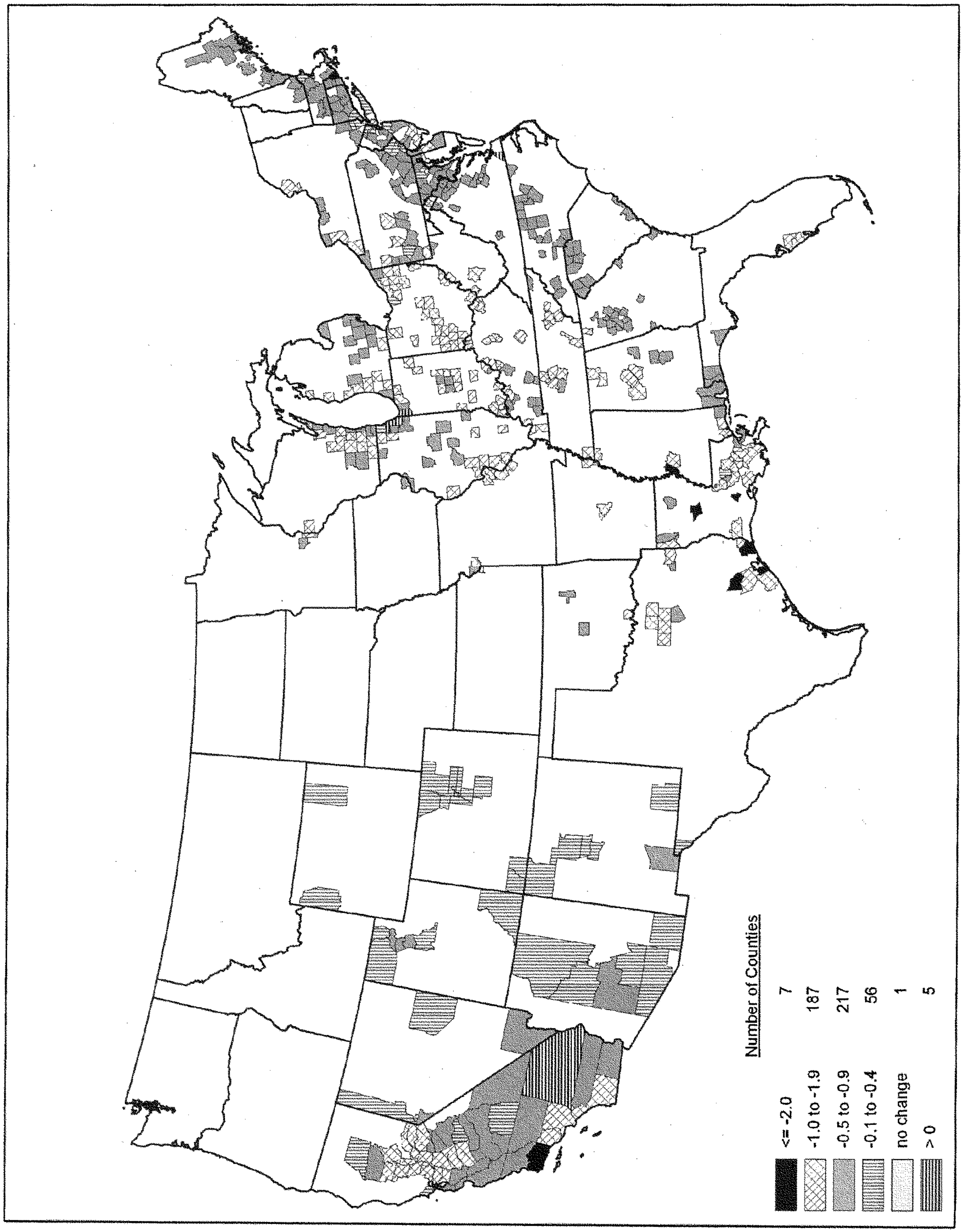

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Figure II–3 shows those U.S. counties in 2030 which are projected to experience a change in their ozone design values as a result of this proposed rule. The most significant decreases, equal or greater than −2.0 ppb, would occur in 7 counties across the U.S. including: Grant (−2.1 ppb) and Lafayette (−2.0 ppb) Counties in Louisiana; Montgomery (−2.0 ppb), Galveston (−2.0 ppb), and Jefferson (−2.0 ppb) Counties in Texas; Warren County (−2.9 ppb) in Mississippi; and Santa Barbara County (−2.7 ppb) in California. One hundred eighty-seven (187) counties would see annual ozone design value reductions from −1.0 to −1.9 ppb while an estimated 217 additional counties would see annual design value reductions from −0.5 to −0.9 ppb. Note that 5 counties including: Suffolk (+1.5 ppb) and Hampton (+0.8 ppb) Counties in Virginia; Cook County (+0.7 ppb) in Illinois; Lake County (+0.2 ppb) in Indiana; and San Bernardino County (+0.1 ppb) in California are projected to experience an increase in ozone design values because of the NO_X disbenefit that occurs under certain conditions.[39] It is expected that future local and national controls that decrease VOC, CO, and regional ozone will mitigate any localized disbenefits.

EPA's review of the ozone NAAQS is currently underway and a proposed decision in this review is scheduled for May 2007 with a final rule scheduled for February 2008. If the ozone NAAQS is revised then new nonattainment areas could be designated. While EPA is not relying on it for purposes of justifying this proposal, the emission reductions from this rulemaking would also be helpful to states if there is an ozone NAAQS revision.

(d) Ozone Air Quality Modeling Methodology

A national scale air quality modeling analysis was performed to estimate future year ozone concentrations for this proposed rule. To model the air quality benefits of this rule we used the Community-Scale Air Quality (CMAQ) model. CMAQ simulates the numerous physical and chemical processes involved in the formation, transport, and destruction of ozone and particulate matter. In addition to the CMAQ model, the modeling platform includes the emissions, meteorology, and initial and boundary condition data which are inputs to this model. Consideration of the different processes that affect primary directly emitted and secondary PM at the regional scale in different locations is fundamental to understanding and assessing the effects of pollution control measures that affect PM, ozone and deposition of pollutants to the surface. A complete description of the CAMQ model and methodology employed to develop the future year impacts of this proposed rule are found in Chapter 2.1 of the draft RIA.

It should be noted that the emission control scenarios used in the air quality and benefits modeling are slightly different than the emission control program being proposed. The differences reflect further refinements of the regulatory program since we performed the air quality modeling for this rule. Emissions and air quality modeling decisions are made early in the analytical process. Chapter 3 of the draft RIA describes the changes in the inputs and resulting emission inventories between the preliminary assumptions used for the air quality modeling and the final proposed regulatory scenario. These refinements to the proposed program would not significantly change the results summarized here or our conclusions drawn from this analysis.

(3) Air Toxics

People experience elevated risk of cancer and other noncancer health effects from exposure to air toxics. Mobile sources are responsible for a significant portion of this risk. According to the National Air Toxic Assessment (NATA) for 1999, mobile sources were responsible for 44 percent of outdoor toxic emissions and almost 50 percent of the cancer risk. Benzene is the largest contributor to cancer risk of all 133 pollutants quantitatively assessed in the 1999 NATA. Mobile sources were responsible for 68 percent of benzene emissions in 1999. Although the 1999 NATA did not quantify cancer risks associated with exposure to this diesel exhaust, EPA has concluded that diesel exhaust ranks with the other air toxic substances that the national-scale assessment suggests pose the greatest relative risk.

According to 1999 NATA, nearly the entire U.S. population was exposed to an average level of air toxics that has the potential for adverse respiratory health effects (noncancer). Mobile sources were responsible for 74 percent of the noncancer (respiratory) risk from outdoor air toxics in 1999. The majority of this risk was from acrolein, and formaldehyde also contributed to the risk of respiratory health effects. Although not included in NATA's estimates of noncancer risk, PM from gasoline and diesel mobile sources contribute significantly to the health effects associated with ambient PM.

It should be noted that the NATA modeling framework has a number of limitations which prevent its use as the sole basis for setting regulatory standards. These limitations and uncertainties are discussed on the 1999 NATA Web site.[40] Even so, this modeling framework is very useful in identifying air toxic pollutants and sources of greatest concern, setting regulatory priorities, and informing the decision making process.

The following section provides a brief overview of air toxics which are associated with nonroad engines, including locomotive and marine diesel engines, and provides a discussion of the health risks associated with each air toxic.

(a) Diesel Exhaust (DE)

Locomotive and marine diesel engine emissions include diesel exhaust (DE), a complex mixture comprised of carbon dioxide, oxygen, nitrogen, water vapor, carbon monoxide, nitrogen compounds, sulfur compounds and numerous low-molecular-weight hydrocarbons. A number of these gaseous hydrocarbon components are individually known to be toxic including aldehydes, benzene and 1,3-butadiene. The diesel particulate matter (DPM) present in diesel exhaust consists of fine particles (<2.5 μm), including a subgroup with a large number of ultrafine particles (<0.1 μm). These particles have large surface area which makes them an excellent medium for adsorbing organics and their small size makes them highly respirable and able to reach the deep lung. Many of the organic compounds present on the particles and in the gases are individually known to have mutagenic and carcinogenic properties. Diesel exhaust varies significantly in chemical composition and particle sizes between different engine types (heavy-duty, light-duty), engine operating conditions (idle, accelerate, decelerate), and fuel formulations (high/low sulfur fuel). Also, there are emissions differences between on-road and nonroad engines because the nonroad engines are generally of older technology. This is especially true for locomotive and marine diesel engines.[41]

[39] NO_X reductions can at certain times and in some areas cause ozone levels to increase. Such "disbenefits" are predicted in our modeling for this proposed rule. For a discussion of the phenomenon see the draft RIA Chapter 2.2. In spite of this disbenefit, the air quality modeling we conducted makes clear that the overall effect of this proposed rule is positive with 456 counties experiencing a decrease in both their 2020 and 2030 ozone design value.

[40] U.S. EPA (2006) National-Scale Air Toxics Assessment for 1999. *http://www.epa.gov/ttn/atw/nata1999.*

[41] U.S. EPA (2002) Health Assessment Document for Diesel Engine Exhaust. EPA/600/8–90/057F Office of Research and Development, Washington, DC. Pp 1–1, 1–2. This document is available

After being emitted in the engine exhaust, diesel exhaust undergoes dilution as well as chemical and physical changes in the atmosphere. The lifetime for some of the compounds present in diesel exhaust ranges from hours to days.

(i) Diesel Exhaust: Potential Cancer Effect of Diesel Exhaust

In EPA's 2002 Diesel Health Assessment Document (Diesel HAD),[42] diesel exhaust was classified as likely to be carcinogenic to humans by inhalation at environmental exposures, in accordance with the revised draft 1996/1999 EPA cancer guidelines. A number of other agencies (National Institute for Occupational Safety and Health, the International Agency for Research on Cancer, the World Health Organization, California EPA, and the U.S. Department of Health and Human Services) have made similar classifications. However, EPA also concluded in the Diesel HAD that it is not possible currently to calculate a cancer unit risk for diesel exhaust due to a variety of factors that limit the current studies, such as limited quantitative exposure histories in occupational groups investigated for lung cancer.

For the Diesel HAD, EPA reviewed 22 epidemiologic studies on the subject of the carcinogenicity of workers exposed to diesel exhaust in various occupations, finding increased lung cancer risk, although not always statistically significant, in 8 out of 10 cohort studies and 10 out of 12 case-control studies within several industries, including railroad workers. Relative risk for lung cancer associated with exposure ranged from 1.2 to 1.5, although a few studies show relative risks as high as 2.6. Additionally, the Diesel HAD also relied on two independent meta-analyses, which examined 23 and 30 occupational studies respectively, which found statistically significant increases in smoking-adjusted relative lung cancer risk associated with diesel exhaust, of 1.33 to 1.47. These meta-analyses demonstrate the effect of pooling many studies and in this case show the positive relationship between diesel exhaust exposure and lung cancer across a variety of diesel exhaust-exposed occupations.[43] [44] [45]

In the absence of a cancer unit risk, the Diesel HAD sought to provide additional insight into the significance of the diesel exhaust-cancer hazard by estimating possible ranges of risk that might be present in the population. An exploratory analysis was used to characterize a possible risk range by comparing a typical environmental exposure level for highway diesel sources to a selected range of occupational exposure levels. The occupationally observed risks were then proportionally scaled according to the exposure ratios to obtain an estimate of the possible environmental risk. A number of calculations are needed to accomplish this, and these can be seen in the EPA Diesel HAD. The outcome was that environmental risks from diesel exhaust exposure could range from a low of 10^{-4} to 10^{-5} to as high as 10^{-3}, reflecting the range of occupational exposures that could be associated with the relative and absolute risk levels observed in the occupational studies. Because of uncertainties, the analysis acknowledged that the risks could be lower than 10^{-4} or 10^{-5}, and a zero risk from diesel exhaust exposure was not ruled out.

Retrospective health studies of railroad workers have played an important part in determining that diesel exhaust is a likely human carcinogen. Key evidence of the diesel exhaust exposure linkage to lung cancer comes from two retrospective case-control studies of railroad workers which are discussed at length in the Diesel HAD.

(ii) Diesel Exhaust: Other Health Effects

Noncancer health effects of acute and chronic exposure to diesel exhaust emissions are also of concern to the Agency. EPA derived an RfC from consideration of four well-conducted chronic rat inhalation studies showing adverse pulmonary effects. [46] [47] [48] [49] The RfC is 5 $\mu g/m^3$ for diesel exhaust as measured by diesel PM. This RfC does not consider allergenic effects such as those associated with asthma or immunologic effects. There is growing evidence, discussed in the Diesel HAD, that diesel exhaust can exacerbate these effects, but the exposure-response data are presently lacking to derive an RfC. The EPA Diesel HAD states, ''With DPM [diesel particulate matter] being a ubiquitous component of ambient PM, there is an uncertainty about the adequacy of the existing DE [diesel exhaust] noncancer database to identify all of the pertinent DE-caused noncancer health hazards. (p. 9–19).

Diesel exhaust has been shown to cause serious noncancer effects in occupational exposure studies. One study of railroad workers and electricians, cited in the Diesel HAD,[50] found that exposure to diesel exhaust resulted in neurobehavioral impairments in one or more areas including reaction time, balance, blink reflex latency, verbal recall, and color vision confusion indices. Pulmonary function tests also showed that 10 of the 16 workers had airway obstruction and another group of 10 of 16 workers had chronic bronchitis, chest pain, tightness, and hyperactive airways. Finally, a variety of studies have been published subsequent to the completion of the Diesel HAD. One such study, published in 2006 [51] found that railroad engineers and conductors with diesel exhaust exposure from operating trains had an increased incidence of chronic obstructive pulmonary disease (COPD) mortality. The odds of COPD mortality increased with years on the job so that those who had worked more than 16 years as an engineer or conductor after 1959 had an increased risk of 1.61 (95% confidence interval, 1.12—2.30). EPA is assessing the significance of this study within the context of the broader literature.

electronically at *http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=29060*.

[42] U.S. EPA (2002) Health Assessment Document for Diesel Engine Exhaust. EPA/600/8–90/057F Office of Research and Development, Washington, DC. This document is available electronically at *http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=29060*.

[43] U.S. EPA (2002) Health Assessment Document for Diesel Engine Exhaust. EPA/6008–90/057F Office of Research and Development, Washington, DC. 9–11.

[44] Bhatia, R., Lopipero, P., Smith, A. (1998) Diesel exposure and lung cancer. Epidemiology 9(1):84–91.

[45] Lipsett, M: Campleman, S; (1999) Occupational exposure to diesel exhaust and lung cancer: a meta-analysis. Am J Public Health 80(7): 1009–1017.

[46] Ishinishi, N; Kuwabara, N; Takaki, Y; *et al.* (1988) Long-term inhalation experiments on diesel exhaust. In: Diesel exhaust and health risks. Results of the HERP studies. Ibaraki, Japan: Research Committee for HERP Studies; pp. 11–84.

[47] Heinrich, U; Fuhst, R; Rittinghausen, S; *et al.* (1995) Chronic inhalation exposure of Wistar rats and two different strains of mice to diesel engine exhaust, carbon black, and titanium dioxide. Inhal. Toxicol. 7:553–556.

[48] Mauderly, JL; Jones, RK; Griffith, WC; *et al.* (1987) Diesel exhaust is a pulmonary carcinogen in rats exposed chronically by inhalation. Fundam. Appl. Toxicol. 9:208–221.

[49] Nikula, KJ; Snipes, MB; Barr, EB; *et al.* (1995) Comparative pulmonary toxicities and carcinogenicities of chronically inhaled diesel exhaust and carbon black in F344 rats. Fundam. Appl. Toxicol. 25:80–94.

[50] Kilburn (2000). See HAD Chapter 5–7.

[51] Hart, JE, Laden F; Schenker, M.B.; and Garshick, E. Chronic Obstructive Pulmonary Disease Mortality in Diesel-Exposed Railroad Workers; Environmental Health Perspective July 2006: 1013–1016.

(iii) Ambient $PM_{2.5}$ Levels and Exposure to Diesel Exhaust PM

The Diesel HAD also briefly summarizes health effects associated with ambient PM and discusses the EPA's annual National Ambient Air Quality Standard (NAAQS) of 15 μg/m³. There is a much more extensive body of human data showing a wide spectrum of adverse health effects associated with exposure to ambient PM, of which diesel exhaust is an important component. The $PM_{2.5}$ NAAQS is designed to provide protection from the noncancer and premature mortality effects of $PM_{2.5}$ as a whole, of which diesel PM is a constituent.

(iv) Diesel Exhaust PM Exposures

Exposure of people to diesel exhaust depends on their various activities, the time spent in those activities, the locations where these activities occur, and the levels of diesel exhaust pollutants in those locations. The major difference between ambient levels of diesel particulate and exposure levels for diesel particulate is that exposure accounts for a person moving from location to location, proximity to the emission source, and whether the exposure occurs in an enclosed environment.

1. Occupational Exposures

Occupational exposures to diesel exhaust from mobile sources, including locomotive engines and marine diesel engines, can be several orders of magnitude greater than typical exposures in the non-occupationally exposed population.

Over the years, diesel particulate exposures have been measured for a number of occupational groups resulting in a wide range of exposures from 2 to 1,280 μg/m³ for a variety of occupations. Studies have shown that miners and railroad workers typically have higher diesel exposure levels than other occupational groups studied, including firefighters, truck dock workers, and truck drivers (both short and long haul).[52] As discussed in the Diesel HAD, the National Institute of Occupational Safety and Health (NIOSH) has estimated a total of 1,400,000 workers are occupationally exposed to diesel exhaust from on-road and nonroad vehicles including locomotive and marine diesel engines.

2. Elevated Concentrations and Ambient Exposures in Mobile Source-Impacted Areas

Regions immediately downwind of rail yards and marine ports may experience elevated ambient concentrations of directly-emitted $PM_{2.5}$ from diesel engines. Due to the unique nature of rail yards and marine ports, emissions from a large number of diesel engines are concentrated in a small area. Furthermore, emissions occur at or near ground level, allowing emissions of diesel engines to reach nearby receptors without fully mixing with background air.

A recent study conducted by the California Air Resources Board (CARB) examined the air quality impacts of railroad operations at the J.R. Davis Rail Yard, the largest rail facility in the western United States.[53] The yard occupies 950 acres along a one-quarter mile wide and four mile long section of land in Roseville, CA. The study developed an emissions inventory for the facility for the year 2000 and modeled ambient concentrations of diesel PM using a well-accepted dispersion model (ISCST3). The study estimated substantially elevated concentrations in an area 5,000 meters from the facility, with higher concentrations closer to the rail yard. Using local meteorological data, annual average contributions from the rail yard to ambient diesel PM concentrations under prevailing wind conditions were 1.74, 1.18, 0.80, and 0.25 μg/m³ at receptors located 200, 500, 1000, and 5000 meters from the yard, respectively. Several tens of thousands of people live within the area estimated to experience substantial increases in annual average ambient $PM_{2.5}$ as a result of rail yard emissions.

Another study from CARB evaluated air quality impacts of diesel engine emissions within the Ports of Long Beach and Los Angeles in California, one of the largest ports in the U.S.[54] Like the earlier rail yard study, the port study employed the ISCST3 dispersion model. Also using local meteorological data, annual average concentrations were substantially elevated over an area exceeding 200,000 acres. Because the ports are located near heavily-populated areas, the modeling indicated that over 700,000 people lived in areas with at least 0.3 μg/m³ of port-related diesel PM in ambient air, about 360,000 people lived in areas with at least 0.6 μg/m³ of diesel PM, and about 50,000 people lived in areas with at least 1.5 μg/m³ of ambient diesel PM directly from the port.

Overall, while these studies focus on only two large marine port and railroad facilities, they highlight the substantial contribution these facilities make to elevated ambient concentrations in populated areas.

We have recently initiated a study to better understand the populations that are living near rail yards and marine ports nationally. As part of the study, a computer geographic information system (GIS) is being used to identify the locations and property boundaries of these facilities nationally, and to determine the size and demographic characteristics of the population living near these facilities. We anticipate that the results of this study will be complete in 2007 and we intend to add this report to the public docket.

(a) Gaseous Air Toxics—Benzene, 1,3-butadiene, Formaldehyde, Acetaldehyde, Acrolein, POM, Naphthalene

Locomotive and marine diesel engine exhaust emissions contribute to ambient levels of other air toxics known or suspected as human or animal carcinogens, or that have non-cancer health effects. These other compounds include benzene, 1,3-butadiene, formaldehyde, acetaldehyde, acrolein, polycyclic organic matter (POM), and naphthalene. All of these compounds, except acetaldehyde, were identified as national or regional risk drivers in the 1999 National-Scale Air Toxics Assessment (NATA) and have significant inventory contributions from mobile sources. That is, for a significant portion of the population, these compounds pose a significant portion of the total cancer and noncancer risk from breathing outdoor air toxics. The reductions in locomotive and marine diesel engine emissions proposed in this rulemaking would help reduce exposure to these harmful substances.

Air toxics can cause a variety of cancer and noncancer health effects. A number of the mobile source air toxic pollutants described in this section are known or likely to pose a cancer hazard in humans. Many of these compounds also cause adverse noncancer health effects resulting from chronic,[55]

[52] Diesel HAD Page 2–110, 8–12; Woskie, SR; Smith, TJ; Hammond, SK: *et al.* (1988a) Estimation of the DE exposures of railroad workers: II. National and historical exposures. Am J Ind Med 12:381–394.

[53] Hand, R.; Pingkuan, D.; Servin, A.; Hunsaker, L.; Suer, C. (2004) Roseville rail yard study. California Air Resources Board. [Online at *http://www.arb.ca.gov/diesel/documents/rrstudy.htm*].

[54] Di, P.; Servin, A.; Rosenkranz, K.; Schwehr, B.; Tran, H. (2006) Diesel particulate matter exposure assessment study for the Ports of Los Angeles and Long Beach. California Air Resources Board. [Online at *http://www.arb.ca.gov/msprog/offroad/marinevess/marinevess.htm*].

[55] Chronic exposure is defined in the glossary of the Integrated Risk Information (IRIS) database (*http://www.epa.gov/iris*) as repeated exposure by

subchronic,[56] or acute [57] inhalation exposures. These include neurological, cardiovascular, liver, kidney, and respiratory effects as well as effects on the immune and reproductive systems.

Benzene: The EPA's Integrated Risk Information (IRIS) database lists benzene as a known human carcinogen (causing leukemia) by all routes of exposure, and that exposure is associated with additional health effects, including genetic changes in both humans and animals and increased proliferation of bone marrow cells in mice.[58] [59] [60] EPA states in its IRIS database that data indicate a causal relationship between benzene exposure and acute lymphocytic leukemia and suggests a relationship between benzene exposure and chronic non-lymphocytic leukemia and chronic lymphocytic leukemia. A number of adverse noncancer health effects including blood disorders, such as preleukemia and aplastic anemia, have also been associated with long-term exposure to benzene.[61] [62] The most sensitive noncancer effect observed in humans, based on current data, is the depression of the absolute lymphocyte count in blood.[63] [64] In addition, recent work, including studies sponsored by the Health Effects Institute (HEI), provides evidence that biochemical responses are occurring at lower levels of benzene exposure than previously known.[65] [66] [67] [68] EPA's IRIS program has not yet evaluated these new data.

1,3-Butadiene: EPA has characterized 1,3-butadiene as carcinogenic to humans by inhalation.[69] [70] The specific mechanisms of 1,3-butadiene-induced carcinogenesis are unknown. However, it is virtually certain that the carcinogenic effects are mediated by genotoxic metabolites of 1,3-butadiene. Animal data suggest that females may be more sensitive than males for cancer effects; while there are insufficient data in humans from which to draw conclusions about sensitive subpopulations. 1,3-Butadiene also causes a variety of reproductive and developmental effects in mice; no human data on these effects are available. The most sensitive effect was ovarian atrophy observed in a lifetime bioassay of female mice.[71]

Formaldehyde: Since 1987, EPA has classified formaldehyde as a probable human carcinogen based on evidence in humans and in rats, mice, hamsters, and monkeys.[72] EPA is currently reviewing recently published epidemiological data. For instance, recently released research conducted by the National Cancer Institute (NCI) found an increased risk of nasopharyngeal cancer and lymphohematopoietic malignancies such as leukemia among workers exposed to formaldehyde.[73] [74] NCI is currently performing an update of these studies. A recent National Institute of Occupational Safety and Health (NIOSH) study of garment workers also found increased risk of death due to leukemia among workers exposed to formaldehyde.[75] Based on the developments of the last decade, in 2004, the working group of the International Agency for Research on Cancer (IARC) concluded that formaldehyde is carcinogenic to humans (Group 1), on the basis of sufficient evidence in humans and sufficient evidence in experimental animals—a higher classification than previous IARC evaluations.

Formaldehyde exposure also causes a range of noncancer health effects, including irritation of the eyes (tearing of the eyes and increased blinking) and mucous membranes.

Acetaldehyde: Acetaldehyde is classified in EPA's IRIS database as a probable human carcinogen, based on nasal tumors in rats, and is considered toxic by the inhalation, oral, and intravenous routes.[76] The primary acute effect of exposure to acetaldehyde vapors is irritation of the eyes, skin, and respiratory tract.[77] The agency is currently conducting a reassessment of the health hazards from inhalation exposure to acetaldehyde.

Acrolein: Acrolein is intensely irritating to humans when inhaled, with acute exposure resulting in upper respiratory tract irritation and congestion. EPA determined in 2003 using the 1999 draft cancer guidelines that the human carcinogenic potential of acrolein could not be determined because the available data were inadequate. No information was

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the oral, dermal, or inhalation route for more than approximately 10 percent of the life span in humans (more than approximately 90 days to 2 years in typically used laboratory animal species).

[56] Defined in the IRIS database as exposure to a substance spanning approximately 10 percent of the lifetime of an organism.

[57] Defined in the IRIS database as exposure by the oral, dermal, or inhalation route for 24 hours or less.

[58] U.S. EPA. 2000. Integrated Risk Information System File for Benzene. This material is available electronically at *http://www.epa.gov/iris/subst/0276.htm*.

[59] International Agency for Research on Cancer, IARC monographs on the evaluation of carcinogenic risk of chemicals to humans, Volume 29, Some industrial chemicals and dyestuffs, International Agency for Research on Cancer, World Health Organization, Lyon, France, p. 345–389, 1982.

[60] Irons, R.D.; Stillman, W.S.; Colagiovanni, D.B.; Henry, V.A. (1992) Synergistic action of the benzene metabolite hydroquinone on myelopoietic stimulating activity of granulocyte/macrophage colony-stimulating factor in vitro, Proc. Natl. Acad. Sci. 89:3691–3695.

[61] Aksoy, M. (1989). Hematotoxicity and carcinogenicity of benzene. Environ. Health Perspect. 82:193–197.

[62] Goldstein, B.D. (1988). Benzene toxicity. Occupational medicine. State of the Art Reviews. 3:541–554.

[63] Rothman, N., G.L. Li, M. Dosemeci, W.E. Bechtold, G.E. Marti, Y.Z. Wang, M. Linet, L.Q. Xi, W. Lu, M.T. Smith, N. Titenko-Holland, L.P. Zhang, W. Blot, S.N. Yin, and R.B. Hayes (1996) Hematotoxicity among Chinese workers heavily exposed to benzene. Am. J. Ind. Med. 29:236–246.

[64] U.S. EPA 2002 Toxicological Review of Benzene (Noncancer Effects). Environmental Protection Agency, Integrated Risk Information System (IRIS), Research and Development, National Center for Environmental Assessment, Washington, DC. This material is available electronically at *http://www.epa.gov/iris/subst/0276.htm*.

[65] Qu, O.; Shore, R.; Li, G.; Jin, X.; Chen, C.L.; Cohen, B.; Melikian, A.; Eastmond, D.; Rappaport, S.; Li, H.; Rupa, D.; Suramaya, R.; Songnian, W.; Huifant, Y.; Meng, M.; Winnik, M.; Kwok, E.; Li, Y.; Mu, R.; Xu, B.; Zhang, X.; Li, K. (2003). HEI Report 115, Validation & Evaluation of Biomarkers in Workers Exposed to Benzene in China.

[66] Qu, Q., R. Shore, G. Li, X. Jin, L.C. Chen, B. Cohen, et al. (2002). Hematological changes among Chinese workers with a broad range of benzene exposures. Am. J. Industr. Med. 42: 275–285.

[67] Lan, Qing, Zhang, L., Li, G., Vermeulen, R., et al. (2004). Hematotoxically in Workers Exposed to Low Levels of Benzene. Science 306: 1774–1776.

[68] Turtletaub, K.W. and Mani, C. (2003). Benzene metabolism in rodents at doses relevant to human exposure from Urban Air. Research Reports Health Effect Inst. Report No.113.

[69] U.S. EPA. 2002. Health Assessment of 1,3-Butadiene. Office of Research and Development, National Center for Environmental Assessment, Washington Office, Washington, DC. Report No. EPA600–P–98–001F. This document is available electronically at *http://www.epa.gov/iris/supdocs/buta-sup.pdf*.

[70] U.S. EPA. 2002. ''Full IRIS Summary for 1,3-butadiene (CASRN 106–99–0)'' Environmental Protection Agency, Integrated Risk Information System (IRIS), Research and Development, National Center for Environmental Assessment, Washington, DC. *http://www.epa.gov/iris/subst/0139.htm*.

[71] Bevan, C.; Stadler, J.C.; Elliot, G.S.; *et al.* (1996) Subchronic toxicity of 4-vinylcyclohexene in rats and mice by inhalation. Fundam. Appl. Toxicol. 32:1–10.

[72] U.S. EPA (1987). Assessment of Health Risks to Garment Workers and Certain Home Residents from Exposure to Formaldehyde, Office of Pesticides and Toxic Substances, April 1987.

[73] Hauptmann, M.; Lubin, J.H.; Stewart, P.A.; Hayes, R.B.; Blair, A. 2003. Mortality from lymphohematopoietic malignancies among workers in formaldehyde industries. Journal of the National Cancer Institute 95: 1615–1623.

[74] Hauptmann, M..; Lubin, J.H.; Stewart, P.A.; Hayes, R.B.; Blair, A. 2004. Mortality from solid cancers among workers in formaldehyde industries. American Journal of Epidemiology 159: 1117–1130.

[75] Pinkerton, L.E. 2004. Mortality among a cohort of garment workers exposed to formaldehyde: an update. Occup. Environ. Med. 61: 193–200.

[76] U.S. EPA. 1988. Integrated Risk Information System File of Acetaldehyde. Research and Development, National Center for Environmental Assessment, Washington, DC. This material is available electronically at *http://www.epa.gov/iris/subst/0290.htm*.

[77] U.S. EPA. 1988. Integrated Risk Information System File of Acetaldehyde. Research and Development, National Center for Environmental Assessment, Washington, DC. This material is available electronically at *http://www.epa.gov/iris/subst/0290.htm*.

available on the carcinogenic effects of acrolein in humans and the animal data provided inadequate evidence of carcinogenicity.[78]

Polycyclic Organic Matter (POM): POM is generally defined as a large class of organic compounds which have multiple benzene rings and a boiling point greater than 100 degrees Celsius. Many of the compounds included in the class of compounds known as POM are classified by EPA as probable human carcinogens based on animal data. One of these compounds, naphthalene, is discussed separately below.

Recent studies have found that maternal exposures to PAHs in a population of pregnant women were associated with several adverse birth outcomes, including low birth weight and reduced length at birth, as well as impaired cognitive development at age three.[79] [80] EPA has not yet evaluated these recent studies.

Naphthalene: Naphthalene is found in small quantities in gasoline and diesel fuels but is primarily a product of combustion. EPA recently released an external review draft of a reassessment of the inhalation carcinogenicity of naphthalene.[81] The draft reassessment recently completed external peer review.[82] Based on external peer review comments, additional analyses are being considered. California EPA has released a new risk assessment for naphthalene, and the IARC has reevaluated naphthalene and re-classified it as Group 2B: possibly carcinogenic to humans.[83] Naphthalene also causes a number of chronic non-cancer effects in animals, including abnormal cell changes and growth in respiratory and nasal tissues.[84]

In addition to reducing substantial amounts of NO_X and $PM_{2.5}$ emissions from locomotive and marine diesel engines, the standards being proposed today would also reduce air toxics emitted from these engines. This will help mitigate some of the adverse health effects associated with operation of these engines.

C. Other Environmental Effects

There is a number of public welfare effects associated with the presence of ozone and $PM_{2.5}$ in the ambient air. In this section we discuss the impact of $PM_{2.5}$ on visibility and materials and the impact of ozone on plants, including trees, agronomic crops and urban ornamentals.

(1) Visibility

Visibility can be defined as the degree to which the atmosphere is transparent to visible light.[85] Visibility impairment manifests in two principal ways: as local visibility impairment and as regional haze.[86] Local visibility impairment may take the form of a localized plume, a band or layer of discoloration appearing well above the terrain as a result of complex local meteorological conditions. Alternatively, local visibility impairment may manifest as an urban haze, sometimes referred to as a ‘‘brown cloud’’. This urban haze is largely caused by emissions from multiple sources in the urban areas and is not typically attributable to only one nearby source or to long-range transport. The second type of visibility impairment, regional haze, usually results from multiple pollution sources spread over a large geographic region. Regional haze can impair visibility in large regions and across states.

Visibility is important because it has direct significance to people's enjoyment of daily activities in all parts of the country. Individuals value good visibility for the well-being it provides them directly, where they live and work, and in places where they enjoy recreational opportunities. Visibility is also highly valued in significant natural areas such as national parks and wilderness areas and special emphasis is given to protecting visibility in these areas. For more information on visibility see the final 2004 PM AQCD as well as the 2005 PM Staff Paper.[87] [88]

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[78] U.S. EPA. 2003. Integrated Risk Information System File of Acrolein. Research and Development, National Center for Environmental Assessment, Washington, DC. This material is available electronically at *http://www.epa.gov/iris/subst/0364.htm.*

[79] Perera, F.P.; Rauh, V.; Tsai, W–Y.; et al. (2002) Effect of transplacental exposure to environmental pollutants on birth outcomes in a multiethnic population. Environ Health Perspect. 111: 201–205.

[80] Perera, F.P.; Rauh, V.; Whyatt, R.M.; Tsai, W.Y.; Tang, D.; Diaz, D.; Hoepner, L.; Barr, D.; Tu, Y.H.; Camann, D.; Kinney, P. (2006) Effect of prenatal exposure to airborne polycyclic aromatic hydrocarbons on neurodevelopment in the first 3 years of life among inner-city children. Environ Health Perspect 114: 1287–1292.

[81] U.S. EPA. 2004. Toxicological Review of Naphthalene (Reassessment of the Inhalation Cancer Risk), Environmental Protection Agency, Integrated Risk Information System, Research and Development, National Center for Environmental Assessment, Washington, DC. This material is available electronically at *http://www.epa.gov/iris/subst/0436.htm.*

[82] Oak Ridge Institute for Science and Education. (2004). External Peer Review for the IRIS Reassessment of the Inhalation Carcinogenicity of Naphthalene. August 2004. *http://cfpub2.epa.gov/ncea/cfm/recordisplay.cfm?deid=86019.*

[83] International Agency for Research on Cancer (IARC). (2002). Monographs on the Evaluation of the Carcinogenic Risk of Chemicals for Humans. Vol. 82. Lyon, France.

[84] U.S. EPA. 1998. Toxicological Review of Naphthalene, Environmental Protection Agency, Integrated Risk Information System, Research and Development, National Center for Environmental Assessment, Washington, DC. This material is available electronically at *http://www.epa.gov/iris/subst/0436.htm.*

[85] National Research Council, 1993. Protecting Visibility in National Parks and Wilderness Areas. National Academy of Sciences Committee on Haze in National Parks and Wilderness Areas. National Academy Press, Washington, DC. This document is available in Docket EPA-HQ-OAR–2005–0036. This book can be viewed on the National Academy Press Web site at *http://www.nap.edu/books/0309048443/html/.*

[86] See discussion in U.S. EPA, National Ambient Air Quality Standards for Particulate Matter; Proposed Rule; January 17, 2006, Vol 71 p 2676. This information is available electronically at *http://epa.gov/fedrgstr/EPA-AIR/2006/January/Day-17/a177.pdf.*

[87] U.S. EPA (2004). Air Quality Criteria for Particulate Matter (Oct 2004), Volume I Document No. EPA600/P–99/002aF and Volume II Document No. EPA600/P–99/002bF. This document is available in Docket EPA-HQ-OAR–2005–0036.

[88] U.S. EPA (2005). Review of the National Ambient Air Quality Standard for Particulate Matter: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper. EPA–452/R–05–005. This document is available in Docket EPA-HQ-OAR–2005–0036.

Fine particles are the major cause of reduced visibility in parts of the United States. EPA is pursuing a two-part strategy to address visibility. First, to address the welfare effects of PM on visibility, EPA set secondary $PM_{2.5}$ standards which would act in conjunction with the establishment of a regional haze program. In setting this secondary standard EPA concluded that $PM_{2.5}$ causes adverse effects on visibility in various locations, depending on PM concentrations and factors such as chemical composition and average relative humidity. Second, section 169 of the Clean Air Act provides additional authority to address existing visibility impairment and prevent future visibility impairment in the 156 national parks, forests and wilderness areas categorized as mandatory class I federal areas (62 FR 38680–81, July 18, 1997).[89] In July 1999 the regional haze rule (64 FR 35714) was put in place to protect the visibility in mandatory class I federal areas. Visibility can be said to be impaired in both $PM_{2.5}$ nonattainment areas and mandatory class I federal areas.[90]

Locomotives and marine engines contribute to visibility concerns in these areas through their primary $PM_{2.5}$ emissions and their NO_X emissions which contribute to the formation of secondary $PM_{2.5}$.

Current Visibility Impairment

Recently designated $PM_{2.5}$ nonattainment areas indicate that, as of March 2, 2006, almost 90 million people live in nonattainment areas for the 1997 $PM_{2.5}$ NAAQS. Thus, at least these populations would likely be experiencing visibility impairment, as well as many thousands of individuals who travel to these areas. In addition, while visibility trends have improved in mandatory class I federal areas the most recent data show that these areas continue to suffer from visibility impairment. In summary, visibility impairment is experienced throughout the U.S., in multi-state regions, urban areas, and remote mandatory class I federal areas.[91] [92] The mandatory federal class I areas are listed in Chapter 2 of the draft RIA for this action. The areas that have design values above the 1997 $PM_{2.5}$ NAAQS are also listed in Chapter 2 of the draft RIA for this action.

Future Visibility Impairment

Recent modeling for this proposed rule was used to project visibility conditions in the 116 mandatory class I federal areas across the U.S. in 2020 and 2030 resulting from the proposed locomotive and marine diesel engine standards. The results suggest that improvement in visibility would occur in all class I federal areas although areas would continue to have annual average deciview levels above background in 2020 and 2030. Table II–2 groups class I federal areas by regions and illustrates that regardless of geographic area, reductions in $PM_{2.5}$ emissions from this rule would benefit visibility in each region of the U.S. in mandatory class I federal areas.

TABLE II–2.—SUMMARY OF MODELED 2030 VISIBILITY CONDITIONS IN MANDATORY CLASS I FEDERAL AREAS

[Annual average deciview]

Region	Predicted 2030 visibility baseline w/o rule rule	Predicted 2030 visibility with rule control	Change in annual average deciview
Eastern			
Southeast	17.52	17.45	.07
Northeast/Midwest	14.85	14.80	.05
Western			
Southwest	9.36	9.32	.04
West (CA–NV–UT)	9.99	9.92	.07
Rocky Mountain	8.37	8.33	.04
Northwest	9.11	9.05	.06
National Class I Area Average	10.97	10.91	.06

Notes:

(a) Background visibility conditions differ by regions: Eastern natural background is 9.5 deciview (or visual range of 150 kilometers) and the West natural background is 5.3 deciview (or visual range of 230 kilometers).

(b) The results average visibility conditions for mandatory Class I Federal areas in the regions.

(c) The results illustrate the type of visibility improvements for the primary control options. The proposal differs based on updated information; however, we believe that the net results would approximate future PM emissions.

(2) Plant and Ecosystem Effects of Ozone

Ozone contributes to many environmental effects, with impacts to plants and ecosystems being of most concern. Ozone can produce both acute and chronic injury in sensitive species depending on the concentration level and the duration of the exposure. Ozone effects also tend to accumulate over the growing season of the plant, so that even lower concentrations experienced for a longer duration have the potential to create chronic stress on vegetation. Ozone damage to plants includes visible injury to leaves and a reduction in food production through impaired photosynthesis, both of which can lead to reduced crop yields, forestry production, and use of sensitive ornamentals in landscaping. In addition, the reduced food production in plants and subsequent reduced root growth and storage below ground, can result in

[89] These areas are defined in section 162 of the Act as those national parks exceeding 6,000 acres, wilderness areas and memorial parks exceeding 5,000 acres, and all international parks which were in existence on August 7, 1977.

[90] As mentioned above, the EPA has recently proposed to amend the PM NAAQS (71 FR 2620, Jan. 17, 2006). The proposal would set the secondary NAAQS equal to the primary standards for both $PM_{2.5}$ and $PM_{10-2.5}$. EPA also is taking comment on whether to set a separate $PM_{2.5}$ standard, designed to address visibility (principally in urban areas), on potential levels for that standard within a range of 20 to 30 μg/m³, and on averaging times for the standard within a range of four to eight daylight hours.

[91] US EPA, Air Quality Designations and Classifications for the Fine Particles ($PM_{2.5}$) National Ambient Air Quality Standards, December 17, 2004. (70 FR 943, Jan 5. 2005) This document is also available on the Web at: *http://www.epa.gov/pmdesignations/*.

[92] US EPA. Regional Haze Regulations, July 1, 1999. (64 FR 35714, July 1, 1999).

other, more subtle plant and ecosystems impacts. These include increased susceptibility of plants to insect attack, disease, harsh weather, interspecies competition and overall decreased plant vigor. The adverse effects of ozone on forest and other natural vegetation can potentially lead to species shifts and loss from the affected ecosystems, resulting in a loss or reduction in associated ecosystem goods and services. Lastly, visible ozone injury to leaves can result in a loss of aesthetic value in areas of special scenic significance like national parks and wilderness areas. The final 2006 Criteria Document presents more detailed information on ozone effects on vegetation and ecosystems.

As discussed above, locomotive and marine diesel engine emissions of NO_X contribute to ozone and therefore the proposed NO_X standards will help reduce crop damage and stress on vegetation from ozone.

(3) Acid Deposition

Acid deposition, or acid rain as it is commonly known, occurs when NO_X and SO_2 react in the atmosphere with water, oxygen and oxidants to form various acidic compounds that later fall to earth in the form of precipitation or dry deposition of acidic particles. It contributes to damage of trees at high elevations and in extreme cases may cause lakes and streams to become so acidic that they cannot support aquatic life. In addition, acid deposition accelerates the decay of building materials and paints, including irreplaceable buildings, statues, and sculptures that are part of our nation's cultural heritage.

The proposed NO_X standards would help reduce acid deposition, thereby helping to reduce acidity levels in lakes and streams throughout the country and helping accelerate the recovery of acidified lakes and streams and the revival of ecosystems adversely affected by acid deposition. Reduced acid deposition levels will also help reduce stress on forests, thereby accelerating reforestation efforts and improving timber production. Deterioration of historic buildings and monuments, vehicles, and other structures exposed to acid rain and dry acid deposition also will be reduced, and the costs borne to prevent acid-related damage may also decline. While the reduction in nitrogen acid deposition will be roughly proportional to the reduction in NO_X emissions, the precise impact of this rule will differ across different areas.

(4) Eutrophication and Nitrification

The NO_X standards proposed in this action will help reduce the airborne nitrogen deposition that contributes to eutrophication of watersheds, particularly in aquatic systems where atmospheric deposition of nitrogen represents a significant portion of total nitrogen loadings.

Eutrophication is the accelerated production of organic matter, particularly algae, in a water body. This increased growth can cause numerous adverse ecological effects and economic impacts, including nuisance algal blooms, dieback of underwater plants due to reduced light penetration, and toxic plankton blooms. Algal and plankton blooms can also reduce the level of dissolved oxygen, which can adversely affect fish and shellfish populations. In recent decades, human activities have greatly accelerated nutrient impacts, such as nitrogen and phosphorus, causing excessive growth of algae and leading to degraded water quality and associated impairment of fresh water and estuarine resources for human uses.[93]

Severe and persistent eutrophication often directly impacts human activities. For example, losses in the nation's fishery resources may be directly caused by fish kills associated with low dissolved oxygen and toxic blooms. Declines in tourism occur when low dissolved oxygen causes noxious smells and floating mats of algal blooms create unfavorable aesthetic conditions. Risks to human health increase when the toxins from algal blooms accumulate in edible fish and shellfish, and when toxins become airborne, causing respiratory problems due to inhalation. According to the NOAA report, more than half of the nation's estuaries have moderate to high expressions of at least one of these symptoms '' an indication that eutrophication is well developed in more than half of U.S. estuaries.[94]

(5) Materials Damage and Soiling

The deposition of airborne particles can reduce the aesthetic appeal of buildings and culturally important articles through soiling, and can contribute directly (or in conjunction with other pollutants) to structural damage by means of corrosion or erosion.[95] Particles affect materials principally by promoting and accelerating the corrosion of metals, by degrading paints, and by deteriorating building materials such as concrete and limestone. Particles contribute to these effects because of their electrolytic, hygroscopic, and acidic properties, and their ability to adsorb corrosive gases (principally sulfur dioxide). The rate of metal corrosion depends on a number of factors, including the deposition rate and nature of the pollutant; the influence of the metal protective corrosion film; the amount of moisture present; variability in the electrochemical reactions; the presence and concentration of other surface electrolytes; and the orientation of the metal surface.

The $PM_{2.5}$ standards proposed in this action will help reduce the airborne particles that contribute to materials damage and soiling.

D. Other Criteria Pollutants Affected by This NPRM

Locomotive and marine diesel engines account for about 1 percent of the mobile sources carbon monoxide (CO) inventory. Carbon monoxide (CO) is a colorless, odorless gas produced through the incomplete combustion of carbon-based fuels. The current primary NAAQS for CO are 35 ppm for the 1-hour average and 9 ppm for the 8-hour average. These values are not to be exceeded more than once per year. As of October 2006, there are 15.5 million people living in 6 areas (10 counties) that are designated as nonattainment for CO.

Carbon monoxide enters the bloodstream through the lungs, forming carboxyhemoglobin and reducing the delivery of oxygen to the body's organs and tissues. The health threat from CO is most serious for those who suffer from cardiovascular disease, particularly those with angina or peripheral vascular disease. Healthy individuals also are affected, but only at higher CO levels. Exposure to elevated CO levels is associated with impairment of visual perception, work capacity, manual dexterity, learning ability and performance of complex tasks. Carbon monoxide also contributes to ozone nonattainment since carbon monoxide reacts photochemically in the atmosphere to form ozone. Additional information on CO related health effects

[93] Deposition of Air Pollutants to the Great Waters, Third Report to Congress, June 2000, EPA–453/R–00–005. This document can be found in Docket No. OAR–2002–0030, Document No. OAR–2002–0030–0025. It is also available at *www.epa.gov/oar/oaqps/gr8water/3rdrpt/obtain.html*.

[94] Bricker, Suzanne B., et al. National Estuarine Eutrophication Assessment, Effects of Nutrient Enrichment in the Nation's Estuaries, National Ocean Service, National Oceanic and Atmospheric Administration, September, 1999.

[95] U.S EPA (2005). Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper. This document is available in Docket EPA–HQ–OAR–2005–0036.

can be found in the Air Quality Criteria for Carbon Monoxide.[96]

E. Emissions From Locomotive and Marine Diesel Engines

(1) Overview

The engine standards being proposed in this rule would affect emissions of particulate matter ($PM_{2.5}$), oxides of nitrogen (NO_X), volatile organic compounds (VOCs), and air toxics. Carbon monoxide is not specifically targeted in this proposal although the technologies applied to control these other pollutants are expected to also reduce CO emissions.

Locomotive and marine diesel engine emissions are expected to continue to be a significant part of the mobile source emissions inventory both nationally and in ozone and $PM_{2.5}$ nonattainment areas in the coming years. In the absence of new emissions standards, we expect overall emissions from these engines to decrease modestly over the next ten to fifteen years than remain relatively flat through 2025 due to existing regulations such as lower fuel sulfur requirements, the phase in of locomotive and marine diesel Tier 1 and Tier 2 engine standards, and the Tier 0 locomotive remanufacturing requirements. Beginning thereafter, emission inventories from these engines would once again begin increasing due to growth in the locomotive and marine sectors. Under today's proposed standards, by 2030, annual NO_X emissions from these engines would be reduced by 765,000 tons, $PM_{2.5}$ emissions by 28,000 tons, and VOC emissions by 42,000 tons.

In this section we first present base case emissions inventory contributions for locomotive and marine diesel engines and other mobile sources assuming no further emission controls beyond those already in place. The 2001 inventory numbers were developed and used as an input into our air quality modeling. Individual sub-sections which follow discuss $PM_{2.5}$, NO_X, and VOC pollutants, in terms of expected emission reductions associated with the proposed standards. The tables and figures illustrate the Agency's analysis of current and future emissions contributions from locomotive and marine diesel engines.

(2) Estimated Inventory Contribution

Locomotive and marine diesel engine emissions contribute to nationwide PM, NO_X, VOC, CO, and air toxics inventories. Our current baseline and future year estimates for NO_X and $PM_{2.5}$ inventories (50-state) are set out in Tables II–3 and II–4. Based on our analysis undertaken for this rulemaking, we estimate that in 2001 locomotives and marine diesel engines contributed almost 60,000 tons (18 percent) to the national mobile source diesel $PM_{2.5}$ inventory and about 2.0 million tons (16 percent) to the mobile source NO_X inventory. In 2030, absent the standards proposed today, these engines would contribute about 50,000 tons (65 percent) to the mobile source diesel $PM_{2.5}$ inventory and almost 1.6 million tons (35 percent) to the mobile source NO_X inventory.

The national locomotives and marine diesel engine $PM_{2.5}$ and NO_X inventories in 2030 would be roughly twice as large as the combined $PM_{2.5}$ and NO_X inventories from on-highway diesel and land-based nonroad diesel engines. In absolute terms—locomotives and marine diesel engines, in 2030, would annually emit 22,000 more tons of $PM_{2.5}$ and 890,000 more tons of NO_X than all highway and nonroad diesels combined. This occurs because EPA has already taken steps to bring engine emissions from both on-highway and nonroad diesels to near-zero levels, while locomotives and marine diesel engines continue to meet relatively modest emission requirements. Table II–4 shows that in 2001 the land-based nonroad diesel category contributed about 160,000 tons of $PM_{2.5}$ emissions and by 2030 they drop to under 18,000 tons. Likewise, in 2001, annual $PM_{2.5}$ emissions from highway diesel engines totaled about 110,000 tons falling in 2030 to about 10,000 tons. Table II–3 shows a similar downward trend occurring for annual NO_X emissions. In 2001, NO_X emissions from highway diesel engines' amounted to over 3.7 million tons but by 2030 they fall to about 260,000 tons. Finally, land-based nonroad diesels in 2001 emitted over 1.5 million tons of NO_X but by 2030 these emissions drop to approximately 430,000 tons.

Marine diesel engine and locomotive inventories were developed using multiple methodologies. Chapter 3 of the draft RIA provides a detailed explanation of our approach. In summary, the quality of data available for locomotive inventories made it possible to develop more detailed estimates of fleet composition and emission rates than we have previously done. Locomotive emissions were calculated based on estimated current and projected fuel consumption rates. Emissions were calculated separately for the following locomotive categories: line-haul locomotives in large railroads, switching locomotives in large railroads (including Class II/III switch railroads owned by Class I railroads), other line-haul locomotives (i.e., local and regional railroads), other switch/terminal locomotives, and passenger locomotives. Our inventories for marine diesel engines were created using the inventory for marine diesel engines up to 30 liters per cylinder displacement including recreational, commercial, and auxiliary applications was developed by using a methodology based on engine population, hours of use, average engine loads, and in-use emissions factors.

TABLE II–3.—NATIONWIDE ANNUAL NO_X BASELINE EMISSION LEVELS

Category	2001			2030		
	NO_X short tons	Percent of mobile source	Percent of total	NO_X	Percent of mobile source	Percent of total short tons
Locomotive	1,118,786	9.0	5.1	854,226	19.0	8.1
Recreational Marine Diesel	40,437	0.3	0.2	48,155	1.1	0.5
Commercial Marine (C1 & C2)	833,963	6.7	3.8	679,973	15.1	6.4
Land-Based Nonroad Diesel	1,548,236	12.5	7.1	434,466	9.7	4.1
Commercial Marine (C3)*	224,100	1.8	1.0	531,641	11.8	5.0
Small Nonroad SI	100,319	0.8	0.5	114,287	2.5	1.1
Recreational Marine SI	42,252	0.3	0.2	92,188	2.1	0.9
SI Recreational Vehicles	5,488	0.0	0.0	20,136	0.4	0.2
Large Nonroad SI (>25hp)	321,098	2.6	1.5	46,253	1.0	0.4

[96] U.S. EPA (2000). Air Quality Criteria for Carbon Monoxide, EPA/600/P–99/001F. This document is available in Docket EPA–HQ–OAR–2004–0008.

TABLE II–3.—NATIONWIDE ANNUAL NO_X BASELINE EMISSION LEVELS—Continued

Category	2001			2030		
	NO_X short tons	Percent of mobile source	Percent of total	NO_X	Percent of mobile source	Percent of total short tons
Aircraft	83,764	0.7	0.4	118,740	2.6	1.1
Total Off Highway	4,318,443	34.8	19.8	2,940,066	65.5	27.7
Highway Diesel	3,750,886	30.2	17.2	260,915	5.8	2.5
Highway non-diesel	4,354,430	35.0	20.0	1,289,780	28.7	12.2
Total Highway	8,105,316	65.2	37.2	1,550,695	34.5	14.6
Total Diesel (distillate) Mobile	7,292,308	58.7	33.5	2,277,735	50.7	21.5
Total Mobile Sources	12,423,758	100	57.0	4,490,761	100	42.4
Stationary Point and Area Sources	9,355,659	-	43.0	6,111,866	-	57.6
Total Man-Made Sources	21,779,418	-	100	10,602,627	-	100

* This category includes emissions from Category 3 (C3) propulsion engines and C2/3 auxiliary engines used on ocean-going vessels.

TABLE II–4.—NATIONWIDE ANNUAL $PM_{2.5}$ BASELINE EMISSION LEVELS

Category	2001			2030		
	$PM_{2.5}$ short tons	Percent of diesel mobile	Percent of mobile source	$PM_{2.5}$ short tons	Percent of diesel mobile	Percent of mobile source
Locomotive	29,660	8.9	6.36	25,109	32.2	10.01
Recreational Marine Diesel	1,096	0.3	0.24	1,141	1.5	0.45
Commercial Marine (C1 & C2)	28,728	8.6	6.16	23,758	30.5	9.47
Land-Based Nonroad Diesel	164,180	49.2	35.2	17,934	23.0	7.1
Commercial Marine (C3)	20,023		4.30	52,682		20.99
Small Nonroad SI	25,575		5.5	35,761		14.3
Recreational Marine SI	17,101		3.7	6,378		2.5
SI Recreational Vehicles	12,301		2.6	9,953		4.0
Large Non road SI (>25hp)	1,610		0.3	2,844		1.1
Aircraft	5,664		1.22	8,569		3.41
Total Off Highway	305,939		65.6	184,129		73.4
Highway Diesel	109,952	33.0	23.6	10,072	12.9	4.0
Highway non-diesel	50,277		10.8	56,734		22.6
Total Highway	160,229		34.4	66,806		26.6
Total Diesel (distillate) Mobile	333,618	100	71.6	78,014	100	31.1
Total Mobile Sources	466,168		100	250,934		100
Stationary Point and Area Sources Diesel	3,189			2,865		
Stationary Point and Areas Sources non-diesel	1,963,264			1,817,722		
Total Stationary Point and Area Sources	1,966,453			1,820,587		
Total Man-Made Sources	2,432,621			2,071,521		

(3) $PM_{2.5}$ Emission Reductions

In 2001 annual emissions from locomotive and marine diesel engines totaled about 60,000 tons. Table II–4 shows the distribution of these $PM_{2.5}$ emissions: locomotives contributed about 30,000 tons, recreational marine diesel roughly 1,000 tons, and commercial marine diesel (C1 and C2) 29,000 tons. Due to current standards, annual $PM_{2.5}$ emissions from these engines drop to 50,000 tons in 2030 with roughly proportional emission reductions occurring in both the locomotive and commercial marine diesel categories while the recreational marine diesel category experiences a slight increase in $PM_{2.5}$ emissions. Both Tables II–5 and Figure II–4 show $PM_{2.5}$ emissions nearly flat through 2030 before beginning to rise again due to growth in these sectors.

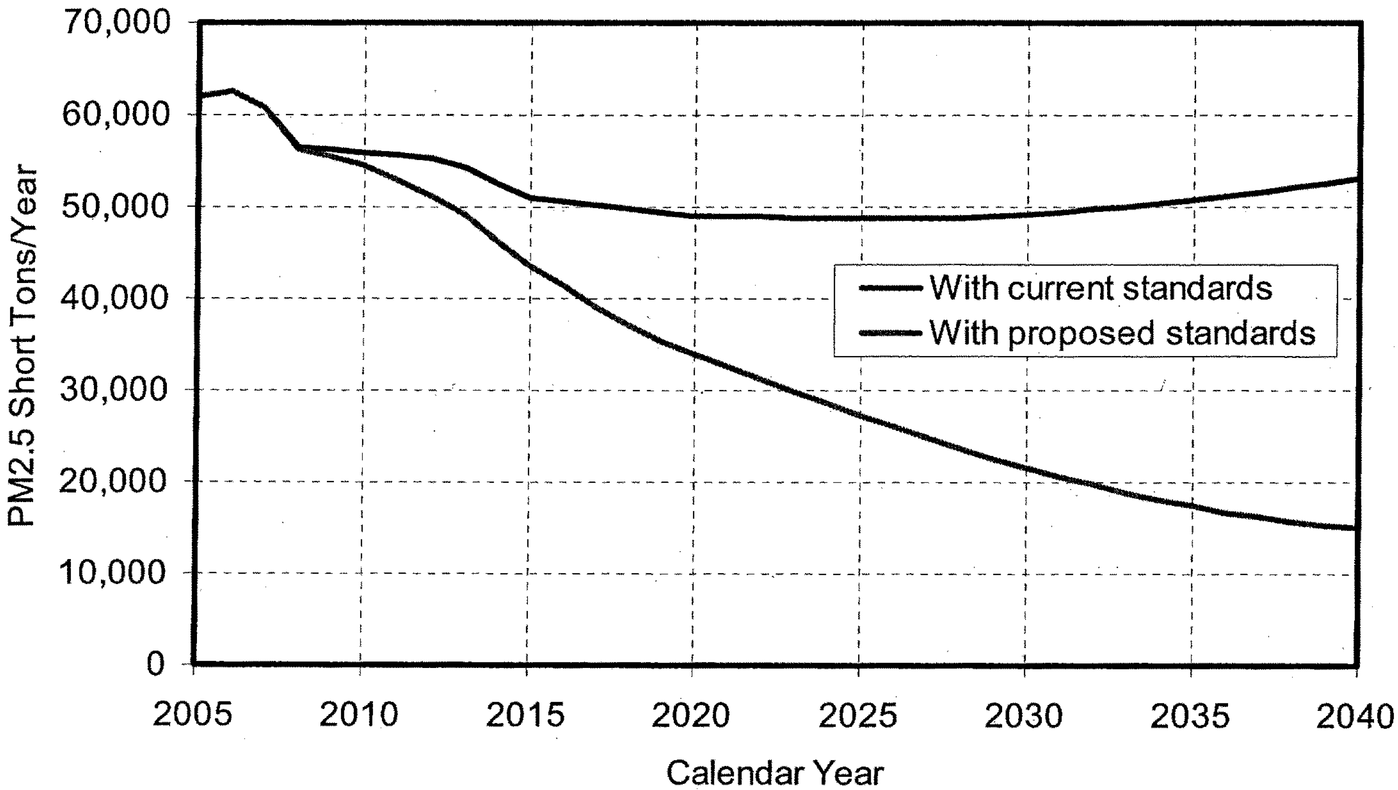
Table II–5 shows how the proposed rule would begin reducing $PM_{2.5}$ emissions from the current national inventory baseline starting in 2015 when annual reductions of 7,000 tons would occur. By 2020 that number would grow to 15,000 tons of $PM_{2.5}$, by 2030 to 28,000 annual tons, and reductions would continue to grow through 2040 to about 39,000 tons of $PM_{2.5}$ annually.

TABLE II–5.—LOCOMOTIVE AND MARINE DIESEL $PM_{2.5}$ EMISSIONS

[Short tons/year]

	2015	2020	2030	2040
Without Proposed Rule	51,000	50,000	50,000	54,000
With Proposed Rule	44,000	35,000	22,000	15,000
Reductions From Proposed Rule	7,000	15,000	28,000	39,000

Figure II-4 $PM_{2.5}$ Reductions from Proposal



Although this proposed rule results in large nationwide $PM_{2.5}$ inventory reductions, it would also help urban areas that have significant locomotive and marine diesel engine emissions in their inventories. Table II–6 shows the percent these engines contribute to the mobile source diesel $PM_{2.5}$ inventory in a variety of urban areas in 2001 and 2030. In 2001, a number of metropolitan areas saw locomotives and marine diesel engines contribute a much larger share to their local inventories than the national average including Houston (42 percent), Los Angeles (32 percent), and Baltimore (23 percent). In 2030, each of these metropolitan areas would continue to see locomotive and marine diesel engines comprise a larger portion of their mobile source diesel $PM_{2.5}$ inventory than the national average as would other communities including Cleveland (72 percent), Chicago (70 percent) and Chattanooga (70 percent).

TABLE II–6.—LOCOMOTIVE AND MARINE DIESEL CONTRIBUTION TO MOBILE SOURCE DIESEL $PM_{2.5}$ INVENTORIES IN SELECTED METROPOLITAN AREAS IN 2001 AND 2030

Metropolitan area (MSA)	2001 Percent	2030 Percent
National Average	18	65
Los Angeles, CA	32	73
Houston, TX	42	85
Chicago, IL	25	70
Philadelphia, PA	20	64
Cleveland-Akron-Lorain, OH	26	72
St. Louis, MO	22	68
Seattle, WA	17	61
Kansas City, MO	21	68
Baltimore, MD	23	68
Cincinnati, OH	24	70
Boston, MA	8	41
Huntington-Ashland WV-KY-OH	53	91
New York, NY	4	21
San Joaquin Valley, CA	9	39
Minneapolis-St. Paul, MN	11	48
Atlanta, GA	6	30
Phoenix-Mesa, AZ	5	27
Birmingham, AL	17	58
Detroit, MI	5	26
Chattanooga, TN	22	70

TABLE II–6.—LOCOMOTIVE AND MARINE DIESEL CONTRIBUTION TO MOBILE SOURCE DIESEL $PM_{2.5}$ INVENTORIES IN SELECTED METROPOLITAN AREAS IN 2001 AND 2030—Continued

Metropolitan area (MSA)	2001 Percent	2030 Percent
Indianapolis, IN	5	30

(4) NO_X Emissions Reductions

In 2001 annual emissions from locomotive and marine diesel engines totaled about 2.0 million tons. Table II–3 shows the distribution of these NO_X emissions: locomotives contributed about 1.1 million tons, recreational marine diesel roughly 40,000 tons, and commercial marine diesel (C1 and C2) 834,000 tons. Due to current standards, annual NO_X emission from these engines drop to 1.6 million tons in 2030 with roughly proportional emission reductions occurring in both the locomotive and commercial marine diesel categories while the recreational marine diesel category experiences an increase in $PM_{2.5}$ emissions. Both Table II–7 and Figure II–5 show NO_X

emissions remaining nearly flat through 2030 before beginning to rise again due to growth in these sectors.

Table II–7 shows how the proposed rule would begin reducing NO_X emissions from the current national inventory baseline starting in 2015 when annual reductions of 84,000 tons would occur. By 2020 that number would grow to 293,000 tons of NO_X, by 2030 to 765,000 annual tons, and reductions would continue to grow through 2040 to about 1.1 million tons of NO_X annually.

These numbers are comparable to emission reductions projected in 2030 for our already established nonroad Tier 4 program. Table II–8 provides the 2030 NO_X emission reductions (and PM reductions) for this proposed rule compared to the Heavy-Duty Highway rule and Nonroad Tier 4 rule. The 2030 NO_X reductions of about 740,000 tons for the Nonroad Tier 4 are similar to those from this proposed rule.

TABLE II–7.—LOCOMOTIVE AND MARINE DIESEL NO_X EMISSIONS

[Short tons/year]

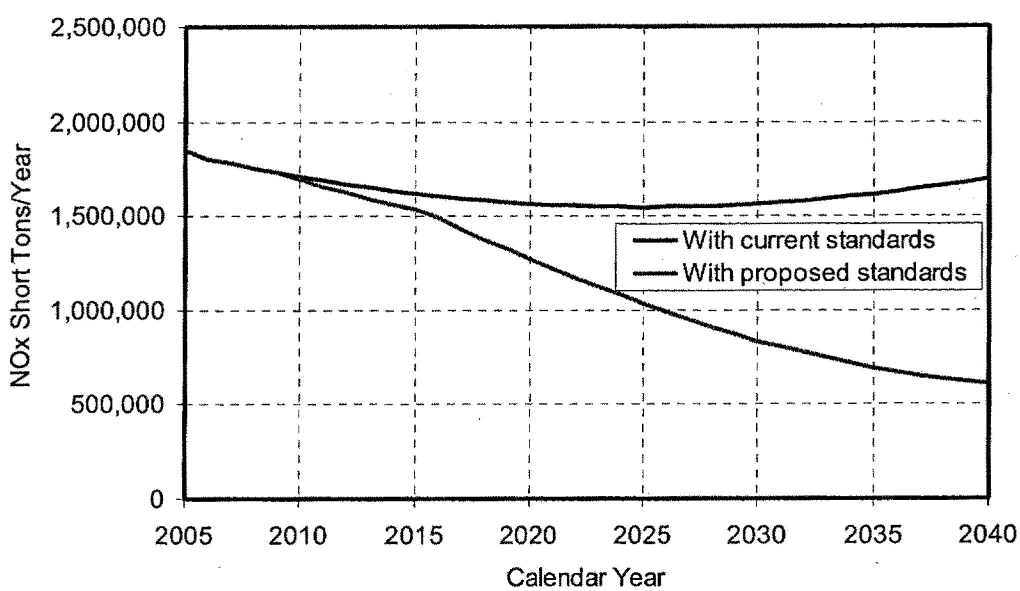
	2015	2020	2030	2040
Without Proposed Rule	1,633,000	1,582,000	1,582,000	1,703,000
With Proposed Rule	1,549,000	1,289,000	817,000	579,000
Reductions From Proposed Rule	84,000	293,000	765,000	1,124,000

TABLE II–8.—PROJECTED 2030 EMISSIONS REDUCTIONS FROM RECENT MOBILE SOURCE RULES

[Short tons]

Rule	NO_X	$PM_{2.5}$
Proposed Locomotive and Marine	765,000	28,000
Nonroad Tier 4	738,000	129,000
Heavy-Duty Highway	2,600,000	109,000

Figure II-5 NO_x Reductions from Proposal



Although this proposed rule results in large nationwide NO_X inventory reductions, it would also help urban areas that have significant concentrations of locomotive and marine diesel engines in their inventories. Table II–9 shows the percent these engines contribute to the mobile source diesel NO_X inventory in a variety of urban areas in 2001 and 2030. In 2001, a number of metropolitan areas saw locomotives and marine diesel engines contribute a much larger share to their local inventories than the national average including Houston (32 percent), Kansas City (20 percent), and Los Angeles (19 percent). In 2030, each of these metropolitan areas would continue to see locomotive and marine diesel engines comprise a larger portion of their mobile source diesel $PM_{2.5}$ inventory than the national average as would other communities including Birmingham (43 percent), Chicago (42 percent) and Chattanooga (40 percent).

TABLE II–9.—LOCOMOTIVE AND MARINE DIESEL ENGINE CONTRIBUTION TO MOBILE SOURCE NO_X INVENTORIES IN SELECTED METROPOLITAN AREAS IN 2001 AND 2030

Metropolitan areas (MSA)	2001 Percent	2030 Percent
National Average	16	35
Los Angeles, CA	19	38
Houston, TX	32	45
Chicago, IL	20	42
Philadelphia, PA	14	19
Cleveland-Akron-Lorain, OH	19	40
New York, NY	5	8
St. Louis, MO	16	37
Seattle, WA	14	31
Kansas City, MO	20	44
Cincinnati, OH	18	39
Huntington-Ashland, WV-KY-OH	39	37
Boston, MA	7	11
San Joaquin Valley, CA	9	26
Minneapolis-St. Paul, MN	9	20
Atlanta, GA	5	13
Birmingham, AL	17	43
Baltimore, MD	8	10
Phoenix-Mesa, AZ	6	15
Detroit, MI	3	9
Chattanooga, TN	16	40
Indianapolis, IN	5	13

(5) Volatile Organic Compounds Emissions Reductions

Emissions of volatile organic compounds (VOCs) from locomotive and marine diesel engines based on a 50-state inventory are shown in Table II–10, along with the estimates of the reductions in 2015, 2020, 2030 and 2040 we expect would result from the VOC exhaust emission standard in our proposed rule. In 2015 15,000 tons of VOCs would be reduced and by 2020 reductions would almost double to 27,000 tons annually from these engines. Over the next ten years annual reductions from controlled locomotive and marine diesel engines would produce annual VOC reductions of 42,000 tons in 2030 and 54,000 tons in 2040.

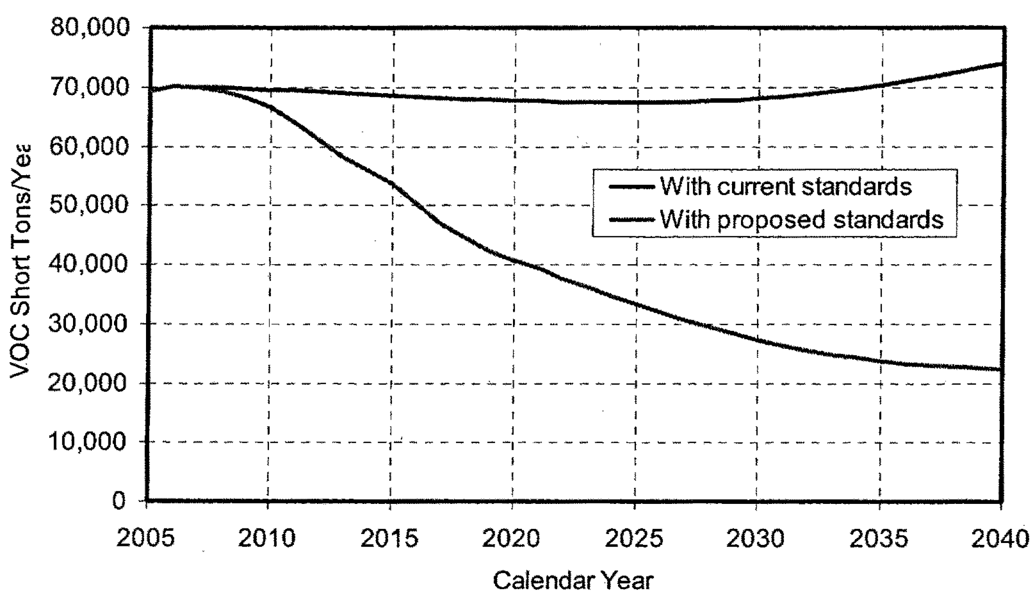
Figure II–6 shows our estimate of VOC emissions between 2005 and 2040 both with and without the proposed standards of this rule. We estimate that VOC emissions from locomotive and marine diesel engines would be reduced by 60 percent by 2030 and by 70 percent in 2040.

TABLE II–10.—LOCOMOTIVE AND MARINE DIESEL VOC EMISSIONS

[short tons/year]

	2015	2020	2030	2040
Without Proposed Rule	72,000	71,000	72,000	78,000
With Proposed Rule	57,000	44,000	30,000	24,000
Reductions From Proposed Rule	15,000	27,000	42,000	54,000

Figure II-6 VOC Reductions from Proposal



III. Emission Standards

This section details the emission standards, implementation dates, and other major requirements of the proposed program. Following brief summaries of the types of locomotives and marine engines covered and of the existing standards, we describe the proposed provisions for setting:

- Tier 3 and Tier 4 standards for newly-built locomotives,
- Standards for remanufactured Tier 0, 1, and 2 locomotives,

- Standards and other provisions for diesel switch locomotives,
- Requirements to reduce idling locomotive emissions, as well as possible ways to encourage emission reductions through the optimization of multi-locomotive teams (consists), and
- Tier 3 and Tier 4 standards for newly-built marine diesel engines.

As discussed in sections I.A(2) and VII.A(2), we are also soliciting comment on setting standards for remanufactured marine diesel engines.

A detailed discussion of the technological feasibility of the proposed standards follows the description of the proposed program. The section concludes with a discussion of considerations and activities surrounding emissions from large Category 3 engines used on ocean-going vessels, although we are not proposing provisions for these engines in this rulemaking.

To ensure that the benefits of the standards are realized in-use and throughout the useful life of these engines, and to incorporate lessons learned over the last few years from the existing test and compliance program, we are also proposing revised test procedures and related certification requirements. In addition, we are proposing to continue the averaging, banking, and trading (ABT) emissions credits provisions to demonstrate compliance with the standards. These provisions are described further in section IV.

A. What Locomotives and Marine Engines Are Covered?

The regulations being proposed would affect locomotives currently regulated under part 92 and marine diesel engines and vessels currently regulated under parts 89 and 94, as described below.[97]

With some exceptions, the regulations apply for all locomotives that operate extensively within the United States. See section IV.B for a discussion of the exemption for locomotives that are used only incidentally within the U.S. The exceptions include historic steam-powered locomotives and locomotives powered solely by an external source of electricity. In addition, the regulations generally do not apply to existing locomotives owned by railroads that are classified as small businesses.[98] Furthermore, engines used in locomotive-type vehicles with less than 750 kW (1006 hp) total power (used primarily for railway maintenance), engines used only for hotel power (for passenger railcar equipment), and engines that are used in self-propelled passenger-carrying railcars, are excluded from these regulations. The engines used in these smaller locomotive-type vehicles are generally subject to the nonroad engine requirements of Parts 89 and 1039.

There are currently three tiers of locomotive emission standards. The Tier 0 standards apply only to locomotives originally manufactured before 2002, the Tier 1 standards apply to new locomotives manufactured in 2002–2004, and the Tier 2 standards apply to new locomotives manufactured in 2005 and later. Under the existing regulations, the applicability of the Tier 1 and Tier 2 standards is based on the date of manufacture of the locomotive, rather than the engine. Thus, a newly manufactured engine in 2005 that is used to repower a 1990 model year locomotive would be subject to the Tier 0 emission standards, which are also applicable to all other 1990 model year locomotives. As described in section IV.B, we are proposing some changes to this approach.

The marine diesel engines covered by this rule would include propulsion engines used on vessels from recreational and small fishing boats to super-yachts, tugs and Great Lakes freighters, and auxiliary engines ranging from small gensets to large generators on ocean-going vessels.[99] Marine diesel engines are categorized both by per cylinder displacement and by rated power. Consistent with our existing marine diesel emission control program, the proposed standards would apply to any marine diesel engine with per cylinder displacement below 30 liters installed on a vessel flagged or registered in the United States. According to our existing definitions, a marine engine is defined as an engine that is installed or intended to be installed on a marine vessel.

While marine diesel engines up to 37 kW (50 hp) are currently covered by our nonroad Tier 1 and Tier 2 standards, they were not included in the nonroad Tier 3 and Tier 4 programs. Instead, they are covered in this rule, making this a comprehensive control strategy for all marine diesel engines below 30 liters per cylinder displacement. This is a very broad range of engines and they are grouped into several categories for the existing standards, as described in detail in Chapter 1 of the draft RIA.

Consistent with our current marine diesel engine program, the standards described in this proposal would apply to engines manufactured for sale in the United States or imported into the United States beginning with the effective date of the standards. Any engine installed on a new vessel flagged or registered in the U.S. would be required to meet the appropriate emission limits. Also consistent with our current marine diesel engine program, the standards would also apply to any engine installed for the first time in a marine vessel flagged or registered in the U.S. after having been used in another application subject to different emission standards. In other words, an existing nonroad diesel engine would become a new marine diesel engine, and subject to the marine diesel engine standards, when it is marinized for use in a marine application.

Our current marine diesel engine emission controls do not apply to marine diesel engines on foreign vessels entering U.S. ports. At this time we believe it is appropriate to postpone consideration of the application of our national standards to engines on foreign vessels to a future rulemaking that would consider controls for Category 3 engines on ocean-going vessels. This will allow us consider the engines on foreign vessels as an integrated system, to better evaluate the regulatory options available for controlling their overall emission contribution to U.S. ambient air quality.

Nevertheless, we are soliciting comment on whether the emission standards we are proposing in this action should apply to engines below 30 liters per cylinder displacement installed on foreign vessels entering U.S. ports, and to no longer exclude these engines from the emission standards under 40 CFR 94.1(b)(3). Commenters are also invited to suggest when the standards should apply to foreign vessels. For example, the standards could apply based on the date the engine is built or, consistent with MARPOL Annex VI, the date the vessel is built.

B. Existing EPA Standards

NO_X emission levels from newly-built locomotives have been reduced over the past several years from unregulated levels of over 13 g/bhp-hr (17 g/kW-hr) to the current Tier 2 standard level for newly-built locomotives of 5.5 g/bhp-hr

[97] All of the regulatory parts referenced in this preamble are parts in Title 40 of the Code of Federal Regulations, unless otherwise noted.

[98] This small business provision is limited to railroads that are classified as small businesses by the Small Business Administration (SBA). Many but not all Class II and III railroads qualify as small businesses for this provision. See the 1998 locomotive rule (63 FR 18978, April 16, 1998) for a complete discussion of the basis and application of this provision.

[99] Marine diesel engines at or above 30 l/cyl displacement are not included in this program. See Section 3E, below.

(7.3 g/kW-hr)—a 60 percent reduction.[100] PM reductions on the order of 50 percent have also been achieved under a Tier 2 standard level of 0.20 g/bhp-hr (0.27 g/kW-hr). EPA emission standards for marine diesel engines vary somewhat due to the ranges in size and application of engines included; however Tier 2 levels for recreational and commercial marine engines are generally comparable in stringency to those adopted for locomotives, and are now in the process of phasing in over 2004–2009. See Chapter 1 of the draft RIA for a complete listing of the existing standards, including standards for remanufactured locomotives.

The Tier 2 emissions reductions have been achieved largely through engine calibration optimization and engine hardware design changes (such as improved fuel injectors and turbochargers, increased injection pressure, intake air after-cooling, combustion chamber design, reduced oil consumption and injection timing) Although these reductions in locomotive and marine emissions are important, they only bring today's cleanest locomotives and marine diesels to roughly the emissions levels of new trucks in the early 1990's, on the basis of grams per unit of work done.

C. What Standards Are We Proposing?

(1) Locomotive Standards

(a) Line-Haul Locomotives

We are proposing new emission standards for newly-built and remanufactured line-haul locomotives. Our proposed standards for newly-built line-haul locomotives would be implemented in two tiers: First, a new Tier 3 PM standard of 0.10 g/bhp-hr (0.13 g/kW-hr) taking effect in 2012, based on engine design improvements; second, new Tier 4 standards of 0.03 g/bhp-hr (0.04 g/kW-hr) for PM, 0.14 g/bhp-hr (0.19 g/kW-hr) for HC (both taking effect in 2015), and 1.3 g/bhp-hr (1.8 g/kW-hr) for NO_X (taking effect in 2017), based on the application of the high-efficiency catalytic aftertreatment technologies now being developed and introduced in the highway diesel sector. Our proposed standards for remanufactured line-haul locomotives would apply to all Tier 0, 1, and 2 locomotives and are based on engine design improvements. The feasibility of the proposed standards and the technologies involved are discussed in detail in section III.D. Table III–1 summarizes the proposed line-haul locomotive standards and implementation dates. See section III.C(3) for a discussion of the HC standards.

TABLE III–1.—PROPOSED LINE-HAUL LOCOMOTIVE STANDARDS

[g/bhp-hr]

Standards apply to:	Date	PM	NO_X	HC
Remanufactured Tier 0 & 1	2008 as Available, 2010 Required	0.22	[a] 7.4	[a] 0.55
Remanufactured Tier 2	2008 as Available, 2013 Required	0.10	5.5	0.30
New Tier 3	2012	0.10	5.5	0.30
New Tier 4	PM and HC 2015 NO_X 2017	0.03	1.3	0.14

[a] For Tier 0 locomotives originally manufactured without a separate loop intake air cooling system, these standards are 8.0 and 1.00 for NO_X and HC, respectively.

(i) Remanufactured Locomotive Standards

We have previously regulated remanufactured locomotive engines under section 213(a)(5) of the Clean Air Act as new locomotive engines and we propose to continue to do so in this rule. Under our proposed standards, the existing fleet of locomotives that are currently subject to Tier 0 standards (our current remanufactured engine standards) would need to comply with a new Tier 0 PM standard of 0.22 g/bhp-hr (0.30 g/kW-hr). They would also need to comply with a new Tier 0 NO_X line-haul standard of 7.4 g/bhp-hr (9.9 g/kW-hr), except that Tier 0 locomotives that were built without a separate coolant loop for intake air (that is, using engine coolant for this purpose) would be subject to a less stringent Tier 0 NO_X standard of 8.0 g/bhp-hr (10.7 g/kW-hr) on the line-haul cycle.

These non-separate loop locomotives were generally built before 1993, though some are of more recent model years. Because of their age, many of them are likely to be retired and not remanufactured again, and many are entering lower use applications within the railroad industry. Correspondingly, their contribution to the locomotive emissions inventory is diminishing. Our analysis indicates that it is feasible to obtain a NO_X reduction for them on the order of 15 percent, from the current Tier 0 line-haul NO_X standard of 9.5 g/bhp-hr to the proposed 8.0 g/bhp-hr standard. However, we expect that any further reduction would require the addition of a separate intake air coolant loop, which provides more efficient cooling and therefore lower NO_X. This would be a fairly expensive hardware change and could have sizeable impacts on the locomotive platform layout and weight constraints. We are aware that this group of older, non-separate loop Tier 0 locomotives is fairly diverse, and that achieving even a 8.0 g/bhp-hr NO_X standard along with a stringent Tier 0 PM standard will be more difficult on some of these models than on others. We request comment on whether there are any locomotive families within this group for which meeting the proposed 8.0 g/bhp-hr standard may not be feasible, especially considering the cost of doing so and the age of the locomotives involved. Commenters should discuss feasibility and projected costs, and should also discuss the extent to which this concern is mitigated by the prospect that these locomotives will be retired rather than remanufactured anyway, or will be moved to lower usage switcher or small railroad applications, and therefore will be less likely to be remanufactured under the new Tier 0 standards.

We propose to apply the new Tier 0 standards (and corresponding switch-cycle standards) when the locomotive is remanufactured on or after January 1, 2008. However, if no certified emissions

[100] Consistent with past EPA rulemakings, our regulations generally express standards, power ratings, and other quantities in international SI (metric) units—kW, g/kW-hr, etc. One exception to this is Part 92 (locomotives), which for historical reasons expresses standards in g/bhp-hr. This proposal retains these established norms for locomotive and marine engine regulations. However, in this preamble we have chosen to express standards in units of g/bhp-hr, to provide a common frame of reference. Where helpful for clarity, we have also included g/kW-hr standards in parentheses. In any compliance questions that might arise from differences in these due to, for example, rounding conventions, the regulations themselves establish the applicable requirements.

control system exists for the locomotive before October 31, 2007, these standards will instead apply 3 months after such a system is certified, but no later than January 1, 2010. This would provide an incentive to develop and certify systems complying with these standards as early as possible, but allow the railroad to avoid having to delay planned rebuilds if a certified system is not available when the program is expected to begin in 2008. We also propose to include a reasonable cost provision, described in section IV.B, to protect against the unlikely event that the only certified systems made available when this program starts in 2008 will be exorbitantly priced.

Although under this approach, certification of new remanufacture systems before 2010 is voluntary, we believe that developers would strive to certify systems to the new standards as early as possible, even in 2008, to establish these products in the market, especially for the higher volume locomotive models anticipated to have significant numbers coming due for remanufacture in the next few years. This focus on higher volume products also maximizes the potential for large emission reductions very early in this program, greatly offsetting the effect of slow turnover to new Tier 3 and Tier 4 locomotives inherent in this sector.

We are also proposing to set new more stringent standards for locomotives currently subject to Tier 1 and Tier 2 standards, to apply at the point of next remanufacture after the proposed implementation dates. Tier 1 locomotives would need to comply with the same new PM standard of 0.22 g/bhp-hr (0.30 g/kW-hr) required of Tier 0 locomotives (they are already subject to the 7.4 g/bhp-hr (9.9 g/kW-hr) NO_X standard). This in essence expands the model years covered by the Tier 1 standards from 2002–2004 to roughly 1993–2004, greatly increasing the size of the Tier 1 fleet while at the same time reducing emissions from this broadened fleet. Under the proposal, Tier 2 locomotives on the rails today or built prior to the start of Tier 3 would need to comply with a new Tier 2 PM line-haul standard of 0.10 g/bhp-hr (0.13 g/kW-hr). Because this is equal to the Tier 3 standard, it essentially adds the entire fleet of Tier 2 locomotives to the clean Tier 3 category over a period of just a few years, as they go through a remanufacture cycle.

The implementation schedule for the new Tier 1 standard would be the same as the 2008/2010 schedule discussed above for Tier 0 locomotives. Meeting the new Tier 2 standard would be required somewhat later, in 2013, reflecting the additional redesign challenge involved in meeting this more stringent standard, and the need to spread the redesign and certification workload faced by the manufacturers overall. However, as for Tier 0 and Tier 1 locomotives, we are proposing that if a certified Tier 2 remanufacture system meeting the new standard is available early, anytime after January 1, 2008, this system would be required to be used, starting 3 months after it is certified, subject to a reasonable cost provision as with early Tier 0 and Tier 1 remanufactures. We request comment on whether use of certified Tier 2 remanufacture systems should be required on the same schedule as Tier 3, that is, starting in 2012, given that we expect the upgraded Tier 2 designs to be very similar to newly-built Tier 3 designs, and the likelihood that substantial numbers of Tier 2 locomotives may be approaching their first scheduled remanufacture by 2012.

These proposed remanufactured locomotive standards represent PM reductions of about 50 percent, and (for Tier 0 locomotives with separate loop intake air cooling) NO_X reductions of about 20 percent. Significantly, these reductions would be substantial in the early years. This would be important to State Implementation Plans (SIPs) being developed to achieve attainment with national ambient air quality standards (NAAQS), owing to the 2008 start date and relatively rapid remanufacture schedule (roughly every 7 years, though it varies by locomotive model and age).

(ii) Newly-Built Locomotive Standards

We are requesting comment on whether additional NO_X emission reductions would be feasible and appropriate for Tier 3 locomotives in the 2012 timeframe. There are proven diesel technologies not currently employed in Tier 2 locomotives that can significantly reduce NO_X emissions, most notably cooled exhaust gas recirculation (EGR). Although employed successfully in the heavy-duty highway diesel sector since 2003, a considerable development and redesign program would need to be undertaken by locomotive manufacturers to apply cooled EGR to Tier 3 locomotives. This development work would not be limited to the engine but would include substantial changes to the locomotive chassis to handle the higher levels of heat rejection (engine cooling demand) required for cooled EGR. We project that it would require a similar degree of engineering time and effort to develop a cooled EGR solution for locomotive diesel engines as it will to develop the urea SCR based solution upon which we are basing our proposed Tier 4 NO_X standard. Therefore, we have not considered the application of cooled EGR in setting our proposed Tier 3 standard.

It may be possible to reoptimize existing Tier 2 NO_X control technologies, most notably injection timing retard (used to some degree on all diesel locomotives), to achieve a more modest NO_X reduction of 10 to 20 percent from the current Tier 2 levels. In fact, a version of General Electric's Tier 2 locomotive is available today that achieves such NO_X reductions for special applications such as the California South Coast Locomotive Fleet Average Emissions Program. In general, the use of injection timing retard to control NO_X emissions comes with a tradeoff against fuel economy, durability and increased maintenance depending upon the degree to which injection timing retard is applied. Experience with on-highway trucks suggests that a 20 percent NO_X reduction based solely on injection timing retard could result in an increase of fuel consumption as much as 5 percent. We request comment on the feasibility and other impacts of applying technologies such as these in the Tier 3 timeframe. We also request comment on the extent to which any workload-based impediments to applying such technologies in Tier 3 could be addressed via balancing it by obtaining less than the proposed NO_X reductions from remanufactured locomotives. We believe that a Tier 3 NO_X standard below 5 g/bhp-hr might be achievable with a limited impact if additional engineering resources were invested to optimize such a system for general line-haul application. We encourage commenters supporting lower NO_X levels for Tier 3 locomotives to address whether some tradeoff in engineering development (or emissions averaging) between new Tier 3 locomotives and remanufactured Tier 0 locomotives might be appropriate. For example, would it be appropriate to set a Tier 3 NO_X standard at 4.5 g/bhp-hr, but relax the NO_X standard for later model Tier 0 locomotives to 8.0 g/bhp-hr instead of 7.4 g/bhp-hr?

We are proposing that a manufacturer may defer meeting the Tier 4 NO_X standard until 2017. However, we expect that each manufacturer will undertake a single comprehensive redesign program for Tier 4, using this allowed deferral to work through any implementation and technology prove-out issues that might arise with advanced NO_X control technology, but relying on the same basic locomotive platform and overall emission control space allocations for all Tier 4 product years. For this reason we are proposing that locomotives certified under Tier 4 in 2015 and 2016 without Tier 4 NO_X control systems have this system added when they undergo their first remanufacture, and be subject to the Tier 4 NO_X standard thereafter.

We are proposing that, starting in Tier 4, line-haul locomotives will not be required to meet standards on the switch cycle. Line-haul locomotives were originally made subject to switch cycle standards to help ensure robust control in use and in recognition of the fact that many line haul locomotives have in the past been used for switcher service later in life. As explained in section III.C(1)(b), the latter is of less concern today. Also, we expect that the aftertreatment technologies used in Tier 4 will provide effective control over a broad range of operation, thus lessening the need for a switch cycle to ensure robust control. We propose that newly-built Tier 3 locomotives and Tier 0 through Tier 2 locomotives remanufactured under this program be subject to switch cycle standards, set at levels above the line-haul cycle standards (Table III–1) in the same proportion that the original Tier 0 through Tier 2 switch cycle standards are above their corresponding line-haul cycle standards. See section III.C(1)(b) for details.

(b) Switch Locomotives

Our 1998 locomotive rule included some provisions aimed at addressing emissions from switch locomotives. We adopted a set of switcher standards and a switcher test cycle. This cycle made use of the same notch-by-notch test data as the line haul cycle, but reweighted these notch-specific emission results to correspond to typical switcher duty. In addition to controlling emissions from dedicated switchers, we viewed this cycle as adding robustness to the line-haul emissions control program. For this reason, and because aging line-haul locomotives have often in the past found utility as switchers, we subjected all regulated locomotives to the switch cycle. We also allowed for dedicated switch locomotives, defined as locomotives designed or used primarily for short distance operation and using an engine with rated power at 2300 hp (1700 kW) or less, to be optionally exempted from the line-haul cycle standards.

There have been a number of changes in the rail industry since our 1998 rulemaking that are relevant to switchers. First, locomotives marketed for line-haul service have continued to increase in size, to a point where today's 4000+hp (3000+kW) line-haul locomotives are too large for practical use in switching service. Second, there have been practically no U.S. sales of newly-built switchers by the primary locomotive builders, EMD and GE, for many years. Third, smaller builders have entered this market, selling new or refurbished locomotives with one to three newly-built diesel engines originally designed for the nonroad equipment market, but recertified under Part 92, or sold under the 40 CFR 92.907 provisions that allow limited sales of locomotives using nonroad-certified engines. Fourth, although this new generation of switchers has shown great promise, their purchase prices on the order of a million dollars or more, compared to the relatively low cost of maintaining old switchers, have limited sales primarily for use in California and Texas where state government subsidies are available.

All of these factors together have produced a situation in which the current fleet of old switchers, including many pre-1973 locomotives not subject to any emissions standards, is maintained and kept in service. Because they have relatively light duty cycles and generally operate very close to repair facilities, they can be maintained almost indefinitely. Though many have poor fuel economy, this alone is not of great enough concern to the railroads to warrant replacing them because even very busy switchers consume a fraction of the fuel used by long-distance line-haul locomotives.

At the same time, these older switch locomotives have come under increasing public scrutiny. When operated in railyards located in urban neighborhoods, they have often become the focus of complaints from citizens groups about noise, smoke, and other emissions, and state and local governments have begun to place a higher priority on reducing their emissions.[101]

We note that switchers (or any other locomotives) that have not been remanufactured to EPA standards are not considered covered by the full preemption of state and local emission standards in section 209(e)(1) of the Clean Air Act, which applies to standards relating to the control of emissions from new locomotive engines. Similarly, the preemption that does apply for locomotives that are certified to EPA standards does not generally apply for any locomotive that has significantly exceeded its useful life. The provisions of section 209(e)(2) pertaining to other nonroad engines would apply for such engines, as well as other engines used in locomotives excluded from the definition of ''new.'' Such engines may be subject to regulation by California and other states.

As discussed in section II.B, we too are concerned that emissions from locomotives in urban railyards, many of which are switch locomotives, are causing substantial adverse health effects. Some railroads have been attempting to address these concerns, adopting voluntary idling restrictions and, where government subsidies are available, replacing older switchers with cleaner, quieter new-generation switchers. In light of these trends and market realities, we believe it is appropriate to propose standards and other provisions specific to switch locomotives, aimed at obtaining substantial overall emission reductions from this important fleet of locomotives.

We are proposing Tier 3 and 4 emission standards for newly-built switch locomotives, shown in Table III–2, based on the capability of the Tier 3 and 4 nonroad engines that will be available to power switch locomotives in the future under our clean nonroad diesel program. We propose to retain the existing switch locomotive test cycle upon which compliance with these standards would be measured, but not to apply the line-haul standards and cycle to Tier 3 and 4 switchers, in light of the divergence that has occurred in the design of newly-built switch and line-haul locomotives. We also propose that Tier 0, 1, and 2 switch locomotives certified only on the switch cycle (as allowed in our Part 92 regulations), be subject to a set of remanufactured locomotive standards equivalent to our proposed program for remanufactured line-haul locomotives, with proportional levels of emission reductions. These standards are also the switch cycle standards for the Tier 3 and earlier line-haul locomotives that are subject to compliance requirements on the switch cycle. In the case of the Tier 3 line-haul locomotives, we are proposing that the Tier 2 switch cycle standards be applied rather than the Tier 3 standards for dedicated switchers because the latter are based on nonroad engines.

[101] See, for example, letter from Catherine Witherspoon, Executive Director of the California Air Resources Board, to EPA Administrator Stephen Johnson, September 7, 2006.

TABLE III–2.—PROPOSED EMISSION STANDARDS FOR SWITCH LOCOMOTIVES

[g/bhp-hr]

Switch locomotive standards apply to:	PM	NO_X	HC	Date
Remanufactured Tier 0	0.26	11.8	2.10	2008 as available, 2010 required.
Remanufactured Tier 1	0.26	11.0	1.20	2008 as available, 2010 required.
Remanufactured Tier 2	0.13	8.1	0.60	2008 as available, 2013 required.
Tier 3	0.10	5.0	0.60	2011.
Tier 4	0.03	1.3	0.14	2015.

Standards and implementation dates for large nonroad engines vary by horsepower and by whether or not the engine is designed for portable electric power generation (gensets), as shown in Table III–3. This is significant for the switch locomotive program because it has been the practice for switch locomotive builders to use a variety of nonroad engine configurations. For example, a manufacturer building a 2100 hp switcher using nonroad engines in 2011 could team three 700 hp engines designed to the nonroad Tier 4 standards of 0.01 g/bhp-hr PM and 0.30 g/bhp-hr NO_X, or two 1050 hp engines at 0.075/2.6 g/bhp-hr PM/NO_X, or a single 2100 hp engine at 0.075/0.50 or 0.075/2.6 g/bhp-hr PM/NO_X, depending on if the engine is a genset engine or not.

As discussed in the nonroad Tier 4 rulemaking in which we set these standards, we believe that the standards set for all of these nonroad engines achieve the greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available, with appropriate consideration to factors listed in the Clean Air Act. There are reasons for a switcher manufacturer to choose one configuration of engines over another related to function, packaging, reliability and other factors. We believe that limiting a manufacturer's choice to only the cleanest configuration in any given year would hinder optimum designs and thereby would tend to work against our goal of encouraging the turnover of the current fleet of old switchers. Furthermore, we note that there is no single large engine category that consistently has the most stringent nonroad Tier 4 PM and NO_X standards from year to year. We also note that, because State subsidies for the purchase of new switch locomotives have been clearly tied to their lower emissions, and also because the use of lower-emitting engines can generate valuable ABT credits, there is likely to be continuing pressure driving the industry toward the cleanest nonroad engines available in whatever new switcher market does develop.

TABLE III–3.—LARGE NONROAD ENGINE TIER 4 STANDARDS

[g/bhp-hr]

Rated power	PM	NO_X	Model year
≦750 hp	0.01	[a] 3.0 (NO_X+NMHC)	2011
	0.01	0.30	2014
750–1200 hp	0.075	2.6	2011
	0.02	[b] 0.50	2015
>1200 hp	0.075	[b] 0.50	2011
	0.02	[b] 0.50	2015

[a] 0.30 NO_X for 50% of sales in 2011–2013, or alternatively 1.5 g NO_X for 100% of sales.
[b] 2.6 for non-genset engines—setting the long-term Tier 4 standard for these engines was deferred in the Nonroad Tier 4 Rule.

There is one exception to this approach that we consider necessary. In the Tier 4 nonroad engine rule, we deferred setting a final Tier 4 NO_X standard for non-genset engines over 750 hp. These are typically used in large bulldozers and mine haul trucks. This was done in order to allow additional time to evaluate the technical issues involved in adapting NO_X control technology to these applications and engines (69 FR 38979, June 29, 2004). We believe it is appropriate to propose a Tier 4 NO_X standard for switch locomotives in 2015 based on SCR technology, as we are proposing for line-haul locomotives in 2017. We believe this to be feasible because the switch locomotive designer will have a variety of nonroad engine choices equipped with SCR available in 2015, such as multiple <750 hp engines or larger genset engines, an opportunity that is not available to large nonroad machine designers due to functional and packaging constraints. To set a non-SCR based standard for switch locomotives indefinitely, or to wait to do so after we set the final Tier 4 NO_X standard for mobile machine engines above 750 hp, would create significant uncertainty for the manufacturers and railroads, and would be contrary to our intent to reduce locomotive emissions in switchyards. We note too that SCR introduction in the fairly limited fleet of newly-built switchers likely to exist in 2015 and 2016 provides an opportunity for railroads to become familiar with urea handling and SCR operation in accessible switchyards, before large scale introduction in the far-ranging line-haul fleet.

Although we are factoring the current practice of building new switchers powered by nonroad-certified engines into the design of the program, it is not our intent to discourage the development and sale of traditional medium-speed engine switch locomotives. We have evaluated the proposed Tier 3 and 4 standards in this context and have concluded that they will be feasible for switchers using medium-speed engines as well as higher-speed nonroad engines.

Because in today's market the certifying switch locomotive manufacturer is typically a purchaser of nonroad engines and not involved in their design, we see the value in providing a streamlined option to help in the early implementation of this program. As described in Section IV, we are proposing that, for a program start-up period sufficient to encourage the turnover of the existing switcher fleet to the new cleaner engines, switch locomotives may use nonroad-certified engines without need for certification under the locomotive program. Because of large differences in how the locomotive and nonroad programs operate in such areas as useful life and in-use testing, we do not believe it appropriate to allow locomotive ABT credits to be generated or used by locomotives sold under this option, though of course this would not preclude nonroad engine ABT credits under that program. For the same reasons, we also think it makes sense to eventually sunset this option after it has served its purpose of encouraging the early introduction of new low-emitting switch locomotives. We propose that the streamlined path be available for 10 years, through 2017, and ask for comment on whether a shorter or longer interval is appropriate, taking into account the turnover incentive provisions described below. We are proposing other compliance and ABT provisions relevant to switch locomotives as discussed in section IV.B(1), (2), (3), and (9).

Finally, we are proposing a rewording of the definition of a switch locomotive to make clear that it is the total switch locomotive power rating that must be below 2300 hp to qualify, not the engine power rating, and to drop the unnecessary stipulation that it be designed or used primarily for short distance operation. This clears up the ambiguity in the current definition over multi-engine switchers.

(c) Reduction of Locomotive Idling Emissions

Even in very efficient railroad operations, locomotive engines spend a substantial amount of time idling, during which they emit harmful pollutants, consume fuel, create noise, and increase maintenance costs. A significant portion of this idling occurs in railyards, as railcars and locomotives are transferred to build up trains. Many of these railyards are in urban neighborhoods, close to where people live, work, and go to school.

Short periods of idling are sometimes unavoidable, such as while waiting on a siding for another train to pass. Longer periods of idling operation may be necessary to run accessories such as cab heaters/air conditioners or to keep engine coolant (generally water without anti-freeze to maximize cooling efficiency) from freezing and damaging the engine if an auxiliary source of heat or power is not installed on the locomotive. Locomotive idling may also occur due to engineer habits of not shutting down the engine, and the associated difficulty in determining just when the engine can be safely shut down and for how long.

Automatic engine stop/start (AESS) systems have been developed to start or stop a locomotive engine based on parameters such as: ambient temperature, battery charge, water and oil temperature, and brake system pressure. AESS systems have been proven to reliably and safely reduce unnecessary idling. Typically they will shutdown the locomotive after a specified period of idling (typically 15–30 minutes) as long as the parameters are all within their required specifications. If one of the aforementioned parameters goes out of its specified range, the AESS will restart the locomotive and allow it to idle until the parameters have returned to their required limits. Although developed primarily to save fuel, AESS systems also reduce idling emissions and noise by reducing idling time. Any emissions spike from engine startup has been found to be minor, and thus idle emissions are reduced in proportion to idling time eliminated. It is expected that overall PM and NO_X idling emission reductions of up to 50 percent can be achieved through the use of AESS.

A further reduction in idling emissions can be achieved through the use of onboard auxiliary power units (APUs), either as standalone systems or in conjunction with an AESS. There are two main manufacturers of APUs, EcoTrans which manufacturers the K9 APU, and Kim Hotstart which manufactures the Diesel Driven Heating System (DDHS). In contrast to AESS, which works to reduce unnecessary idling, the APU goes further by also reducing the amount of time when locomotive engine idling is necessary, especially in cold weather climates. APUs are small (less than 50 hp) diesel engines that stop and start themselves as needed to provide heat to both the engine coolant and engine oil, power to charge the batteries and to run necessary accessories such as those required for cab comfort. This allows the much larger locomotive engine to be shut down while the locomotive remains in a state of readiness thereby reducing fuel consumption without the risk of the engine being damaged in cold weather. If an APU does not have the capability of an AESS built in, it may need to be installed in conjunction with one in order to receive the full complement of idle reductions that the combination of technologies can provide. The APUs are nonroad engines compliant with EPA or State of California nonroad engine standards, and emit at much lower levels than an idling locomotive.

Installation of an APU today costs approximately $25,000 to $35,000; while an AESS can cost anywhere from $7,500 to $15,000.[102] The costs vary depending on the model and configuration of the locomotive on which the equipment is being installed, and would likely be substantially lower if incorporated into the design of a newly-built locomotive. The amount of idle reduction each system can provide is also dependent on a number of variables, such as what the function of the locomotive is (e.g. a switcher or a line-haul), where it operates (i.e. geographical area), and what its operating characteristics are (e.g. number of hours per day it operates). The duty cycles in 40 CFR 92.132, based on real world data available at the time they were adopted in 1998, indicate a line haul locomotive idles nearly 40% of its operating time, and a switcher locomotive idles nearly 60% of its operating time. This idling time can be further divided into low idle (when there is no load on the engine) and normal idle (when there is a load on the engine). Only low idle can be reduced by an AESS, while an APU can reduce normal idle (or idle in a higher notch such as notch 3 which can burn up to 11 gallons per hour). Another difference between the two types of idle is the fuel consumption rate which is less at low idle than normal idle (2.4–3.6 gallons per hour vs. 2.9–5.4 gallons per hour, based on Tier 2 certification data).

Although there is a gradual trend in the railroad industry toward wider use of these types of idle control devices, we believe it is important for ensuring air quality benefits to propose that idle controls be required as part of a certified emission control system. We are proposing that at least an AESS system be required on all new Tier 3 and Tier 4 locomotives, and also installed on all existing locomotives that are subject to the new remanufactured engine standards, at the point of first remanufacture under the new standards, unless the locomotive is already equipped with idle controls. Specifically, we are requiring that locomotives equipped with an AESS device under this program must shut down the locomotive engine after no more than 30 continuous minutes of idling, and be able to stop and start the engine at least six times per day without

[102] Jessica Montañez and Matthew Mahler, ‘‘Reducing Idling Locomotives Emissions’’, NC Department of Environment and Natural Resources, DAQ *http://daq.state.nc.us/planning/locoindex.shtml.*

causing engine damage or other serious problems. The system must prevent the locomotive engine from being restarted to resume extended idling unless one of the following conditions necessitates such idling: to prevent engine damage such as damage caused by coolant freezing, to maintain air brake pressure, to perform necessary maintenance, or to otherwise comply with applicable government regulations. EPA approval of alternative criteria could be requested provided comparable idle emissions reduction is achieved.

As described in the RIA, it is widely accepted that for most locomotives, the fuel savings that result in the first several years after installation of an AESS system will more than offset the cost of adding the system to the locomotive. Given these short payback times for adding idle reduction technologies to a typical locomotive, normal market forces have led the major railroads to retrofit many of their locomotives with such controls. However, as is common with pollution, market forces generally do not account for the external social costs of the idling emissions. This proposal addresses those locomotives for which the railroads determine that the fuel savings are insufficient to justify the cost of the retrofit. We believe that applying AESS to these locomotives is appropriate when one also considers the very significant emissions reductions that would result, as well as the longer term fuel savings. We request comment on the need for this requirement. We also request comment regarding the reasons why a railroad might choose not to apply AESS absent this provision. Are there costs for AESS and retrofits that are higher than our analysis would suggest? Are there other reasons that would lead a railroad to not adopt AESS universally?

Even though we are proposing to require only AESS systems, we encourage the additional use of APUs by providing in our proposed test regulations a way for the manufacturer to appropriately account for the emission benefits of greater idle reduction. See Section IV.B(8) for further discussion. We are not proposing that APUs must be installed on every locomotive because it is not clear how much additional benefit they would provide outside of regions and times of the year where low temperatures or other factors that warrant the use of an APU exist, and they do involve some inherent design and operational complexities that could not be justified without commensurate benefits. We are however asking for comment on requiring that some subset of new locomotives be equipped with APUs where feasible and beneficial. We are also asking for comments on whether to adopt a regulatory provision that would exempt a railroad from AESS and/or APU requirements if it demonstrated that it was achieving an equal or greater degree of idle reduction using some other method.

(d) Load Control in a Locomotive Consist

A locomotive consist is the linking of two or more locomotives in a train, typically where the lead locomotive has control over the power and dynamic brake settings on the trailing locomotives. For situations where locomotives are operated in a consist, EPA is requesting comment on how the engine loads could be managed in a way which reduces the combined emissions of the consist, and in what way our program can be set up to encourage such reductions. Consists are commonly used in long trains to achieve the power and traction levels necessary to move, stop, and control the train. The trailing locomotives can be directly-coupled to the lead locomotive, or, they may be placed anywhere along the train and controlled remotely by the lead. The load settings of the individual locomotives that make up a consist are not always equal—for example, if the train has crested a hill, the leading locomotive(s) could be operating under dynamic brake (to control the speed of the train) while the trailing locomotives could be producing propulsion power (to reduce strain on the couplers). Depending on the load, track, terrain, and weather conditions, it is conceivable that the engine loads of a consist could be managed to provide the lowest fuel consumption for the power/traction needed. For example, the train power can be distributed so that the lead engine is operating at its optimum brake-specific fuel consumption point while trailing engines are operated at reduced power settings and/or shut down. The capability to manage and distribute engine power in a locomotive consist is available on the market today.

We have been made aware that it may be possible to optimize the configuration of locomotives in a consist for emissions performance without compromising other key goals such as fuel economy and safety. Our proposed regulations do not explicitly take such possible optimization into account. However, if commenters believe that significant emission reductions can be attained by controlling the engine loads in a consist (beyond those attained by the current practice of operating the consist to achieve the lowest fuel consumption rate), we would solicit their views on how to calculate the emissions reduction and on how the in-use operation of the consist could be logged and reported. For example, it may be appropriate to allow a manufacturer to use alternative notch weightings tailored to operation in an emissions-optimized consist in demonstrating compliance with the emissions standards, thus providing added flexibility in designing such locomotives to meet the standards.

(2) Marine Standards

We are also proposing new emissions standards for newly-built marine diesel engines with displacements under 30 liters per cylinder, including those used in commercial, recreational, and auxiliary power applications. As for locomotives, our ANPRM described a one-step marine diesel program that would bring about the introduction of high-efficiency exhaust aftertreatment in this sector. Just as for locomotives, our analyses of the technical issues related to the application of aftertreatment technologies to marine engines, informed by our many discussions with stakeholders, have resulted in a proposal for new standards in multiple steps, focused especially on the engines with the greatest potential for large PM and NO_X emission reductions. Our technical analyses are summarized in section III.D and are detailed in the draft RIA.

In contrast to the locomotive sector, the marine diesel sector covered by this rule is quite diverse. Commercial propulsion applications range from small fishing boats to Great Lakes freighters. Recreational propulsion applications range from sailboats to super-yachts. Similarly, auxiliary power applications range from small gensets, to generators used on barges, to large power-generating units used on ocean-going vessels. Many of the propulsion engines are used to propel high-speed planing boats, both commercial and recreational, where low weight and high power density are critically important. Some engines are situated in crowded engine compartments accessed through a hatch in the deck, while others occupy relatively spacious engine rooms. All of them share a high premium on reliability, considering the potentially serious ramifications of engine failure while underway.

The resulting diversity in engine design characteristics is correspondingly large. Sizes range from a few horsepower to thousands of horsepower. Historically, we have categorized marine engines for standards-setting purposes based on cylinder displacements: C1 engines of less than 5 liters/cylinder, C2 from 5 to 30 liters/cylinder, and Category 3 (C3) at greater than 30 liters/cylinder. (These C3 engines typically power ocean-crossing ships and burn residual fuel; we are not including such engines in this proposal). Our past standard-setting efforts have found it helpful to make further distinctions as well, considering small (less than 37 kW (50 hp)) engines and C1 recreational engines as separate categories.

Recreational engines typically power recreational vessels designed primarily for speed, and this imposes certain constraints on the type of engine they can use. For a marine vessel to reach high speeds, it is necessary to reduce the surface contact between the vessel and the water, and consequently these vessels typically operate in a planing mode. Planing imposes important design requirements, calling for low vessel weight and short periods of very high power— and thus prompting a need for high power density engines. The tradeoff is less durability, and recreational engines are correspondingly warranted for fewer hours of operation than commercial marine engines. These special characteristics are represented in EPA duty-cycle and useful life provisions for recreational marine engines.

Unlike the locomotive sector, the vast majority of marine diesel engines are derivatives of land-based nonroad diesel engines. Marine diesel engine sales are significantly lower (by 10 or even 100 fold) than the sales of the land-based nonroad engines from which they are derived. For this reason, changes to marine engine technology typically follow the changes made to the parent nonroad engine. For example, it may be economically infeasible to develop and introduce a new fuel system for a marine diesel engine with sales of 100 units annually, while being desirable to do so for a land-based nonroad diesel engine with sales of 10,000 or more units annually. Further, having developed a new technology for land-based diesel engines, it is often cheaper to simply apply the new technology to the marine diesel engine rather than continuing to carry a second set of engine parts within a manufacturing system for a marginal number of additional sales. Recognizing this reality, our proposed marine standards are phased in to follow the introduction of similar engine technology standards from our Nonroad Tier 4 emissions program. In most cases, the corresponding marine diesel standards will follow the Nonroad Tier 4 standards by one to two years.

We are proposing to retain the per-cylinder displacement approach to establishing cutpoints for standards, but are revising and refining it in several places to ensure that the appropriate standards apply to every group of engines in this very diverse sector, and to provide for an orderly phase-in of the program to spread out the redesign workload burden:

(1) We are proposing to move the C1/C2 cutpoint from 5 liters/cylinder to 7 liters/cylinder, because the latter is a more accurate cutpoint between today's high- and medium-speed diesels (in terms of revolutions per minute (rpm)), with their correspondingly different emissions characteristics.

(2) We also propose to revise the per-cylinder displacement cutpoints within Category 1 to better refine the application of standards.

(3) An additional differentiation is proposed between high power density engines typically used in planing vessels and standard power density engines, with a cutpoint between them set at 35 kW/liter (47 hp/liter). In addition to recreational vessels, the high power-density engines are used in some commercial vessels, including certain kinds of crew boats, research vessels, and fishing vessels. Unlike most commercial vessels, these vessels are built for higher speed, which allows them to reach research fields, oil platforms, or fishing beds more quickly. This proposal addresses the technical challenges related to reducing emissions from engines with high power density.

(4) In the past, we did not formally include marine diesels under 37 kW (50 hp) in Category 1, but regulated them separately as part of the nonroad engine program, referring to them elsewhere as ''small marine engines''. They are typically marinized land-based nonroad diesel engines. Because we are now proposing to include these engines in the current marine diesel rulemaking, this distinction is no longer needed and so we are including these engines in Category 1 for Tier 3 and Tier 4 standards.

(5) Finally, we would further group engines by total rated power, especially in regard to setting appropriate long-term aftertreatment-based standards.

Note that we are retaining the differentiation between recreational and non-recreational marine engines within Category 1 because there are differences in the proposed standards for them.

Although this carefully targeted approach to standards-setting results in a somewhat complicated array of emissions standards, we believe it is justified because it maximizes overall emission reductions by ensuring the most stringent standards feasible for a given group of marine engines, and it also helps engine and vessel designers to implement the program in the most cost effective manner. The proposed standards and implementation schedules are shown on Tables III–4–7.

Briefly summarized, the proposed marine diesel standards include stringent engine-based Tier 3 standards, phasing in over 2009–2014. In addition, the proposed standards include aftertreatment-based Tier 4 standards for engines at or above 600 kW (800 hp), phasing in over 2014–2017, except that Tier 4 would not apply to recreational engines under 2000 kW (2670 hp). For engines of power ratings not included in the Tier 3 and Tier 4 tables, the previous tier of standards (Tier 2 or Tier 3, respectively) continues to apply.

TABLE III–4.—PROPOSED TIER 3 STANDARDS FOR MARINE DIESEL C1 COMMERCIAL STANDARD POWER DENSITY

Rated kW	L/cylinder	PM g/bhp-hr	NO_X+HC g/bhp-hr	Model year
<19 kW	<0.9	0.30	5.6	2009
19–<75 kW	[a] <0.9	0.22	5.6	2009
		[b] 0.22	[b] 3.5	2014
75–3700 kW	<0.9	0.10	4.0	2012
	0.9–<1.2	0.09	4.0	2013
	1.2–<2.5	[c] 0.08	4.2	2014
	2.5–<3.5	[c] 0.08	4.2	2013
	3.5–<7.0	[c] 0.08	4.3	2012

[a] <75 kW engines at or above 0.9 L/cylinder are subject to the corresponding 75–3700 kW standards.
[b] Option: 0.15 PM/4.3 NO_X in 2014.

[c] This standard level drops to 0.07 in 2018 for <600 kW engines.

TABLE III–5.—PROPOSED TIER 3 STANDARDS FOR MARINE DIESEL C1 RECREATIONAL AND COMMERCIAL HIGH POWER DENSITY

Rated kW	L/cylinder	PM g/bhp-hr	NO_X+HC g/bhp-hr	Model year
<19 kW	<0.9	0.30	5.6	2009
19–<75 kW	[a] <0.9	0.22	5.6	2009
		[b] 0.22	[b] 3.5	2014
	<0.9	0.11	4.3	2012
75—3700 kW	0.9–<1.2	0.10	4.3	2013
	1.2–<2.5	0.09	4.3	2014
	2.5–<3.5	0.09	4.3	2013
	3.5–<7.0	0.09	4.0	2012

[a] <75 kW engines at or above 0.9 L/cylinder are subject to the corresponding 75–3700 kW standards.
[b] Option: 0.15 PM/4.3 NO_X+HC in 2014.

TABLE III–6.—PROPOSED TIER 3 STANDARDS FOR MARINE DIESEL C2

Rated kW	L/cylinder	PM g/bhp-hr	NO_X+HC g/bhp-hr	Model year
=<3700 kW	7–<15	0.10	4.6	2013
	15–<20	[a] 0.20	[a] 6.5	2014
	20–<25	0.20	7.3	2014
	25–<30	0.20	8.2	2014

[a] For engines at or below 3300 kW in this group, the PM/NO_X+HC Tier 3 standards are 0.25/5.2.

TABLE III–7.—PROPOSED TIER 4 STANDARDS FOR MARINE DIESEL C1 AND C2

Rated kW	PM g/bhp-hr	NO_X g/bhp-hr	HC g/bhp-hr	Model year
>3700 kW	[a] 0.09	1.3	0.14	2014
	0.04	1.3	0.14	[b] 2016
1400–3700 kW	0.03	1.3	0.14	[c] 2016
600–<1400 kW	0.03	1.3	0.14	[b] 2017

[a] This standard is 0.19 for engines with 15–30 liter/cylinder displacement.
[b] Optional compliance start dates are proposed within these model years; see discussion below.
[c] Option for engines with 7–15 liter/cylinder displacement: Tier 4 PM and HC in 2015 and Tier 4 NO_X in 2017.

The proposed Tier 3 standards for engines with rated power less than 75 kW (100 hp) are based on the nonroad diesel Tier 2 and Tier 3 standards, because these smaller marine engines are largely derived from (and often nearly identical to) the nonroad engine designs. The relatively straightforward carry-over nature of this approach also allows for an early implementation schedule, model year 2009, providing substantial early benefits to the program. However, some of the less than 75 kW nonroad engines are also subject to aftertreatment-based Tier 4 nonroad standards, and our proposal would not carry these over into the marine sector, due to vessel design and operational constraints discussed in Section III.D. Because of the preponderance of both direct- and indirect-injection diesel engines in the 19 to 75 kW (25–100 hp) engine market today, we are proposing two options available to manufacturers for meeting Tier 3 standards on any engine in this range, as indicated in Table III–4. One option focuses on lower PM and the other on lower NO_X, though both require substantial reductions in both PM and NO_X and would take effect in 2014.

With important exceptions, we propose that marine diesel engines at or above 75 kW (100 hp) be subject to new emissions standards in two steps, Tier 3 and Tier 4. The proposed Tier 3 standards are based on the engine-out emission reduction potential of the nonroad Tier 4 diesel engines which will be introduced beginning in 2011. Tier 3 standards for C1 engines would generally take effect in 2012, though for some engines, they would start in 2013 or 2014. We are not basing our proposed marine Tier 3 emission standards on the existing nonroad Tier 3 emission standards for two reasons. First, the nonroad Tier 3 engines will be replaced beginning in 2011 with nonroad Tier 4 engines, and given the derivative nature of marine diesel manufacturing, we believe it is more appropriate to use those Tier 4 engine capabilities as the basis for the proposed marine standards. Second, the advanced fuel and combustion systems that we expect these Tier 4 nonroad engines to apply will allow approximately a 50 percent reduction in PM when compared to the reduction potential of the nonroad Tier 3 engines. The proposed Tier 3 standards levels would vary slightly, from 0.08 to 0.11 g/bhp-hr (0.11 to 0.15 g/kW-hr) for PM and from 4.0 to 4.3 g/bhp-hr (5.4 to 5.8 g/kW-hr) for NO_X+HC. Tier 3 standards for C2 engines would take effect in 2013 or 2014, depending on engine displacement, and standards levels would also vary, from 0.10 to 0.25 g/bhp-hr (0.14 to 0.34 g/kW-hr) for PM and 4.6 to 8.2 g/bhp-hr (6.2 to 11.0 g/kW-hr) for NO_X+HC. For the largest C2 engines, those above 3700 kW (4900 hp), the NO_X+HC standard would remain at the Tier 2 levels until Tier 4 begins for these engines in 2014.

We are proposing that high-efficiency aftertreatment-based Tier 4 standards be applied to all commercial and auxiliary C1 and C2 engines over 600 kW (800 hp). These standards would phase in over 2014–2017. Marine diesels over 600 kW, though fewer in number, are the workhorses of the inland waterway and intercoastal marine industry, running at high load factors, for many hours a day, over decades of heavy use. As a result they also account for the very large majority of marine diesel engine emissions. However, for engines at or below 600 kW, our technical analysis indicates that applying aftertreatment to them appears at this time not to be feasible. There are many reasons for this preliminary conclusion, varying in relative importance with engine size and application, but generally including insufficient space in below-deck engine compartments, catalyst packaging limitations for water-injected exhaust systems, poor catalyst performance in water-jacketed exhaust systems, and weight constraints in planing hull vessels.

Although with time and investment these issues may be resolvable for some under 600 kW (800 hp) applications, we are not, at this time, proposing Tier 4 standards for these engines. We may do so at some point in the future, such as after the successful prove-out of aftertreatment in the larger marine engines and in nonroad diesel engines have established a clearer technology path for extension to these engines. The approach taken in this proposal concentrates Tier 4 design and development efforts into the engine and vessel applications where they can do the most good.

We are confident that there is a subset of recreational vessels that are large enough to accommodate the added size of engines equipped with aftertreatment and that have appropriate maintenance procedures to ensure that the aftertreatment systems are appropriately maintained, for example, because they have a professional crew as opposed to being maintained by the owner. Based on a review of publicly available sales literature, we believe that at least the subset of recreational vessels with engines at rated power above 2000 kW (2760 hp) have the space and design layout conducive to aftertreatment and professional crews such that aftertreatment-based standards are feasible. Therefore, we are proposing to apply the Tier 4 standards to recreational marine diesel engines at rated power above 2000 kW, but we request comment on whether this is the appropriate threshold, along with any available information supporting the commenter's view. We also request comment on the issue of ULSD availability for these vessels in places that they may visit outside the United States. The rapid pace at which the industrial nations are shifting to ULSD has surpassed expectations. By no means does this ensure its availability in every port that might be frequented by large U.S. yachts, but it does give confidence that ULSD will be a global product, and certainly not confined to the coastal U.S. when Tier 4 yachts begin to appear in 2016. These large yachts are operated by professional crews who plan their itineraries ahead of time and are unlikely to put in for fuel without checking out the facility ahead of time, though quite possibly this may require somewhat more diligence in the early years of the program while the ULSD-needing fleet is ramping up in size. We also expect that, from the marinas' perspective, those frequented by these affluent visitors typically covet this business today, and will likely be reticent to leave ULSD off the list of offerings and amenities aimed at attracting them.

We are setting the Tier 4 standards for most engines above 600 kW (800 hp) at 0.03 g/bhp-hr (0.04 g/kW-hr) for PM, based on the use of PM filters, and 1.3 g/bhp-hr (1.8 g/kW-hr) for NO_X based on the use of urea SCR systems. The largest marine diesel engines, those above 3700 kW (4900 hp), would be subject to this SCR-based NO_X standard in 2014, along with a new engine-based PM standard. The Tier 4 PM standard for these engines would then start in 2016, with the addition of a filter-based 0.04 g/bhp-hr (0.06 g/kW-hr) standard. See section III.C(3) for a discussion of the Tier 4 HC standard.

Note that the implementation schedule in the above marine standards tables is expressed in terms of model years, consistent with past practice and the format of our regulations. However, in two cases we believe it is appropriate to provide a manufacturer the option to delay compliance somewhat, as long as the standards are implemented within the indicated model year. Specifically, we are proposing to allow a manufacturer to delay Tier 4 compliance within the 2017 model year for 600–1000 kW (800–1300 hp) engines by up to 9 months (but no later than October 1, 2017) and, for Tier 4 PM, within the 2016 model year for over 3700 kW (4900 hp) engines by up to 12 months (but no later than December 31, 2016). We consider this option to delay implementation appropriate in order to give some flexibility in spreading the implementation workload and ensure a smooth transition to the long-term Tier 4 program.

The proposed Tier 4 standards for locomotives and C2 diesel marine engines of comparable size are at the same numerical levels but differ somewhat in implementation schedule, with locomotive Tier 4 starting in 2015 for PM and 2017 for NO_X, and diesel marine Tier 4 for both PM and NO_X starting in 2016 (for engines in the 1400–3700 kW (1900–4900 hp) range). We consider these implementation schedules to be close enough to warrant our providing an option to meet either schedule for these marine engines, aimed at facilitating the development of engines for both markets, a common practice today. Because the locomotive Tier 4 phase-in is offset by only one year on either side of the marine Tier 4 2016 date, we do not expect this option to introduce major competitiveness issues between manufacturers who will be designing engines for both markets and those who will be designing for only the marine market. Furthermore, we see no reason to make this option available only those who make locomotive products, and are therefore proposing its availability to any manufacturer. Comment is requested on the need for the option, and on whether it should be limited to a particular subset of engines.

We note too that the Tier 3 marine standards for locomotive-like marine engines (that is, in the 7–15 liters/cylinder group) although having the same implementation date and numerical PM standard level as locomotive Tier 3, includes a 4.6 g/bhp-hr (6.1 g/kW-hr) NO_X+HC standard, compared to the 5.5 g/bhp-hr (7.3 g/kW-hr) NO_X standard for locomotive Tier 3. We request comment on whether some provision is needed to avoid the need for designing an engine primarily used in locomotives to meet the marine standard in order to have both ready for Tier 3, on whether sufficient ABT credits are likely to be available to deal with this, and on how to ensure we do not lose environmental benefits or inadvertently create competitiveness problems.

Some marine engine families include engines of the same basic design and emissions performance but achieving widely varying power ratings in engine models marketed through varying the number of cylinders, for example 8 to 20. These families can and do straddle power cutpoints, most notably at the 3700 kW (4900 hp) cutpoint, above which NO_X aftertreatment is expected to be needed in 2014 under our proposed standards, and at the 600 kW (800 hp) cutpoint for application of the proposed Tier 4 standards. We understand that manufacturers have concerns about additional design and certification work needed for an engine family falling into two categories, especially with regard to the 600 and 3700 kW cutpoints which involve very different standards or start dates on either side of the cutpoint. We request comment on whether this concern is a serious one for the manufacturers, on suggestions for how to address it fairly without a loss of environmental benefit, and on whether our not addressing it would cause undesirable shifts in ratings offered in the market in order to stay on one side or the other of the cutpoints. One particular idea on which we request comment is allowing engines above 3700 kW an option to meet the Tier 4 PM requirement in 2014 and the Tier 4 NO_X requirement December 31, 2016, similar to the less than 3700 kW option discussed above.

We are concerned that applying the Tier 4 standards to engines above 600 kW (800 hp) may create an incentive for vessel builders who would normally use engines greater than 600 kW to instead use a larger number of smaller engines in a vessel to get the equivalent power output. Generally, the choice of engines for a vessel is directly a function of the work that vessel is intended to do. There may be cases, however, in which a vessel designer that might have used, for example, two 630 kW engines, chooses instead to use three 420 kW engines to avoid the Tier 4 standards. We have concerns about the environmental impacts of such a result. There also may be competitiveness concerns. Therefore, we are seeking comment on whether substitution of several smaller engines for one or two larger engines is likely to occur as a result of differential standards, and on what can be done to avoid it. For example, the Tier 4 standards could be applied to engines in multi-engine vessels with a total power above a certain threshold, such as 1100 kW (1500 hp). We recognize that this would result in a need to equip engines somewhat below 600 kW with aftertreatment devices, but we believe the feasibility concerns such as space constraints discussed above for engines below this cutpoint are diminished in multi-engine vessel designs. Alternatively, we could require vessel manufacturers seeking to use more than two engines to make a demonstration to us that they are not attempting to circumvent the aftertreatment-based requirements, for example by showing that the vessel design they are using traditionally incorporates three or more engines or that there is a specific design requirement that leads to the use of several smaller engines. A third option would be to base the Tier 4 standards on the size (or other characteristics) of the vessel, for vessels that have two or more propulsion engines. Commenters on this issue should address the feasibility and potential market impacts of these potential solutions and are asked to offer their own suggestions as well.

(3) Carbon Monoxide, Hydrocarbon, and Smoke Standards

We are not proposing new standards for CO. Emissions of CO are typically relatively low in diesel engines today compared to non-diesel pollution sources. Furthermore, among diesel application sectors, locomotives and marine diesel engines are already subject to relatively stringent CO standards in Tier 2—essentially 1.5 and 3.7 g/bhp-hr, respectively, compared to the current heavy-duty highway diesel engine CO standard of 15.5 g/bhp-hr. Therefore, under our proposal, the Tier 3 and Tier 4 CO standards for all locomotives and marine diesel engines would remain at current Tier 2 levels and remanufactured Tier 0, 1 and 2 locomotives would likewise continue to be subject to the existing CO standards for each of these tiers. Although we are not setting more stringent standards for CO in Tier 4, we note that aftertreatment devices using precious metal catalysts that we project will be employed to meet Tier 4 PM, NO_X and HC standards would provide meaningful reductions in CO emissions as well.

As discussed in section II, HC emissions, often characterized as VOCs, are precursors to ozone formation, and include compounds that EPA considers to be air toxics. As for CO, emissions of HC are typically relatively low in diesel engines today compared to non-diesel sources. However, in contrast to CO standards, the line-haul locomotive Tier 2 HC standard of 0.30 g/bhp-hr, though comparable to emissions from other diesel applications in Tier 2 and Tier 3, is more than twice that of the long-term 0.14 g/bhp-hr standard set for both the heavy-duty highway 2007 and nonroad Tier 4 programs. For marine diesel engines the Tier 2 HC standard is expressed as part of a combined NO_X+HC standard varying by engine size between 5.4 and 8.2 g/bhp-hr, which clearly allows for high HC levels. Our proposed more stringent Tier 3 NO_X+HC standards for marine diesel engines would likely provide some reduction in HC emissions, but we expect that the catalyzed exhaust aftertreatment devices used to meet the proposed Tier 4 locomotive and marine NO_X and PM standards would concurrently provide very sizeable reductions in HC emissions. Therefore, in accordance with the Clean Air Act section 213 provisions outlined in section I.B(3) of this preamble, we are proposing that the 0.14 g/hp-hr HC standard apply for locomotives and marine diesel engines in Tier 4 as well.

We are proposing that the existing form of the HC standards be retained through Tier 3. That is, locomotive and marine HC standards would remain in the form of total hydrocarbons (THC), except for gaseous- and alcohol-fueled engines (See 40 CFR § 92.8 and § 94.8). Consistent with this, the Tier 3 marine NO_X+HC standards are proposed to be based on THC, except that Tier 3 standards for less than 75 kW (100 hp) engines would be based on NMHC, consistent with their basis in the nonroad engine program. However, we propose that the Tier 4 HC standards be expressed as NMHC standards, consistent with aftertreatment-based standards adopted for highway and nonroad diesel engines.

As in the case of other diesel mobile sources, we believe that existing smoke standards are of diminishing usefulness as PM levels drop to very low levels, as engines with PM at these levels emit very little or no visible smoke. We are therefore proposing to drop the smoke standards for locomotives and marine engines for any engines certified to a PM family emission limit (FEL) or standard of 0.05 g/bhp-hr (0.07 g/kW-hr) or lower. This allows engines certified to Tier 4 PM or to an FEL slightly above Tier 4 to avoid unnecessary testing for smoke.

D. Are the Proposed Standards Feasible?

In this section we describe the feasibility of the various emissions control technologies we project would be used to meet the standards proposed today. Because of the range of engines and applications we cover in this proposal, and because of the technology that will be available to them for emissions control, our proposed standards span a range of emissions levels. We have identified a number of different emissions control technologies we would expect to be used to meet the proposed standards. These technologies range from incremental improvements to existing engine components for the proposed remanufacturing program to highly advanced catalytic exhaust treatment systems similar to those expected to be used to control emissions from heavy-duty diesel trucks and nonroad equipment.

In this section we first describe the feasibility of emissions control technologies we project would be used to meet the standards we are proposing for existing engines that are remanufactured as new (i.e., Tier 0, Tier 1, Tier 2). We also describe how these same technologies would be applied to meet our proposed interim standards for new engines (i.e., Tier 3). We conclude this section with a discussion of catalytic exhaust treatment technologies projected to be used to meet our proposed Tier 4 standards. A more detailed analysis of these technologies and the issues related to their application to locomotive and marine diesel engines can be found in the draft Regulatory Impact Analysis (RIA).

(1) Emissions Control Technologies for Remanufactured Engine Standards and for New Tier 3 Engine Standards

In the locomotive sector, emissions standards already exist for engines that are remanufactured as new. Some of these engines were originally unregulated (i.e. Tier 0), and others were originally built to earlier emissions standards (Tier 1 and Tier 2). We are proposing more stringent standards for these engines that apply whenever the locomotives are remanufactured as new. Our proposed remanufactured standards apply to locomotive engines that were originally built as early as 1973.

We project that incremental improvements to existing engine components would be feasible to meet our proposed locomotive remanufactured engine standards. In many cases, similar improvements to these have already been implemented on newly built locomotives to meet our current new locomotive standards. To meet the lower NO_X standard proposed for the Tier 0 locomotive remanufacturing program, we expect that improvements in fuel system design, engine calibration and optimization of existing after-cooling systems may be used to reduce NO_X from the current 9.5 g/bhp-hr Tier 0 standard to 7.4 g/bhp-hr. These are the same technologies used to meet the current Tier 1 NO_X emission standard of 7.4 g/bhp-hr. In essence, locomotive manufacturers will duplicate current Tier 1 locomotive NO_X emission solutions and adapt those same solutions to the portion of the existing Tier 0 fleet that can accommodate them. For older Tier 0 locomotives manufactured without separate-circuit cooling systems for intake air charge air cooling, reaching the Tier 1 NO_X level will not be possible. For these engines 8.0 g/hp-hr NO_X emissions represents the lowest achievable level.

To meet all of our proposed PM standards for the remanufacturing program and for the new locomotive Tier 3 interim standard, we expect that lubricating oil consumption controls will be implemented, along with the ultra low sulfur diesel fuel requirement for locomotive engines (which was previously finalized in our nonroad clean diesel rulemaking). Because of the significant fraction of lubricating oil present in PM from today's locomotives, we believe that existing low-oil-consumption piston ring-pack designs, when used in conjunction with improvements to closed crankcase ventilation systems, will provide significant, near-term PM reductions. These technologies can be applied to all locomotive engines, including those built as far back as 1973. And based upon our on-highway and nonroad clean diesel experience, we also believe that the use of ultra low sulfur diesel fuel in the locomotive sector will assist in meeting the Tier 2 remanufacturing and Tier 3 PM standards. We believe that the combination of reduced sulfate PM and improvement of oil and crankcase emission control to near Tier 3 nonroad or 2007 heavy-duty on-highway levels will provide an approximately 50% reduction in PM emissions.

We believe that some fraction of the remanufacturing systems can be developed and certified as early as 2008, so we are proposing the required usage of Tier 0, Tier 1 and Tier 2 emission control systems as soon as they are available starting in 2008. However, we estimate that it will take approximately 3 years to complete the development and certification process for all of the Tier 0 and Tier 1 emission control systems, so we have proposed full implementation of the Tier 0 and Tier 1 remanufactured engine standards in 2010. We base this lead time on the types of technology that we expect to be implemented, and on the amount of lead time locomotive manufacturers needed to certify similar systems for our current remanufacturing program. The new engine changes necessary to meet the Tier 3 and remanufactured Tier 2 PM emission standards will require additional engine changes leading us to propose an implementation date for those engines of 2012 for Tier 3 engines and 2013 for remanufactured Tier 2 engines. These changes include further improvements to ring pack designs—especially for two-stroke engines, and the implementation of high efficiency crankcase ventilation systems. These technologies are described and illustrated in detail in our draft Regulatory Impact Analysis.

In the marine sector, emissions standards do not currently exist for engines that are remanufactured as new. In today's proposal, we are requesting comment on a marine diesel engine remanufacturing program that would apply to some of these marine engines whenever they are remanufactured as new (see section VII.A(2)). Because we are requesting comment on a marine engine remanufacturing program that essentially parallels our locomotive remanufacturing program, we expect that the same emissions control technologies described above would be implemented for remanufactured marine diesel engines just as for remanufactured locomotive engines.

We are proposing more stringent emissions standards for all newly built marine diesel engines that have a displacement of less than thirty liters per cylinder. For marine diesel engines that are either used in recreational vessels or are rated to produce less than 600 kW of power, we are proposing emissions standards that likely would not require the use of catalytic exhaust treatment technology. We are also proposing similar standards, as interim standards, for marine diesel engines that are used in commercial vessels and are rated to produce 600 kW of power or more (except if greater than 3700 kW). Collectively, we refer to these standards as our Tier 3 marine diesel engine standards.

To meet our proposed Tier 3 marine diesel engine standards, we believe that engine manufacturers will utilize incremental improvements to existing engine components. To meet the lower NO_X standards we expect that improvements in fuel system design and engine calibration will be implemented. For Category 1 engines from 75 kW through 560 kW, these technologies would be similar to designs and calibrations that likely will be used to meet our nonroad Tier 4 standards for engines. For Category 1 engines below 75 kW and greater than 560kW, and for Category 2 engines that have cylinder displacements less than 15 L/cylinder, these technologies are similar to designs that will be used to meet our nonroad Tier 3 standards, and our proposed locomotive Tier 3 standards.

In almost all instances, marine diesel engines are derivative of land based nonroad engines or locomotive engines. In order to meet our nonroad Tier 4 emission levels (phased in from 2011–2015), nonroad engines will see significant base engine improvements designed to reduce engine-out emissions. Refer to our nonroad Tier 4 rulemaking for details on the designs and calibrations we expect to be used to meet the Tier 3 standards we are proposing for the lower horsepower marine engines. For example, we expect marine engines to utilize high-pressure, common-rail fuel injection systems or improvements in unit injector design. When such fuel system improvements are used in conjunction with engine mapping and calibration optimization, the Tier 3 marine diesel engine standards can be met. Since this technology and these components already have been implemented on on-highway, nonroad, and some locomotive engines, they can be applied to marine engines beginning as early as 2009.

Because some marine engines are not as similar to on-highway, nonroad or locomotive engines as others, we believe that full implementation of these technologies for marine engines cannot be accomplished until 2012. We expect that the PM emissions control technologies that will be used to meet our proposed Tier 3 marine diesel engine standards will be similar to the technology used to meet our nonroad Tier 3 PM standards and our proposed locomotive Tier 3 PM standards. That is, we believe that a combination of fuel injection improvements, plus the use of existing low-oil-consumption piston ring-pack designs and improved closed crankcase ventilation systems will provide significant PM reductions. And based upon our on-highway and non-road clean diesel experience, we also believe that the use of ultra low sulfur diesel fuel in the marine sector will assist in meeting the Tier 3 PM standards.

Because all of the aforementioned technologies to reduce NO_X and PM emissions can be developed for production, certified, and introduced into the marine engine sector without extended lead-time, we believe that these technologies can be implemented for some engines as early as 2009, and for all engines by 2014. We believe that this later date is needed only for those marine engines that are not similar to other on-highway, nonroad, or locomotive engines.

(2) Catalytic Exhaust Treatment Technologies for New Engines

For marine diesel engines in commercial service that are greater than 600 kW, for all marine engines greater than 2000 kW, and for all locomotives, we are proposing stringent Tier 4 standards based on the use of advanced catalytic exhaust treatment systems to control both PM and NO_X emissions. There are four main issues to address when analyzing the application of this technology to these new sources: the efficacy of the fundamental catalyst technology in terms of the percent reduction in emissions given certain engine conditions such as exhaust temperature; its applicability in terms of packaging; its long-term durability; and whether or not the technology significantly impacts an industry's supply chain infrastructure—especially with respect to supplying urea reductant for SCR to locomotives and vessels. We have carefully examined these points, and based upon our analysis (detailed in our draft Regulatory Impact Analysis), we believe that we have identified robust PM and NO_X catalytic exhaust treatment systems that are applicable to locomotives and marine engines that also pose a manageable impact on the rail and marine industries' infrastructure.

(a) Catalytic PM Emissions Control Technology

The most effective exhaust aftertreatment used for diesel PM emissions control is the diesel particulate filter (DPF). More than a million light diesel vehicles that are OEM-equipped with DPF systems have been sold in Europe, and over 200,000 DPF retrofits to diesel engines have been conducted worldwide.[103] Broad application of catalyzed diesel particulate filter (CDPF) systems with greater than 90 percent PM control is beginning with the introduction of 2007 model year heavy-duty diesel trucks in the United States. These systems use a combination of both passive and active soot regeneration. CDPF systems utilizing metal substrates are a further development that trades off a degree of elemental carbon soot control for reduced backpressure, improvements in the ability of the trap to clear oil ash, greater design freedom regarding filter size/shape, and greater robustness. Metal-CDPFs were initially introduced as passive-regeneration retrofit technologies for diesel engines designed to achieve approximately 60 percent control of PM emissions. Recent data from further development of these systems for Euro-4 truck applications has shown that metal-CDPF trapping efficiency for elemental carbon PM can exceed 70 percent for engines with inherently low elemental carbon emissions.[104] Data from locomotive testing confirms a relatively low elemental carbon fraction and relatively high organic fraction for PM emissions from medium-speed Tier 2 locomotive engines.[105] The use of an oxidizing catalyst with platinum group metals (PGM) coated directly to the CPDF combined with a diesel oxidation catalyst (DOC) mounted upstream of the CDPF would provide 95 percent or greater removal of HC, including the semi-volatile organic compounds that contribute to PM. Such systems would reduce overall PM emissions from a locomotive or marine diesel engine by upwards of 90 percent.

We believe that locomotive and marine diesel engine manufacturers will benefit from the extensive development taking place to implement DPF technologies in advance of the heavy-duty truck and nonroad PM standards in Europe and the U.S. Given the steady-state operating characteristics of locomotive and marine engines, DPF regeneration strategies will certainly be capable of precisely controlling PM under all conditions and passively regenerating whenever the exhaust gas temperature is >250 °C. Therefore, we believe that the Tier 4 PM standards we are proposing for locomotive and marine diesel engines are technologically feasible. And given the level of activity in the on-highway and nonroad sectors to implement DPF technology, we believe that our proposed implementation dates for locomotive and marine diesel engines are appropriate and achievable.

(b) Catalytic NO_X Emissions Control Technology

We have analyzed a variety of technologies available for NO_X reduction to determine their applicability to diesel engines in the locomotive and marine sectors. As described in more detail in our draft RIA, we are assuming locomotive and marine diesel engine manufacturers will choose to use—Selective Catalytic Reduction, or SCR to comply with our proposed standards. SCR is a commonly used aftertreatment device for meeting stricter NO_X emissions standards in diesel applications worldwide. Stationary power plants fueled with coal, diesel, and natural gas have used SCR for three decades as a means of controlling NO_X emissions, and currently, European heavy-duty truck manufacturers are using this technology to meet Euro 5 emissions limits. To a lesser extent, SCR has been introduced on diesel engines in the U.S. market, but the applications have been limited to marine ferryboat and stationary electrical power generation demonstration projects in California and

[103] ''Diesel Particulate Filter Maintenance: Current Practices and Experience'', Manufacturers of Emission Controls Association, June 2005, *http://meca.org/galleries/default-file/Filter_Maintenance_White_Paper_605_final.pdf.*

[104] Jacob, E., Lämmerman, R., Pappenheimer, A., Rothe, D. ''Exhaust Gas Aftertreatment System for Euro 4 Heavy-duty Engines'', MTZ, June, 2006.

[105] Smith, B., Sneed, W., Fritz, S. ''AAR Locomotive Emissions Testing 2005 Final Report''.

several of the Northeast states. However, by 2010, when 100 percent of the heavy-duty diesel trucks are required to meet the NO_X limits of the 2007 heavy-duty highway rule, several heavy-duty truck engine manufacturers have indicated that they will use SCR technology.[106] [107] While other promising NO_X-reducing technologies such as lean NO_X catalysts, NO_X adsorbers, and advanced combustion control continue to be developed (and may be viable approaches to the standards we are proposing today), our analysis assumes that SCR will be the technology of choice in the locomotive and marine diesel engine sectors.

An SCR catalyst reduces nitrogen oxides to elemental nitrogen (N_2) and water by using ammonia (NH_3) as the reducing agent. The most-common method for supplying ammonia to the SCR catalyst is to inject an aqueous urea-water solution into the exhaust stream. In the presence of high-temperature exhaust gasses (>200 °C), the urea hydrolyzes to form NH_3 and CO_2. The NH_3 is stored on the surface of the SCR catalyst where it is used to complete the NO_X-reduction reaction. In theory, it is possible to achieve 100 percent NO_X conversion if the NH_3-to-NO_X ratio (α) is 1:1 and the space velocity within the catalyst is not excessive. However, given the space limitations in packaging exhaust aftertreatment devices in mobile applications, an α of 0.85–1.0 is often used to balance the need for high NO_X conversion rates against the potential for NH_3 slip (where NH_3 passes through the catalyst unreacted). The urea dosing strategy and the desired α are dependent on the conditions present in the exhaust gas; namely temperature and the quantity of NO_X present (which can be determined by engine mapping, temperature sensors, and NO_X sensors). Overall NO_X conversion efficiency, especially under low-temperature exhaust gas conditions, can be improved by controlling the ratio of two NO_X species within the exhaust gas; NO_2 and NO. This can be accomplished through use of an oxidation catalyst upstream of the SCR catalyst to promote the conversion of NO to NO_2. The physical size and catalyst formulation of the oxidation catalyst are the principal factors that control the NO_2-to-NO ratio, and by extension, improve the low-temperature performance of the SCR catalyst.

Recent studies have shown that an SCR system is capable of providing well in excess of 80 percent NO_X reduction efficiency in high-power, diesel applications.[108] thnsp[109] thnsp;[110] SCR catalysts can achieve significant NO_X reduction throughout much of the exhaust gas temperature operating range observed in locomotive and marine applications. Collaborative research and development activities between diesel engine manufacturers, truck manufacturers, and SCR catalyst suppliers have also shown that SCR is a mature, cost-effective solution for NO_X reduction on diesel engines in other mobile sources. While many of the published studies have focused on highway truck applications, similar trends, operational characteristics, and NO_X reduction efficiencies have been reported for marine and stationary applications as well.[111] Given the preponderance of studies and data—and our analysis summarized here and detailed in the draft RIA—we believe that this technology is appropriate for locomotive and marine diesel applications. Furthermore, we believe that locomotive and marine diesel engine manufacturers will benefit from the extensive development taking place to implement SCR technologies in advance of the heavy-duty truck NO_X standards in Europe and the U.S. The urea dosing systems for SCR, already in widespread use across many different diesel applications, are expected to become more refined, robust, and reliable in advance of our proposed Tier 4 locomotive and marine standards. Given the steady-state operating characteristics of locomotive and marine engines, SCR NO_X control strategies will certainly be capable of precisely controlling NO_X under all conditions whenever the exhaust gas temperature is greater than 150 °C.

To ensure that we have the most up-to-date information on urea SCR NO_X technologies and their application to locomotive and marine engines, we have met with a number of locomotive and marine engine manufacturers, as well as manufacturers of catalytic NO_X emissions control systems. Through our discussions we have learned that some engine manufacturers currently perceive some risk regarding urea injection accuracy and long-term catalyst durability, both of which could result in either less efficient NO_X reduction or ammonia emissions. We have carefully investigated these issues, and we have concluded that accurate urea injection systems and durable catalysts already exist and have been applied to urea SCR NO_X emissions control systems that are similar to those that we expect to be implemented in locomotive and marine applications.

Urea injection systems applied to on-highway diesel trucks and diesel electric power generators already ensure accurate injection of urea, and these applications have similar—if not more dynamic—engine operation as compared to locomotive and marine engine operation. To ensure accurate urea injection across all engine operating conditions, these systems utilize NO_X sensors to maintain closed-loop feedback control of urea injection. These NO_X sensor-based feedback control systems are similar to oxygen sensor-based systems that are used with catalytic converters on virtually every gasoline vehicle on the road today. We believe these NO_X sensor based control systems are directly applicable to locomotive and marine engines.

Ammonia emissions, which are already minimized through the use of closed-loop feedback urea injection, can be all-but-eliminated with an oxidation catalyst downstream of the SCR catalyst. Such catalysts are in use today and have been shown to be 95% effective at reducing ammonia emissions.

Catalyst durability is affected by sulfur and other chemicals that can be present in some diesel fuel and lubricating oil. These chemicals have been eliminated in other applications by the use of ultra-low sulfur diesel fuel and low-SAPS (sulfated ash, phosphorous, and sulfur) lubricating oil. Locomotive and marine operators already will be using ultra low sulfur diesel by the time urea NO_X SCR systems would be needed, and low SAPS oil can be used in locomotive and marine engines. Thermal and mechanical vibration durability of catalysts has been addressed through the selection of proper materials and the design of support and mounting structures that are capable of withstanding the shock and vibration levels present in locomotive and marine applications. More details on catalyst durability and urea injection accuracy are available in the remainder of this section and also in our draft RIA.

[106] "Review of SCR Technologies for Diesel Emission Control: European Experience and Worldwide Perspectives," presented by Dr. Emmanuel Joubert, 10th DEER Conference, July 2004.

[107] Lambert, C., "Technical Advantages of Urea SCR for Light-Duty and Heavy-Duty Diesel Vehicle Applications," SAE Technical Paper 2004–01–1292, 2004.

[108] Walker, A.P. *et al.*, "The Development and In-Field Demonstration of Highly Durable SCR Catalyst Systems," SAE 2004–01–1289.

[109] Conway, R. *et al.*, "Combined SCR and DPF Technology for Heavy Duty Diesel Retrofit," SAE Technical Paper 2005–01–1862, 2005.

[110] "The Development and On-Road Performance and Durability of the Four-Way Emission Control SCRTTM System," presented by Andy Walker, 9th DEER Conference, August 28, 2003.

[111] Telephone conversation with Gary Keefe, Argillon, June 6, 2006.

Even though we believe that the issues of catalyst durability and urea injection accuracy have been addressed in existing NO_X SCR emissions control systems, we invite comments and the submission of additional information and data regarding catalyst durability and urea injection accuracy.

(c) Durability of Catalytic PM and NO_X Emissions Control Technology

Published studies indicate that SCR systems should experience very little deterioration in NO_X conversion throughout the life-cycle of a diesel engine.[112] The principal mechanism of deterioration in an SCR catalyst is thermal sintering—the loss of catalyst surface area due to the melting and growth of active catalyst sites under high-temperature conditions (as the active sites melt and combine, the total number of active sites at which catalysis can occur is reduced). This effect can be minimized by design of the SCR catalyst washcoat and substrate for the exhaust gas temperature window in which it will operate. Another mechanism for catalyst deterioration is catalyst poisoning—the plugging and/or chemical de-activation of active catalytic sites. Phosphorus from the engine oil and sulfur from diesel fuel are the primary components in the exhaust stream which can de-activate a catalytic site. The risk of catalyst deterioration due to sulfur poisoning will be all but eliminated with the 2012 implementation of ULSD fuel (<15 ppm S) for locomotive and marine applications. Catalyst deterioration due to phosphorous poisoning can be reduced through the use of engine oil with low sulfated-ash, phosphorus, and sulfur content (low-SAPS oil) and through reduced engine oil consumption. The high ash content in current locomotive and marine engine oils is related to the need for a high total base number (TBN) in the oil formulation. Because today's diesel fuel has relatively high sulfur levels, a high TBN in the engine oil is necessary today to neutralize the acids created when fuel-borne sulfur migrates to the crankcase. With the use of ULSD fuel, acid formation in the crankcase will not be a significant concern. The low-SAPS oil will be available for on-highway use by October 2006 and is specified by the American Petroleum Institute as ''CJ–4.'' We also expect that Tier 3 locomotive and marine engine designs will have reduced oil consumption in order to meet the Tier 3 PM standards, and that the Tier 4 designs will be an evolutionary development that will apply catalytic exhaust controls to the Tier 3 engine designs. The durability of other exhaust aftertreatment devices, namely the DOC and CDPF, will also benefit from the use of ULSD fuel, reduced oil consumption and low-SAPS engine oil because the reduction in exposure of these devices to sulfur and phosphorous will improve their effectiveness and the reduction in ash loading will increase the CDPF ash-cleaning intervals.

(d) Packaging of Catalytic PM and NO_X Emissions Control Technology

We project that locomotive manufacturers will need to re-package/re-design the exhaust system components to accommodate the aftertreatment system. Our analysis shows the packaging requirements for the aftertreatment system are such that they can be accommodated within the envelope defined by the Association of American Railroads (AAR) Plate ''L'' clearance diagram for freight locomotives.[113] Typical volume required for the SCR catalyst and post-SCR ammonia slip catalyst for Euro V and U.S. 2010 heavy-duty truck applications is approximately 2 times the engine displacement, and the upstream DOC/CDPF volume is approximately 1–1.5 times the engine displacement. Due to the longer useful life and maintenance intervals required for locomotive applications, we estimate that the SCR catalyst volume will be sized at approximately 2.5 times the engine displacement, and the combined DOC/CDPF volume will be approximately 1.7 times the engine displacement. For an engine with 6 ft^3 of total displacement, the volume requirement for the aftertreatment components would be approximately 25 ft^3. EPA engineers have examined Tier 2 EMD and GE line-haul locomotives and conclude that there is adequate space to package these components. This conclusion also applies to new switcher locomotives, which, while being shorter in length than line-haul locomotives, will also be equipped with smaller, less-powerful engines—resulting in smaller volume requirements for the aftertreatment components. Given the space available on today's locomotives, we feel that packaging catalytic PM and NO_X emissions control technology on-board locomotives is actually less challenging than packaging similar technology on-board other mobile sources such as light-duty vehicles, heavy-duty trucks, and nonroad equipment. Given that similar exhaust systems are either already implemented on-board these vehicles or will be implemented on these vehicles years before similar systems would be required on-board locomotives, we believe that any packaging issues would be successfully addressed early in the locomotive redesign process.

For commercial vessels that use marine diesel engines greater than 600 kW, we expect that marine vessel builders will need to re-package and re-design the exhaust system components to accommodate the aftertreatment components expected to be necessary to meet the proposed standards. Our discussions with marine architects and engineers, along with our review of vessel characteristics, leads us to conclude for commercial marine vessels, adequate engine room space can be made available to package aftertreatment components. Packaging of these components, and analyzing their mass/placement effect on vessel characteristics, will become part of the design process undertaken by marine architecture firms.[114]

We did determine, however, that for recreational vessels and for vessels equipped with engines less than 600 kW, catalytic PM and NO_X exhaust treatment systems were less practical from a packaging standpoint than for the larger, commercially operated vessels. We did identify catalytic emissions control systems that would significantly reduce emissions from these smaller vessels. However, after taking into consideration costs, energy, safety, and other relevant factors, we identified a number of reasons why we are not proposing at this time any standards that would likely require catalytic exhaust treatment systems on these smaller vessels. One reason is that most of these vessels use seawater (fresh or saltwater) cooled exhaust systems, and even seawater injection into their exhaust systems, to cool engine exhaust to prevent overheating materials such as a fiberglass hull. This current practice of cooling and seawater injection could reduce the effectiveness of catalytic exhaust treatment systems. This is significantly more challenging than for gasoline catalyst systems due to much larger relative catalyst sizes and cooler exhaust temperatures typical of diesel engines. In addition, because of these

[112] Conway, R. *et al.*, ''NO_X and PM Reduction Using Combined SCR and DPF Technology in Heavy Duty Diesel Applications,'' SAE Technical Paper 2005–01–3548, 2005.

[113] ''AAR Manual of Standards and Recommended Practices,'' Standard S–5510, Association of American Railroads.

[114] Telephone conversation between Brian King, Elliot Bay Design Group, and Brian Nelson, EPA, July 24, 2006.

vessels' small size and their typical design to operate by planing high on the surface of the water, catalytic exhaust treatment systems pose several significant packaging and weight challenges. Normally, such packaging and weight challenges would be addressed by the use of lightweight hull and superstructure materials. However, the currently accepted lightweight vessel materials are incompatible with the temperatures required to sustain catalyst effectiveness. One solution could be new lightweight hull and superstructure materials which would have to be developed, tested and approved prior to their application on vessels using catalytic exhaust treatment systems. Given these issues, we believe it is prudent to not propose catalytic exhaust treatment-based emission standards for marine diesel engines below 600 kW at this time.

(e) Infrastructure Impacts of Catalytic PM and NO_X Emissions Control Technology

For PM trap technology the locomotive and marine industries will have minimal impact imposed upon their industries' infrastructures. Since PM trap technology relies on no separate reductant, any infrastructure impacts would be limited to some minor changes in maintenance practices or maintenance facilities. Such maintenance would be limited to the infrequent process of removing lubricating oil ash buildup from within a PM trap. This type of maintenance might require facilities to remove PM traps for cleaning. This might involve the use of a crane or other lifting device. We understand that much of this kind of infrastructure already exists for other locomotive and marine engine maintenance practices. We have toured shipyards and locomotive maintenance facilities at rail switchyards, and we observed that such facilities are generally already adequate for any required PM trap maintenance.

We do expect some impact on the railroad and marine sectors to accommodate the use of a separate reductant for use in a NO_X SCR system. For light-duty, heavy-duty, and nonroad applications, the preferred reductant in an SCR system is a 32.5 percent urea-water solution. The 32.5 percent solution, also known as the ''eutectic'' concentration, provides the lowest freezing point (−11 °C or 12 °F) and assures that the ratio of urea-to-water will not change when the solution begins to freeze.[115] Heated storage tanks and insulated dispensing equipment may be necessary to prevent freeze-up in Northern climates. In addition, the urea dosing apparatus (urea storage tank, pump, and lines) onboard the locomotive or marine vessel may require similar protections. Locomotives and marine vessels are commonly refueled from large, centralized fuel storage tanks, tanker trucks, or tenders with long-term purchase agreements. Urea suppliers will be able to distribute urea to the locomotive and marine markets in a similar manner, or they may choose to employ multi-compartment diesel fuel/urea tanker trucks for delivery of both products simultaneously. The frequency that urea needs to be added will be dependent on the urea storage capacity, duty-cycle, and urea dosing rate for each application. Discussions concerning the urea infrastructure in North America and specifications for an emissions-grade urea solution are now under way amongst light- and heavy-duty on-highway diesel stakeholders.

Although an infrastructure for widespread transportation, storage, and dispensing of SCR-grade urea does not currently exist in the U.S., the affected stakeholders in the light- and heavy-duty on-highway and nonroad diesel sectors are expected to follow the European model, in which diesel engine/truck manufacturers and fuel refiners/distributors formed a collaborative working group known as ''AdBlue.'' The goal of the AdBlue organization is to resolve potential problems with the supply, handling, and distribution of urea and to establish standards for product purity.[116] Concerning urea production capacity, the U.S. has more-than-sufficient capacity to meet the additional needs of the rail and marine industries. For example, in 2003, the total diesel fuel consumption for Class I railroads was approximately 3.8 billion gallons.[117] If 100 percent of the Class I locomotive fleet were equipped with SCR catalysts, approximately 190 million gallons-per-year of 32.5 percent urea-water solution would be required.[118] It is estimated that 190 million gallons of urea solution would require 0.28 million tons of dry urea (1 ton dry urea is needed to produce 667 gallons of 32.5 percent urea-water solution). Currently, the U.S. consumes 14.7 million tons of ammonia resources per year, and relies on imports for 41 percent of that total (of which, urea is the principal derivative). In 2005 domestic ammonia producers operated their plants at 66 percent of rated capacity, resulting in 4.5 million tons of reserve production capacity.[119] In the hypothetical situation above, where 100 percent of the locomotive fleet required urea, only 6.2 percent of the reserve domestic capacity would be needed to satisfy the additional demand. A similar analysis for the marine industry, with a yearly diesel fuel consumption of 2.2 billion gallons per year, would not significantly impact the urea demand-to-reserve capacity equation. Since the rate at which urea-SCR technology is introduced to the railroad and marine markets will be gradual—and the reserve urea production capacity is more-than-adequate to meet the expected demand in the 2017 timeframe—EPA does not project any urea cost or supply issues will result from implementing the proposed Tier 4 standards.

(3) The Proposed Standards Are Technologically Feasible

Our proposal covers a wide range of engines and the implementation of a range of emissions controls technologies, and we have identified a range of technologically feasible emissions control technologies that likely would be used to meet our proposed standards. Some of these technologies are incremental improvements to existing engine components, and many of these improved components have already been applied to similar engines. The other technologies we identified involve catalytic exhaust treatment systems. For these technologies we carefully examined the catalyst technology, its applicability to locomotive and marine engine packaging constraints, its durability with respect to the lifetime of today's locomotive and marine engines, and its impact on the infrastructure of the rail and marine industries. From our analysis, which is presented in detail in our draft RIA, we conclude that incremental improvements to engine components and the implementation of catalytic PM and NO_X exhaust treatment technology would be feasible to meet our proposed emissions standards.

[115] Miller, W. *et al.*, ''The Development of Urea-SCR Technology for U.S. Heavy Duty Trucks,'' SAE Technical Paper 2000–01–0190, 2000.

[116] ''Ensuring the Availability and Reliability of Urea Dosing for On-Road and Non-Road,'' presented by Glenn Barton, Terra Corp., 9th DEER Conference, August 28, 2003.

[117] ''National Transportation Statistics—2004,'' Table 4–5, U.S. Bureau of Transportation Statistics.

[118] Assuming the dosing rate of 32.5 percent urea-water solution is 5 percent of the total fuel consumed; 3.8 billion gallons of diesel fuel * 0.05 = 190 million gallons of urea-water solution.

[119] ''Mineral Commodity Summaries 2006,'' page 118, U.S. Geological Survey, *www.minerals.usgs.gov/minerals/pubs/mcs/mcs2006.pdf.*

(4) A Request for Detailed Technical Comments

We have carried out an extensive outreach program with the regulated industry to understand the potential impacts and technical challenges to the application of aftertreatment technology to diesel locomotives and marine engines. We are requesting comments on all parts of our resulting analyses summarized in the preceding sections and presented in greater detail in the Draft RIA.

Further, we request comment on the following list of detailed questions provided to the Agency by a stakeholder regarding particular challenges in applying aftertreatment technologies to diesel locomotives. Some of these questions raise concerns about the feasibility of the proposed Tier 4 standards under specific environmental conditions. We present theses questions without endorsing the appropriateness of applying these conditions to locomotive catalyst designs. The reader should refer to the preceding sections and the draft RIA for our analyses of the relevant issues.

(1) How do the following attributes of the locomotive exhaust environment impact the ability of a Zeolite SCR type catalyst to operate within 10% of its ''as new'' conversion efficiency (~94%) after 34,000 MW-hours of operation?

◦ 150 hours per year operation at 600 Celsius exhaust temperature at the inlet to the SCR, due to DPF regeneration.'' (20-minute regeneration every 20 hours of operation).

◦ 120 minutes per year operation at 700 Celsius.

◦ Soot exposure equal to 0.03 g/bhp-hr.

◦ Shock loading averaging 1,000 mechanical shock pulses per year due to hard coupling.

◦ Extended periods of vibration where the vibration load on the catalysts can reach 6G and 1000 Hz.

◦ Water exposure due to rains, icing, water spray and condensed frozen or liquid water during 20% of its life.

◦ Salt fog consisting of 5 ± 1% salt concentration by weight with fallout rate between 0.00625 and 0.0375 ml/cm^2/hr.

◦ The catalysts will be subject to sands composed of 95% of SiO_2 with particle size between 1 to 650 microns in diameter with sand concentration of 1.1 ± 0.25 g/m^3 and air velocity of 29 m/s (104 km/h).

◦ Exposure to dusts comprised of red china clay and silicon flour of particle sizes that are between 1 to 650 microns in diameter with dust concentration of 10.6 ± 7 g/m^3 with a velocity equal to locomotive motion velocity on catalyst surfaces.

(2) Is it feasible for a Zeolite SCR catalyst (as compared to the Vanadium-based catalysts) to operate within 10% of its as new conversion efficiency (~94%) after sustained exposure to real exhaust? If it is, why is it feasible? If it is not feasible, please explain why it is not.

(3) Is it feasible to maintain the conversion efficiency of a diesel oxidation catalyst at least at 45% in the same catalyst environment described in (1) above? In your comments, please explain why or why not.

(4) The feasibility of achieving low ammonia slip, i.e., less than 5 ppm, from urea-based SCR systems that dose at or above 1:1 ratios when applied to an exhaust stream with 500–600 ppm NO_X under both steady state and transient load conditions.

(5) The feasibility of a reliable NO_X sensor with 5% accuracy to control urea dosing sufficiently to achieve a 95% NO_X conversion efficiency using a Zeolite-based SCR when not kinetically limited.

(6) The expected level of ammonia slip catalyst selectivity back to NO_X when a Zeolite-based SCR is dosed at 1:1 ratios and applied to diesel engines above 3.0 MW with an exhaust stream of 500–600 ppm NO_X.

(7) The effect on overall locomotive weight and balance when applying DPF and SCR devices with a weight in excess of 8000 lbs and volume in excess of 40 cubic feet mounted above the engine.

(8) The expected effect on locomotive operating range when adding urea storage equal to 5% of locomotive fuel capacity and a 2% decrease in locomotive fuel efficiency.

(9) Incidental emissions generation resulting from the production and distribution of urea for railroad usage (200,000,000 gallons/year).

(10) The comparative performance of a given engine on the marine v. locomotive duty cycle to include an assessment of SCR technologies (i.e., *Zeolilte* v. *Vanadium*), expected effectiveness for each application, and any considerations that may be unique for one application versus the other that could impact overall NO_X conversion effectiveness.

(11) The impact of the proposed Tier 4 NO_X limit of 1.3 g/hp-hr versus incrementally higher limits on fuel burn and greenhouse gas emissions.

EPA notes that many of these issues are addressed elsewhere in the preamble and in the draft RIA. We invite comment on these questions in the context of the information provided elsewhere on these issues. In providing comments to these eleven questions, we ask that commenters provide information both directly responsive to the individual question and further to the relevance of the question in determining the appropriate emission standard for diesel locomotives. For example, question 1 lists a wide range of conditions for catalyst systems on a diesel locomotive. In that context, EPA also invites comment on the following questions.

• How do the shock loading, vibration loading, soot exposure, and temperature exposure conditions listed in Question 1 compare to conditions faced by other applications of Zeolite-type urea SCR systems that are either under development or that have been developed for on-highway diesel, nonroad diesel, marine and stationary gas turbine applications?

• Question 1 asserts that a locomotive catalyst design would directly expose catalyst substrates to rain water, icing, water spray and condensed frozen or liquid water during 20% of its life. Are there catalyst packaging and installation issues that would necessitate any direct exposure of catalyst substrates to weather?

• Question 1 implies that a locomotive catalyst design would directly expose catalyst substrates to salt fogs consisting of 5 ± 1% salt concentration by weight with fallout rate between 0.00625 and 0.0375 ml/cm^2/hr. What salt concentrations in salt fogs and what fallout rates have SCR systems applied to ocean-going vessels been exposed to? How would the systems designs, exposures and impacts be similar to or different from locomotive applications? Are there unique characteristics of locomotive catalyst installations that would increase their exposure to salt fog relative to other applications operated near or in ocean environments? What direct experiences have ocean-going vessels had regarding the durability of their catalytic emission control systems?

• Question 1 implies that locomotive catalyst systems must withstand exposure to sand ingested by the engine at a rate of up to 50 pounds per hour at notch 8. The question also implies that locomotive catalyst substrates must withstand exposure to a combination of red china clay and silicon flour at a rate of up to one-quarter ton per hour at notch 8. Are these appropriate metrics that reasonably take into consideration the design of the locomotive air-intake and filtration system and the ability of the engine and turbocharger systems to withstand such extreme exposure to ingestion of abrasive materials? Are tests replicating this condition routinely conducted to demonstrate the durability of the engine and turbocharger systems and emissions compliance following such high rates of engine ingestion of abrasive materials?

• Questions 2 and 3 imply that greater than 45% DOC oxidation efficiency is required to maintain Zeolite SCR catalyst efficiency at greater than 94% NO_X efficiency, and that 94% NO_X efficiency is required to meet the proposed Tier 4 NO_X standard. Is greater than 45% oxidation efficiency for an upstream DOC necessary for locomotives to meet the 1.3 g/bhp-hr NO_X standard over the range of exhaust temperature encountered by locomotives over the line-haul duty cycle when using a Zeolite-based SCR system? Is 94% NO_X efficiency from the current Tier 2 locomotive baseline even necessary to achieve 1.3 g/bhp-hr NO_X emissions when using a Zeolite SCR catalyst system over the line-haul duty-cycle?

• What level of ammonia slip is achievable from modern urea-SCR systems using closed-loop feedback control? Is 5 ppm an appropriate level to set for maximum ammonia slip under any conditions?

• Is 5% of point the limit of zirconia-NO_X sensor accuracy? Does NO_X sensor accuracy currently limit NO_X conversion efficiency of feedback controlled SCR systems, and if so by how much? What level of NO_X conversion efficiency using a Zeolite-based SCR when not kinetically limited is achievable using current feedback control systems using of zirconia-NO_X sensors? What level of NO_X conversion efficiency can be expected taking into consideration projected NO_X sensor and feedback control system development over the next ten to fifteen years?

Comments submitted should provide detailed technical information and data to the extent possible. The EPA solicits comment on the extent to which any factor may impact the ability to achieve the proposed standard and if the proposed standard cannot be achieved in the commenter's view, what standard can be achieved.

E. What Are EPA's Plans for Diesel Marine Engines on Large Ocean-Going Vessels?

Today's proposal covers marine diesel engines up to 30 l/cyl displacement installed on vessels flagged or registered in the U.S. There are two additional significant sources of air pollution from diesel marine engines which are not covered by today's proposal: first, marine diesel engines of any size (Category 1, 2 or 3) installed on foreign-flagged vessels; and second, marine diesel engines at or above 30 l/cyl displacement (Category 3) installed on U.S. flagged vessels. The largest environmental concern for these types of engines are the large, ocean-going marine vessels (OGV), which are typically larger than 2,000 gross tons and involved primarily in international commerce. Ocean-going marine vessels typically are powered by one or more Category 3 diesel engines for propulsion of the vessel, and they typically also have several Category 2 engines to provide auxiliary power. Engines on OGV are predominately fueled by residual fuel (often called "heavy fuel oil"), which is a by-product of distilling crude oil to produce lighter petroleum products such as gasoline, distillate diesel fuel, and kerosene and has a high sulfur content, up to 45,000 ppm.[120] Ocean-going vessels are a significant contributor to air pollution in the United States, in particular in coastal areas and ports. Current projections indicate that on a national level, OGVs flagged in the U.S. and other countries will contribute about 21 percent of mobile source PM, 12 percent NO_X and 76 percent of SO_X in the year 2030. These contributions can be much higher in some coastal and port areas. However, recent inventory estimates performed for the California Air Resources Board and the Commission for Environmental Cooperation in North America suggest that we are significantly underestimating the emissions for C3 engines, by as much as a factor of 2 or 3.[121]

EPA has a number of activities underway which hold promise for reducing air pollution from OGVs. These include: a future rulemaking action on C3 engine standards; negotiations underway at the International Maritime Organization to establish a new set of environmentally protective international emission standards for OGVs; studies to assess the feasibility of establishing one or more SO_X Emission Control Areas adjacent to North America to reduce SO_X and particulate matter from OGVs; and voluntary actions through our Clean Ports USA program.

(1) Future C3 Marine Rule

In 2003 we issued a final rule for new C3 engines installed on U.S. flagged vessels. That final action established NO_X limits for new C3 engines which are equal to the current international NO_X standards for C3 engines established through Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78). The MARPOL standards are based on the capabilities of emission control technologies from the early 1990s, and are significantly higher then emission standards for any other mobile source in the United States. In the 2003 final rule, we identified the technical challenges associated with the application of after-treatment technologies to these engines and vessels, but committed to revisiting the issue of the appropriate long-term emission standards for C3 marine engines, both those which are on vessels flagged in the U.S. and those which are installed on foreign flagged vessels. In revisiting the standards we indicated that we would consider the state of technology that may permit deeper emission reductions and the status of international action for more stringent standards. We committed to a final Agency action by April 27, 2007.

In 2003, we believed the next round of emission standard discussions at the IMO would be well underway, if not concluded, by April of 2006. In 2003, we also believed the IMO deliberations would be one of the avenues to explore improvements in emission control technology for C3 engines and ocean-going vessels, and would provide valuable technical input for EPA's C3 rulemaking.

Despite efforts by the United States Government at IMO, deliberations regarding future emission standards for OGV did not begin until April 2006. The current round of negotiations at IMO is expected to continue through 2007. The discussions thus far at IMO have yielded new technical information which EPA will be able to make use of in our future C3 rulemaking. We expect to issue a revised schedule for the C3 rule in the next few months as well as solicit comments on the appropriate technologies, standards, and lead time EPA should consider for C3 standards.

(2) International Standards Deliberation at IMO

With respect to the discussions currently underway at the IMO, the United States Government is actively

[120] Residual fuel also possesses a high viscosity and density, which makes it harder to handle and use of this fuel requires special equipment such as heaters, centrifuges, and purifiers. It typically also has a high ash, and nitrogen content compared to distillate diesel fuels. It is not produced to a set of narrow specifications, and so fuel parameters can be highly variable.

[121] Corbett, J.J., et al. Estimation, Validation, and Forecasts of Regional Commercial Marine Vessel Inventories, Tasks 1 and 2: Baseline Inventory and Ports Comparison, Final Report, dated 3 May 2006. Prepared for the California Air Resources Board, the Californian Environmental Protection Agency and the Commission for Environmental Cooperation in North America. ARB contract 04–346, CEC Contract 113.11. A copy of this document can be found at*www.arb.ca.gov/research/seca/jctask12.pdf*.

engaged in the negotiation of a new set of international standards for Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL Annex VI). Since the current Annex VI NO_X limits have entered into effect, and in the time frame since EPA issued our 2003 rule, improvements in both in-cylinder and external emission control technologies have been demonstrated, both in the laboratory and on-board OGVs. These technologies offer the potential to substantially reduce NO_X emissions from OGVs. In addition, the use of lower sulfur residual or distillate fuels and/or the use of SO_X scrubbing technologies offer the potential to substantially reduce PM and SO_X emissions from OGVs. We believe the member states of the IMO, including the United States, have a unique opportunity to establish appropriate long-term standards to address air pollution from OGVs.

The current discussions for the next tier of engine emission standards at IMO also provide an opportunity to apply emission reduction technologies to existing vessels. EPA is a strong supporter of reducing pollution of existing vessels through mandatory rebuild/retrofit requirements and we will continue to pursue this objective at the IMO.

(3) SO_X Emission Control Areas

The existing international agreements adopted by the IMO provide the opportunity for signatories to Annex VI of the International Convention for the Prevention of Pollution from Ships to propose the designation of one or more SO_X Emission Control Areas (SECA). When operating in a SECA, all OGVs must either use fuel with a maximum sulfur content of 15,000 ppm or use emission control technology such that the vessel meets a SO_X limit of 6 g/kW-hr (a value deemed equivalent to 15,000 ppm sulfur). This represents only approximately a 45 percent reduction in SO_X emissions compared to the world-wide fuel sulfur average for heavy-fuel oil of about 27,000 ppm. EPA is currently performing environmental impact and economic analyses that will assist the federal government in making a determination whether the U.S. Government should consider a proposal designating a SECA to one or more areas adjacent to North America. We are working closely with the Canadian Government Canada) on these efforts, and we also intend to coordinate our actions with Mexico. This could allow for the inclusion of additional coastal areas within SECAs for North American. It must be noted that the United States has not yet ratified Annex VI and any decision regarding whether the United States will pursue the designation of a SECA will be influenced by where the United States stands with respect to ratification of MARPOL Annex VI.

(4) Clean Ports USA

As part of EPA's National Clean Diesel Campaign, Clean Ports USA is an incentive-based, public-private partnership designed to reduce emissions from existing diesel engines and vessels at ports. The Clean Ports USA team works to bring together partners and build coalitions to identify and develop cost-effective diesel emission reduction projects that address the key issues affecting ports today. EPA provides technical support in verifying the effectiveness of retrofit technology, to ensure through rigorous testing that the emissions reductions promised by vendors are in fact achieved in the field.

Clean Ports USA is providing incentives to port authorities, terminal operators, cargo interests, trucking fleets, and maritime fleet owners to:

• Retrofit and replace older diesel engines with verified technologies such as diesel oxidation catalysts (DOCs), diesel particulate filters (DPFs).
• Use cleaner fuels (ultra-low sulfur diesel fuel, emulsions).
• Increase operational efficiency, including environmental management systems, logistics, and appointment systems.
• Reduce engine idling.
• Replace older engines with new, cleaner engines.

Additional information is available on the Clean Ports USA Web site at *www.epa.gov/cleandiesel/ports*.

IV. Certification and Compliance Program

This section describes the regulatory changes proposed for the locomotive and marine compliance programs. The most obvious change is that the proposed regulations have been written in plain language. They are structured to contain the provisions that are specific to locomotives in a new proposed part 1033 and contain the provisions that are specific to marine engines and vessels in a new proposed part 1042. We also propose to apply the general provisions of existing parts 1065 and 1068.[122] The proposed plain language regulations, however, are not intended to significantly change the compliance program, except as specifically noted in today's notice (and we are not reopening for comment the substance of any part of the program that remains unchanged substantively). As proposed, these plain language regulations would supersede the regulations in part 92 and 94 (for Categories 1 and 2) as early as the 2008 model year. See section III for the starting dates for different engines. The changes from the existing programs are described below along with other notable aspects of the compliance program. **Note:** The term manufacturer is used in this section to include locomotive and marine manufacturers and locomotive remanufacturers. It would also include marine remanufacturers if we finalize remanufacture standards.

A. Issues Common to Locomotives and Marine

For many aspects of compliance, we are proposing similar provisions for marine engines and locomotives, which are discussed in this section. Also included in this section are issues which are similar, but where we are proposing different provisions. The other compliance issues are discussed in sections IV. B. (for locomotives) and IV. C. (for marine).

(1) Modified Test Procedures

(a) Incorporation of Part 1065 Test Procedures for Locomotive and Marine Diesel Engines

As part of our initiative to update the content, organization and writing style of our regulations, we are revising our test procedures. We have grouped all of our engine dynamometer and field testing test procedures into one part entitled, ''Part 1065: Test Procedures.'' For each engine or vehicle sector for which we have recently promulgated standards (such as land-based nonroad diesel engines or recreational vehicles), we identified an individual part as the standard-setting part for that sector. These standard-setting parts then refer to one common set of test procedures in part 1065. We intend in this proposal to continue this process of having all our engine programs refer to a common set of procedures by applying part 1065 to all locomotive and marine diesel engines.

In the past, each engine or vehicle sector had its own set of testing procedures. There are many similarities in test procedures across the various sectors. However, as we introduced new regulations for individual sectors, the

[122] In a separate rulemaking, which has been submitted to the Office of Management and Budget (OMB) for review, we will be proposing modifications to the existing provisions of 40 CFR part 1068. We have placed into the docket for this current proposal, a copy of the draft part 1068 regulatory language that was submitted to OMB. Readers interested in the compliance provisions that would apply to locomotives and marine diesel engines should also read the actual regulatory changes that will be proposed in that upcoming rulemaking.

more recent regulations featured test procedure updates and improvements that the other sectors did not have. As this process continued, we recognized that a single set of test procedures would allow for improvements to occur simultaneously across engine and vehicle sectors. A single set of test procedures is easier to understand than trying to understand many different sets of procedures, and it is easier to move toward international test procedure harmonization if we only have one set of test procedures. We note that procedures that are particular for different types of engines or vehicles, for example, test schedules designed to reflect the conditions expected in use for particular types of vehicles or engines, would remain separate and would be reflected in the standard-setting parts of the regulations.

As compared to the existing locomotive and marine diesel test procedures found in parts 92 and 94, part 1065 test procedures are organized and written for improved clarity. In addition, we are proposing part 1065 for locomotive and marine diesel engines to improve the content of their respective testing specifications, including the following:

- Specifications and calculations written in the international system of units (SI).
- Procedures by which manufacturers can demonstrate that alternate test procedures are equivalent to specified procedures.
- Specifications for new measurement technology that has been shown to be equivalent or more accurate than existing technology.
- Procedures that improve test repeatability.
- Calculations that simplify emissions determination.
- New procedures for field testing engines.
- More comprehensive sets of definitions, references, and symbols.
- Calibration and accuracy specifications that are scaled to the applicable standard, which allows us to adopt a single specification that applies to a wide range of engine sizes and applications.

Some emission-control programs already rely on the test procedures in part 1065. These programs regulate land-based on-highway heavy-duty engines, land-based nonroad diesel engines, recreational vehicles, and nonroad spark-ignition engines over 19 kW.

We are adopting the lab-testing and field-testing specifications in part 1065 for all locomotive and marine diesel engines. These procedures replace those currently published in parts 92 and 94. We are making a gradual transition from the part 92 and 94 procedures. For several years, manufacturers would be able to optionally use the part 1065 procedures. Part 1065 procedures would be required for any new testing by the model year in which the Tier 4 standard applies to a locomotive or marine diesel engine or by 2012 for a locomotive or marine diesel engine that is not proposed to be subject to a Tier 4 standard. For any testing completed for any emissions standard that is less stringent than the respective Tier 4 standard, manufacturers may continue to rely on carryover test data based on part 92 or 94 procedures to certify engine families in later years. In addition, for any other programs that refer to the test procedures in parts 92 or 94, we are including updated references for all these other programs to refer instead to the appropriate cite in part 1065.

Part 1065 is also advantageous for in-use testing because it specifies the same procedures for all common parts of field testing and laboratory testing. It also contains new provisions that help ensure that engines are tested in a laboratory in a way that is consistent with how they operate in use. These new provisions would ensure that engine dynamometer lab testing and field testing are conducted in a consistent way.

In the future, we may apply the test procedures specified in part 1065 to other types of engines, so we encourage companies involved in producing or testing other engines to stay informed of developments related to these test procedures.

(b) Revisions to Part 1065

Part 1065 was originally adopted on November 8, 2002 (67 FR 68242), and was initially applicable to standards regulating large nonroad spark-ignition engines and recreational vehicles under 40 CFR parts 1048 and 1051. The recent rulemaking adopting emission standards for nonroad diesel engines has also made part 1065 optional for Tier 2 and Tier 3 nonroad standards and required for Tier 4 standards. The test procedures initially adopted in part 1065 were sufficient to conduct testing, but on July 13, 2005 (70 FR 11534) we promulgated a final rule that reorganized these procedures and added content to make various improvements. In particular, we reorganized part 1065 by subparts as shown below:

- *Subpart A:* General provisions; global information on applicability, alternate procedures, units of measure, etc.
- *Subpart B:* Equipment specifications; required hardware for testing.
- *Subpart C:* Measurement instruments.
- *Subpart D:* Calibration and verifications; for measurement systems.
- *Subpart E:* Engine selection, preparation, and maintenance.
- *Subpart F:* Test protocols; step-by-step sequences for laboratory testing and test validation.
- *Subpart G:* Calculations and required information.
- *Subpart H:* Fuels, fluids, and analytical gases.
- *Subpart I:* Oxygenated fuels; special test procedures.
- *Subpart J:* Field testing and portable emissions measurement systems.
- *Subpart K:* Definitions, references, and symbols.

The regulations now prescribe scaled specifications for test equipment and measurement instruments by parameters such as engine power, engine speed and the emission standards to which an engine must comply. That way this single set of specifications would cover the full range of engine sizes and our full range of emission standards. Manufacturers would be able to use these specifications to determine what range of engines and emission standards may be tested using a given laboratory or field testing system.

The content of part 1065 is mostly a combination of content from our most recent updates to other test procedures and from test procedures specified by the International Organization for Standardization (ISO). In some cases, however, there is new content that never existed in previous regulations. This new content addresses very recent issues such as measuring very low concentrations of emissions, using new measurement technology, using portable emissions measurement systems, and performing field testing. A detailed description of the changes is provided in a memorandum to the docket.[123]

The new content also reflects a shift in our approach for specifying measurement performance. In the past we specified numerous calibration accuracies for individual measurement instruments, and we specified some verifications for individual components, such as NO_2 to NO converters. We have shifted our focus away from individual instruments and toward the overall performance of complete measurement systems. We did this for several reasons. First, some of what we specified in the

[123] Memorandum to docket EPA–HQ–OAR–2003–0190, ''Redline/Strikeout of 40 CFR 1065 (Test Procedures) Changes and Additions''.

past precluded the implementation of new measurement technologies. These new technologies, sometimes called ''smart analyzers'', combine signals from multiple instruments to compensate for interferences that were previously tolerable at higher emissions levels. These analyzers are useful for detecting low concentrations of emissions. They are also useful for detecting emissions from raw exhaust, which can contain high concentrations of interferences, such as water vapor. This is particularly important for field testing, which will most likely rely upon raw exhaust measurements. Second, this new ''systems approach'' challenges complete measurement systems with a series of periodic verifications, which we feel will provide a more robust assurance that a measurement system as a whole is operating properly. Third, the systems approach provides a direct pathway to demonstrate that a field test system performs similarly to a laboratory system. This is explained in more detail in item 10 below. Finally, we feel that our systems approach will lead to a more efficient way of assuring measurement performance in the laboratory and in the field. We believe that this efficiency will stem from less frequent individual instrument calibrations, and higher confidence that a complete measurement system is operating properly.

We have organized the new content relating to measurement systems performance into subparts C and D. We specify measurement instruments in subpart C and calibrations and periodic system verifications in subpart D. These two subparts apply to both laboratory and field testing. We have organized content specific to running a laboratory emissions test in subpart F, and we separated content specific to field testing in subpart J.

In subpart C we specify the types of acceptable instruments, but we only recommend individual instrument performance. We provide these recommendations as guidance for procuring new instruments. We feel that the periodic verifications that we require in subpart D will sufficiently evaluate the individual instruments as part of their respective overall measurement systems. In subpart F we specify performance validations that must be conducted as part of every laboratory test. In subpart J we specify similar performance validations for field testing that must be conducted as part of every field test. We feel that the periodic verifications in subpart D and the validations for every test that we prescribed in subparts F and J ensure that complete measurement systems are operating properly.

In subpart J we also specify an additional overall verification of portable emissions measurement systems (PEMS). This verification is a comprehensive comparison of a PEMS versus a laboratory system, and it may take several days of laboratory time to set up, run, and evaluate. However, we only require that this particular verification must be performed at least once for a given make, model, and configuration of a field test system.

Below is a brief description of the content of each subpart, highlighting some of the most important content.

(i) Subpart A: General Provisions

In Subpart A we identify the applicability of part 1065 and describe how procedures other than those in part 1065 may be used to comply with a standard-setting part. In § 1065.10(c)(1), we specify that testing must be conducted in a way that represents in-use engine operation, such that in the rare case where provisions in part 1065 result in unrepresentative testing, other procedures would be used.

Other information in this subpart includes a description of the conventions we use regarding units and certain measurements; and we discuss recordkeeping. We also provide an overview of how emissions and other information are used to determine final emission results. The regulations in § 1065.15 include a figure illustrating the different ways we allow brake-specific emissions to be calculated.

In this same subpart, we describe how continuous and batch sampling may be used to determine total emissions. We also describe the two ways of determining total work that we approve. Note that the figure indicates our default procedures and those procedures that require additional approval before we will allow them.

(ii) Subpart B: Equipment Specifications

Subpart B first describes engine and dynamometer related systems. Many of these specifications are scaled to an engine's size, speed, torque, exhaust flow rate, etc. We specify the use of in-use engine subsystems such as air intake systems wherever possible in order to best represent in-use operation when an engine is tested in a laboratory.

Subpart B also describes sampling dilution systems. These include specifications for the allowable components, materials, pressures, and temperatures. We describe how to sample crankcase emissions. Subpart B also specifies environmental conditions for PM filter stabilization and weighing.

The regulations in § 1065.101 include a diagram illustrating all the available equipment for measuring emissions.

(iii) Subpart C: Measurement Instruments

Subpart C specifies the requirements for the measurement instruments used for testing. In subpart C we recommend accuracy, repeatability, noise, and response time specifications for individual measurement instruments, but note that we only require that overall measurement systems meet the calibrations and verifications in Subpart D.

In some cases we allow instrument types to be used where we previously did not allow them in parts 92 or 94. For example, we now allow the use of a nonmethane cutter for NMHC measurement, a nondispersive ultraviolet analyzer for NO_X measurement, a zirconia sensor for O_2 measurement, various raw-exhaust flow meters for laboratory and field testing measurement, and an ultrasonic flow meter for CVS systems.

(iv) Subpart D: Calibrations and Verifications

Subpart D describes what we mean when we specify accuracy, repeatability and other parameters in Subpart C. We are adopting calibrations and verifications that scale with engine size and with the emission standards to which an engine is certified. We are replacing some of what we have called ''calibrations'' in the past with a series of verifications, such as a linearity verification, which essentially verifies the calibration of an instrument without specifying how the instrument must be initially calibrated. Because new instruments have built-in routines that linearize signals and compensate for various interferences, our existing calibration specifications in parts 92 and 94 sometimes conflicted with an instrument manufacturer's instructions. In addition, there are new verifications in subpart D to ensure that the new instruments we specify in Subpart C are used correctly.

(v) Subpart E: Engine Selection, Preparation, and Maintenance

Subpart E describes how to select, prepare, and maintain a test engine.

(vi) Subpart F: Test Protocols

Subpart F describes the step-by-step protocols for engine mapping, test cycle generation, test cycle validation, pre-test preconditioning, engine starting, emission sampling, and post-test validations. We allow modest corrections for drift of emission analyzer signals within a certain range. We recommend a step-by-step procedure for weighing PM samples.

(vii) Subpart G: Calculations and Required Information

Subpart G includes all the calculations required in part 1065. Subpart G includes definitions of statistical quantities such as mean, standard deviation, slope, intercept, t-test, F-test, etc. By defining these quantities mathematically we intend to resolve any potential mis-communication when we discuss these quantities in other subparts. We have written all calculations for calibrations and emission calculations in international units. For our standards that are not completely in international units (i.e., grams/horsepower-hour, grams/mile), we specify in part 1065 the correct use of internationally recognized conversion factors.

We also specify emission calculations based on molar quantities for flow rates, instead of volume or mass. This change eliminates the frequent confusion caused by using different reference points for standard pressure and standard temperature. Instead of declaring standard densities at standard pressure and standard temperature to convert volumetric concentration measurements to mass-based units, we declare molar masses for individual elements and compounds. Since these values are independent of all other parameters, they are known to be universally constant.

(viii) Subpart H: Fuels, Fluids, and Analytical Gases

Subpart H specifies test fuels, lubricating oils and coolants, and analytical gases for testing. We eliminated the Cetane Index specification for all diesel fuels, because the existing specification for Cetane Number sufficiently determines the cetane levels of diesel test fuels. We do not identify any detailed specification for service accumulation fuel. Instead, we specify that service accumulation fuel may be either a test fuel or a commercially available in-use fuel. We include a list of ASTM specifications for in-use fuels as examples of appropriate service accumulation fuels. We include an allowance for engine manufacturers to use in-use test fuels that do not meet all of the specifications, provided that the in-use fuel does not adversely affect the manufacturer's ability to demonstrate compliance with the applicable standard. For example a fuel that would result in lower emissions versus the certification fuel would generally adversely affect a manufacturers ability to demonstrate compliance with the applicable standards. We also allow the use of ASTM test methods specified in 40 CFR Part 80 in lieu of those specified in part 1065. We did this because we more frequently review and update the ASTM methods in 40 CFR Part 80 versus those in part 1065.

(ix) Subpart I: Oxygenated Fuels

Subpart I describes special procedures for measuring certain hydrocarbons whenever oxygenated fuels are used. We allow the use of the California NMOG test procedures to measure alcohols and carbonyls.

(x) Subpart J: Field Testing and Portable Emissions Measurement Systems

As described in Subpart J, Portable Emissions Measurement Systems (PEMS) must generally meet the same specifications and verifications that laboratory instruments must meet, according to subparts B, C, and D. However, we allow some deviations from laboratory specifications. In addition to meeting many of the laboratory system requirements, a PEMS must meet an overall verification relative to a series of laboratory measurements. This verification involves repeating a duty cycle several times. This is a comprehensive verification of a PEMS. We are also adopting a procedure for preparing and conducting a field test, and we are adopting drift corrections for PEMS emission analyzers. Given the evolving state of PEMS technology, the field-testing procedures provide for a number of known measurement techniques. We have added provisions and conditions for the use of PEMS in an engine dynamometer laboratory to conduct laboratory testing.

(xi) Subpart K: Definitions, References, and Symbols

In Subpart K we define terms frequently used in part 1065. For example we have defined ''brake power'', ''constant-speed engine'', and ''aftertreatment'' to provide more clarity, and we have definitions for things such as ''300 series stainless steel'', ''barometric pressure'', and ''operator demand''. There are definitions such as ''duty cycle'' and ''test interval'' to distinguish the difference between a single interval over which brake-specific emissions are calculated and the complete cycle over which emissions are evaluated in a laboratory. We also present a thorough and consistent set of symbols, abbreviations, and acronyms in subpart K.

(2) Certification Fuel

It is well-established that measured emissions may be affected by the properties of the fuel used during the test. For this reason, we have historically specified allowable ranges for test fuel properties such as cetane and sulfur content. These specifications are intended to represent most typical fuels that are commercially available in use. This helps to ensure that the emissions reductions expected from the standards occur in use as well as during emissions testing. Because we have reduced the upper limit for locomotive and marine diesel fuel sulfur content for refiners to 15 ppm in 2012, we are proposing to establish new ranges of allowable sulfur content for diesel test fuels. See sectionC.(5) for information about testing marine engines designed to use residual fuel.

For marine diesel engines, we are proposing the use of ULSD fuel as the test fuel for Tier 3 and later standards (when the new plain language regulations begin to apply). We believe this would correspond to the fuels that these engines will see in use over the long term. We recognize that this approach would mean that some marine engines would use a test fuel that is lower in sulfur than in-use fuel during the first few years, and that other Tier 2 marine engines would use a test fuel that is higher in sulfur than fuel already available in use when they are produced. However, we believe that it is more important to align changes in marine test fuels with changes in the PM standards than strictly with changes in the in-use fuel. Nevertheless, we are proposing to allow certification with fuel meeting the 7 to 15 ppm sulfur specification for Tier 2 to simplify testing, but would require PM emissions to be corrected to be equivalent to testing conducted with the specified fuel.

For locomotives, we are proposing to require that Tier 4 engines be certified based on ULSD test fuels. We are also proposing to require that these locomotives use ULSD in the field. We would continue to allow older locomotives to use in the field low sulfur diesel (LSD) fuel, which is the intermediate grade of fuel with sulfur levels between 15 and 500 ppm. Thus, we are proposing to require that remanufacture systems for most of these locomotives be certified on LSD test fuel. We are proposing to allow the use of test fuels other than those specified here. Specifically, we would allow the use of ULSD during emission testing for locomotives otherwise required to use LSD, provided they do not use sulfur-sensitive technology (such as oxidation catalysts). However, as a condition of this allowance, the manufacturer would be required to add an additional amount to the measured PM emissions to make them equivalent to what would have been measured using LSD. For example, we would allow a manufacturer to test with ULSD if they adjusted the measured PM emissions upward by 0.01 g/bhp-hr (which would be a relatively conservative adjustment).

We are proposing special fuel provisions for Tier 3 locomotives and Tier 2 remanufacture systems. We are proposing that the test fuel for these be ULSD without sulfur correction since these locomotives will use ULSD in use for most of their service lives. However, unlike Tier 4 locomotives, we would not require them to be labeled to require the use of ULSD, unless they included sulfur sensitive technology.

We are proposing a new flexibility for locomotives and Category 2 marine engines to reduce fuel costs for testing. Because these engines can consume 200 gallons of diesel fuel per hour at full load, fuel can represent a significant fraction of the testing cost, especially if the manufacturer must use specially blended fuel rather than commercially available fuel. To reduce this cost, we are proposing to allow manufacturers to perform testing of locomotives and Category 2 engines with commercially available diesel fuel.

For both locomotive and marine engines, all of the specifications described above would apply to emission testing conducted for certification, selective enforcement audits, and in-use, as well as any other testing for compliance purposes for engines in the designated model years. Any compliance testing of previous model year engines would be done with the fuels designated in our regulations for those model years.

(3) Supplemental Emission Standards

We are proposing to continue the supplemental emission standards for locomotives and marine engines. For locomotives, this means we would continue to apply notch emission caps, based on the emission rates in each notch, as measured during certification testing. We recognize that for our Tier 4 proposed standards it would not be practical to measure very low levels of PM emissions separately for each notch during testing, and thus we are proposing a change in the calculation of the PM notch cap for Tier 4 locomotives. All other notch caps would be determined and applied as they currently are under 40 CFR 92.8(c). See § 1033.101(e) of the proposed regulations for the detailed calculation.

Marine engines would continue to be subject to not-to-exceed (NTE) standards, however, we are proposing certain changes to these standards based upon our understanding of in-use marine engine operation and based upon the underlying Tier 3 and Tier 4 duty cycle emissions standards that we are proposing. As background, we determine NTE compliance by first applying a multiplier to the duty-cycle emission standard, and then we compare to that value an emissions result that is recorded when an engine runs within a certain range of engine operation. This range of operation is called an NTE zone (see 40 CFR 94.106). The first regulation of ours that included NTE standards was the commercial marine diesel regulation, finalized in 1999. After we finalized that regulation, we promulgated other NTE regulations for both heavy-duty on-highway and nonroad diesel engines. We also finalized a regulation that requires heavy-duty on-highway engine manufacturers to conduct field testing to demonstrate in-use compliance with the on-highway NTE standards. Throughout our development of these other regulations, we have learned many details about how best to specify NTE zones and multipliers that would ensure the greatest degree of in-use emissions control, while at the same time would avoid disproportionately stringent requirements for engine operation that has only a minor contribution to an engine's overall impact on the environment. Based upon the Tier 3 and Tier 4 standards we are proposing—and our best information of in-use marine engine operation—we are proposing certain improvements to our marine NTE standards.

For marine engines we are proposing a broadening of the NTE zones in order to better control emissions in regions of engine operation where an engine's emissions rates (i.e. grams/hour, tons/day) are greatest; namely at high engine speed and high engine load. This is especially important for commercial marine engines because they typically operate at steady-state at high-speed and high-load operation. This proposed change also would make our marine NTE zones much more similar to our on-highway and nonroad NTE zones. Additionally, we analyzed different ways to define the marine NTE zones, and we determined a number of ways to improve and simplify the way we define and calculate the borders of these zones. We feel that these improvements would help clarify when an engine is operating within a marine NTE zone. Please refer to section 1042.101(c) of our draft proposed regulations for a description of our proposed NTE standards. Note that we currently specify different duty cycles to which a marine engine may be certified, based upon the engine's specific application (e.g., fixed-pitch propeller, controllable-pitch propeller, constant speed, etc.). Correspondingly, we also have a unique NTE zone for each of these duty cycles. These different NTE zones are intended to best reflect an engine's real-world range of operation for that particular application. Because we are proposing changes to the shapes of these NTE zones, we request comment as to whether or not these changes best reflect actual in-use operation of marine engines.

We are also proposing changes to the NTE multipliers. We have analyzed how our proposed Tier 3 and Tier 4 emissions standards would affect the stringency of our current marine NTE standards, especially in comparison to the stringency of the underlying duty cycle standards. We recognized that in certain sub-regions of our proposed NTE zones, slightly higher multipliers would be necessary because of the way that our more stringent proposed Tier 3 and Tier 4 emissions standards would affect the stringency of the NTE standards. For comparison, our current marine NTE standards contain multipliers that range in magnitude from 1.2 to 1.5 times the corresponding duty cycle standard. In the changes we are proposing, the new multipliers would range from 1.2 to 1.9 times the standard. Even with these slightly higher NTE multipliers, we are confident that our proposed changes to the marine NTE standards would ensure the greatest degree of in-use emissions control. We are also confident that our proposed changes to the marine NTE standards would continue to ensure proportional emissions reductions, across the full range of marine engine operation. Because we are proposing changes to the NTE multipliers, we request comment as to whether or not these changes best reflect actual in-use emissions profiles of marine engines throughout the NTE zones we are proposing.

We are also proposing to adopt other NTE provisions for marine engines that are similar to our existing heavy-duty on-highway and nonroad diesel NTE standards. We are proposing these particular changes to account for the implementation of catalytic exhaust treatment devices on marine engines and to account for when a marine engine rarely operates within a limited region of the NTE zone (i.e. less than 5 percent of in-use operation). We feel that these provisions have been effective in our on-highway and nonroad NTE programs; therefore, we are proposing to adopt them for our marine NTE standards as well.

We are also proposing for the first time auxiliary marine engine NTE standards, effective for both Tier 3 and Tier 4 auxiliary marine engines. Since these engines are similar to nonroad constant speed engines, we propose to adopt the same NTE standards for auxiliary marine engines as we have already finalized for nonroad constant speed engines. Specifically, these engines are engines certified to the ISO 8178–1 D2 test cycle, illustrated in 40 CFR § 94.105, Table B–4. Refer to 40CFR § 1039.101(e) for our constant speed nonroad engine NTE standards. Because we are proposing marine diesel Tier 3 implementation dates in the 2012 timeframe, we request comment as to whether or not additional lead-time might be necessary to marinize and certify NTE-compliant nonroad engines to the marine diesel Tier 3 standards, especially since it will be within that same timeframe that the similar nonroad Tier 4 engines will be NTE-certified for nonroad use.

We request comment regarding the changes we are proposing for the marine NTE standards.

(4) Emission Control Diagnostics

As described below, we are requesting comment on (but not proposing) a requirement that all Tier 4 engines include simple engine diagnostic system to alert operators to general emission-related malfunctions. (See section IV.A.(7) for related requirements involving SCR systems.) We are, however, proposing special provisions for locomotives that include emission related diagnostics. First, we would require locomotive operators to respond to malfunction indicators by performing the required maintenance or inspection. Second, locomotive manufacturers would be allowed to repair such malfunctioning locomotives during in-use compliance testing (they would still be required to include a description of the malfunction in the in-use testing report.). This approach would take advantage of the unique market structure with two major manufacturers and only a few railroads buying nearly all of the freshly manufactured locomotives. The proposed provisions would create incentives for both the manufacturers and railroads to work together to develop a diagnostic system that effectively revealed real emission malfunctions. Our current regulations already require that locomotive operators complete all manufacturer-specified emission-related maintenance and this new requirement would treat repairs indicated by diagnostic systems as such emission-related maintenance. Thus, the railroads would have a strong incentive to make sure that they only had to perform this additional maintenance when real malfunctions were occurring. On the other hand, manufacturers would want to have all emission malfunctions revealed so that when they test an in-use locomotive they could repair identified malfunction before testing if the railroad had not yet done it.

At this time, we are requesting comment on a adopting a detailed regulatory program to require that all Tier 4 locomotives and marine engines include a specific engine diagnostic system. We believe that most of these engines will be equipped with a basic diagnostic system for other purposes, so codifying a uniform convention based largely on these preexisting systems could be appropriate. Manufacturers would generally not be required to monitor actual emission levels, but rather would be required to monitor functionality. Such systems could be very helpful in maintaining emission performance during the useful life and ensuring that malfunctioning marine catalysts would be replaced. However, we also believe that it might be more appropriate to address this issue in a future rulemaking in the broader context of all nonroad diesel engines.

(5) Monitoring and Reporting of Emissions Related Defects

We are proposing to apply the defect reporting requirements of § 1068.501 to replace the provisions of subparts E in parts 92 and 94. This would result in two significant changes for manufacturers. First, § 1068.501 obligates manufacturers to tell us when they learn that emission control systems are defective and to conduct investigations under certain circumstances to determine if an emission-related defect is present. Manufacturers must initiate these investigations when warranty information, parts shipments, and any other information which is available and indicates that a defect investigation may be fruitful. For this purpose, we consider defective any part or system that does not function as originally designed for the regulatory useful life of the engine or the scheduled replacement interval specified in the manufacturer's maintenance instructions. The parts and systems are those covered by the emissions warranty, and listed in Appendix I and II of part 1068. As we noted in previous rulemakings, we believe the investigation requirement is necessary because it will allow both EPA and the engine manufacturers to fully understand the significance of any unusually high rates of warranty claims and parts replacements for parts or parameters that may have an impact on emissions. We believe that as part of its normal product quality practices, prudent engine manufacturers already conduct a thorough investigation when available data indicate recurring parts failures. Such data is valuable and readily available to most manufacturers and, under this proposal it must be considered to determine whether or not there is a possible defect of an emission-related part.

The second change is related to reporting thresholds. Defect reports submitted in compliance with the current regulations are based on a single threshold applicable to engine families of all production volumes. The single threshold in the existing regulations rarely results in reporting of defects in the smallest engine families covered by this regulation because a relatively high proportion of such engines would have to be known to be defective before reporting is required under a fixed threshold scheme. Therefore, under § 1068.501, the threshold for reporting for the smallest engine families would generally be decreased as compared to the current requirements. These thresholds were established during our rulemaking adopting Tier 4 standards for nonroad diesel engines.[124] Those engines are substantially similar to the engines used in the marine and locomotive sectors, and thus, we believe that these thresholds will also be appropriate for these engines.

We are aware that accumulation of warranty claims and part shipments will likely include many claims and parts that do not represent defects, so we are establishing a relatively high threshold for triggering the manufacturer's responsibility to investigate whether there is, in fact, a real occurrence of an emission-related defect. Manufacturers are not required to count towards the investigation threshold any replacement parts they require to be replaced at specified intervals during the useful life, as specified in the application for certification and maintenance instructions to the owner, because shipments of such parts clearly do not represent defects. All such parts would be excluded from investigation of potential defects and reporting of defects, whether or not any specific part was, in fact, shipped for specified replacement. This proposal is intended to require manufacturers to use

[124] 69 FR 38957, June 29, 2004.

information we would expect them to keep in the normal course of business. We believe in most cases manufacturers would not be required to institute new programs or activities to monitor product quality or performance. A manufacturer that does not keep warranty or replacement part information may ask for our approval to use an alternate defect-reporting methodology that is at least as effective in identifying and tracking potential emissions related defects as the proposed requirements. However, until we approve such a request, the proposed thresholds and procedures continue to apply.

The thresholds for investigation are generally ten percent of total production to date with special limits for small volume engine families. Please note, manufacturers would not investigate for emission related defects until either warranty claims or parts shipments separately reach the investigation threshold. We recognize that a part shipment may ultimately be associated with a particular warranty claim in the manufacturer's database and, therefore, warranty claims and parts shipments would not be aggregated for the purpose of triggering the investigation threshold under this proposal.

The second threshold in this proposal specifies when a manufacturer must report that there is an emission-related defect. This threshold involves a smaller number of engines because each potential defect would have been screened to confirm that it is an emission-related defect. In counting engines to compare with the defect-reporting threshold, the manufacturer would consider a single engine family and model year. However, when a defect report is required, the manufacturer would report all occurrences of the same defect in all engine families and all model years which use the same part. For engines subject to this proposal, the threshold for reporting a defect is two percent of total production for any single engine family with special limits for small volume engine families. It is important to note that while we regard occurrence of the defect threshold as proof of the existence of a reportable defect, we do not regard that occurrence as conclusive proof that recall or other action is merited.

If the number of engines with a specific defect is found to be less than the threshold for submitting a defect report, but information, such as warranty claims or parts shipment data, later indicates additional potentially defective engines, under this proposal the information must be aggregated for the purpose of determining whether the threshold for submitting a defect report has been met. If a manufacturer has actual knowledge from any source that the threshold for submitting a defect report has been met, a defect report would have to be submitted even if the trigger for investigating has not yet been met. For example, if manufacturers receive information from their dealers, technical staff or other field personnel showing conclusively that there is a recurring emission-related defect, they would have to submit a defect report if the submission threshold is reached.

For both the investigation and reporting thresholds, § 1068.501 specifies lower thresholds for very large engines over 560 kW. A defect in these engines can have a much greater impact than defects in smaller engines due to their higher gram per hour emission rates and the increased likelihood that such large engines will be used more continuously.

(6) Rated Power

We are proposing to specify how to determine maximum engine power in the regulations for both locomotives and marine engines. The term ''maximum engine power'' would be used for marine engines instead of previously undefined terms such as ''rated power'' or ''power rating'' to specify the applicability of the standards. We are not proposing to define these terms for our purposes because they already have commercial meanings. The addition of this definition is intended to allow for more objective applicability of the standards. More specifically, for marine engines, we are proposing that maximum engine power would mean the maximum brake power output on the nominal power curve for an engine.

Currently, rated power and power rating are undefined and are specified by the manufacturer during certification. This makes the applicability of the standards unnecessarily subjective and confusing. One manufacturer may choose to define rated power as the maximum measured power output, while another may define it as the maximum measured power at a specific engine speed. Using this second approach, an engine's rated power may be somewhat less than the true maximum power output of the engine. Given the importance of engine power in defining which standards an engine must meet and when, we believe that it is critical that a singular power value be determined objectively according to a specific regulatory definition.

For locomotives, the term ''rated power'' will continue to be used, but would be explicitly defined to be the brakepower of the engine at notch 8. We would continue to use the term ''rated power'' because this definition is consistent with the commercial meaning of the term.

We are also adding a clarification to the regulations for both locomotives and marine engines to recognize that actual engine power varies to some degree during production. Manufacturers would specify maximum engine power (or rated power for locomotives) based on the design specifications for the engine (or locomotive). Measured power from actual production engines would be allowed to vary from that specification to some degree based on normal production variability. The expected production variability would be described by the manufacturer in its application. If the engines that are actually produced are different from those described in the application for certification, the manufacturer would be required to amend its application.

Finally, we are requesting comment on whether we need to specify more precisely how to determine alternator/generator efficiency for locomotive testing. In locomotive testing, engine power is not generally measured directly, but rather is calculated from the measured electrical output of the onboard alternator/generator and the alternator/generator's efficiency. Thus, it is important that the efficiency be calculated in a consistent manner. Specifically, we are requesting comment on whether to require that the efficiency be determined (and applied) separately for each notch, and whether a specific test procedure is necessary.

(7) In-Use Compliance for SCR Operation

As discussed in section III.D, we are projecting that manufacturers would use urea-based SCR systems to comply with the proposed Tier 4 emission standards. These systems are very effective at controlling NO_X emissions as long as the operator continues to supply urea of acceptable quality. Thus we have considered concepts put forward by manufacturers in other mobile source sectors in dealing with this issue that include design features to prevent an engine from being operated without urea if an operator ignores repeated warnings and allows the urea level to run too low. EPA has recently issued a proposed guidance document for urea SCR systems discussing the use of such features on highway diesel vehicles.

Although we request comment on our adopting requirements for manufacturers on the design of SCR systems to ensure use of urea, we believe that the nature of the locomotive and large commercial marine sectors supports a different in-use compliance approach. This approach would focus on requirements for operators of locomotives and marine diesel engines that depend on urea SCR to meet EPA standards, aided by onboard alarm and logging mechanisms that engine manufacturers would be required to include in their engine designs. Except in the rare instance that operation without urea may be necessary, the regulatory provisions proposed here put no burden on the end-user beyond simply filling the urea tank with appropriate quality urea. Specifically, we are proposing:

• That it be illegal to operate without acceptable quality urea when the urea is needed to keep the SCR system functioning properly.

• That manufacturers must include clear and prominent instructions to the operator on the need for, and proper steps for, maintaining urea, including a statement that it is illegal to operate the engine without urea.

• That manufacturers must include visible and audible alarms at the operator's console to warn of low urea levels or inadequate urea quality.

• That engines and locomotives must be designed to track and log, in nonvolatile computer memory, all incidents of engine operation with inadequate urea injection or urea quality.

• That operators must report to EPA in writing any incidence of operation with inadequate urea injection or urea quality within 30 days of each incident.

• That, when requested, locomotive and vessel operators must provide EPA with access to, and assistance in obtaining information from, the electronic onboard incident logs.

We understand that in extremely rare circumstances, such as during a temporary emergency involving risk of personal injury, it may be necessary to operate a vessel or locomotive without adequate urea. We would intend such extenuating circumstances to be taken into account when considering what penalties or other actions are appropriate as a result of such operation. The information from SCR compliance monitoring systems described above may also be useful for state and local air quality agencies and ports to assist them in any marine engine compliance programs they implement. States and localities could require operators to make this information available to them in implementing such programs.

We propose that what constitutes acceptable urea solution quality be specified by the manufacturers in their maintenance instructions, with the requirement that the certified emission control system must meet the emissions standards with any urea solution within stated specifications. This will be facilitated by an industry standard for urea quality, which we expect will be generated in the future as these systems move closer to market. We recognize that requiring onboard detection of inadequate urea quality implies the need for automated sensing of some characteristic indicator such as urea concentration or exhaust NO_X concentration. We request comment on how this can be best managed to minimize the complexity and cost while at the same time precluding tampering through such means as adding water to the urea tank. We request comment on additional compliance provisions, such as mandatory recordkeeping of fuel and urea consumption for each SCR-equipped locomotive or vessel, with periodic reporting requirements.

We believe these proposed provisions can be an effective tool in ensuring urea use for locomotives and large commercial marine vessels because of the relatively small number of railroads and operators of large commercial vessels in the U.S., especially considering that the number of SCR-equipped locomotives and vessels will ramp up quite gradually over time. In-use compliance provisions of the sort we are proposing for locomotives and large commercial marine engines would be much less effective in other mobile source sectors such as highway vehicles because successful enforcement involving millions of vehicle owners would be extremely difficult. The incident logging or recordkeeping requirements could be effective tools for detecting in-use problems besides no-urea or poor-quality urea, such as other tampering or malmaintenance, or operation with broken or frozen urea dosing systems. We request comment on all aspects of the urea maintenance issue, including other measures we should require of manufacturers and operators of SCR-equipped engines, and on the definition of a temporary emergency.

(8) Fuel Labels and Misfueling

In our previous regulation of in-use locomotive and marine diesel fuel, we established a 15 ppm sulfur standard at the refinery gate for locomotive and marine (LM) diesel fuel beginning June 1, 2012. However, we set the downstream standard for LM diesel fuel at 500 ppm sulfur. In this way the LM diesel fuel pool could remain an outlet for off-specification distillate product and interface/transmix material. Because refiners cannot intentionally produce off-specification fuel for locomotives, most in-use locomotive and marine diesel fuel will be ULSD (which contains less than 15 ppm sulfur). Nevertheless, we expect that some fuel will be available with sulfur levels between 15 and 500 ppm.

The advance emission controls that would be used to comply with many of the new standards will require the use of ULSD. Therefore, we are proposing a requirement that manufacturers notify each purchaser of a Tier 4 locomotive or marine engine that it must be fueled only with the ultra low-sulfur diesel fuel meeting our regulations. We also propose to apply this requirement for locomotives and engines having sulfur-sensitive technology and certified using ULSD. We are also proposing that all of these locomotives and vessels must be labeled near the refueling inlet to say: ''Ultra-Low Sulfur Diesel Fuel Only''. These labels would be required to be affixed or updated any time any engine on a vessel is replaced after the proposed program goes into effect.

We are proposing to require the use of ULSD in locomotives and vessels labeled as requiring such use, including all Tier 4 locomotives and marine engines. More specifically, we are proposing that use of the wrong fuel for locomotives or marine engines would be a violation of 40 CFR 1068.101(b)(1) because use of the wrong fuel would have the effect of disabling the emission controls. We request comment on the need for these measures and on additional ideas for preventing misfueling.

(9) Emission Data Engine Selection

Some marine manufacturers have expressed concern over the current provisions in our regulation for selection of an emission data engine. Part 94 specifies that a marine manufacturer must select for testing from each engine family the engine configuration which is expected to be worst-case for exhaust emission compliance on in-use engines. Some manufacturers have interpreted this to mean that they must test all the ratings within an engine family to determine which is the worst-case. Understandably, this interpretation could cause production problems for many manufacturers due to the lead time needed to test a large volume of engines. Our view is that the current provisions do not necessitate testing of all ratings within an engine family. Rather, manufacturers are allowed to base their selection on good engineering judgment, taking into consideration engine features and characteristics which, from experience, are known to produce the highest emissions. This methodology is consistent with the provisions for our on-highway and nonroad engine programs. Therefore, we are proposing to keep essentially the same language in part 1042 as is in part 94.

We are proposing to adopt similar language for locomotives and apply it in the same manner as we do for marine engines.

(10) Deterioration Factor Plan Requirements

In this rulemaking, we are proposing to amend our deterioration factor (DF) provisions to include an explicit requirement that DF plans be submitted by manufacturers for our approval in advance of conducting engine durability testing, or in the case where no new durability testing is being conducted, in advance of submitting the engine certification application. We are not proposing to fundamentally change either the locomotive or marine engine DF requirements other than to require advance approval.

An advance submittal and approval format would allow us sufficient time to ensure consistency in DF procedures, without the need for manufacturers to repeat any durability testing or for us to deny an application for certification should we find the procedures to be inconsistent with the regulatory provisions. We would expect that the DF plan would outline the amount of service accumulation to be conducted for each engine family, the design of the representative in-use duty cycle on which service will be accumulated, and the quantity of emission tests to be conducted over the service accumulation period. We request comment on other items that should be included in the DF plan.

(11) Labeling Simplification

Our current engine regulations (i.e., Part 86, Part 89, Part 94, etc.) have similar but not identical provisions for emission certification labels. These requirements can vary from regulation to regulation and in many cases may request labeling information that manufacturers feel is either not relevant for modern electronic engines or can be made readily available through other sources. In response to manufacturer concerns, we request comment on the concept of developing a common labeling regulation, similar to our consolidation of testing and compliance provisions into part 1068. Commenters supporting a common labeling requirement for diesel engines, should address in detail the requirements of 40 CFR 1039.135 and 86.007–35 (including reserved text) along with the labeling sections being proposed in this notice (1033.135 and 1042.135).

(12) Production Line Testing

We propose to continue the existing production line testing provisions that apply to manufacturers. Some manufacturers have suggested that we should eliminate this requirement on the basis that very low noncompliance rates are being detected at a high expense. We disagree. As we move toward more stringent emission standards with this rulemaking, we anticipate that the margin of compliance with the standards for these engines is likely to decrease. Consequently, this places an even greater significance on the need to ensure little variation in production engines from the certification engine, which is often a prototype engine. For this reason, it is important to maintain our production line testing program. However, the existing regulations allow manufacturers to develop alternate programs that provide equivalent assurance of compliance on the production line, and to use such programs instead of the specified production line testing program. For example, given the small sales volumes associated with marine engines it may be appropriate to include a production verification program for marine engines as part of a manufacturer's broader production verification programs for its nonmarine engines. We believe these existing provisions already address the concerns raised to us by the manufacturers. Nevertheless, we welcome comments regarding the appropriateness of the current provisions.

We are asking for comment on whether manufacturers should be allowed to use special procedures for production line testing of catalyst-equipped engines. For example, should we allow the use of a previously stabilized catalyst instead of an unstabilized (or green) catalyst? If we allow this approach, should we require some additional procedure for ensuring proper in-use operation of the production catalysts? Should we allow manufacturers to demonstrate that the diagnostic system is capable of verifying proper function of the emission controls? Alternatively for locomotives, should we allow a locomotive selected for testing to be introduced into service before testing, provided that it is tested within the first 10,000 miles of operation?

(13) Evaporative Emission Requirements

While nearly all locomotives currently subject to part 92 are fueled with diesel fuel, § 92.7 includes evaporative emission provisions that would apply for locomotives fueled by a volatile liquid fuel such as gasoline or ethanol. These regulations do not specify test procedures or specific numerical limits, but rather set a ''good engineering'' requirements. We propose to adopt these same requirements in part 1033 and request comment on the need to specify a test procedure and specific numerical limits.

We are also proposing to adopt similar requirements for marine engines and vessels that run on volatile fuels. We are not aware of any marine engines currently being produced that would be subject to these requirements, but believe that it would be appropriate to adopt these requirements now, rather than waiting until such engines are produced because it would provide manufacturers certainty. Specifically, we are proposing that if someone were to build a marine vessel to use a compression-ignition engine that runs on a volatile liquid fuel, the engine would be subject to the exhaust standards of part 1042, but the fuel system would be subject to the evaporative emission requirements of the recently proposed part 1045.[125]

(14) Small Business Provisions

There are a number of small businesses that would be subject to this proposal because they are locomotive manufacturers/remanufacturers, railroads, marine engine manufacturers, post-manufacture marinizers, or vessel builders. We are proposing to largely continue the existing provisions that were adopted previously for these small businesses in the 1998 Locomotive and Locomotive Engines Rule (April 16, 1998; 63 FR 18977); our 1999 Commercial Marine Diesel Engines Rule (December 29, 1999; 64 FR 73299); and our 2002 Recreational Diesel Marine program (November 8, 2002; 67 FR 68304). These provisions, which are discussed below, are designed to minimize regulatory burdens on small businesses needing added flexibility to comply with emission standards while still ensuring the greatest emissions reductions achievable. (See section VIII.C of this proposed rule for discussion of our outreach efforts with small entities.) We request comment on whether continuing these provisions is appropriate. We also request comment

[125] Part 1045 is scheduled to be proposed just before this proposed rule.

on whether additional flexibilities are needed.

(a) Locomotive Sector

A significant portion of the locomotive remanufacturing and railroad industry is made up of small businesses. As such, these companies do not tend to have the financial resources or technical expertise to quickly respond to the requirements contained in today's proposed rule. Therefore, as mentioned earlier, we would continue the existing provisions described below.

(i) Production-Line and In-Use Testing Does Not Apply

Production-line and in-use testing requirements would not apply to small locomotive remanufacturers until January 1, 2013, which would be up to five calendar years after this proposed program becomes effective. The advantage of this approach would be to minimize compliance testing during the first five calendar years.

In the 1998 Locomotive Rule (April 16, 1998; 63 FR 18977), the in-use testing exemption was provided to small remanufacturers with locomotives or locomotive engines that became new during the 5-year delay, and this exemption was applicable to these locomotives or locomotive engines for their entire useful life (the exemption was based on model years within the delay period, but not calendar years as we are proposing today). As an amendment to the existing in-use testing exemption, we are proposing that small remanufacturers with these new locomotives or locomotive engines would be required to begin complying with the in-use testing requirements after the five-year delay, January 1, 2013 (exemption based on calendar years). Thus, they would no longer have an exemption from in-use testing for the entire useful life of a locomotive or a locomotive engine. We want to ensure that small remanufacturers would comply with our standards in-use, and subsequently, the public can be assured they are receiving the air quality benefits of the proposed standards. In addition, this proposed amendment would provide a date certain for small remanufacturers on when the in-use testing requirements would begin to apply.

(ii) Small Railroads Exempt From New Standards for Existing Fleet

For locomotives in their existing fleets, the Tier 0 remanufacturing requirements would not apply to railroads qualifying as small businesses. The definition of small business currently used by EPA is same as the definition used by the Small Business Administration, which is based on employment. For line-haul railroads the threshold is 1,500 or fewer employees, and for short-haul railroads it is 500 or fewer employees. Previously we believed that small railroads were not likely to remanufacture their locomotives to ''as new'' condition in most cases, so their locomotives would be generally excluded from the definition of ''new''.

We are requesting comment on whether the current provisions for railroads qualifying as small businesses have been effective and appropriate, on whether they should continue under the new program, and, if so, on whether the existing employee thresholds are appropriate for the purpose of this rulemaking or whether a new threshold based on revenue would be appropriate. Based on the increased efficiencies associated with railroad operations, we believe a railroad with 500 or fewer employees can be viewed as a medium to large business. We believe a different approach based on annual revenues may be more appropriate. For example, should we limit the category of ''small railroad'' to only those railroads that qualify as Class III railroads and that are not owned by a larger company? Under the current classification system, this would limit the exemption to railroads having total revenue less than $25 million per year.

We are clarifying in our definition that intercity passenger or commuter railroads are not included as railroads that are small businesses because they are typically governmental or are large businesses. Due to the nature of their business, these entities are largely funded through tax transfers and other subsidies. Thus, the only passenger railroads that could qualify for the small railroad provisions would be small passenger railroads related to tourism. We invite comment on whether any intercity passenger or commuter railroads would need this exemption for locomotives in their existing fleet.

(iii) Small Railroads Excluded From In-Use Testing Program

The railroad in-use testing program would continue to only apply to Class I freight railroads, and thus, no small railroads would be subject to this testing requirement. It is important to note that most, but not all Class II and III freight railroads qualify as small businesses. This provision provides flexibility to all Class II and III railroads, which includes small railroads. All Class I freight railroads are large businesses. [126]

(iv) Hardship Provisions

Section 1068.245 of the existing regulations in title 40 contains hardship provisions for engine and equipment manufacturers, including those that are small businesses. We are proposing to apply this section for locomotives as described below.

Under this unusual circumstances hardship provision, locomotive manufacturers may apply for hardship relief if circumstances outside their control cause the failure to comply and if the failure to sell the subject locomotives would have a major impact on the company's solvency. An example of an unusual circumstance outside a manufacturer's control may be an ''Act of God,'' a fire at the manufacturing plant, or the unforeseen shut down of a supplier with no alternative available. The terms and time frame of the relief would depend on the specific circumstances of the company and the situation involved. As part of its application for hardship, a company would be required to provide a compliance plan detailing when and how it would achieve compliance with the standards.

(b) Marine Sector

There are numerous small businesses that marinize engines for marine use or build vessels. These businesses do not necessarily have the financial resources or technical expertise to quickly respond to the requirements contained in today's proposed rule. To address this issue, we propose to continue most of the existing provisions, as described below.

(i) Revised Definitions of Small-Volume Manufacturer and Small-Volume Boat Builder

We propose to revise the definitions of small-volume manufacturer (SVM) and small-volume boat builder to include worldwide production. Currently, an SVM is defined as a manufacturer with annual U.S.-directed production of fewer than 1,000 engines (marine and nonmarine engines), and a small-volume boat builder is defined as a boat manufacturer with fewer than 500 employees and with annual U.S.-directed production of fewer than 100 boats. By proposing to include worldwide production in these

[126] U.S. EPA, Assessment and Standards Division, Memorandum from Chester J. France to Alexander Cristofaro of U.S. EPA's Office of Policy, Economics, and Innovation, Locomotive and Marine Diesel RFA/SBREFA Screening Analysis, September 25, 2006.

definitions, we would prevent a manufacturer or boat builder with a large worldwide production of engines or boats, or a large worldwide presence, from receiving relief from the requirements of this program. As discussed above, the provisions that apply to small-volume manufacturers and small-volume boat builders as described below are intended to minimize the impact of this rule for those entities that do not have the financial resources to quickly respond to requirements in the proposed rule.

(ii) Broader Engine Families and Testing Relief

Broader engine families: Post-manufacture marinizers (PMMs) and SVMs would be allowed to continue to group all commercial Category 1 engines into one engine family for certification purposes, all recreational engines into one engine family, and all Category 2 engines into one family. As with existing regulations, these entities would be responsible for certifying based on the ''worst-case'' emitting engine. The advantage of this approach is that it would minimize certification testing because the marinizer and SVMs can use a single engine in the first year to certify their whole product line. In addition, marinizers and SVMs could then carry-over data from year to year until changing engine designs in a way that might significantly affect emissions.

We understand that this broad engine family provision still would require a certification test and the associated burden for small-volume manufacturers. We realize that the test costs are spread over low sales volumes, and we recognize that it may be difficult to determine the worst-case emitter without additional testing. We would require testing because we need a reliable, test-based technical basis to issue a certificate for these engines. However, manufacturers would be able to use carryover to spread costs over multiple years of production.

Production-line and deterioration testing: In addition, SVMs producing engines less than or equal to 800 hp (600 kW) would be exempted from production-line and deterioration testing for the proposed Tier 3 standards. We would assign a deterioration factor for use in calculating end-of-useful life emission factors for certification. This approach would minimize compliance testing since production-line and deterioration testing would be more extensive than a single certification test. The Tier 3 standards proposed for these engines are expected to be engine-out standards and would not require the use of aftertreatment—similar to the existing Tier 1 and Tier 2 standards. The Tier 4 standards proposed for engines greater than 800 hp (600 kW) are expected to require aftertreatment emission-control devices. Currently, we are not aware of any SVMs that produce engines greater than 800 hp (600 kW), except for one marinizer that plans to discontinue their production in the near future.[127] As a proposed revision to the existing provisions, we would not apply these production-line and deterioration testing exemptions to SVMs that begin producing these larger engines in the future due to the sophistication of manufacturers that produce engines with aftertreatment technology. These manufacturers would have the resources to conduct both the design and development work for the aftertreatment emission-control technology, along with production-line and deterioration testing. We invite comments on this proposed revision.

(iii) Delayed Standards

One-year delay: Post-manufacture marinizers generally depend on engine manufacturers producing base engines for marinizing. This can delay the certification of the marinized engines. There may be situations in which, despite its best efforts, a marinizer cannot meet the implementation dates, even with the provisions described in this section. Such a situation may occur if an engine supplier without a major business interest in a marinizer were to change or drop an engine model very late in the implementation process, or was not able to supply the marinizer with an engine in sufficient time for the marinizer to recertify the engine. Based on this concern, we propose to allow a one-year delay in the implementation dates of the Tier 3 standards for post-manufacture marinizers qualifying as small businesses (the definition of small business used by EPA for these provisions for manufacturers of new marine diesel engines—or other engine equipment manufacturing—is 1,000 or fewer employees) and producing engines less than or equal to 800 hp (600 kW). As described earlier, the Tier 4 standards proposed for engines greater than 800 hp (600 kW) are expected to require aftertreatment emission-control devices. We would not apply this one-year delay to small PMMs that begin marinizing these larger engines in the future due to the sophistication of entities that produce engines with aftertreatment technology. We would expect that the large base engine manufacturer (with the needed resources), not the small PMM, would conduct both the design and development work for the aftertreatment emission-control technology, and they would also take on the certification responsibility in the future. Thus, the small PMM marinizing large engines would not need a one-year delay. We invite comments on this proposed revision.

Three-year delay for not-to-exceed (NTE) requirements: Additional lead time is also appropriate for PMMs to demonstrate compliance with NTE requirements. Their reliance on another company's base engines affects the time needed for the development and testing work needed to comply. Thus, PMMs qualifying as small businesses and producing engines less than or equal to 800 hp (600 kW) could also delay compliance with the NTE requirements by up to three years, for the Tier 3 standards. Three years of extra lead time (compared to one year for the primary certification standards) would be appropriate considering their more limited resources. As described earlier, the Tier 4 standards proposed for engines greater than 800 hp (600 kW) are expected to require aftertreatment emission-control devices. We would not apply this three-year delay to small PMMs that begin marinizing these larger engines in the future due to the sophistication of entities that produce engines with aftertreatment technology. We would expect that the large base engine manufacturer (with the needed resources), not the small PMM, would conduct both the design and development work for the aftertreatment emission-control technology, and they would also take on the certification responsibility in the future. Thus, the small PMM marinizing large engines would not need a three-year delay for compliance with the NTE requirements. We invite comments on this proposed revision.

Five-year delay for recreational engines: For recreational marine diesel engines, the existing regulations (2002 Recreational Diesel Marine program; November 8, 2002, 67 FR 68304) allow small-volume manufacturers up to a five-year delay for complying with the standards. However, we do not plan to continue this provision. As discussed earlier, the Tier 3 standards proposed for these engines are expected to be engine-out standards and would not require the use of aftertreatment—similar to the existing Tier 1 and Tier 2 standards. The Tier 4 standards

[127] U.S. EPA, Assessment and Standards Division, Memorandum from Chester J. France to Alexander CristoFaro of the U.S. EPA's Office of Policy, Economics, and Innovation, Locomotive and Marine Diesel RFA/SBREFA Screening Analysis, September 25, 2006.

proposed for engines greater than 800 hp (600 kW) are expected to require aftertreatment emission-control devices. For the recreational marine sector, most of the engines are less than or equal to 800 hp (kW). To meet the Tier 3 standards, the design and development effort is expected to be for recalibration work, which is much less than the work for Tier 4 standards. Also, Tier 3 engines are expected to require far less in terms of new hardware, and in fact, are expected to only require upgrades to existing hardware (i.e., new fuel systems). In addition, manufacturers have experience with engine-out standards from the existing Tier 1 and Tier 2 standards, and thus, they have learned how to comply with such standards. Thus, small-volume manufacturers of recreational marine diesel engines do not need more time to meet the new standards. For small PMMs of recreational marine diesel engines, the one-year delay described earlier would provide enough time for these entities to meet the proposed standards. We invite comment on discontinuing this provision for a 5-year delay.

(iv) Engine Dressing Exemption

Marine engine dressers would continue to be exempted from certification and compliance requirements. Many marine diesel engine manufacturers take a new, land-based engine and modify it for installation on a marine vessel. Some of the companies that modify an engine for installation on a vessel make no changes that might affect emissions. Instead, the modifications may consist of adding mounting hardware and a generator or reduction gears for propulsion. It can also involve installing a new marine cooling system that meets original manufacturer specifications and duplicates the cooling characteristics of the land-based engine, but with a different cooling medium (such as sea water). In many ways, these manufacturers are similar to nonroad equipment manufacturers that purchase certified land-based nonroad engines to make auxiliary engines. This simplified approach of producing an engine can more accurately be described as dressing an engine for a particular application. Because the modified land-based engines are subsequently used on a marine vessel, however, these modified engines would be considered marine diesel engines, which would then fall under these requirements.

To clarify the responsibilities of engine dressers under this proposed rule, while we would continue to consider them to be manufacturers of a marine diesel engine, they would not be required to obtain a certificate of conformity (as long as they ensure that the original label remains on the engine and report annually to EPA that the engine models that are exempt pursuant to this provision). This would be an extension of § 94.907 of the existing regulations. For further details of engine dressers responsibilities see § 1042.605 of the proposed regulations.

(v) Vessel Builder Provisions

For recreational marine engines, the existing regulations (2002 Recreational Diesel Marine program; November 8, 2002, 67 FR 68304) allow manufacturers with a written request from a small-volume boat builder to produce a limited number of uncertified engines (over a five-year period)—an amount equal to 80-percent of the vessel manufacturer's sales for one year. For boat builders with very small production volumes, this 80-percent allowance could be exceeded, as long as sales do not exceed 10 engines in any one year nor 20 total engines over five years and applies only to engines less than or equal to 2.5 liters per cylinder. However, we do not plan to continue this provision. The vast majority of the recreational marine engines would be subject only to the Tier 3 engine-out standards that are not expected to change the physical characteristics of engines (Tier 3 standards would not result in a larger engine or otherwise require any more space within a vessel). This is similar to the Tier 2 engine-out standards, and thus, we believe this provision is not necessary anymore as boat builders are not expected to need to redesign engine compartments of boats, for engines meeting Tier 3 standards. We invite comment on discontinuing this provision for boat builders.

(vi) Hardship Provisions

Sections 1068.245, 1068.250 and 1068.255 of the existing regulations in title 40 contain hardship provisions for engine and equipment manufacturers, including those that are small businesses. We are proposing to apply these sections for marine applications which would effectively continue existing hardship provisions as described below.

PMMs and SVMs: We are proposing to continue two existing hardship provisions for PMMs and SVMs. They may apply for this relief on an annual basis. First, under an economic hardship provision, PMMs and SVMs may petition us for additional lead time to comply with the standards. They must show that they have taken all possible business, technical, and economic steps to comply, but the burden of compliance costs will have a major impact on their company's solvency. As part of its application of hardship, a company would be required to provide a compliance plan detailing when and how it would achieve compliance with the standards. Hardship relief could include requirements for interim emission reductions and/or purchase and use of emission credits. The length of the hardship relief decided during initial review would be up to one year, with the potential to extend the relief as needed. We anticipate that one to two years would normally be sufficient. Also, if a certified base engine is available, the PMMs and SVMs must generally use this engine. We believe this provision would protect PMMs and SVMs from undue hardship due to certification burden. Also, some emission reduction can be gained if a certified base engine becomes available. See the proposed regulatory text in 40 CFR 1068.250 for additional information.

Second, under the unusual circumstances hardship provision, PMMs and SVMs may also apply for hardship relief if circumstances outside their control cause the failure to comply and if the failure to sell the subject engines would have a major impact on their company's solvency. An example of an unusual circumstance outside a manufacturer's control may be an ''Act of God,'' a fire at the manufacturing plant, or the unforeseen shut down of a supplier with no alternative available. The terms and time frame of the relief would depend on the specific circumstances of the company and the situation involved. As part of its application for hardship, a company would be required to provide a compliance plan detailing when and how it would achieve compliance with the standards. We consider this relief mechanism to be an option of last resort. We believe this provision would protect PMMs and SVMs from circumstances outside their control. We, however, would not envision granting hardship relief if contract problems with a specific company prevent compliance for a second time. See the proposed regulatory text in 40 CFR 1068.245 for additional information.

Small-volume boat builders: We are also continuing the unusual circumstances hardship provision for small-volume boat builders (those with less than 500 employees and worldwide production of fewer than 100 boats). Small-volume boat builders may apply for hardship relief if circumstances outside their control cause the failure to comply and if the failure to sell the subject vessels would have a major impact on the company's solvency. An example of an unusual circumstance outside a manufacturer's control may be an ''Act of God,'' a fire at the manufacturing plant, or the unforeseen shut down of a supplier with no alternative available. This relief would allow the boat builder to use an uncertified engine and is considered a mechanism of last resort. The terms and time frame of the relief would depend on the specific circumstances of the company and the situation involved. As part of its application for hardship, a company would be required to provide a compliance plan detailing when and how it would achieve compliance with the standards. See the proposed regulatory text in 40 CFR 1068.245 for additional information.

In addition, small-volume boat builders generally depend on engine manufacturers to supply certified engines in time to produce complying vessels by the date emission standards would begin to apply. We are aware of other applications where certified engines have been available too late for equipment manufacturers to adequately accommodate changing engine size or performance characteristics. To address this concern, we are proposing to allow small-volume boat builders to request up to one extra year before using certified engines if they are not at fault and would face serious economic hardship without an extension. See the proposed regulatory text in 40 CFR 1068.255 for additional information.

(15) Alternate Tier 4 NO_X+HC Standards

We are proposing new Tier 4 NO_X and HC standards for locomotives and marine engines, and proposing to continue our existing emission averaging programs. However, the existing averaging programs do not allow manufacturers to show compliance with HC standards using averaging. Because we are concerned that this could potentially limit the benefits of our averaging program as a phase-in tool for manufacturers, we are proposing an alternate NO_X+HC standard of 1.3 g/bhp-hr that could be used as part of the averaging program.[128] Manufacturers that were unable to comply with the Tier 4 HC standard would be allowed to certify to a NO_X+HC FEL, and use emission credits to show compliance with the alternate standard instead of the otherwise applicable NO_X and HC standards. For example, a manufacturer may choose to use banked emission credits to gradually phase in its Tier 4 1200 kW marine engines by producing a mix of Tier 3 and Tier 4 engines during the early part of 2014. We are proposing that NO_X+HC credits and NO_X credits could be averaged together without discount.

(16) Other Issues

We are also proposing other minor changes to the compliance program. For example, we are proposing that engine manufacturers be required to provide installation instructions to vessel manufacturers and kit installers to ensure that engine cooling systems, aftertreatment exhaust emission controls, and other emission controls are properly installed. Proper installation of these systems is critical to the emission performance of the equipment. Vessel manufacturers and kit installers would be required to follow the instructions to avoid improper installation that could render emission controls inoperative. Improper installation would subject them to penalties equivalent to those for tampering with the emission controls.

We are also clarifying the general requirement that no emission controls for engines subject to this final rule may cause or contribute to an unreasonable risk to public health, welfare, or safety, especially with respect to noxious or toxic emissions that may increase as a result of emission-control technologies. The proposed regulatory language, which addresses the same general concept as the existing §§ 92.205 and 94.205, implements sections 202(a)(4) and 206(a)(3) of the Act and clarifies that the purpose of this requirement is to prevent control technologies that would cause unreasonable risks, rather than to prevent trace emissions of any noxious compounds. This requirement prevents the use of emission-control technologies that produce pollutants for which we have not set emission standards, but nevertheless pose a risk to the public.

B. Compliance Issues Specific to Locomotives

(1) Refurbished Locomotives

Section 213(a)(5) of the Clean Air Act directs EPA to establish emission standards for ''new locomotives and new engines used in locomotives.'' In the previous rulemaking, we defined ''new locomotive'' to mean a freshly manufactured or remanufactured locomotive.[129] We defined ''remanufacture'' of a locomotive as a process in which all of the power assemblies of a locomotive engine are replaced with freshly manufactured (containing no previously used parts) or reconditioned power assemblies. In cases where all of the power assemblies are not replaced at a single time, a locomotive is considered to be ''remanufactured'' (and therefore ''new'') if all of the power assemblies from the previously new engine had been replaced within a five-year period.

The proposed regulations clarify the definition of ''freshly manufactured locomotive'' when an existing locomotive is substantially refurbished including the replacement of the old engine with a freshly manufactured engine. The existing definition in § 92.12 states that freshly manufactured locomotives are locomotives that do not contain more than 25 percent (by value) previously used parts. We allowed freshly manufactured locomotives to contain up to 25 percent used parts because of the current industry practice of using various combinations of used and unused parts. This 25-percent value applies to the dollar value of the parts being used rather than the number because it more properly weights the significance of the various used and unused components. We chose 25 percent as the cutoff because setting a very low cutoff point would have allowed manufacturers to circumvent the more stringent standards for freshly manufactured locomotives by including a few used parts during the final assembly. On the other hand, setting a very high cutoff point could have required remanufacturers to meet standards applicable to freshly manufactured locomotives, but such standards may not have been feasible given the technical limitations of the existing chassis.

We are proposing to add a definition of ''refurbish'' which would mean the act of modifying an existing locomotive such that the resulting locomotive contains less than 50 percent (by value) previously used parts, (but more than 25 percent). We believe that where an existing locomotive is improved to this degree, it is appropriate to consider it separately from locomotives that are simply remanufactured in a conventional sense. As described in section IV.B.(3) we are proposing to set the credit proration factor for

[128] For model year 2015 and 2016 the alternate standard would b3 5.5 g/bhp-hr NO_X+HC. In all cases the alternate standard would be equal to the otherwise applicable NO_X standard.

[129] As is described in this section, freshly manufactured locomotives, repowered locomotives, refurbished locomotives, and all other remanufactured locomotive3s are all ''new locomotives'' in both the existing and proposed regulations.

refurbished switch locomotives equal to the proration factor for 20-year old switchers (0.60).

We are requesting comment on whether refurbished locomotives should be required to meet more stringent standards than locomotives that are simply remanufactured. For example, would it be feasible and cost-effective to require refurbished switch locomotives to meet latest applicable emission standards (i.e., the highest tier of standards that is applicable to freshly manufactured switch locomotives at the time of the remanufacture) rather than the old standards? If not, should they be required to at least meet the Tier 1 or Tier 2 standards?

We recognize that the issues are somewhat different for refurbished line-haul locomotives because of different design constraints that are not present with switchers. If we required refurbished line-haul locomotives to meet very stringent standards, should we allow railroads to refurbish a limited number of line-haul locomotives to less stringent standards? For example, if we required refurbished line-haul locomotives to meet the Tier 3 standards, should we allow railroads to refurbish up to 10 line-haul locomotives per year to the Tier 2 standards.

(2) Averaging, Banking and Trading

We are proposing to continue the existing averaging banking and trading provisions for locomotives. In general, we will continue the historical practice of capping family emission limits (FELs) at the level of the previously applicable standard. However, we are requesting comment on whether we should set lower caps for Tier 4 locomotives similar to what was done for highway engines.[130] We recognize that it would be appropriate to allow the use of emission credits to smooth the transition from Tier 3 to Tier 4, and this requires the FELs to be set at the level of the Tier 3 standards.

In order to ensure that the ABT program is not used to delay the implementation of the Tier 4 technology, we are also proposing to carry over an averaging restriction that was adopted for Tier 2 locomotives in the previous locomotive rulemaking. We would restrict to number of Tier 4 locomotives that could be certified using credits to no more than 50 percent of a manufacturer's annual production. As was true for the earlier restriction, this would be intended to ensure that progress is made toward compliance with the advanced technology expected to be needed to meet the Tier 4 standards. This would encourage manufacturers to make every effort toward meeting the Tier 4 standards, while allowing some use of banked credits to provide needed lead time in implementing the Tier 4 standards by 2015, allowing them to appropriately focus research and development funds. We request comment on the need for this or other restriction on the application of credits to Tier 4 locomotives.

We are proposing to prohibit the carryover of PM credits generated from Tier 0 or Tier 1 locomotives under part 92. The Tier 0 and Tier 1 PM standards under part 92 were set above the average baseline level to act as caps on PM emissions rather than technology-forcing standards. Thus, credits generated against these standards can be considered to be windfall credits. We believe that allowing the carryover of such PM credits would not be appropriate. We would allow credits generated from Tier 2 locomotives to be used under part 1033. We request comment on this prohibition as well as an alternative approach in which part 92 PM credits are discounted significantly rather than prohibited completely.

We are also proposing to update the proration factors for credits generated or used by remanufactured locomotives. The updated proration factors better reflect the difference in service time for line-haul and switch locomotives. The ABT program is based on credit calculations that assume as a default that a locomotive will remain at a single FEL for its full service life (from the point it is originally manufactured until it is scrapped). However, when we established the existing standards, we recognized that technology will continue to evolve and that locomotive owners may wish to upgrade their locomotives to cleaner technology and certify the locomotive to a lower FEL at a subsequent remanufacture. We established proration factors based on the age of the locomotive to make calculated credits for remanufactured locomotives consistent with credits for freshly manufactured locomotive in terms of lifetime emissions. The proposed proration factors are shown in § 1033.705 of the proposed regulations. These would replace the existing proration factors of § 92.305. For example, using the proposed proration factors, a 15 year old line-haul locomotive certified to a new FEL that was 1.00 g/bhp-hr below the applicable standard would generate the same amount of credit as a freshly manufactured locomotive that was certified to an FEL that was 0.43 g/bhp-hr below the applicable standard because the proration factor would be 0.43. For comparison, under the existing regulations, the proration factor would be 0.50. See section IV.B.(3) for additional discussion of proration factor issues related to refurbished switchers.

We are also requesting comment on how to assign emission credits. Under the current regulations, credits can be held by the manufacturer, railroad, or other entities. Since remanufacturing is frequently a collaborative process between the railroad and either a manufacturer or other remanufacturer, there can be multiple entities that are considered to be remanufacturers, and thus allowed to hold the certificate for the remanufactured locomotive. The regulations presume that credits are held by the certificate holder, but they can be transferred to the railroad at the point of sale or the point of remanufacture. We are requesting comment on whether it would be more appropriate to require that credits be transferred to the railroads for some or all cases. Automatically transferring credits to the railroad at the time of remanufacture would be a way of applying the standards on a fleet-average basis. Would this be a better approach for ensuring that the industry applies low emission technology in the most equitable and cost effective manner? Would it reduce the potential for market disruptions? Would it have any other beneficial or adverse consequences not discussed here?

Finally, we are requesting comment on how to treat credits generated and used by Tier 3 and later locomotives. Under the current part 92 ABT program, credits are segregated based on the cycle over which they are generated but not by how the locomotive is intended to be used (switch, line-haul, passenger, etc.). Line-haul locomotives can generate credits for use by switch locomotives, and vice versa, because both locomotives are subject to the same standards. However, for the Tier 3 and Tier 4 programs, switch and line-haul locomotives would be subject to different standards with emissions generally measured only for one test cycle. We are proposing to allow credits generated by Tier 3 or later switch locomotives over the switch cycle to be used by line-haul locomotives to show compliance with line-haul cycle standards. We are requesting comment on (but not proposing) allowing such cross-cycle use of line-haul credits (or switch credits generated by line-haul locomotives) by Tier 3 or later switch locomotives.

To make this approach work, we are also proposing a special calculation

[130] 66 FR 5109–5111, January 18, 2001.

method where the credit using locomotive is subject to standards over only one duty cycle while the credit generating locomotive is subject to standards over both duty cycles (and can thus generate credits over both cycles). In such cases, we would require the use of credits under both cycles. For example, for a Tier 4 line-haul engine family needing 1.0 megagrams of NO_X credits to comply with the line-haul emission standard, the manufacturer would have to use 1.0 megagrams of line-haul NO_X credits and 1.0 megagrams of switch NO_X credits if the line-haul credits were generated by a locomotive subject to standards over both cycles.

Commenters supporting cross-cycle credit averaging should also address uncertainty due to cycle differences and the different ways in which switch and line-haul locomotives are likely to be used. For example, the two cycles are very different and reflect average duty cycles for the two major types of operation. Moreover, because switch locomotive generally spend more time in low-power operation than line-haul locomotives, they tend to last much longer in terms of years. This means that the full benefits of emission reductions from switch locomotives will likely occur further into the future than will the benefits of emission reductions from line-haul locomotives. Should such credits be adjusted to account for this difference? If so, how? Are there other factors that would warrant applying some adjustment to the credits to make them more equivalent to one another?

(3) Switch Credit Calculation

We are proposing to correct the existing ABT program to more appropriately give credits to railroads for upgrading old switchers to use clean engines, rather than to continue using the old high emission engines indefinitely. As with the existing program, credits would be calculated from the difference between the emissions of the old switcher and the emissions of the new replacement switcher, adjusted to account for the projected time the old switcher would have otherwise remained in service. We are also requesting comment on whether other changes need to be made to the switch credit calculation.

The proposed correction would affect the proration factor that is used in the credit calculation to account for the locomotive's emissions projected for the remainder of its service life, relative to a freshly manufactured locomotive. More specifically, the correction we are proposing would create a floor for the credit proration factor for refurbished switch locomotives equal to the proration factor for 20 year old switchers (0.60). For example, under the proposed program, refurbishing a 35 year old switch locomotive to an FEL 1.0 g/bhp-hr below the Tier 0 standard would generate the same amount of credit as a conventional remanufacture of a 20 year old switch locomotive to an FEL 1.0 g/bhp-hr below the Tier 0 standard. This is because we believe that such refurbished switch locomotives will almost certainly operate as long as a 20 year old locomotive that was remanufactured at the same time. Such credits can be generated under the existing program, but not to the full degree that they should be. That original program was designed to address line-haul locomotives, and no special consideration was made for switchers or for substantially refurbishing the locomotive. Most significantly, the existing regulations assume that any locomotive 32 years old or older would only be remanufactured one additional time (i.e., only have one remaining useful life). This is true without regard to how many additional improvements are made to the locomotive to extend its service life. Based on this assumption, any credits generated by such a locomotive are discounted by 86 percent relative to credits generated or used by a freshly manufactured locomotive. While this kind of discount appropriately reflected the differences in future emissions for line-haul locomotives, it greatly underestimates the emission reduction achieved by refurbishing switch locomotives.

The existing and proposed credit programs allow for remanufacturers to generate emission credits by refurbishing an existing old switch locomotive so that it will use engines meeting the standards for freshly manufactured locomotives. However, they do not allow for any credits to be generated by simultaneously creating a freshly manufactured locomotive and scrapping an existing old switch locomotive, even though the emissions impact of the two scenarios may be identical. We request comment on whether it is appropriate to maintain this distinction. Commenters supporting allowing credits to be generated by scrapping old locomotives should address how to ensure that allowing it would not result in windfall credits being generated from old locomotives that would have been scrapped anyway.

(4) Phase-in and Reasonable Cost Limit

We are proposing that the new Tier 0 and 1 emission standards become applicable on January 1, 2010. We are also proposing a requirement for 2008 and 2009 when a remanufacturing system is certified to these new standards. If such system is available before 2010 for a given locomotive at a reasonable cost, remanufacturers of those locomotives may no longer remanufacture them to the previously applicable standards. They must instead comply with the new Tier 0 or 1 emission standards. Similarly, we are proposing a requirement to use certified Tier 2 systems for 2008 through 2012 when a remanufacturing system is certified to the new Tier 2 standards. We are requesting comment on how best to define reasonable cost.

As part of this phase-in requirement, we would allow owners/operators a 90-day grace period in which they could remanufacture their locomotives to the previously applicable standards. This would allow them to use up inventory of older parts. It would also allow sufficient time to find out about the availability of kits and to make appropriate plans for compliance.

We are also requesting comment on whether this requirement will cause any disadvantage to non-OEM remanufacturers who may be unable to develop remanufacture systems in time.

(5) Recertification Without Testing

Once manufacturers have certified an engine family, we have historically allowed them to obtain certificates for subsequent model years using the same test data if the engines remain unchanged from the previous model year. We refer to this type of certification as ''carryover.'' We are proposing to continue this allowance. We are also requesting comment on extending this allowance to owner/operators. Specifically, we request comment on adding the following paragraph to the end of the proposed § 1033.240:

An owner/operator remanufacturing its locomotives to be identical to its previously certified configuration may certify by design without new emission test data. To do this, submit the application for certification described in § 1033.205, but instead of including test data, include a description of how you will ensure that your locomotives will be identical in all material respects to their previously certified condition. You have all of the liabilities and responsibilities of the certificate holder for locomotives you certify under this paragraph.

Several railroads have expressed concern that once they purchase a compliant locomotive, they are at the mercy of the original manufacturer at the time of remanufacture if there are no other certified kits available for that model. The regulatory provision shown above would make it somewhat simpler for a railroad to obtain the certificate because it would eliminate the need to certification testing.

(6) Railroad Testing

Section 92.1003 requires Class I freight railroads to annually test a small sample of their locomotives. We are proposing to adopt the same requirements in § 1033.810. We are requesting comments on whether this program should be changed. In particular, we request suggestions to better specify how a railroad selects which locomotives to test, which has been a source of some confusion in recent years. Commenters suggesting changes should also address when such changes should take effect.

(7) Test Conditions and Corrections

In our previous rule, we established test conditions that are representative of in-use conditions. Specifically, we required that locomotives comply with emission standards when tested at temperatures from 45 °F to 105 °F and at both sea level and altitude conditions up to about 4,000 feet above sea level. One of the reasons we established such a broad range was to allow outdoor testing of locomotives. While we only required that locomotives comply with emission standards when tested at altitudes up to 4,000 feet for purposes of certification and in-use liability, we also required manufacturers to submit evidence with their certification applications, in the form of an engineering analysis, that shows that their locomotives were designed to comply with emission standards at altitudes up to 7,000 feet. We included correction factors that are used to account for the effects of ambient temperature and humidity on NO_X emission rates.

We are proposing to change the lower limit for testing to 60 °F and eliminate the correction for the effects of ambient temperature. In implementing the current regulations, we have found that the broad temperature range with correction, which was established to make testing more practical, was not workable. Given the uncertainty with the existing correction, manufacturers have generally tried to test in the narrower range being proposed today. However, under the proposed regulations, we would allow manufacturers to test at lower temperatures, but would require them to develop correction factors specific to their locomotive designs. We would continue the other existing test condition provisions in the proposed regulations.

(8) Duty Cycles

We are not proposing any changes to the weighting factors for the locomotive duty cycles. However, we are requesting comment on whether such changes would be appropriate in light of the proposed idle reduction requirements. The existing regulations (§ 92.132(a)(4)) specifies an alternate calculation for locomotive equipped with idle shutdown features. Specifically, the regulatory language states:

> For locomotives equipped with features that shut the engine off after prolonged periods of idle, the measured mass emission rate M_{i1} (and M_{i1a} as applicable) shall be multiplied by a factor equal to one minus the estimated fraction reduction in idling time that will result in use from the shutdown feature. Application of this adjustment is subject to the Administrator's approval.

This provision allows a manufacturer to appropriately account for the inclusion of idle reduction features as part of its emission control system. There are three primary reasons why we are not proposing to change the calculation procedures with respect to the proposed idle requirements. First, different shutdown systems will achieve different levels of idle reduction in use. Thus, no single adjustment to the cycle would appropriately reflect the range of reductions that will be achieved. Second, the existing calculation provides an incentive for manufacturers to design shutdown systems that will achieve in the greatest degree of idle reduction that is practical. Finally, our feasibility analysis is based in part on the emission reductions achievable relative to the existing standards. Since some manufacturers already rely on the calculated emission reductions from shutdown features incorporated into many of their locomotive designs, our feasibility is based in part on allowing such calculations.

While we are proposing to continue this approach, we are requesting comment on whether we should be more specific in our regulations about what level of adjustment is appropriate. For example, should we specify that idle emission rates for locomotives meeting our proposed minimum shutdown requirements in § 1033.115 be reduced by 20 percent, unless the manufacturer demonstrates that greater idle reduction will be achieved?

We also recognize that the potential exists for locomotives to include additional power notches, or even continuously variable throttles and that the standard FTP sequence for such locomotives would result in an emissions measurement that does not accurately reflect their in-use emissions performance. Moreover, some locomotives may not have all of the specified notches, making it impossible to test them over the full test. Under the existing regulations, we handle such locomotives under our discretion to allow alternate calculations (40 CFR 92.132(e)). We are requesting comment on whether we need detailed regulations to specify duty cycles for such locomotives. In general, for locomotives missing notches, we believe the existing duty cycle weighting factors should be reweighted without the missing notches. For locomotives without notches or more than 8 power notches, commenters should consider the following information provided to us by manufacturers for the previous rulemaking that shows that typical notch power levels expressed as a percentage of the rated power of the engine as shown in Table IV–below.

TABLE IV–1.—TYPICAL LOCOMOTIVE NOTCH POWER LEVELS

	Notch							
	1	2	3	4	5	6	7	8
Percent of Rated Power	4.5	11.5	23.5	35.0	48.5	64.0	85.0	100.0

(9) Use of Engines Certified Under 40 CFR Parts 89 and 1039

Section 92.907 currently allows the use of a limited number of nonroad engines in locomotive applications without certifying under the locomotive program. We placed limits on the number of nonroad engines that can be used for four primary reasons:

- The locomotive program is uniquely tailored to the railroad industry to ensure emission reductions for actual locomotive operation over 30–60 year service lives.

- At sufficiently high sales levels, the per locomotive cost of certifying under part 92 become less significant.
- It is somewhat inequitable to allow nonroad engine manufacturers the option of certifying the engines in whichever program they believe to be more advantageous to them, considering factors such as compliance testing requirements.
- States and localities have much less ability to regulate locomotives than other engine types, and thus EPA has an obligation to monitor locomotive performance more closely.

We believe that these reasons remain valid and are proposing to continue this type of allowance. However, we are proposing some changes to these procedures. In general, manufacturers have not taken advantage of these existing provisions. In some cases, this was because the manufacturer wanted to produce more locomotives than allowed under the exemption. However, in most cases, it was because the customer wanted a full locomotive certification with the longer useful life and additional compliance assurances. We are proposing new separate approaches for the long term (§ 1033.625) and the short term (§ 1033.150), each of which addresses at least one of these issues.

For the long term, we are proposing to replace the existing allowance to rely on part 89 certificates with a design-certification program that would make the locomotives subject to the locomotive standards in-use, but not require new testing to demonstrate compliance at certification. Specifically, this program would allow switch manufacturers using nonroad engines to introduce up to 15 locomotives of a new model prior to completing the traditional certification requirements. While the manufacturer would be able to certify without new testing, the locomotives have locomotive certificates. Thus, purchasers would have the compliance assurances that they seem to desire.

The short term program is more flexible and would not require that the locomotives comply with the switch cycle standards, and instead the engines would be subject to the part 1039 standards. The manufacturer would be required to use good engineering judgment to ensure that the engines' emission controls will function properly when installed in a locomotive. Given the relative levels of the part 1039 standards and those being proposed in 1033, we do believe there is little environmental risk with this short-term allowance, and thus propose to not have any limits of the sales of such locomotives. Nevertheless, we are proposing that this allowance be limited to model years through 2017. This will provide sufficient time to develop these new switchers. We are not proposing that these locomotives would be exempt from the part 1033 locomotive standards when remanufactured, unless the remanufacturing of the locomotive took place prior to 2018 and involved replacement of the engines with certified new nonroad engines. Otherwise, the remanufactured locomotive would be required to be covered by a part 1033 remanufacturing certificate.

We are also requesting comment on whether specific regulatory language is needed to describe how to test locomotives that have multiple propulsion engines, and when it is appropriate to allow single engine testing for certification.

(10) Auxiliary Emission Control Devices Triggered by GPS Data

Some manufacturers have developed software which can use latitude and longitude to change engine operating characteristics including emissions. Such software fits our definition of an auxiliary emission control device (AECD). If for example, the software were to increase emissions when the locomotive was operated in Mexico; this would cause the locomotive to fail emission standards when in Mexico. Moreover, the emissions from such a locomotive would likely be harmful to both Mexican and U.S. citizens due to emissions transport. AECDs (except those approved during certification) which cause emission exceedences when a locomotive crosses the U.S. border into a foreign country are considered defeat devices and are not permitted. When a locomotive is certified, it should comply with U.S. standards and requirements during all operation. It does not matter where the locomotive goes after it is introduced into commerce. In addition, since emission labels have to contain an unconditional statement of compliance, non-compliant operation in any area, including a foreign country, would render the label language false, and this is not allowed.

(11) Mexican and Canadian Locomotives

Under the existing regulations, Mexican and Canadian locomotives are subject to the same requirements as U.S. locomotives if they operate extensively within the U.S. The regulations 40 CFR 92.804(e) states:

> Locomotives that are operated primarily outside of the United States, and that enter the United States temporarily from Canada or Mexico are exempt from the requirements and prohibitions of this part without application, provided that the operation within the United States is not extensive and is incidental to their primary operation.

We are proposing to change this exemption to make it subject to our prior approval, since we have found that the current language has caused some confusion. When we created this exemption, it was our understanding that Mexican and Canadian locomotives rarely operated in the U.S. and the operation that did occur was limited to within a short distance of the border. We are now aware that there are many Canadian locomotives that do operate extensively within the U.S. and relatively few that would meet the conditions of the exemption. We have also learned that some Mexican locomotives may be operating more extensively in the United States. Thus, it is appropriate to make this exemption subject to our prior approval. To obtain this exemption, a railroad would be required to submit a detailed plan for our review prior to using uncertified locomotives in the U.S. We would grant an exemption for locomotives that we determine will not be used extensively in the U.S. and that such operation would be incidental to their primary operation. Mexican and Canadian locomotives that do not have such an exemption and do not otherwise meet EPA regulations may not enter the United States.

(12) Temporary In-Use Compliance Margins and Assigned Deterioration Factors

The Tier 4 standards would be challenging for manufacturers to achieve, and would require manufacturers to develop and adapt new technologies. Not only would manufacturers be responsible for ensuring that these technologies would allow engines to meet the standards at the time of certification, they would also have to ensure that these technologies continue to be highly effective in a wide range of in-use environments so that their engines would comply in use when tested by EPA. However, in the early years of a program that introduces new technology, there are risks of in-use compliance problems that may not appear in the certification process or during developmental testing. Thus, we believe that for a limited number of model years after new standards take effect it is appropriate to adjust the compliance levels for assessing in-use compliance for diesel engines equipped with aftertreatment. This would provide assurance to the manufacturers that they would not face recall if they exceed standards by a small amount during this transition to clean technologies. This approach is very similar to that taken in the highway heavy-duty rule (66 FR 5113–5114) and general nonroad rule (69 FR 38957), both of which involve similar approaches to introducing the new technologies.

Table IV–2 shows the in-use adjustments that we propose to apply. These adjustments would be added to the appropriate standards or FELs in determining the in-use compliance level for a given in-use hours accumulation. Our intent is that these add-on levels be available only for highly-effective advanced technologies such as particulate traps and SCR. Note that these in-use add-on levels apply only to engines certified through the first few model years of the new standards. During the certification demonstration, manufacturers would still be required to demonstrate compliance with the unadjusted Tier 4 certification standards using deteriorated emission rates. Therefore, the manufacturer would not be able to use these in-use standards as the design targets for the engine. They would need to project that engines would meet the standards in-use without adjustment. The in-use adjustments would merely provide some assurance that they would not be forced to recall engines because of some small miscalculation of the expected deterioration rates.

To put these levels in context, the difference between the NO_X standard with and without the end of life add-on is equivalent to the end of life catalyst efficiency being about 20 percent lower than expected. Our feasibility analysis projects that the SCR catalyst would need to be approximately 80 percent efficient over the locomotive duty cycle at the end of the locomotive's useful life to comply with the 1.3 g/bhp-hr standard. However, if this efficiency dropped to 60 percent, the cycle-weighted emissions would essentially double, increasing by up to 1.3 g/bhp-hr.

TABLE IV–2.—PROPOSED IN-USE ADD-ONS

[g/bhp-hr]

For useful life fractions	NO_X (2017–2019)	PM (2015–2017)
<50% UL	0.7	0.01
50%–75% UL	1.0	
>75% UL	1.3	

C. Compliance Issues Specific to Marine Engines

(1) Useful Life

We specify in 40 CFR 94.9 minimum values for the useful life compliance period. We require manufacturers to specify longer useful lives for engines that are designed to last longer than these minimum values. We also allow manufacturers to ask for shorter useful lives where they can demonstrate that the engines will rarely exceed the requested value in use. Some manufacturers have proposed that the useful life scheme in our regulation be modified to more closely reflect the design lives of current marine engines and the fact that design life inherently varies with engine cylinder size and power density. Our existing regulations do account for this variation by specifying nominal minimum useful life values which most engines are certified to. Manufacturers are required to certify to longer useful lives if their engines are designed to last significantly longer than this minimum. The regulations also include provisions for a manufacturer to request a shorter useful life. This was recently amended to include a more prescriptive basis for manufacturers to demonstrate that a shorter useful life is more appropriate.[131] Specifically, our regulations used to require that the demonstration include data from in-use engines. Manufacturers were concerned that they generally do not (and cannot) have the data from in-use engines that is needed to justify an alternate useful life prior to obtaining certification and putting engines into service. The amended regulations allow manufacturers to use information equivalent to in-use data, such as data from research engines or similar engine models that are already in production. Additionally, the demonstration currently required must include recommended overhaul intervals, any mechanical warranties offered for the engine or its components, and any relevant customer design specifications. Given the above amendments, we do not feel that a sweeping change to our useful life scheme is warranted at this time. We would be willing to consider modifying our scheme in the future should manufacturers provide data for characteristics used to design engine overhaul intervals (e.g., compression loss, oil consumption increase, engine component wear, etc.) in specific cylinder size and power density categories.

(2) Replacement Engines

Under the provisions of our current marine diesel engine program, when an engine on an existing vessel is replaced with a new engine, that new engine must be certified to the standards in existence when the vessel is repowered. These repower requirements apply to both propulsion and auxiliary engines. We are proposing to apply this approach under the new regulations rather than the provisions of § 1068.240.

We provided an exemption in 40 CFR 94.1103(b)(3) which allows a vessel owner to replace an existing engine with a new uncertified engine or a new engine certified to an earlier standard engine in certain cases. This is only allowed, however, if it can be demonstrated that no new engine that is certified to the emission limits in effect at that time is produced by any manufacturer with the appropriate physical or performance characteristics needed to repower the vessel. In other words, if a new certified engine cannot be used, an engine manufacturer may produce a new replacement engine that does not meet all of the requirements in effect at that time. For example, if a vessel has twin Tier 1 propulsion engines and it becomes necessary to replace one of them after the Tier 3 standards go into effect, the vessel owner can request approval for an engine manufacture to produce a new Tier 1 engine if it can be demonstrated that the vessel would not function properly if the engines are not identically matched.

There are certain conditions for this exemption. The replacement engine must meet standards at least as stringent as those of the original engine. So, for example, if the original engine is a pre-Tier 1 engine, then the replacement engine need not meet any emission limits. If the old engine was a Tier 1 engine, the new engine must meet at

[131] 70 FR 40458, July 13, 2005.

least the Tier 1 limits. As described in this section, the new engine does not necessarily need to meet stricter limits that may otherwise apply when the replacement occurs. Also as a condition for the exemption, the engine manufacturer must take possession of the original engine or make sure it is destroyed. In addition, the replacement engine must be clearly labeled to show that it does not comply with the standards and that sale or installation of the engine for any purpose other than as a replacement engine is a violation of federal law and subject to civil penalty. Our regulations specify the information that must be on the label. In this proposal, we are adding a provision to cover the case where the engine meets a previous tier of standards.

As described above, this provision requires EPA to make the determination that no certified engine would meet the required physical or performance needs of the vessel. However, we recently revised this provision to allow the engine manufacturer to make this determination in cases of catastrophic engine failure. In these cases, the vessel is not usable until a replacement engine is found and installed. The engine manufacturers and vessel owners were concerned that our review would take a considerable amount of time. In addition, they were also concerned that reviewing all potential replacement engines for suitability would also take a lot of time. Note that in cases where a vessel owner simply wants to replace an engine with a new version of the same engine as part of a vessel overhaul for example, it would still be necessary to obtain our approval.

In catastrophic failure situations, our regulations now allow an engine manufacturer to determine that no compliant engine can be used for a replacement engine, provided that certain conditions are met. First, the manufacturer must determine that no certified engine is available, either from its own product lineup or that of the manufacturer of the original engine (if different). Second, the engine manufacturer must document the reasons why an engine of a newer tier is not usable, and this report must be made available to us upon request. Finally, no other significant modifications to the vessel can be made as part of the process of replacing the engine, or for a period of 6 months thereafter. This is to avoid the situation where an engine is replaced prior to a vessel modification that would otherwise result in the vessel becoming ''new'' and its engines becoming subject to the new engine standards. In addition, the replacement of important navigation systems at the same time may actually allow the use of a newer tier engine.

We are returning to this provision to add an additional requirement. Specifically, the determination (either by the engine manufacturer in the case of a catastrophic failure or by us in all other cases) must show that no engine of the current or any previous tier would meet the physical or performance requirements of the engine. In other words, after the Tier 4 standards go into effect, it must be demonstrated that no other Tier 4, or Tier 3, Tier 2, or Tier 1 engines would work. Similarly, when the Tier 3 standards are in effect it must be demonstrated that no other Tier 3, or Tier 2 or Tier 1 engine would work. If there are engines from two or more previous tiers of standards that would meet the performance requirements, then the requirement would be to use the engine from the cleanest tier of standards.

(3) Personal Use Exemption

The existing control program provides for exemptions from the standards, including testing, manufacturer-owned engines, display engines, competition engines, national security, and export. We also provide an engine dresser exemption that applies to marine diesel engines that are produced by marinizing a certified highway, nonroad, or locomotive engine without changing it in any way that may affect the emissions characteristics of the engine.

In addition to these existing exemptions we are also proposing a new provision that would exempt an engine installed on a vessel manufactured by a person for his or her own use (see 40 CFR 1042.630). This proposal is intended to address the hobbyists and fishermen who make their own vessel (from a personal design, for example, or to replicate a vintage vessel) and who would otherwise be considered to be a manufacturer subject to the full set of emission standards by introducing a vessel into commerce. The exemption is intended to allow such a person to install a rebuilt engine, an engine that was used in another vessel owned by the person building the new vessel, or a reconditioned vintage engine (to add greater authenticity to a vintage vessel). The exemption is not intended to allow such a person to order a new uncontrolled engine from an engine manufacturer. We expect this exemption to involve a very small number of vessels, so the environmental impact of this proposed exemption would be negligible.

Because the exemption is intended for hobbyists and fishermen, we are setting additional requirements for it. First, the vessel may not be used for general commercial purposes. The one exception to this is that the exemption allows a fisherman to use the vessel for his or her own commercial fishing. Second, the exemption would be limited to one such vessel over a ten-year period and would not allow exempt engines to be sold for at least five years. We believe these restrictions would not be unreasonable for a true hobby builder or comparable fisherman. Moreover, we would require that the vessel generally be built from unassembled components, rather than simply completing assembly of a vessel that is otherwise similar to one that will be certified to meet emission standards. The person also must be building the vessel him- or herself, and not simply ordering parts for someone else to assemble. Finally, the vessel must be a vessel that is not classed or subject to Coast Guard inspections or surveys.

We are requesting comment on all aspects of this proposed exemption. We also request comment on whether this application of the exemption should be limited to fishing vessels under a certain length (e.g., 36 feet), to ensure that it is limited to small operators, and/or whether it should be limited to vessels that are engaged only in seasonal fishing and not used year-round.

(4) Gas Turbine Engines

While gas turbine engines [132] are used extensively in naval ships, they are not used very often in commercial ships. Because of this and because we do not currently have sufficient information, we are not proposing to regulate marine gas turbines in this rulemaking. Nevertheless, we believe that gas turbines could likely meet the proposed standards (or similar standards) since they generally have lower emissions than diesel engines and will reconsider gas turbines in a future rulemaking. We are requesting that commenters familiar with gas turbines provide to us any emissions information that is available. We would also welcome comments on whether it would be appropriate to regulate turbines and diesels together. Commenters supporting the regulation of turbines should also address whether any special provisions would be needed for the testing and certification of turbines.

[132] Gas turbine engines are internal combustion engines that can operate using diesel fuel, but do not operate on a compression-ignition or other reciprocating engine cycle. Power is extracted from the combustion gas using a rotating turbine rather than reciprocating pistons.

(5) Residual Fuel Engines

Our Category 1 and Category 2 marine diesel engine standards, both the existing emission limits (Tiers 1 and 2) and the proposed emission limits (Tiers 3 and 4) apply to all newly built marine diesel engines regardless of the fuel they are designed to use. In the vast majority of cases, this fuel would be distillate diesel fuel similar to diesel fuel used in highway or land-based nonroad applications. However, there are a small number of Category 1 and Category 2 auxiliary engines that are designed to use residual fuel. Residual fuel is a by-product of distilling crude oil to produce lighter petroleum products such as gasoline, DM-grade diesel fuel (also called ''distillate diesel'' which is used in on-highway, land-based nonoroad, and marine diesel engines), and kerosene. Residual fuel possesses a high viscosity and density, which makes it harder to handle (usage requires special equipment such as heaters, centrifuges, and purifiers). It typically has a high ash, nitrogen, and sulfur content compared to distillate diesel fuels. It is not produced to a set of narrow specifications, and so fuel parameters can be highly variable. All of these characteristics of residual fuel make it difficult to handle, and it is typically used only in Category 3 engines on ocean-going vessels or in very large (above 30 l/cylinder) generators used in land-based power plants. Residual fuel is traditionally not used in Category 1 or Category 2 propulsion engines because of the fuel handling equipment required onboard and because it can affect engine responsiveness. However, it may be used in Category 1 or Category 2 auxiliary engines used on ocean-going vessels, to simplify the fuel requirements for the vessel (both propulsion and auxiliary engines would operate on the same fuel).

In contrast to the federal program, the engine testing and certification provision in Annex VI allow manufacturers to test engines on distillate fuel even if they are intended to operate on residual fuel. This approach was adopted because it was thought that the use of residual fuel would not affect NO_X, and the Annex VI standards are NO_X only. At the same time, however, the NO_X Technical Code allows a ten percent allowance for in-use testing on residual fuel, to accommodate any marginal impact on NO_X and also to reflect the fact that the engine would be adjusted differently to operate on residual fuel.

The Annex VI approach was rejected for our national Category 1 and Category 2 engines standards. We noted in our 1999 FRM that residual fuel is sufficiently different from distillate as to be an alternative fuel. We also noted that changes to an engine to make it operable on residual fuel could constitute a violation of the tampering prohibition in § 94.1103(a)(3). More importantly, however, all of our emission control programs are predicated on an engine meeting the emission standards in use. We have a variety of provisions that help ensure this outcome, including specifying the useful life of an engine, specification of an emission deterioration factor, durability testing, and not-to-exceed zone requirements to ensure compliance over the range of operations an engine is likely to see in-use. These provisions are necessary to ensure that the emission reductions we expect from the emission limits actually occur. This would not be the case with the Annex VI approach. While an engine may pass the certification requirements using distillate fuel, it is unclear what emission reductions would actually occur from engines using residual fuel. So, for example, while the Annex VI NO_X limits were expected to achieve a 30 percent reduction from uncontrolled levels for marine diesel engines, we estimated the actual reduction for residual fuel Category 3 engines to be closer to 20 percent (see 68 FR 9777, February 28, 2003).

For these reasons, our existing requirements for engines less than 30 l/cyl displacement require certification that specifies that if a Category 1 or Category 2 engine is designed to be capable of using a fuel other than or in addition to distillate fuel (e.g., natural gas, methanol, or nondistillate diesel, or a mixed fuel), exhaust emission testing must be performed using a commercially available fuel of that type, with fuel specifications approved by us (40 CFR 94.108(b)(1)).

In recent months, shipbuilders have notified us that they are unable to obtain certified Category 1 or Category 2 residual fuel auxiliary engines for installation on newly built vessels with Category 3 propulsion engines. The standard building practice for these vessels is to install auxiliary engines that use the same fuel, residual fuel, as the propulsion engine. This approach is common throughout the industry because it simplifies the fuel handling systems for the vessel (only one grade of fuel is required for the vessel's primary power plants, although there may be one or two smaller distillate fuel auxiliary engines for emergency purposes) and it reduces the costs of operating the vessel (residual fuel is less expensive than distillate fuel). Shipbuilders indicated they have been unable to find Category 1 or Category 2 auxiliary engines certified to the Tier 2 standards on residual fuel. Engine manufacturers have indicated that they have not certified these engines on residual fuel because it is not profitable to do this for only the U.S. market (according to the U.S. Maritime Administration, while the U.S. fleet of ocean-going vessels above 10,000 deadweight tons is 13th largest in the world with 295 vessels, there were only 13 vessels built in 2005).[133] Engine manufacturers also informed us that they are not sure they could meet the PM limits for the Category 1 engines on residual fuel.

The most obvious solution for vessels in this situation is to install and use certified distillate fuel engines. Ship builders have indicated that this option would be prohibitively expensive for ship owners and have asked EPA to reconsider the control program for these engines. We are requesting comment on this issue, and especially on the costs associated with installing and using distillate auxiliary engines instead of residual auxiliary engines on these vessels. We are particularly interested in data that would indicate whether such additional costs would represent an undue burden to the owners of these vessels and whether the additional cost in terms of tons of PM and NO_X reduced would be significantly higher than what is required of users of non-residual fuel auxiliary engines.

One possibility to address the shipbuilders' concerns would be to create a compliance flexibility for auxiliary engines intended to be installed on vessels with Category 3 propulsion engines. The flexibility could consist of pulling ahead NO_X aftertreatment for these engines by setting a tighter NO_X limit (1.8 g/kW-hr) while setting an alternative PM limit (0.5 g/kW-hr) equivalent to the Tier 2 Category 2 limit. These engines would still be required to be certified on residual fuel, for the reasons described above. However, we could allow alternative PM measurement procedures, such as a two-step approach that would remove the water component of the exhaust, which would take into account the difficulty in measuring PM

[133] See Top 25 Merchant Fleets of the World—Major world fleets by vessel type, listed by Flag of Registry and Country of Ownership. U.S. ranks 13th by flag, but 5th by ownership. (Updated 11/21/06) accessed at *http://www.marad.dot.gov/MARAD_statistics/index.html#Fleet%20Statistics* and World Merchant Fleet 2001–2005 (July 2006) accessed at *http://www.marad.dot.gov/MARAD_statistics/2005%20STATISTICS/World%20Merchant%20Fleet%202005.pdf.*

when the sulfur levels of the test fuel are high.

Controlling emissions from residual fuelled engines is inherently difficult due to the characteristics of residual fuels. In particular, the high levels of sulfur and other metals present in residual fuel lead to high levels of PM emissions and can damage catalyst based emission control technologies. Urea SCR catalyst systems have been developed to work under similar conditions for coal fired power plants and some marine applications. We project that these solutions could be used to enable a residual fuelled marine diesel engine to meet the same emission NO_X emission standard as distillate fuelled engines of 1.8 g/kWhr. Unfortunately, the high levels of sulfur and other metals in residual fuels make it impossible to apply catalyst based emission control systems to reduce PM emissions. Stationary residual fuelled engines have demonstrated that PM emission levels around 0.5 g/kWhr are possible, and we believe similar solutions can be applied to these same engines in marine applications.

Such a compliance flexibility would not be automatic; engine manufacturers would have to apply for it. This is necessary to ensure that the questions of test fuel and PM measurement are resolved before the certification testing begins. In addition, engines would have to be labeled as intended for use only as auxiliary engines onboard vessels with Category 3 propulsion engines.

We are requesting comment on all aspects of this compliance flexibility, including the need for it and how it should be structured.

V. Costs and Economic Impacts

In this section, we present the projected cost impacts and cost effectiveness of the proposed standards, and our analysis of potential economic impacts on affected markets. The projected benefits and benefit-cost analysis are presented in Section VI. The benefit-cost analysis explores the net yearly economic benefits to society of the reduction in mobile source emissions likely to be achieved by this rulemaking. The economic impact analysis explores how the costs of the rule will likely be shared across the manufacturers and users of the engines and equipment that would be affected by the standards.

The total monetized benefits of the proposed standards, when based on published scientific studies of the risk of PM-related premature mortality, these benefits are projected to be more than $12 billion in 2030, assuming a 3 percent discount rate (or $11 billion assuming a 7 percent discount rate). Our estimate of total monetized benefits based on the PM-related premature mortality expert elicitation is between $4.6 billion and $33 billion in 2030, assuming a 3 percent discount rate (or $4.3 and $30 billion assuming a 7 percent discount rate). The social costs of the proposed program are estimated to be approximately $600 million in 2030.[134] The impact of these costs on society are estimated to be minimal, with the prices of rail and marine transportation services estimated to increase by less about 0.4 percent for locomotive transportation services and about 0.6 percent for marine transportation services.

Further information on these and other aspects of the economic impacts of our proposal are summarized in the following sections and are presented in more detail in the Draft RIA for this rulemaking. We invite the reader to comment on all aspects of these analyses, including our methodology and the assumptions and data that underlie our analysis.

A. Engineering Costs

The following sections briefly discuss the various engine and equipment cost elements considered for this proposal and present the total engineering costs we have estimated for this rulemaking; the reader is referred to Chapter 5 of the draft RIA for a complete discussion of our engineering cost estimates. When referring to ''equipment'' costs throughout this discussion, we mean the locomotive and/or marine vessel related costs as opposed to costs associated with the diesel engine being placed into the locomotive or vessel. Estimated new engine and equipment engineering costs depend largely on both the size of the piece of equipment and its engine, and on the technology package being added to the engine to ensure compliance with the proposed standards. The wide size variation of engines covered by this proposal (e.g., small marine engines with less than 37 kW (50 horsepower, or hp) through locomotive and marine C2 engines with over 3000 kW (4000 hp) and the broad application variation (e.g., small pleasure crafts through large line haul locomotives and cargo vessels) that exists in these industries makes it difficult to present an estimated cost for every possible engine and/or piece of equipment. Nonetheless, for illustrative purposes, we present some example per engine/equipment engineering cost impacts throughout this discussion. This engineering cost analysis is presented in detail in Chapter 5 of the draft RIA.

Note that the engineering costs here do not reflect changes to the fuel used to power locomotive and marine engines. Our Nonroad Tier 4 rule (69 FR 38958) controlled the sulfur level in all nonroad fuel, including that used in locomotives and marine engines. The sulfur level in the fuel is a critical element of the proposed locomotive and marine program. However, since the costs of controlling locomotive and marine fuel sulfur have been considered in our Nonroad Tier 4 rule, they are not considered here. This analysis considers only those costs associated with the proposed locomotive and marine program. Also, the engineering costs presented here do not reflect any savings that are expected to occur because of the engine ABT program and the various flexibilities included in the program which are discussed in section IV of this preamble. As discussed there, these program features have the potential to provide savings for both engine and locomotive/vessel manufacturers. We request comment with supporting data and/or analysis on the engineering cost estimates presented here and the underlying analysis presented in Chapter 5 of the draft RIA.

(1) New Engine and Equipment Variable Engineering Costs

Engineering costs for exhaust emission control devices (i.e., catalyzed DPFs, urea SCR systems, and DOCs) were estimated using a methodology consistent with the one used in our 2007 heavy-duty highway rulemaking. In that rule, surveys were provided to nine engine manufacturers seeking information relevant to estimating the engineering costs for and types of emission-control technologies that might be enabled with ultra low-sulfur diesel fuel (15 ppm S). The survey responses were used as the first step in estimating the engineering costs of advanced emission control technologies anticipated for meeting the 2007 heavy-duty highway standards. We then built upon these engineering costs using input from members of the Manufacturers of Emission Controls Association (MECA). We also used this information in our recent nonroad Tier 4 (NRT4) rule. Because the anticipated emission control technologies expected to be used on locomotive and marine engines are the same as or similar to

[134] The estimated 2030 social welfare cost of 567.3 million is based on an earlier version of the engineering costs of the rule which estimated $568.3 million engineering costs in 2030 (see table V–15). The current engineering cost estimate for 2030 is $605 million. See section V.C.5 for an explanation of the difference. The estimated social costs of the program will be updated for the final rule.

those expected for highway and nonroad engines, and because the expected suppliers of the technologies are the same for these engines, we have used that analysis as the starting point for estimating the engineering costs of these technologies in this rule.[135] Importantly, the analysis summarized here and detailed in the draft RIA takes into account specific differences between the locomotive and marine products when compared to on-highway trucks (e.g., engine size).

Engineering costs of control include variable costs (for new hardware, its assembly, and associated markups) and fixed costs (for tooling, research, redesign efforts, and certification). We are projecting that the Tier 3 standards will be met by optimizing the engine and emission controls that will exist on locomotive and marine engines in the Tier 3 timeframe. Therefore, we have estimated no hardware costs associated with the Tier 3 standards. For the Tier 4 standards, we are projecting that SCR systems and DPFs will be the most likely technologies used to comply. Upon installation in a new locomotive or a new marine vessel, these devices would require some new equipment related hardware in the form of brackets and new sheet metal. The annual variable costs for example years, the PM/NO_X split of those engineering costs, and the net present values that would result are presented in Table V–1.[136] As shown, we estimate the net present value for the years 2006 through 2040 of all variable costs at $1.4 billion using a three percent discount rate, with $1.3 billion of that being engine-related variable costs. Using a seven percent discount rate, these costs are $630 million and $586 million, respectively.

TABLE V–1.—NEW ENGINE AND EQUIPMENT VARIABLE ENGINEERING COSTS

[$Millions]

Year	Engine variable engineering costs	Equipment variable engineering costs	Total variable engineering costs	Total for PM	Total for NO_X+NMHC
2011	0	0	0	0	0
2012	0	0	0	0	0
2015	32	4	36	34	2
2020	87	6	94	49	45
2030	105	8	113	59	54
2040	104	8	112	59	53
NPV at 3%	1,297	99	1,395	749	646
NPV at 7%	586	44	630	342	288

We can also look at these variable engineering costs on a per engine basis rather than an annual total basis. Doing so results in the costs summarized in Table V–2. These costs represent the engineering costs for a typical engine placed into a piece of equipment within each of the given market segments and, where applicable, power ranges on a one-to-one basis (i.e., one engine per locomotive or vessel). For a vessel using two engines, the costs would be double those shown. The costs shown represent the total engine-related engineering hardware costs associated with all of the proposed emissions standards (Tier 3 and Tier 4) to which the given power range and market segment would need to comply. For example, a commercial marine engine below 600 kW (805 hp) would need to comply with the Tier 3 standards as its final tier and would, therefore, incur no new hardware costs. In contrast, while a commercial marine engine over 600 kW is expected to comply with both Tier 3 and then Tier 4 and would, therefore, incur engine hardware costs associated with the Tier 4 standards. The costs also represent long term costs or those costs after expected learning effects have occurred and warranty costs have stabilized.

TABLE V–2.—2 LONG-TERM VARIABLE ENGINEERING COST PER NEW ENGINE TO COMPLY WITH THE FINAL TIER OF STANDARDS

[$/engine]

Power range	Locomotive line haul	Locomotive switcher [a]	C1 Marine	C2 Marine	Recreational marine [b]	Small marine
<50 Hp (<37 kW)	[c]					[d]$0
50≤hp<75 (37<=kW<56)			0		0	
75≤hp<200 (56<=kW<149)			0		0	
200≤hp<400 (149≤kW<298)			0		0	
400≤hp<800 (298≤kW<597)			0		0	
800≤hp<2000 (597≤kW<1492)			11,560	29,980	0	
≥2000 Hp (≥1492 kW)	54,650	13,640	20,550	55,770	0	

[a] Locomotive switchers generally use land based nonroad engines (i.e., NRT4 engines); therefore, we have used NRT4 cost estimates for locomotive switchers in this rulemaking.
[b] Recreational marine engines >2000 kW are considered within the C1 Marine category.
[c] A blank entry means there are no engines in that market segment/power range.
[d] $0 means costs are estimated at $0.

[135] "Economic Analysis of Diesel Aftertreatment System Changes Made Possible by Reduction of Diesel Fuel Sulfur Content," Engine, Fuel, and Emissions Engineering, Incorporated, December 15, 1999, Public Docket No. A–2001–28, Docket Item II–A–76.

[136] The PM/NO_X+NMHC cost allocations for variable costs used in this cost analysis are as follows: Urea SCR systems including marinization costs on marine applications are 100% NO_X+NMHC; DPF systems including marinization costs on marine applications are 100% PM; and, equipment hardware costs are split evenly.

(2) New Engine and Equipment Fixed Engineering Costs

Because these technologies are being researched for implementation in the highway and nonroad markets well before the locomotive and marine emission standards take effect, and because engine manufacturers will have had several years complying with the highway and nonroad standards, we believe that the technologies used to comply with the locomotive and marine standards will have undergone significant development before reaching locomotive and marine production. In fact, we believe that this transfer of learning—from highway to nonroad to locomotive and marine—is real and have quantified it. Chapter 5 of the draft RIA details our approach and we seek comment on the 10 percent and 70 percent factors we have employed at each transfer step. We anticipate that engine manufacturers would introduce a combination of primary technology upgrades to meet the new emission standards. Achieving very low NO_X emissions requires basic research on NO_X emission-control technologies and improvements in engine management. There would also have to be some level of tooling expenditures to make possible the fitting of new hardware on locomotive and marine engines. We also expect that locomotives and marine vessels being fitted with Tier 4 engines would have to undergo some level of redesign to accommodate the aftertreatment devices expected to meet the Tier 4 standards. The total of fixed engineering costs and the net present values of those costs are shown in Table V–3.[137] As shown, we have estimated the net present value for the years 2006 through 2040 of all fixed engineering costs at $424 million using a three percent discount rate, with $381 million of that being engine-related fixed costs. Using a seven percent discount rate, these costs are $324 million and $297 million, respectively.

TABLE V–3.—ENGINE AND EQUIPMENT FIXED ENGINEERING COSTS

($Million)

Year	Engine research	Engine tooling	Engine certification	Equipment redesign	Total fixed engineering costs	Total for PM	Total for NO_X+NMHC
2011	75	19	5	0	99	39	59
2012	55	0	0	0	55	18	37
2015	51	17	1	22	90	34	56
2020	0	0	0	4	4	2	2
2030	0	0	0	0	0	0	0
2040	0	0	0	0	0	0	0
NPV at 3%	341	33	7	43	424	155	269
NPV at 7%	267	24	6	27	324	118	206

Some of the estimated fixed engineering costs would occur in years prior to the Tier 3 standards taking affect in 2012. Engine manufacturers would need to invest in engine tooling and certification prior to selling engines that meet the standards. Engine research is expected to begin five years in advance of the standards for which the research is done. We have estimated some engine research for both the Tier 3 and Tier 4 standards, although the research associated with the Tier 4 standards is expected to be higher since it involves work on aftertreatment devices which only the Tier 4 standards would require. By 2017, the Tier 4 standards would be fully implemented and engine research toward the Tier 4 standards would be completed. Similarly, engine tooling and certification efforts would be completed. We have estimated that equipment redesign, driven mostly by marine vessel redesigns, would continue for many years given the nature of the marine market. Therefore, by 2017 all engine-related fixed engineering costs would be zero, and by 2024 all equipment-related fixed engineering costs would be zero.

(3) Engine Operating Costs

We anticipate an increase in costs associated with operating locomotives and marine vessels. We anticipate three sources of increased operating costs: urea use; DPF maintenance; and a fuel consumption impact. Increased operating costs associated with urea use would occur only in those locomotives/vessels equipped with a urea SCR engine. Maintenance costs associated with the DPF (for periodic cleaning of accumulated ash resulting from unburned material that accumulates in the DPF) would occur in those locomotives/vessels that are equipped with a DPF engine. The fuel consumption impact is anticipated to occur more broadly—we expect that a one percent fuel consumption increase would occur for all new Tier 4 engines, locomotive and marine, due to higher exhaust backpressure resulting from aftertreatment devices. We also expect a one percent fuel consumption increase would occur for remanufactured Tier 0 locomotives due to our expectation that the tighter NO_X standard would be met using retarded timing. These costs and how the fleet cost estimates were generated are detailed in Chapter 5 of the draft RIA and are summarized in Table V–4.[138]

[137] The PM/NO_X+NMHC cost allocations for fixed costs used in this cost analysis are as follows: Engine research expenditures are 67% NO_X+NMHC and 33% PM; engine tooling and certification costs are split evenly; and, equipment redesign costs are split evenly.

[138] The PM/NO_X+NMHC cost allocations for operating costs used in this cost analysis are as follows: Urea costs are 100% NO_X+NMHC; DPF maintenance costs are 100% PM; and, fuel consumption impacts are split evenly.

TABLE V–4.—ESTIMATED INCREASED OPERATING COSTS

($Millions)

Year	Urea use	DPF maintenance	Fuel consumption impact	Total operating costs	Total for PM	Total for NO_X+MHC
2011	0	0	11	11	5	5
2012	0	0	13	13	6	6
2015	4	0	21	25	11	15
2020	85	3	50	137	28	110
2030	300	8	99	407	57	350
2040	458	11	142	611	82	528
NPV at 3%	2,850	74	1,116	4,039	631	3,408
NPV at 7%	1,090	29	477	1,595	267	1,328

As shown, we have estimated the net present value for the years 2006 through 2040 of the annual operating costs at $4 billion using a three percent discount rate and $1.6 billion using a seven percent discount rate. The urea and DPF maintenance costs are zero until Tier 4 engines start being sold since only the Tier 4 engines are expected to add these technologies. Urea use represents the largest source of increased operating costs. Because urea use is meant for controlling NO_X emissions, most of the operating costs are associated with NO_X+NMHC control.

(4) Engineering Costs Associated With the Remanufacturing Program

We have also estimated engineering costs associated with the locomotive remanufacturing program. The remanufacturing process is not a low cost endeavor. However, it is much less costly than purchasing a new engine. The engineering costs we have estimated associated with the remanufacturing program are not meant to capture the remanufacturing process but rather the incremental engineering costs to that process. Therefore, the remanufacturing costs estimated here are only those engineering costs resulting from the proposed requirement to meet a more stringent standard than the engine was designed to meet at its original sale. These engineering costs and how the fleet cost estimates were generated are detailed in Chapter 5 of the draft RIA and are summarized in Table V–5.[139] As shown, we have estimated the net present value for the years 2006 through 2040 of the annual engineering costs associated with the locomotive remanufacturing program at $1.4 billion using a three percent discount rate and $682 million using a seven percent discount rate.

TABLE V–5.—ESTIMATED ENGINEERING COSTS ASSOCIATED WITH THE LOCOMOTIVE REMANUFACTURING PROGRAM

($Millions)

Year	Remanufacturing Program Costs	Total for PM	Total for NO_X+NMHC
2011	97	49	49
2012	75	37	37
2015	31	15	15
2020	15	8	8
2030	85	43	43
2040	153	77	77
NPV at 3%	1,374	687	687
NPV at 7%	682	341	341

(5) Total Engineering Costs

The total engineering costs associated with today's proposal are the summation of the engine and equipment engineering costs, both fixed and variable, the operating costs, and the engineering costs associated with the locomotive remanufacturing program. These costs are summarized in Table V–6.

TABLE V–6.—TOTAL ENGINEERING COSTS OF THE PROPOSAL

[$Millions]

Year	Engine related engineering costs	Equipment related engineering costs	Operating costs	Engineering costs of the remanufacturing program	Total engineering costs	Total PM costs	Total NO_X+NMHC costs
2011	99	0	11	97	207	93	113
2012	55	0	13	75	142	62	80

[139] Costs associated with the remanufacturing program are split evenly between NO_X+NMHC and PM.

TABLE V–6.—TOTAL ENGINEERING COSTS OF THE PROPOSAL—Continued

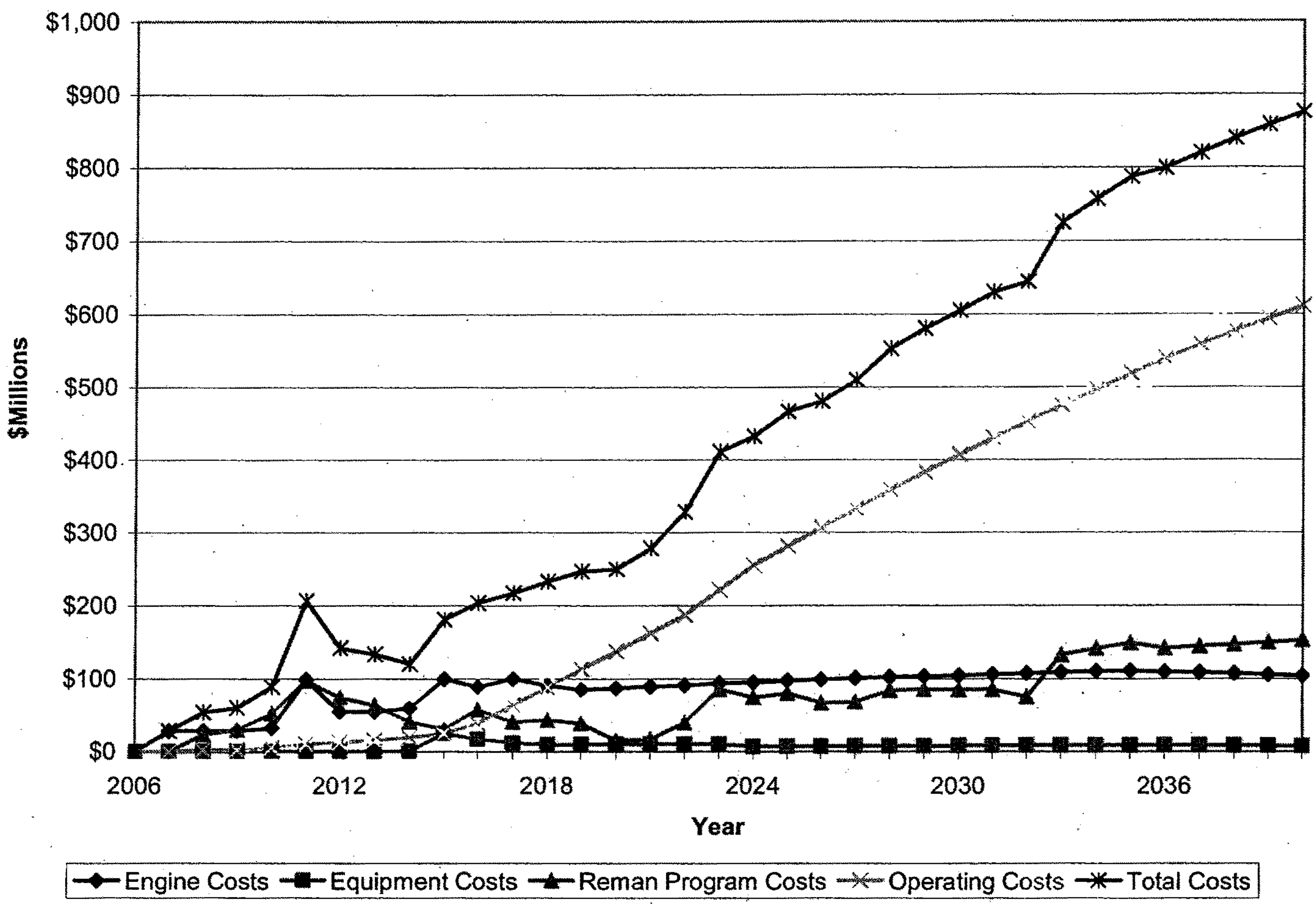
[$Millions]

Year	Engine related engineering costs	Equipment related engineering costs	Operating costs	Engineering costs of the remanufacturing program	Total engineering costs	Total PM costs	Total NO_X+NMHC costs
2015	100	25	25	31	181	93	88
2020	87	10	187	15	250	836	164
2030	105	8	407	85	605	159	446
2040	104	8	611	153	876	218	658
NPV at 3%	1,678	141	4,039	1,374	7,233	2,222	5,011
NPV at 7%	883	71	1,595	682	3,231	1,068	2,163

As shown, we have estimated the net present value of the annual engineering costs for the years 2006 through 2040 at $7.2 billion using a three percent discount rate and $3.2 billion using a seven percent discount rate. Roughly half of these costs are operating costs, with the bulk of those being urea related costs. As explained above in the operating cost discussion, because urea use is meant for controlling NO_X emissions, most of the operating costs and, therefore, the majority of the total engineering costs are associated with NO_X+NMHC control.

Figure V–1 graphically depicts the annual engineering costs associated with today's proposed program. The engine costs shown represent the engineering costs associated with engine research and tooling, etc., and the incremental costs for new hardware such as DPFs and urea SCR systems. The equipment costs shown represent the engineering costs associated with equipment redesign efforts and the incremental costs for new equipment-related hardware such as sheet metal and brackets. The remanufacturing program costs include incremental engineering costs for the locomotive remanufacturing program. The operating costs include incremental increases in operating costs associated with urea use, DPF maintenance, and a one percent fuel consumption increase for Tier 4 engines and remanufactured Tier 0 locomotives. The total program engineering costs are shown in Table V–6 as $7.2 billion at a three percent discount rate and $3.2 billion at a seven percent discount rate.

Figure V-1 Annual Engineering Costs of the Proposed New Engine Standards and Locomotive



Remanufacturing Program

B. Cost Effectiveness

One tool that can be used to assess the value of the proposed program is the engineering costs incurred per ton of emissions reduced. This analysis involves a comparison of our proposed program to other measures that have been or could be implemented. As summarized in this section and detailed in the draft RIA, the locomotive and marine diesel program being proposed today represents a highly cost effective mobile source control program for reducing PM and NO_X emissions.

We have calculated the cost per ton of our proposed program based on the net present value of all engineering costs incurred and all emission reductions generated from the current year 2006 through the year 2040. This approach captures all of the costs and emissions reductions from our proposed program including those costs incurred and emissions reductions generated by the locomotive remanufacturing program. The baseline case for this evaluation is the existing set of engine standards for locomotive and marine diesel engines and the existing locomotive remanufacturing requirements. The analysis timeframe is meant to capture both the early period of the program when very few new engines that meet the proposed standards would be in the fleet, and the later period when essentially all engines would meet the new standards.

Table V–7 shows the emissions reductions associated with today's proposal. These reductions are discussed in more detail in section II of this preamble and Chapter 3 of the draft RIA.

TABLE V–7.—ESTIMATED EMISSIONS REDUCTIONS ASSOCIATED WITH THE PROPOSED LOCOMOTIVE AND MARINE STANDARDS

[Short tons]

Year	$PM_{2.5}$	PM_{10} [a]	NO_X	NMHC
2015	7,000	7,000	84,000	14,000

TABLE V–7.—ESTIMATED EMISSIONS REDUCTIONS ASSOCIATED WITH THE PROPOSED LOCOMOTIVE AND MARINE STANDARDS—Continued

[Short tons]

Year	$PM_{2.5}$	PM_{10} [a]	NO_X	NMHC
2020	15,000	15,000	293,000	25,000
2030	28,000	29,000	765,000	39,000
2040	38,000	40,000	1,123,000	50,000
NPV at 3%	315,000	325,000	7,869,000	480,000
NPV at 7%	136,000	140,000	3,188,000	216,000

[a] Note that, $PM_{2.5}$ is estimated to be 97 percent of the more inclusive PM_{10} emission inventory. In Section II we generate and present $PM_{2.5}$ inventories since recent research has determined that these are of greater health concern. Traditionally, we have used PM_{10} in our cost effectiveness calculations. Since cost effectiveness is a means of comparing control measures to one another, we use PM_{10} in our cost effectiveness calculations for comparisons to past control measures.

Using the engineering costs shown in Table V–6 and the emission reductions shown in Table V–7, we can calculate the $/ton associated with today's proposal. These are shown in Table V–8. The resultant cost per ton numbers depend on how the engineering costs presented above are allocated to each pollutant. Therefore, as described in section V.A, we have allocated costs as closely as possible to the pollutants for which they are incurred. These allocations are also discussed in detail in Chapter 5 of the draft RIA.

TABLE V–8.—PROPOSED PROGRAM AGGREGATE COST PER TON AND LONG-TERM ANNUAL COST PER TON

Pollutant	2006 thru 2040 discounted lifetime cost per ton at 3%	2006 thru 2040 discounted lifetime cost per ton at 7%	Long-term cost per ton in 2030
NO_X+NMHC	$600	$630	$550
PM	6,840	7,640	5,560

The costs per ton shown in Table V–8 for 2006 through 2040 use the net present value of the annualized engineering costs and emissions reductions associated with the program for the years 2006 through 2040. We have also calculated the costs per ton of emissions reduced in the year 2030 using the annual engineering costs and emissions reductions in that year alone. These numbers are also shown in Table V–8 and represent the long-term annual costs per ton of emissions reduced.[140] All of the costs per ton include costs and emission reductions that will occur from the locomotive remanufacturing program.

In comparison with other emissions control programs, we believe that the proposed locomotive and marine program represents a cost effective strategy for generating substantial NO_X+NMHC and PM reductions. This can be seen by comparing the cost effectiveness of this proposed with the cost effectiveness of a number of standards that EPA has adopted in the past.Table V–9 and Table V–10 summarize the cost per ton of several past EPA actions to reduce emissions of NO_X+NMHC and PM from mobile sources.

[140] "Long-term" cost here refers to the ongoing cost of the program where only operating and variable costs remain (no more fixed costs). We have chosen 2030 to represent those costs here.

TABLE V–9.—PROPOSED LOCOMOTIVE AND MARINE STANDARDS COMPARED TO PREVIOUS MOBILE SOURCE

[Programs for NO_X+NMHC]

Program	$/ton NO_X+NMHC
Today's locomotive & marine proposal	600
Tier 4 Nonroad Diesel (69 FR 39131)	1,010
Tier 2 Nonroad Diesel (EPA420–R–98–016, Chapter 6)	630
Tier 3 Nonroad Diesel (EPA420–R–98–016, Chapter 6)	430
Tier 2 vehicle/gasoline sulfur (65 FR 6774)	1,400–2,350
2007 Highway HD (66 FR 5101)	2,240
2004 Highway HD (65 FR 59936)	220–430

Note: Costs adjusted to 2002 dollars using the Producer Price Index for Total Manufacturing Industries.

TABLE V–10.—PROPOSED LOCOMOTIVE AND MARINE STANDARDS COMPARED TO PREVIOUS MOBILE SOURCE

[Programs for PM]

Program	$/ton PM
Today's locomotive & marine proposal	6,840
Tier 4 Nonroad Diesel (69 FR 39131)	11,200
Tier 1/Tier 2 Nonroad Diesel (EPA420–R–98–016, Chapter 6)	2,390
2007 Highway HD (66 FR 5101)	14,180

Note: Costs adjusted to 2002 dollars using the Producer Price Index for Total Manufacturing Industries.

C. EIA

We prepared an Economic Impact Analysis (EIA) to estimate the economic impacts of the proposed emission control program on the locomotive and marine diesel engine and vessel markets. In this section we briefly describe the Economic Impact Model (EIM) we developed to estimate the market-level changes in price and outputs for affected markets, the social costs of the program, and the expected distribution of those costs across stakeholders. We also present the results of our analysis. We request comment on all aspects of the analysis, including the model and the model inputs.

We estimate the net social costs of the proposed program to be approximately $600 million in 2030.[141] [142] The rail sector is expected to bear about 64 percent of the social costs of the program in 2030, and the marine sector is expected to bear about 36 percent. In each of these two sectors, these social costs are expected to be born primarily by producers and users of locomotive and marine transportation services (63.3 and 33.2 percent, respectively). The remaining 3.5 percent is expected to be borne by locomotive, marine engine, and marine vessel manufacturers and fishing and recreational users.

With regard to market-level impacts in 2030, the average price of a locomotive is expected to increase about 2.6 percent ($49,100 per unit), but sales are not expected to decrease. In the marine markets, the expected impacts are different for engines above and below 800 hp (600 kW). With regard to engines above 800 hp and the vessels that use them, the average price of an engine is expected to increase by about 8.4 percent for C1 engines and 18.7 percent for C2 engines ($13,300 and $48,700, respectively). However, the expected impact of these increased prices on the average price of vessels that use these engines is smaller, at about 1.1 percent and 3.6 percent respectively ($16,200 and $141,600). The decrease in engine and vessel production is expected to be negligible, at less than 10 units. For engines less than 800 hp and the vessels that use them, the expected price increase and quantity decrease are expected to be negligible, less than 0.1 percent. Finally, even with the increases in the prices of locomotives and large marine diesel engines, the expected impacts on prices in the locomotive and marine transportation service markets are small, at 0.4 and 0.6 percent, respectively.

(1) What Is an Economic Impact Analysis?

An EIA is prepared to inform decision makers about the potential economic consequences of a regulatory action. The analysis consists of estimating the social costs of a regulatory program and the distribution of these costs across stakeholders. These estimated social costs can then be compared with estimated social benefits presented above. As defined in EPA's Guidelines for Preparing Economic Analyses, social costs are the value of the goods and services lost by society resulting from (a) the use of resources to comply with and implement a regulation and (b) reductions in output.[143] In this analysis, social costs are explored in two steps. In the market analysis, we estimate how prices and quantities of goods and services affected by the proposed emission control program can be expected to change once the program goes into effect. In the economic welfare analysis, we look at the total social costs associated with the program and their distribution across key stakeholders.

(2) What Is the Economic Impact Model?

The EIM is the behavioral model we developed to estimate price and quantity changes and total social costs associated with the emission controls under consideration. The EIM simulates how producers and consumers of affected products can be expected to respond to an increase in production costs as a result of the proposed emission control program. In this EIM, compliance costs are directly borne by producers of affected goods. Producers of affected products will try to pass some or all of the increased production costs on to the consumers of these goods through price increases. In response to the price increases, consumers will decrease their demand for the affected good. Producers will react to the decrease in quantity demanded by decreasing the quantity they produce; the market will react by setting a higher price for those fewer units. These interactions continue until a new market equilibrium price and quantity combination is achieved. The amount of the compliance costs that can be passed on to consumers is ultimately limited by the price sensitivity of purchasers and producers in the relevant market (represented by the price elasticity of demand and supply). The EIM explicitly models these behavioral responses and estimates new equilibrium prices and output and the resulting distribution of social costs across these stakeholders (producers and consumers).

(3) What Economic Sectors Are Included in This Economic Impact Analysis?

In this EIA we estimate the impacts of the proposed emission control program on two broad sectors: rail and marine. The markets analyzed are summarized in Table V–11.

TABLE V–11.—ECONOMIC SECTORS INCLUDED IN THE LOCO/MARINE ECONOMIC IMPACT MODEL

Sector	Market	Demand	Supply
Rail	Rail Transportation Services.	Entities that use rail transportation services as production input or for personal transportation.	Railroads.
	Locomotives	Railroads	Locomotive manufacturers (integrated manufacturers).
Marine	Marine Transportation Services.	Entities that use marine transportation services as production input.	Entities that provide marine transportation services. • Tug/tow/pushboat companies. • Cargo companies. • Ferry companies. • Supply/crew companies. • Other commercial users.

[141] All estimates presented in this section are in 2005$.

[142] The estimated 2030 social welfare cost of 267.3 million is based on an earlier version of the engineering costs of the rule which estimated $568.3 million engineering costs in 2030 (see table V–17). The current engineering cost estimate for 2030 is $605 million. See section V.C.5 for an explanation of the difference. The estimated social costs of the program will be updated for the final rule.

[143] EPA Guidelines for Preparing Economic Analyses, EPA 240–R–00–003, September 2000, p 113. A copy of this document can be found at *http://yosemite.epa.gov/ee/epa/eed.nsf/webpages/Guidelines.html*

TABLE V–11.—ECONOMIC SECTORS INCLUDED IN THE LOCO/MARINE ECONOMIC IMPACT MODEL—Continued

Sector	Market	Demand	Supply
	Marine Vessels	Entities that provide marine transportation services. • Tug/tow/pushboat companies. • Cargo companies. • Ferry companies. • Supply/crew companies. • Other commercial users. • Fishing persons. • Recreation users.	Vessel manufacturers.
	Marine Diesel Engines	Vessel manufacturers	Engine manufacturers.

(a) Rail Sector Component

The rail sector component of the EIM is a two-level model consisting of suppliers and users of locomotives and rail transportation services.

Locomotive Market. The locomotive market consists of locomotive manufacturers (line haul, switcher, and passenger) on the supply side and railroads on the demand side. The vast majority of locomotives built in any given year are for line haul applications; a small number of passenger locomotives are built every year, and even fewer switchers. The locomotive market is characterized by integrated manufacturers (the engine and locomotive are made by the same manufacturer) and therefore the engine and equipment impacts are modeled together. The EIM does not distinguish between power bands for locomotives. This is because while there is some variation in power for different engine models, the range is not large. On average line haul locomotives are typically about 4,000 hp, passenger locomotives are about 3,000 hp, and switchers are about 2,000 hp.

Recently, a new switcher market is emerging in which manufacturers are expected to be less integrated, and the manufacturer of the engine is expected to be separate from the manufacturer of the switcher.[144] Because the characteristics of this new market are speculative at this time, the switcher market component of the EIM is modeled in the same way as line haul locomotives (integrated manufacturers; same behavioral parameters), but uses separate baseline equilibrium prices and quantities. The compliance costs used for switchers reflect the expected design characteristics for these locomotives and their lower total power. We request comment on the switcher aspect of the model. Consistent with the engineering cost analysis, the passenger market is combined with the switcher market in this EIA because we do not have separate compliance costs estimates for each of those two market segments. We request comment on this, and on whether it would be more appropriate to model the passenger market like the line haul market.

Rail Transportation Services. The rail transportation services market consists of entities that provide and utilize rail transportation services. On this supply side, these are the railroads. On the demand side, these are rail transportation service users such as the chemical and agricultural industries and the personal transportation industry. The EIM does not estimate the economic impact of the proposed emission control program on ultimate finished goods markets that use rail transportation services as inputs. This is because transportation services are only a small portion of the total variable costs of goods and services manufactured using these bulk inputs. Also, changes in prices of transportation services due to the estimated compliance costs are not expected to be large enough to affect the prices and output of goods that use rail transportation services as an input.

(b) Marine Sector Component

The marine sector component of the EIM distinguishes between engine, vessel, and ultimate user markets (marine transportation service users, fishing users, recreational users). This is because, in contrast to the locomotive market, manufacturers in the diesel marine market are not integrated. Marine engines and vessels are manufactured by different entities.

Marine Engine Market. The marine engine markets consist of marine engine manufacturers on the supply side and vessel manufacturers on the demand side. The model distinguishes between three types of engines, commercial propulsion, recreational propulsion, and auxiliary. Engines are broken out into eight categories based on rated power and displacement: small engines below 50 hp (37 kW); five C1 engine categories (50–200 hp, 200–400 hp, 400–800 hp, 800–2,000 hp, >2,000 hp); and two C2 engine categories (800–2,000 hp, >2,000 hp). For the purpose of the EIA, the C1/C2 threshold is 5 l/cyl displacement, even though the new C1/C2 threshold is proposed to be 7 l/cyl displacement. The 5 l/cyl threshold was used because it is currently applicable limit. In addition, there is currently only one engine family in the 5 to 7 l/cyl range, and it is not possible to project what future sales will be in that range or if more engine families will be added.

Marine Vessel Market. The marine vessel market consists of marine vessel manufacturers on the demand side and marine vessel users on the supply side. The model distinguishes between seven vessel categories: Recreational, fishing, tow/tug/push, ferry, supply/crew, cargo, and other. Each of these vessels would have at least one propulsion engine and at least one auxiliary engine. For fishing and recreational vessels, the purchasers of those vessels are the end users and so the EIM is a two-level model for those two markets. For the fishing market, this approach is appropriate because demand for fishing vessels comes directly from the fishing industry; fishing vessels are a fixed capital input for that industry. For the recreational market, demand for vessels comes directly from households that use these vessels for recreational activities and acquire them for the personal enjoyment of the owner. For the other commercial vessel markets (tow/tug/push, ferry, supply/crew, cargo, other), demand is derived from the transportation services they provide, and so demand is from the transportation service market and the providers of those services more specifically. Therefore it is necessary to

[144] Until recently, switchers have typically been converted line haul locomotives and very few, if any, new dedicated switchers were built in any year. Recently, however, the power and other characteristics of line haul locomotives have made them less attractive for switcher usage. Their high power means they consume more fuel than smaller locomotives, and they have less attractive line-of-sight characteristics than what is needed for switchers. Therefore, the industry is anticipating a new market for dedicated switchers.

include the marine transportation services market in the model.

Marine Transportation Services. The marine transportation services market consists of entities that provide and utilize marine transportation services: vessel owners on the supply side and marine transportation service users on the demand side. The firms that use these marine transportation services are very similar to those that use locomotive transportation services: those needing to transport bulk chemicals and minerals, coal, agricultural products, etc. These transportation services are production inputs that depend on the amount of raw materials or finished products being transported and thus marine transportation costs are variable costs for the end user. Demand for these transportation services will determine the demand for vessels used to provide these services (tug/tow/pushboats, cargo, ferries, supply/crew, other commercial vessels).

(c) Market Linkages

The individual levels of the rail and marine components of the EIM are linked to provide feedback between consumers and producers in relevant markets. The locomotive and marine components of the EIM are not linked however, meaning there is no feedback mechanism between the locomotive and marine sectors. Although locomotives and marine vessels such as tugs, towboats, cargo, and ferries provide the same type of transportation service, the characteristics of these markets are quite different and are subject to different constraints that limit switching from one type of transportation service to the other. For the limited number of cases where there is direct competition between rail and marine transportation services, we do not expect this rule to change the dynamics of the choice between marine or rail providers of these services because (1) the estimated compliance costs imposed by this rule are relatively small in comparison with the total production costs of providing transportation services, and (2) both sectors would be subject to the new standards.

(4) What Are the Key Features of the Economic Impact Model?

A detailed description of the features of the EIM and the data used in this analysis is provided in Chapter 7 of the RIA prepared for this rule. The model methodology is firmly rooted in applied microeconomic theory and was developed following the methodology set out in OAQPS's Economic Analysis Resource Document.[145]

The EIM is a computer model comprised of a series of spreadsheet modules that simulate the supply and demand characteristics of each of the markets under consideration. The initial market equilibrium conditions are shocked by applying the compliance costs for the control program to the supply side of the markets (this is done by shifting the relevant supply curves by the amount of the compliance costs). The EIM uses the model equations, model inputs, and a solution algorithm to estimate equilibrium prices and quantities for the markets with the regulatory program. These new prices and quantities are used to estimate the social costs of the model and how those costs are shared among affected markets.

The EIM uses a multi-market partial equilibrium approach to track changes in price and quantity for the modeled markets. As explained in EPA's Guidelines for Preparing Economic Analyses, ''partial equilibrium'' means that the model considers markets in isolation and that conditions in other markets are assumed to be either unaffected by a policy or unimportant for social cost estimation. Multi-market models go beyond partial equilibrium analysis by extending the inquiry to more than just a single market and attempt to capture at least some of the interaction between markets.[146] In the marine sector, the model captures the interactions between the engine markets, the vessel markets, and the marine transportation service markets; in the rail sector, it captures the interactions between the locomotive markets and the rail transportation service markets.

The EIM uses an intermediate run time frame. This means that some factors of production are fixed and some are variable. In very short analyses, all factors of production would be assumed to be fixed, leaving the producers with no means to respond to the increased production costs associated with the regulation (e.g., they cannot adjust labor or capital inputs). Under this time horizon, the costs of the regulation fall entirely on the producer. In the long run, all factors of production are variable and producers can adjust production in response to cost changes imposed by the regulation (e.g., using a different labor/capital mix) and changes in consumer demand due to price changes. In the intermediate run there is some resource immobility which may cause producers to suffer producer surplus losses, but they can also pass some of the compliance costs to consumers.

The EIM assumes a perfectly competitive market structure. The perfect competition assumption is widely accepted for this type of analysis, and only in rare cases are other approaches used.[147] It should be noted that the perfect competition assumption is not about the number of firms in a market; it is about how the market operates. The markets included in this analysis do not exhibit evidence of noncompetitive behavior: These are mature markets; there are no indications of barriers to entry for the marine transportation, fishing, and recreational markets; the firms in the affected markets are not price setters; and there is no evidence of high levels of strategic behavior in the price and quantity decisions of the firms. The perfect competition assumption is discussed in more detail in Chapter 7 of the RIA.

The perfect competition assumption has an impact on the way the EIM is structured. In a competitive market the supply curve is based on the industry marginal cost curve; fixed costs do not influence production decisions at the margin. Therefore, in the market analysis, the model is shocked by variable costs only. However, an argument can be made that fixed costs must be recovered; otherwise manufacturers would go out of business. This analysis assumes that manufacturers cover their fixed costs through their current product development budgets. If this is the case, then the rule would have the effect of shifting product development resources to regulatory compliance from other market-based investment decisions. Thus, fixed costs are a cost to society because they displace other product development activities that may improve the quality or performance of engines and equipment. Therefore these costs are included in the social welfare costs, as a social cost that accrues to producers. We request comment on the extent to which manufacturers can be expected to use current product development resources to cover the fixed costs associated with the standards (thus foregoing product development projects in the short term),

[145] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Innovative Strategies and Economics Group, OAQPS Economic Analysis Resource Document, April 1999. A copy of this document can be found at *http://www.epa.gov/ttn/ecas/econdata/Rmanual2/*.

[146] EPA Guidelines for Preparing Economic Analyses, EPA 240–R–00–003, September 2000, pp. 125–6.

[147] See, for example, EPA Guidelines for Preparing Economic Analyses, EPA 240–R–00–003, September 2000, p 126.

and whether current product development budgets would cover the compliance costs in the year in which they occur. We also request comment on whether companies would instead attempt to pass on these fixed costs as an additional price increase and, if the latter, how much of the fixed costs would be passed on, and for how long.

The EIM is a market-level analysis that estimates the aggregate economic impacts of the control program on the relevant markets. It is not a firm-level analysis and therefore the supply elasticity or individual compliance costs facing any particular manufacturer may be different from the market average. This difference can be important, particularly where the rule affects different firms' costs over different volumes of production. However, to the extent there are differential effects, EPA believes that the wide array of flexibilities provided in this rule are adequate to address any cost inequities that may arise.

Finally, consistent with the proposed emission controls, this EIA covers locomotives and marine diesel engines and vessels sold in 50 states.

(5) What Are the Key Model Inputs?

Key model inputs for the EIM are the behavioral parameters, the market equilibrium quantities and prices, and the compliance costs estimates.

The model's behavioral paramaters are the price elasticities of supply and demand. These parameters reflect how producers and consumers of the engines and equipment affected by the standards can be expected to change their behavior in response to the costs incurred in complying with the standards. More specifically, the price elasticity of supply and demand (reflected in the slope of the supply and demand curves) measure the price sensitivity of consumers and producers. The price elasticities used in this analysis are summarized in V–12 and are described in more detail in Chapter 7 of the RIA. An ''inelastic'' price elasticity (less than one) means that supply or demand is not very responsive to price changes (a one percent change in price leads to less than one percent change in demand). An ''elastic'' price elasticity (more than one) means that supply or demand is sensitive to price changes (a one percent change in price leads to more than one percent change in demand). A price elasticity of one is unit elastic, meaning there is a one-to-one correspondence between a change in price and change in demand.

TABLE V–12.—BEHAVIORAL PARAMETERS USED IN LOCO/MARINE ECONOMIC IMPACT MODEL

Sector	Market	Demand elasticity	Source	Supply elasticity	Source
Rail	Rail Transportation Services.	−0.5 (inelastic)	Literature Estimate	0.6 (inelastic)	Literature Estimate.
	Locomotives (all types).	Derived	N/A	2.7 (elastic)	Calibration Method Estimate.
Marine	Marine Transportation Services.	−0.5 (inelastic)	Literature Estimate	0.6 (inelastic)	Literature Estimate.
	Vessels Commercial [a]	Derived	N/A	2.3 (elastic)	Econometric Estimate.
	Fishing	−1.4 (elastic)	Econometric Estimate	1.6 (elastic)	Econometric Estimate.
	Recreational	−1.4 (elastic)	Econometric Estimate	1.6 (elastic)	
	Engines	Derived	N/A	3.8 (elastic)	Econometric Estimate.

[a] Commercial vessels include tug/tow/pushboats, ferries, cargo vessels, crew/supply boats, and other commercial vessels.

Initial market equilibrium quantities for these markets are simulated using the same current year sales quantities used in the engineering cost analysis. The initial market equilibrium prices were derived from industry sources and published data and are described in Chapter 7 of the RIA.

The compliance costs used to shock the model, to simulate the application of the control program, are the same as the engineering costs described in Section V.A. However, the EIM uses an earlier version of the engineering costs developed for this rule. The engineering costs for 2030 presented in Section V.A. are estimated to be $605 million, which is $37 million more than the compliance costs used in this EIA. Over the period from 2007 through 2040, the net present value of the engineering costs in Section V.A. is $7.2 billion while the NPV of the estimated social costs over that period based on the compliance costs used in his chapter is $6.9 billion (3 percent discount rate). The differences are primarily in the form of operating costs ($22 million for the rail sector, $10 million for the marine sector). The variable costs for locomotives are slightly smaller ($4.0 million) and for marine are somewhat higher ($5.0 million). The difference for marine engines occurs in part because the engineering costs in Section V.A. include Tier 4 costs for recreational marine engines over 2,000 kW. There are also small differences for the estimated operating costs. As a result of these differences, the amount of the social costs imposed on producers and consumers of rail and marine transportation services as a result of the proposed program would be larger than estimated in this section, while the impacts on the prices and quantities of locomotives would be slightly less. In addition, there would be larger social costs for the recreational marine sector. Nevertheless, the estimated market impacts and the distribution of the social costs among stakeholders would be about the same as those presented below.

There are four types of compliance costs associated with the program: fixed costs, variable costs, operating costs, and remanufacturing costs. The timing of these costs are different and, in some cases, overlap.

Fixed costs are not included in the market analysis (they are not used to shock the model). However, the fixed costs associated with the standards are a cost to society (in the form of foregone product development) and therefore must be reflected in the total social costs as a cost to producers. In this EIA, fixed costs are accounted for in the year in which they occur and are attributed to the respective locomotive, marine engine, and vessel manufacturers. These manufacturers are expected to see losses of producer surplus as early as 2007.

Variable costs are the driver of the market impacts. There are no variable costs associated with the Tier 3 new engine standards because the Tier 3 standards are engine-out emission limits and engine manufacturers are expected to comply by maximizing the emission reduction potential of controls they are already using rather than adding new components. The variable costs associated with Tier 4 begin to apply in 2015, for locomotive PM standards; 2016, for marine PM and NO_X standards; and 2017, for locomotive NO_X standards.

Operating costs are the additional costs for associated with urea use and DPF maintenance as well as additional fuel consumption for both Tier 4 engines and remanufactured locomotive Tier 0 engines. These begin to occur when the standards go into effect. In the EIM, operating costs are attributed to railroads and vessel owners. On the marine side, all marine operating costs are applied to the marine transportation services market even though there will be Tier 4 engine in the recreational and fishing markets. This approach was taken because the operating costs (fuel and urea consumption) were estimated based on fuel consumption and we believe that most of the fuel consumed in the marine sector is by vessels in the marine transportation services sector. As a result of this assumption, the impacts on the marine transportation service market may be somewhat over-estimated. We request comment on this simplifying assumption.

Remanufacturing costs are incurred when locomotives are remanufactured (there is no corresponding remanufacture requirement for marine diesel, although we are requesting comment on such a program). These costs represent the difference between the cost of current remanufacture kits and those that will be required pursuant to the standards. In the EIM, these costs are allocated to the railroads; the remanufacture market is not modeled separately. This is appropriate because railroads are required to purchase these kits when they rebuild their locomotives. Their sensitivity to price changes is likely to be very inelastic because they cannot operate the relevant locomotives without using a certified remanufacture kit. This means the kit manufacturers would be able to pass most if not all of the costs of these kits to the railroads. We request comment on this approach for including remanufacture costs in the model.

(6) What Are the Results of the Economic Impact Modeling?

Using the model and data described above, we estimated the economic pacts of the proposed emission control program. The results of our analysis are summarized in this section. Detailed results for all years are included in the appendices to Chapter 7 of the RIA. Also included in Appendix 7H to that chapter are sensitivity analyses for several key inputs.

The EIA consists of two parts: a market analysis and welfare analysis. The market analysis looks at expected changes in prices and quantities for affected products. The welfare analysis looks at economic impacts in terms of annual and present value changes in social costs.

We performed a market analysis for all years and all engines and equipment types. Detailed results can be found in the appendices to Chapter 7 of the RIA. In this section we present summarized results for selected years.

Due to the structure of the program (see section V.C.5 above), the estimated market and social costs impacts of the program in the early years are small and are primarily due to the locomotive remanufacturing program. By 2016, the impacts of the program are more significant due to the operational costs associated with the Tier 4 standards (urea usage). Consequently, a large share of the social costs of the program after the Tier 4 standards to into effect fall on the marine and rail transportation service sectors. These operational costs are incurred by the providers of these services, but they are expected to pass along some of these costs to their customers.

(a) Market Analysis Results

In the market analysis, we estimate how prices and quantities of goods affected by the proposed emission control program can be expected to change once the program goes into effect. The analysis relies on the baseline equilibrium prices and quantities for each type of equipment and the price elasticity of supply and demand. It predicts market reactions to the increase in production costs due to the new compliance costs (variable, operating, and remanufacturing costs). It should be noted that this analysis does not allow any other factors to vary. In other words, it does not consider that manufacturers may adjust their production processes or marketing strategies in response to the control program.

A summary of the market analysis results is presented in Table V–13 for 2011, 2016, and 2030. These years were chosen because 2011 is the first year of the Tier 3 standards, 2016 is when the Tier 4 standards begin for most engines, and 2030 illustrates the long-term impacts of the program. Results for all years can be found in Chapter 7 of the RIA.

The estimated market impacts are designed to provide a broad overview of the expected market impacts that is useful when considering the impacts of the rule. Absolute price changes and relative price/quantity changes reflect production-weighted averages of the individual market-level estimates generated by the model for each group of engine/equipment markets. For example, the estimated marine diesel engine price changes are production-weighted averages of the estimated results for all of the marine diesel engine markets included in the group.[148] The absolute change in quantity is the sum of the decrease in units produced across sub-markets within each engine/equipment group. For example, the estimated marine diesel engine quantity changes reflect the total decline in marine diesel engines produced. The aggregated data presented in Table V–13 is intended to provide a broad overview of the expected market impacts that is useful when considering the impacts of the rule on the economy as a whole and not the impacts on a particular engine or equipment category.

Locomotive Sector Impacts. On the locomotive side, the proposed program is expected to have a negligible impact on locomotive prices and quantities. In 2011, the expected impacts are mainly the result of the operating costs associated with locomotive remanufacturing standards. These standards impose an operating cost on railroad transportation providers and are expected to result in a slight increase in the price of locomotive transportation services (about 0.1 percent, on average) and a slight decrease in the quantity of services provided (about 0.1 percent, on average). The locomotive remanufacturing program is also expected to have a small impact on the new locomotive market. The remanufacturing program will increase railroad operating costs, which expected to result in an increase in the price of transportation services. This increase will results in a decrease in demand for rail transportation services and

[148] As a result, estimates for specific types of engines and equipment may be different than the reported group average. The detail results for markets are reported in the Appendices to Chapter 7 of the RIA.

ultimately in a decrease in the demand for locomotives and a decrease in their price. In other words, the market will contract slightly. We estimate a reduction in the price of locomotives of about $425, or about 0.02 percent on average.

Beginning in 2016, the market impacts are affected by both the operating costs and the direct costs associated with the Tier 4 standards. As a result of both of these impacts, the price of a new locomotive is expected to increase by about 1.9 percent ($35,900), on average and the quantity produced is expected to decrease by about 0.1 percent, on average (less than one locomotive). Locomotive transportation service prices are expected to decrease by about 0.1 percent). By 2030, the price of new locomotives is expected to increase by about 2.6 percent ($49,000), on average, and the quantity expected to decrease by about 0.2 percent (less than one locomotive). The price of rail transportation services is expected to increase by about 0.4 percent.

Marine Sector Impacts. On the marine engine side, the expected impacts are different for engines above and below 800 hp (600 kW). With regard to engines above 800 hp and the vessels that use them, the proposed program does not begin to affect market prices or quantities until the Tier 4 standards go into effect, which is in 2016 for most engines. For these engines, the price of a new engine in 2016 is expected to increase between 11.0 and 24.6 percent, on average ($17,300 for C1 engines above 800 hp and $64,100 for C2 engines above 800 hp), depending on the type of engine, and sales are expected to decrease less than 2.0 percent, on average. The price of vessels that use them is expected to increase between 1.7 and 1.0 percent ($20,900 for vessels that use C1 engines above 800 hp and $188,600 for vessels that use C2 engines above 800 hp) and sales are expected to decrease less than 2.0 percent. The percent change in price in the marine transportation sector is expected to be about 0.1 percent. By 2030, the price of these engines is expected to increase between 8.4 and 18.7 percent, on average ($13,200 for C1 engines above 800 hp and $48,700 for C2 engine above 800 hp), depending on the type of engine, and sales are expected to decrease by less than 2 percent, on average. The price of vessels is expected to increase between 1 and 3.6 percent ($16,200 for vessels that use C1 engines above 800 hp and $141,600 for vessels that use C2 engines above 800 hp) and sales are expected to decrease by less than 2 percent. The percent change in price in the marine transportation is expected to be about 0.6 percent.

With regard to engines below 800 hp, the market impacts of the program are expected to be negligible.[149] This is because there are no variable costs associated with the standards for these engines. The market impacts associated with the program are indirect effects that stem from the impacts on the marine service markets for the larger engines that would be subject to direct compliance costs. Changes in the equilibrium outcomes in those marine service markets may lead to reductions for marine services in other marine engine and vessel markets, including the markets for smaller marine diesel engines and vessels. The result is that in some years there may be small declines in the equilibrium price in the markets for marine diesel engines less than 800 hp. This would occur because an increase in the price and a decrease in the quantity of marine transportation services provided by vessels with engines above 800 hp that results in a change in the price of marine transportation services may have follow-on effects in other marine markets and lead to decreases in prices for those markets. For example, the large vessels used to provide transportation services are affected by the rule. Their compliance costs lead to a higher vessel price and a reduced demand for those vessels. This reduced demand indirectly affects other marine transportation services that support the larger vessels, and leads to a decrease in price for those markets as well.

TABLE V–13.—ESTIMATED MARKET IMPACTS FOR 2011, 2016, 2030 (2005$)

Market	Average variable engineering cost per unit	Change in price		Change in variable	
		Absolute	Percent	Absolute	Percent
2011					
Rail Sector					
Locomotives	$0	−$425	−0.02	0	−0.1
Transportation Services	NA	NA[a]	0.1	NA[a]	0.1
Marine Sector					
Engines:					
C1>800 hp	0	0	0.00	0	0.0
C2>800 hp	0	0	0.00	0	0.0
Other marine	0	0	0.00	0	0.0
Vessels:					
C1>800 hp	0	0	0.00	0	0.0
C2>800 hp	0	0	0.00	0	0.0
Other marine	0	0	0.00	0	0.0
Transportation Services	NA	NA[a]	0.00	NA[a]	0.0
2016					
Rail Sector					
Locomotives	36,363	35,929	1.9	0	−0.1

[149] The market results for engines and vessels below 800 hp are provided in a Technical Support Document that can be found in the docket for this rule.

TABLE V–13.—ESTIMATED MARKET IMPACTS FOR 2011, 2016, 2030 (2005$)—Continued

Market	Average variable engineering cost per unit	Change in price		Change in variable	
		Absolute	Percent	Absolute	Percent
Transportation Services	NA	NA [a]	0.1	NA [a]	−0.1
Marine Sector [a]					
Engines:					
C1>800 hp	18,105	17,330	11.0	−7	−1.7
C2>800 hp	64,735	64,073	24.6	−1	−0.9
Other marine	0	0	0.00	0	0.0
Vessels:					
C1>800 hp	2,980	20,898	1.5	−9	−1.7
C2>800 hp	6,515	188,559	4.8	−1	−0.9
Other marine	0	−1	0.00	−0	0.0
Transportation Services	NA	NA [a]	0.1	NA [a]	−0.1
2030					
Rail Sector					
Locomotives	50,291	49,087	2.6	0	−0.2
Transportation Services	NA	NA [a]	0.4	NA [a]	−0.2
Marine Sector					
Engines:					
C1>800 hp	13,885	13,261	8.4	−6	−1.4
C2>800 hp	49,360	48,692	18.7	−1	−0.9
Other marine	0	0	0.0	0	0.0
Vessels:					
C1>800 hp	2,979	16,155	1.1	−8	−1.5
C2>800 hp	6,516	141,563	3.6	−1	−0.9
Other marine	0	−4	0.0	−2	0.0
Transportation Services	NA	NA [a]	0.6	NA [a]	−0.3

[a] The prices and quantities for transportation services are normalized ($1 for 1 unit of services provided) and therefore it is not possible to estimate the absolute change price or quanitity; see 7.3.1.5.

(b) Economic Welfare Analysis

In the economic welfare analysis we look at the costs to society of the proposed program in terms of losses to key stakeholder groups that are the producers and consumers in the rail and marine markets. The estimated surplus losses presented below reflect all engineering costs associated with the proposed program (fixed, variable, operating, and remanufacturing costs). Detailed economic welfare results for the proposed program for all years are presented in Chapter 7 of the RIA.

A summary of the estimated annual net social costs is presented in Table V–14. This table shows that total social costs for each year are slightly less than the total engineering costs. This is because the total engineering costs do not reflect the decreased sales of locomotives, engines and vessels that are incorporated in the total social costs. In addition, in the early years of the program the estimated social costs of the proposed program are not expected to increase regularly over time. This is because the compliance costs for the locomotive remanufacture program are not constant over time.

TABLE V–14.—ESTIMATED ANNUAL ENGINEERING AND SOCIAL COSTS, THROUGH 2040 (2005)

Year	Engineering costs						Total social costs
	Marine operating costs	Marine engine and vessel costs	Rail operating costs	Rail remanuf. costs	Rail new locomotive costs	Total	
2007	$0.0	$25.0	$0.0	$0.0	$3.2	$28.2	$28.2
2008	$0.0	$25.0	$1.3	$56.7	$3.2	$86.1	$86.1
2009	$0.0	$25.0	$1.4	$33.2	$3.2	$62.7	$62.7
2010	$0.0	$25.0	$3.8	$51.5	$7.3	$87.5	$87.5
2011	$0.0	$86.0	$7.9	$96.9	$10.8	$201.6	$201.5
2012	$0.0	$41.2	$9.7	$74.3	$12.3	$137.5	$137.5
2013	$0.0	$41.2	$12.0	$62.4	$12.3	$127.9	$127.9
2014	$2.8	$41.2	$12.6	$40.0	$16.9	$113.5	$113.5
2015	$5.6	$74.1	$14.9	$29.1	$48.8	$172.5	$172.5
2016	$14.8	$48.6	$19.0	$55.5	$55.3	$193.1	$192.6
2017	$23.9	$44.9	$32.7	$39.3	$66.5	$207.3	$206.7
2018	$36.0	$33.9	$44.6	$41.9	$67.9	$224.3	$223.9
2019	$48.0	$34.2	$56.5	$36.7	$61.9	$237.4	$236.9
2020	$60.0	$34.5	$68.5	$12.9	$64.0	$239.9	$239.5

TABLE V–14.—ESTIMATED ANNUAL ENGINEERING AND SOCIAL COSTS, THROUGH 2040 (2005)—Continued

Year	Engineering costs						Total social costs
	Marine operating costs	Marine engine and vessel costs	Rail operating costs	Rail remanuf. costs	Rail new locomotive costs	Total	
2021	$72.0	$34.8	$80.8	$14.9	$66.2	$268.7	$268.2
2022	$83.9	$35.1	$93.6	$37.4	$68.1	$318.1	$317.6
2023	$95.7	$35.4	$106.7	$83.2	$69.8	$390.8	$390.2
2024	$107.5	$35.7	$120.1	$72.0	$70.8	$406.0	$405.4
2025	$119.1	$35.9	$133.8	$76.5	$72.5	$437.9	$437.2
2026	$130.6	$36.2	$147.7	$63.2	$73.5	$451.2	$450.4
2027	$141.9	$33.6	$161.5	$64.6	$74.7	$476.3	$475.5
2028	$153.0	$33.9	$175.5	$80.3	$75.6	$518.2	$517.3
2029	$163.3	$34.2	$189.4	$81.8	$76.3	$544.9	$544.0
2030	$172.6	$34.5	$203.3	$81.2	$76.8	$568.3	$567.3
2031	$181.2	$34.8	$217.1	$81.4	$77.6	$592.1	$591.1
2032	$189.0	$35.1	$231.1	$77.2	$78.5	$610.9	$609.8
2033	$196.4	$35.4	$244.9	$133.5	$78.9	$689.2	$688.0
2034	$203.6	$35.7	$258.7	$142.6	$79.6	$720.1	$718.8
2035	$210.4	$36.0	$272.4	$150.1	$79.8	$748.8	$747.4
2036	$216.9	$36.4	$285.8	$143.2	$77.5	$759.7	$758.3
2037	$222.7	$36.7	$299.2	$145.9	$75.8	$780.3	$778.8
2038	$227.9	$37.0	$312.0	$148.8	$73.9	$799.6	$798.1
2039	$232.4	$37.3	$324.4	$152.0	$71.8	$818.0	$816.4
2040	$236.3	$37.7	$336.3	$155.0	$69.5	$834.7	$833.2
2040 NPV at 3% [a,b]						$6,907.8	$6,896.8
2040 NPV at 7% [a,b]						$3,107.7	$3,103.2
2030 NPV at 3% [a,b]						$3,938.7	$3,932.6
2030 NPV at 7% [a,b]						$2,175.5	$2,172.5

[a] EPA EPA presents the present value of cost and benefits estimates using both a three percent and a seven percent social discount rate. According to OMB Circular A–4, "the 3 percent discount rate represents the 'social rate of time preference'* * * * * [which] means the rate at which 'society' discounts future consumption flows to their present value"; "the seven percent rate is an estimate of the average before-tax rate of return to private capital in the U.S. economy " [that] approximates the opportunity cost of capital.

[b] *Note:* These NPV calculations are based on the period 2006–2040, reflecting the period when the analysis was completed. This has the consequence of discounting the current year costs, 2007, and all subsequent years are discounted by an additional year. The result is a smaller stream of social costs than by calculating the NPV over 2007–2040 (3% smaller for 3% NPV and 7% smaller for 7% NPV).

Table V–15 shows how total social costs are expected to be shared across stakeholders, for selected years. According to these results, the rail sector is expected to bear most of the social costs of the program, ranging from 57.3 percent in 2011 to 67.3 percent in 2016. Producers and consumers of locomotive transportation services are expected to bear most of those social costs, ranging from 51.9 percent in 2011 to 63.3 percent in 2030. As explained above, these results assume the railroads absorb all remanufacture kit compliance costs (the remanufacture kit manufacturers pass all costs of the new standards to the railroads). The marine sector is expected to bear the remaining social costs, ranging from 42.7 percent in 2011 to 32.7 percent in 2016. Producers of marine diesel engines are expected to bear more of the program costs in the early years (42.7 percent in 2011), but by 2020 producers and consumers in the marine transportation services market are expected to bear a larger share of the social costs, 31.5 percent.

TABLE V–15.—SUMMARY OF ESTIMATED SOCIAL COSTS FOR 2011, 2016, 2020, 2030

[2005$, $million]

Stakeholder group	2011		2016	
	Surplus change	Percent	Surplus change	Percent
Locomotives				
Locomotive producers	−$11.1	5.5	−$13.4	7.0
Rail transportation service providers	−$47.5	23.6	−$52.9	27.5
Rail transportation service consumers	−$57.0	28.3	−$63.5	33.0
Total locomotive sector	−$115.6	57.3	−$129.7	67.3
Marine				
Marine engine producers	−$86.0	42.7	−$0.9	0.5
C1 > 800 hp	−$22.8		−$0.7	
C2 > 800 hp	−$27.8		−$0.2	
Other marine	−$35.4		−$0.0	

TABLE V–15.—SUMMARY OF ESTIMATED SOCIAL COSTS FOR 2011, 2016, 2020, 2030—Continued

[2005$, $million]

Stakeholder group	2011 Surplus change	2011 Percent	2016 Surplus change	2016 Percent
Marine vessel producers	−$0	0.0	−$18.0	9.3
C1 > 800 hp	−$0		−$13.6	
C2 > 800 hp	−$0		−$4.4	
Other marine	−$0		−$0.0	
Recreational and fishing vessel consumers	−$0	0.0	−$9.6	5.0
Marine transportation service providers	−$0	0.0	−$15.6	8.1
Marine transportation service consumers	−$0	0.0	−$18.7	9.7
Total marine sector	−$86.0	42.7	−$62.9	32.7
Total Program	−$201.5		−$192.6	

Stakeholder group	2020 Surplus change	2020 Percent	2030 Surplus change	2030 Percent
Locomotives				
Locomotive producers	−$0.7	0.3	−$1.8	0.3
Rail transportation service providers	−$65.8	27.5	−$163.2	28.8
Rail transportation service consumers	−$78.9	32.9	−$195.9	34.5
Total locomotive sector	−$145.3	60.7	−$360.9	63.6
Marine				
Marine engine producers	−$0.8	0.3	−$0.9	0.2
C1 > 800 hp	−$0.6		−$0.7	
C2 > 800 hp	−$0.2		−$0.2	
Other marine	−$0.0		−$0.0	
Marine vessel producers	−$10.1	4.2	−$8.2	1.4
C1 > 800 hp	−$7.8		−$6.4	
C2 > 800 hp	−$2.3		−$1.6	
Other marine	−$0.1		−$0.1	
Recreational and fishing vessel consumers	−$7.8	3.3	−$8.5	1.5
Marine transportation service providers	−$34.3	14.3	−$85.8	15.1
Marine transportation service consumers	−$41.2	17.2	−$103.0	18.2
Total marine sector	−$94.1	39.3	−$206.5	36.4
Total Program	−$239.5	100.0	−$567.3	100.0

Table V–16 provides additional detail about the sources of surplus changes, for 2020 when the per unit compliance costs are stable. On the marine side, this table shows that engine and vessel producers are expected to pass along much of the engine and vessel compliance costs to the marine transportation service providers who purchase marine vessels. These marine transportation service providers, in turn, are expected to pass some of the costs to their customers. This is also expected to be the case in the rail sector.

TABLE V–16.— DISTRIBUTION OF ESTIMATED SURPLUS CHANGES BY MARKET AND STAKEHOLDER FOR 2020

[2005$, million$]

	Total engineering costs	Surplus change
Marine Markets		
Engine Producers	$29.3	−$0.8
Vessel Producers	$5.2	−$10.1
Engine price changes		−$8.1
Equipment cost changes		−$2.0
Recreational and Fishing Consumers		−$7.8
Engine price changes		−$6.2
Equipment cost changes		−$1.6
Transportation Service Providers	$60.0	−$34.3
Increased price vessels		−$6.9

TABLE V–16.— DISTRIBUTION OF ESTIMATED SURPLUS CHANGES BY MARKET AND STAKEHOLDER FOR 2020—Continued

[2005$, million$]

	Total engineering costs	Surplus change
Operating costs		−$27.4
Users of Transportation Service		−$41.2
Increased price vessels		−$8.2
Operating costs		−$32.9
Rail Markets		
Locomotive Producers	$64.0	−$0.7
Rail Service Providers	$81.4	−$65.8
Increased price new locomotives		−$28.8
Remanufacturing costs	$9.5	−$8.1
Operating costs	$63.6	−$28.9
Users of Rail Transportation Service		−$78.9
Increased price new locomotives		−$34.6
Remanufacturing costs		−$9.7
Operating costs		−$34.7
Total	$239.9	$239.6

The present value of net social costs of the proposed standards through 2040, shown in Table V–14, is estimated to be $6.9 billion (2005$).[150] This present value is calculated using a social discount rate of 3 percent and the stream of social welfare costs from 2006 through 2040. We also performed an analysis using a 7 percent social discount rate.[151] Using that discount rate, the present value of the net social costs through 2040 is estimated to be $3.1 billion (2005$).

Table V–17 shows the distribution of total surplus losses for the program from 2006 through 2040. This table shows that the rail sector is expected to bear about 65 percent of the total program social costs through 2040, and that most of the costs are expected to be borne by the rail transportation service producers and consumers. On the marine side, most of the marine sector costs are expected to be borne by the marine transportation service providers and consumers. This is consistent with the structure of the program, which leads to high compliance costs for those stakeholder groups.

TABLE V–17.—ESTIMATED NET SOCIAL COSTS THROUGH 2040 BY STAKEHOLDER

($million, 2005$)

Stakeholder groups	Surplus change NPV 3%	Percent of total surplus	Surplus change NPV 7%	Percent of total surplus
Locomotives				
Locomotive producers	$92.8	1.3%	$63.5	2.0%
Rail transportation service providers	$1,988.8	28.8%	$878.1	28.3%
Rail transportation service consumers	$2,386.4	34.6%	$1,053.7	33.9%
Total locomotive sector	$4,468.1	64.8%	$1,995.4	64.4%
Marine				
Marine engine producers	$313.3	4.5%	$242.3	7.8%
C1 > 800 hp	$102.1		$73.9	
C2 > 800 hp	$112.4		$84.4	
Other marine	$98.7		$84.0	
Marine vessel producers	$143.8	2.1%	$71.3	2.3%
C1 > 800 hp	$110.1		$54.3	
C2 > 800 hp	$32.4		$16.5	
Other marine	$1.3		$0.5	
Recreational and fishing vessel consumers	$110.0	1.6%	$51.0	1.6%
Marine transportation service providers	$846.2	12.3%	$338.2	10.9%
Marine transportation service consumers	$1,015.4	14.7%	$405.9	13.1%
Total marine sector	$2,428.7	35.2%	$1,107.7	35.7%
Total Program	$6,896.8		$3,103.1	

[150] **Note:** These NPV calculations are based on the period 2006–2040, reflecting the period when the analysis was completed. This has the consequence of discounting the current year costs, 2007, and all subsequent years are discounted by an additional year. The result is a smaller stream of social costs than by calculating the NPV over 2007–2040 (3% smaller for 3% NPV and 7% smaller for 7% NPV).

[151] EPA has historically presented the present value of cost and benefits estimates using both a 3 percent and a 7 percent social discount. The 3 percent rate represents a demand-side approach and reflects the time preference of consumption (the rate at which society is willing to trade current consumption for future consumption). The 7 percent rate is a cost-side approach and reflects the shadow price of capital.

(7) What Are the Significant Limitations of the Economic Impact Analysis?

Every economic impact analysis examining the market and social welfare impacts of a regulatory program is limited to some extent by limitations in model capabilities, deficiencies in the economic literatures with respect to estimated values of key variables necessary to configure the model, and data gaps. In this EIA, there three potential sources of uncertainty: (1) Uncertainty resulting from the way the EIM is designed, particularly from the use of a partial equilibrium model; (2) uncertainty resulting from the values for key model parameters, particularly the price elasticity of supply and demand; and (3) uncertainty resulting from the values for key model inputs, particularly baseline equilibrium price and quantities.

Uncertainty associated with the economic impact model structure arises from the use of a partial equilibrium approach, the use of the national level of analysis, and the assumption of perfect competition. These features of the model mean it does not take into account impacts on secondary markets or the general economy, and it does not consider regional impacts. The results may also be biased to the extent that firms have some control over market prices, which would result in the modeling over-estimating the impacts on producers of affected goods and services.

The values used for the price elasticities of supply and demand are critical parameters in the EIM. The values of these parameters have an impact on both the estimated change in price and quantity produced expected as a result of compliance with the proposed standards and on how the burden of the social costs will be shared among producer and consumer groups. In selecting the values to use in the EIM it is important that they reflect the behavioral responses of the industries under analysis.

Where possible, the EIA relies on published price elasticities of supply and demand. For those cases where there are no published sources, we estimated these parameters (see Appendix 7F of the RIA prepared for this rule). The methods used for estimation include a production fuction approach using data at the industry level (engines and recreational vessels) and a calibration approach (locomotiove supply). These methods were chosen because of limitations with the available data, which was limited to industry-level data. However, the use of aggregate industry level data may not be appropriate or an accurate way to estimate the price elasticity of supply compared to firm-level or plant-level data. This is because, at the aggregate industry level, the size of the data sample is limited to the time series of the available years and because aggregate industry data may not reveal each individual firm or plant production function (heterogeneity). There may be significant differences among the firms that may be hidden in the aggregate data but that may affect the estimated elasticity. In addition, the use of time series aggregate industry data may introduce time trend effects that are difficult to isolate and control.

To address these concerns, EPA intends to investigate estimates for the price elasticity of supply for the affected industries for which published estimates are not available, using an alternative method and data inputs. This research program will use the cross-sectional data model at either the firm level or the plant level from the U.S. Census Bureau to estimate these elasticities. We plan to use the results of this research provided the results are robust and they are available in time for the analysis for the final rule.

Finally, uncertainty in measurement of data inputs can have an impact on the results of the analysis. This includes measurement of the baseline equilibrium prices and quantities and the estimation of future year sales. In addition, there may be uncertainty in how similar engines and equipment were combined into smaller groups to facilitate the analysis. There may also be uncertainty in the compliance cost estimations.

To explore the effects of key sources of uncertainty, we performed a sensitivity analysis in which we examine the results of using alternative values for the price elasticity of suppy and demand and alternative methods to incorporate operational costs (across a larger group of marine vessels). The results of these analyses are contained in Appendix 7H of the RIA prepared for this rule.

Despite these uncertainties, we believe this economic impact analysis provides a reasonable estimate of the expected market impacts and social welfare costs of the proposed standards in future. Acknowledging benefits omissions and uncertainties, we present a best estimate of the social costs based on our interpretation of the best available scientific literature and methods supported by EPA's Guidelines for Preparing Economic Analyses and the OAQPS Economic Analysis Resource Document.

VI. Benefits

A. Overview

This section presents our analysis of the health and environmental benefits that can be expected to occur as a result of the proposed locomotive and marine engine standards throughout the period from initial implementation through 2030. Nationwide, the engines that are subject to the proposed emission standards in this rule are a significant source of mobile source air pollution. The proposed standards will reduce exposure to NO_X and direct PM emissions and help avoid a range of adverse health effects associated with ambient ozone and $PM_{2.5}$ levels. In addition, the proposed standards will help reduce exposures to diesel PM exhaust, various gaseous hydrocarbons and air toxics. As described below, the reductions in ozone and PM from the proposed standards are expected to result in significant reductions in premature deaths and other serious human health effects, as well as other important public health and welfare effects.

To estimate the net benefits of the proposed standards, we use the estimated costs presented in section V and sophisticated air quality and benefit modeling tools. The benefit modeling is based on peer-reviewed studies of air quality and health and welfare effects associated with improvements in air quality and peer-reviewed studies of the dollar values of those public health and welfare effects. These methods are generally consistent with benefits analyses performed for the recent analysis of the Clean Air Interstate Rule (CAIR) standards and the recently finalized PM NAAQS analysis.[152,153] They are described in detail in the RIA prepared for this rule.

EPA typically quantifies PM- and ozone-related benefits in its regulatory impact analyses (RIAs) when possible. In the analysis of past air quality regulations, ozone-related benefits have included morbidity endpoints and welfare effects such as damage to commercial crops. EPA has not recently included a separate and additive mortality effect for ozone, independent of the effect associated with fine particulate matter. For a number of

[152] U.S. Environmental Protection Agency. March 2005. Regulatory Impact Analysis for the Final Clean Air Interstate Rule. *Prepared by:* Office of Air and Radiation. Available at *http://www.epa.gov/cair.*

[153] U.S. Environmental Protection Agency. October 2006. Final Regulatory Impact Analysis (RIA) for the Proposed National Ambient Air Quality Standards for Particulate Matter. *Prepared by:* Office of Air and Radiation. Available at *http://www.epa.gov/ttn/ecas/ria.html.*

reasons, including (1) advice from the Science Advisory Board (SAB) Health and Ecological Effects Subcommittee (HEES) that EPA consider the plausibility and viability of including an estimate of premature mortality associated with short-term ozone exposure in its benefits analyses and (2) conclusions regarding the scientific support for such relationships in EPA's 2006 Air Quality Criteria for Ozone and Related Photochemical Oxidants (the CD), EPA is in the process of determining how to appropriately characterize ozone-related mortality benefits within the context of benefits analyses for air quality regulations. As part of this process, we are seeking advice from the National Academy of Sciences (NAS) regarding how the ozone-mortality literature should be used to quantify the reduction in premature mortality due to diminished exposure to ozone, the amount of life expectancy to be added and the monetary value of this increased life expectancy in the context of health benefits analyses associated with regulatory assessments. In addition, the Agency has sought advice on characterizing and communicating the uncertainty associated with each of these aspects in health benefit analyses.

Since the NAS effort is not expected to conclude until 2008, the agency is currently deliberating how best to characterize ozone-related mortality benefits in its rulemaking analyses in the interim. For the analysis of the proposed locomotive and marine standards, we do not quantify an ozone mortality benefit. So that we do not provide an incomplete picture of all of the benefits associated with reductions in emissions of ozone precursors, we have chosen not to include an estimate of total ozone benefits in the proposed RIA. By omitting ozone benefits in this proposal, we acknowledge that this analysis underestimates the benefits associated with the proposed standards. Our analysis, however, indicates that the rule's monetized $PM_{2.5}$ benefits alone substantially exceed our estimate of the costs.

The range of benefits associated with the proposed program are estimated based on the risk of several sources of PM-related mortality effect estimates, along with all other PM non-mortality related benefits information. These benefits are presented in Table VI–1. The benefits reflect two different sources of information about the impact of reductions in PM on reduction in the risk of premature death, including both the American Cancer Society (ACS) cohort study and an expert elicitation study conducted by EPA in 2006. In order to provide an indication of the sensitivity of the benefits estimates to alternative assumptions, in Chapter 6 of the RIA we present a variety of benefits estimates based on two epidemiological studies (including the ACS Study and the Six Cities Study) and the expert elicitation. EPA intends to ask the Science Advisory Board to provide additional advice as to which scientific studies should be used in future RIAs to estimate the benefits of reductions in PM. These estimates, and all monetized benefits presented in this section, are in year 2005 dollars.

TABLE VI–1.—ESTIMATED MONETIZED PM-RELATED HEALTH BENEFITS OF THE PROPOSED LOCOMOTIVE AND MARINE ENGINE STANDARDS

	Total benefits [a b c d] (billions 2005$)	
	2020	2030
PM mortality derived from the ACS cohort study; Morbidity functions from epidemiology literature		
Using a 3% discount rate	$4.4+B	$12+B
Confidence Intervals (5th–95th %ile)	($1.0–$10)	($2.1–$27)
Using a 7% discount rate	$4.0+B	$11+B
Confidence Intervals (5th–95th %ile)	($1.0–$9.2)	($1.8–$25)
PM mortality derived from lower bound and upper bound expert-based result; [e] Morbidity functions from epidemiology literature		
Using a 3% discount rate	$1.7+B − $12+B	$4.6+B − $33+B
Confidence Intervals (5th–95th %ile)	($0.2 − $8.5) − ($2.0 − $27)	($1.0 − $23) − ($5.4 − $72)
Using a 7% discount rate	$1.6+B − $11+B	$4.3+B − $30+B
Confidence Intervals (5th–95th %ile)	($0.2 − $7.8) − ($1.8 − $24)	($1.0 − $21) − ($4.9 − $65)

[a] Benefits include avoided cases of mortality, chronic illness, and other morbidity health endpoints.

[b] PM-related mortality benefits estimated using an assumed PM threshold of 10 μ/m^3. There is uncertainty about which threshold to use and this may impact the magnitude of the total benefits estimate. For a more detailed discussion of this issue, please refer to Section 6.6.1.3 of the RIA.

[c] For notational purposes, unquantified benefits are indicated with a "B" to represent the sum of additional monetary benefits and disbenefits. A detailed listing of unquantified health and welfare effects is provided in VI–4.

[d] Results reflect the use of two different discount rates: 3 and 7 percent, which are recommended by EPA's Guidelines for Preparing Economic Analyses and OMB Circular A–4. Results are rounded to two significant digits for ease of presentation and computation.

[e] The effect estimates of nine of the twelve experts included in the elicitation panel fall within the empirically-derived range provided by the ACS and Six-Cities studies. One of the experts fall below this range and two of the experts are above this range. Although the overall range across experts is summarized in this table, the full uncertainty in the estimates is reflected by the results for the full set of 12 experts. The twelve experts' judgments as to the likely mean effect estimate are not evenly distributed across the range illustrated by arraying the highest and lowest expert means. Likewise the 5th and 95th percentiles for these highest and lowest judgments of the effect estimate do not imply any particular distribution within those bounds. The distribution of benefits estimates associated with each of the twelve expert responses can be found in Tables 6.4–3 and 6.4–4 in the RIA.

B. Quantified Human Health and Environmental Effects of the Proposed Standards

In this section we discuss the $PM_{2.5}$ benefits of the proposed standards. We discuss how these benefits are monetized in the next section. It should be noted that the emission control scenarios used in the air quality and benefits modeling are slightly different than the emission control program being proposed. The differences reflect further refinements of the regulatory program since we performed the air quality modeling for this rule. Emissions and air quality modeling decisions are made early in the analytical process. Section 3.6 of the RIA describes the changes in the inputs and resulting emission inventories between the preliminary assumptions used for the air quality modeling and the final proposed emission control scenario.

(1) Estimated PM Benefits

To model the PM air quality benefits of this rule we used the Community Multiscale Air Quality (CMAQ) model. CMAQ simulates the numerous physical and chemical processes involved in the formation, transport, and deposition of particulate matter. This model is commonly used in regional applications to estimate the PM reductions expected to occur from a given set of emissions controls. The meteorological data input into CMAQ are developed by a separate model, the Penn State University/National Center for Atmospheric Research Mesoscale Model, known as MM5. The modeling domain covers the entire 48-State U.S., as modeled in the Clean Air Interstate Rule (CAIR).[154] The grid resolution for the PM modeling domain was 36 x 36 km. More detailed information is included in the air quality modeling technical support document (TSD), which is located in the docket for this rule.

The modeled ambient air quality data serves as an input to the Environmental Benefits Mapping and Analysis Program (BenMAP).[155] BenMAP is a computer program developed by EPA that integrates a number of the modeling elements used in previous Regulatory Impact Analyses (e.g., interpolation functions, population projections, health impact functions, valuation functions, analysis and pooling methods) to translate modeled air concentration estimates into health effects incidence estimates and monetized benefits estimates.

Table VI–2 presents the estimates of reduced incidence of PM-related health effects for the years 2020 and 2030, which are based on the modeled air quality improvements between a baseline, pre-control scenario and a post-control scenario reflecting the proposed emission control strategy.

Since the publication of CAIR, we have completed the full-scale expert elicitation assessing the uncertainty in the concentration-response function for PM-related premature mortality. Consistent with the recommendations of the National Research Council (NRC) report ''Estimating the Public Health Benefits of Proposed Air Pollution Regulations,'' [156] we are integrating the results of this probabilistic assessment into the main benefits analysis as an alternative to the epidemiologically-derived range of mortality incidence provided by the ACS and Six-cities cohort studies (Pope et al., 2002 and Laden et al., 2006). Of the twelve experts included in the panel of experts, average premature mortality incidence derived from eleven of the experts are larger than the ACS-based estimate. One expert's average effect estimate falls below the ACS-based estimate. Details on the PM-related mortality incidence derived from each expert are presented in the draft RIA.

The use of two sources of PM mortality reflects two different sources of information about the impact of reductions in PM on reduction in the risk of premature death, including both the published epidemiology literature and an expert elicitation study conducted by EPA in 2006. In 2030, based on the estimate provided by the ACS study, we estimate that PM-related annual benefits would result in 1,500 fewer premature fatalities. When the range of expert opinion is used, we estimate between 460 and 4,600 fewer premature mortalities in 2030. We also estimate 940 fewer cases of chronic bronchitis, 3,300 fewer non-fatal heart attacks, 1,100 fewer hospitalizations (for respiratory and cardiovascular disease combined), one million fewer days of restricted activity due to respiratory illness and approximately 170,000 fewer work-loss days. We also estimate substantial health improvements for children from reduced upper and lower respiratory illness, acute bronchitis, and asthma attacks. These results are based on an assumed cutpoint in the long-term mortality concentration-response functions at 10 μg/m^3, and an assumed cutpoint in the short-term morbidity concentration-response functions at 10 μg/m^3. The impact using four alternative cutpoints (3 μg/m^3, 7.5 μg/m^3, 12 μg/m^3, and 14 μg/m^3) has on $PM_{2.5}$-related mortality incidence estimation is presented in Chapter 6 of the draft RIA.

TABLE VI–2 ESTIMATED REDUCTION IN INCIDENCE OF ADVERSE HEALTH EFFECTS RELATED TO THE PROPOSED LOCOMOTIVE AND MARINE ENGINE STANDARDS [a]

	2020	2030
Health effect	Mean incidence reduction (5th–95th percentile)	
PM-Related Endpoints		
Premature Mortality—Derived from Epidemiology Literature [b c] Adult, age 30±Range based on ACS cohort study (Pope *et al.* 2002	570 (220–920)	1,500 (590–2,400)
Infant, age <1 year—Woodruff *et al.* 1997	1 (1–2)	2 (1–4)
Premature Mortality—Derived from Expert Elicitation [c d] Adult, age 25±Lower and Upper Bound EE Results, Respectively.	180–1,700 (0–830)—(870–2,600)	460–4,600 (0–2,200)–(2,300–6,900)
Chronic bronchitis (adult, age 26 and over)	370 (68– 670)	940 (170–1,700)
Acute myocardial infarction (adults, age 18 andolder)	1,200 (640–1,700)	3,300 (1,800–4,800)
Hospital admissions—respiratory (all ages) [e]	130 (65–200)	350 (170–510)
Hospital admissions—cardiovascular (adults, age >18) [f]	270 (170–380)	770 (490–1,100)

[154] See the technical support document for the Final Clean Air Interstate Rule Air Quality Modeling. This document is available in Docket EPA–HQ–OAR–2004–0008.

[155] Information on BenMAP, including downloads of the software, can be found at *http://www.epa.gov/ttn/ecas/* benmodels.html.

[156] National Research Council (NRC). 2002. Estimating the Public Health Benefits of Proposed Air Pollution Regulations. Washington, DC: The National Academies Press.

TABLE VI–2 ESTIMATED REDUCTION IN INCIDENCE OF ADVERSE HEALTH EFFECTS RELATED TO THE PROPOSED LOCOMOTIVE AND MARINE ENGINE STANDARDS [a]—Continued

	2020	2030
Emergency room visits for asthma (age 18 years and younger)	460 (270–650)	1,000 (620–1,500)
Acute bronchitis (children, age 8–12)	1,000 (0–2,100)	2,600 (0–5,300)
Lower respiratory symptoms (children, age 7–14)	11,000 (5,400–17,000)	28,000 (14,000–43,000)
Upper respiratory symptoms (asthmatic children, age 9–18)	8,300 (2,600–14,000)	21,000 (6,600–35,000)
Asthma exacerbation (asthmatic children, age 6–18)	10,000 (1,100–29,000)	26,000 (2,800–74,000)
Work loss days (adults, age 18–65)	71,000 (62,000–81,000)	170,000 (150,000–190,000)
Minor restricted-activity days (adults, age 18–65)	420,000 (360,000–490,000)	1,000,000 (850,000–1,200,000)

[a] Incidence is rounded to two significant digits. PM estimates represent benefits from the proposed standards nationwide.
[b] Based on application of the effect estimate derived fromthe ACS study.[157] Infant premature mortality based upon studies by Woodruff, *et al.* 1997.[158]
[c] PM-related mortality benefits estimated using an assumed PM threshold at 10 μg/m^3. There is uncertainty about which threshold to use and this may impact the magnitude of the total benefits estimate. For a more detailed discussion of this issue, please refer to Chapter 6 of the RIA.
[d] Based on effect estimates derived from the full-scale expert elicitation assessing the uncertainty in the concentration-response function for PM-related premature mortality (IEc, 2006).[159] The effect estimates of 11 of the 12 experts included in the elicitation panel falls estimate derived from the ACS study. One of the experts fall below the ACS estimate.
[e] Respiratory hospital admissions for PM include admissions for COPD, pneumonia, and asthma.
[f] Cardiovascular hospital admissions for PM include total cardiovascular and subcategories for ischemic heart disease, dysrhythmias, and heart failure.

C. Monetized Benefits

Table VI–3 presents the estimated monetary value of reductions in the incidence of health and welfare effects. Total annual PM-related health benefits are estimated to be between $4.6 and $33 billion in 2030, using a three percent discount rate (or $4.3 and $30 billion assuming a 7 percent discount rate). This estimate is based on the opinions of outside experts on PM and therisk of premature death, alongwith other non-mortality related benefits results. When the range of premature fatalities based on the ACS cohort study is used, we estimate the total benefits related to the proposed standards to be approximately $12 billion in 2030, using a three percent discount rate (or $11 assuming a 7 percent discount rate). All monetized estimates are stated in 2005 dollars. These estimates account for growth in real gross domestic product (GDP) per capita between the present and the years 2020 and 2030. As the table indicates, total benefits are driven primarily by the reduction in premature fatalities each year, which accounts for well over 90 percent of total benefits.

The above estimates of monetized benefits include only one example of non-health related benefits. Changes in the ambient level of $PM_{2.5}$ are known to affect the level of visibility in much of the U.S. Individuals value visibility both in the places they live and work, in the places they travel to for recreational purposes, and at sites of unique public value, such as at National Parks. For the proposed standards, we present the recreational visibility benefits of improvements in visibility at 86 Class I areas located throughout California, the Southwest, and the Southeast. These estimated benefits are approximately $150 million in 2020 and $400 million in 2030, as shown in Table VI–3.

Table VI–3 also indicates with a ''B'' those additional health and environmental benefits of the rule that we were unable to quantify or monetize. These effects are additive to the estimate of total benefits, and are related to two primary sources. First, there are many human health and welfare effects associated with PM, ozone, and toxic air pollutant reductions that remain unquantified because of current limitations in the methods or available data. A full appreciation of the overall economic consequences of the proposed standards requires consideration of all benefits and costs projected to result from the new standards, not just those benefits and costs which could be expressed here in dollar terms. A list of the benefit categories that could not be quantified or monetized in our benefit estimates are provided in Table VI–4. Second, the CMAQ air quality model only captures the benefits of air quality improvements in the 48 states and DC; benefits for Alaska and Hawaii are not reflected in the estimate of benefits.

[157] Pope, C.A., III, R.T. Burnett, M.J. Thun, E.E. Calle, D. Krewski, K. Ito, and G.D. Thurston. 2002. ''Lung Cancer, Cardiopulmonary Mortality, and Long-term Exposure to Fine Particulate Air Pollution.'' Journal of the American Medical association 287: 1132–1141.

[158] Woodruff, T.J., J. Grillo, and K.C. Schoendorf. 1997. ''The Relationship Between Selected Causes of Postneonatal Infant Mortality and Particulate Air Pollution in the United States.'' Environmental Health Perspectives 105(6): 608–612.

[159] Industrial Economics, Incorporated (IEc). 2006. Expanded Expert Judgment Assessment of the Concentration-Response Relationship Between $PM_{2.5}$ Exposure and Mortality. Peer Review Draft. Prepared for: Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC. August.

TABLE VI–3.—ESTIMATED MONETARY VALUE IN REDUCTIONS IN INCIDENCE OF HEALTH AND WELFARE EFFECTS

[in millions of 2005$][a,b]

	2020	2030
$PM_{2.5}$-related health effect		Estimated mean value of reductions (5th and 95th %ile)
Premature mortality—Derived from Epidemiology Studies[c,d,e]		
Adult, age 30+—ACS study (Pope et al. 2002)		
3% discount rate	$3,900 ($500–$8,800)	$10,000 ($1,500–$24,000)
7% discount rate	$3,700 ($500–$7,900)	$9,400 ($1,300–$21,000)
Infant Mortality,<1 year —Woodruff et al. 1997		
3% discount rate	$8 ($1–$18)	$17 ($3–$37)
7% discount rate	$7 ($1–$16)	$15 ($2–$33)
Premature mortality—Derived from Expert Elicitation[c,d,e,f]		
Adult, age 25+—Lower bound EE result		
3% discount rate	$1,200 ($0–$7,200)	$3,300 ($0–$20,000)
7% discount rate	$1,100 ($0–$6,500)	$3,000 ($0–$18,000
Adult, age 25+—Upper bound EE result		
3% discount rate	$12,000 ($1,800–$25,000)	$31,000 ($4,800–$68,000)
7% discount rate	$11,000 ($1,600–$23,000)	$28,000 ($4,400–$62,000)
Chronic bronchitis (adults, 26 and over)	$200 ($10–$800)	$500 ($26–$2,100)
Non-fatal acute myocardial infarctions		
3% discount rate	$123 ($32–$270)	$330 ($80–$730)
7% discount rate	$119 ($30–$270)	$320 ($76–$720)
Hospital admissions for respiratory causes	$2.7 ($1.3–$4.0)	$7.2 ($3.6–$11)
Hospital admissions for cardiovascular causes	$7.3 ($4.6–$10)	$21 ($13–$28)
Emergency room visits for asthma	$0.16 ($0.09–$0.26)	$0.37 ($0.20–$0.60)
Acute bronchitis (children, age 8–12)	$0.44 ($0–$1.2)	$1.1 ($0–$3.1)
Lower respiratory symptoms (children, 7–14)	$0.21 ($0.07–$0.43)	$0.53 ($0.18–$1.1)
Upper respiratory symptoms (asthma, 9–11)	$0.24 ($0.05–$0.59)	$0.62 ($0.14–$1.5)
Asthma exacerbations	$0.53 ($0.04–$2.0)	$1.4 ($0.10–$5.1)
Work loss days	$11 ($9.6–$12)	$27 ($23–$30)
Minor restricted-activity days (MRADs)	$12 ($0.61–$25)	$29 ($1.5–$60)
Recreational Visibility, 86 Class I areas	$150 (na)[f]	$400 (na)
Monetized Total—PM-Mortality Derived from ACS Study; Morbidity Functions.		
3% discount rate	$4.4 ($1.0–$10)	$12 Billion ($2.1–$27)
7% discount rate Billion	$4.0 Billion ($1.0–$9.2)	$11 Billion ($1.8–$25)
Monetized Total—PM-Mortality Derived from Expert Elicitation[g]; Morbidity Functions.		
3% discount rate	$1.7–$12 Billion ($0.2–$8.5)—($2.0–$27)	$4.6–$33 Billion ($1.0–$23)—($5.4–$72)
7% discount rate	$1.6–$11 Billion ($0.2–$7.8)—($1.8–$24)	$4.3–$30 Billion ($1.0–$21)—($4.9–$65)

[a] Monetary benefits are rounded to two significant digits for ease of presentation and computation. PM benefits are nationwide.

[b] Monetary benefits adjusted to account for growth in real GDP per capita between 1990 and the analysis year (2020 or 2030)

[c] PM-related mortality benefits estimated using an assumed PM threshold of 10 μ/m^3. There is uncertainty about which threshold to use and this may impact the magnitude of the total benefits estimate.

[d] Valuation assumes discounting over the SAB recommended 20 year segmented lag structure. Results reflect the use of 3 percent and 7 percent discount rates consistent with EPA and OMB guidelines for preparing economic analyses (EPA, 2000; OMB, 2003).

[e] The valuation of adult premature mortality, derived either from the epidemiology literature or the expert elicitation, is not additive. Rather, the valuations represent a range of possible mortality benefits.

[f] We are unable at this time to characterize the uncertainty in the estimate of benefits of worker productivity and improvements in visibility at Class I areas. As such, we treat these benefits as fixed and add them to all percentiles of the health benefits distribution.

[g] It should be noted that the effect estimates of nine of the twelve experts included in the elicitation panel falls within the scientific study-based range provided by Pope and Laden. One of the experts fall below this range and two of the experts are above this range.

TABLE V1–4.—UNQUANTIFIED AND NON-MONETIZED POTENTIAL EFFECTS OF THE PROPOSED LOCOMOTIVE AND MARINE ENGINE STANDARDS

Pollutant/effects	Effects not included in analysis—changes in:
Ozone Health [a]	Premature mortality: short-term exposures Hospital admissions: respiratory Emergency room visits for asthma Minor restricted-activity days School loss days Asthma attacks Cardiovascular emergency room visits Acute respiratory symptoms Chronic respiratory damage Premature aging of the lungs Non-asthma respiratory emergency room visits Exposure to UVb (+/−) [d]
Ozone Welfare	Yields for -commercial forests -some fruits and vegetables -non-commercial crops Damage to urban ornamental plants Impacts on recreational demand from damaged forest aesthetics Ecosystem functions Exposure to UVb (+/−)
PM Health [b]	Premature mortality—short term exposures [c] Low birth weight Pulmonary function Chronic respiratory diseases other than chronic bronchitis Non-asthma respiratory emergency room visits Exposure to UVb (+/−)
PM Welfare	Residential and recreational visibility in non-Class I areas Soiling and materials damage Damage to ecosystem functions Exposure to UVb (+/−)
Nitrogen and Sulfate Deposition Welfare.	Commercial forests due to acidic sulfate and nitrate deposition Commercial freshwater fishing due to acidic deposition Recreation in terrestrial ecosystems due to acidic deposition Existence values for currently healthy ecosystems Commercial fishing, agriculture, and forests due to nitrogen deposition Recreation in estuarine ecosystems due to nitrogen deposition Ecosystem functions Passive fertilization
CO Health	Behavioral effects
HC/Toxics Health [e]	Cancer (benzene, 1,3-butadiene, formaldehyde, acetaldehyde) Anemia (benzene) Disruption of production of blood components(benzene) Reduction in the number of blood platelets (benzene) Excessive bone marrow formation (benzene) Depression of lymphocyte counts (benzene) Reproductive and developmental effects (1,3- butadiene) Irritation of eyes and mucus membranes(formaldehyde) Respiratory irritation (formaldehyde) Asthma attacks in asthmatics (formaldehyde) Asthma-like symptoms in non-asthmatics(formaldehyde) Irritation of the eyes, skin, and respiratory tract(acetaldehyde) Upper respiratory tract irritation and congestion(acrolein)
HC/Toxics Welfare	Direct toxic effects to animals Bioaccumulation in the food chain Damage to ecosystem function Odor

[a] In addition to primary economic endpoints, there are a number of biological responses that have been associated with ozone health effects including increased airway responsiveness to stimuli, inflammation in the lung, acute inflammation and respiratory cell damage, and increased susceptibility to respiratory infection. The public health impact of these biological responses may be partly represented by our quantified endpoints.

[b] In addition to primary economic endpoints, there are a number of biological responses that have been associated with PM health effects including morphological changes and altered host defense mechanisms. The public health impact of these biological responses may be partly represented by our quantified endpoints.

[c] While some of the effects of short-term exposures are likely to be captured in the estimates, there may be premature mortality due to short-term exposure to PM not captured in the cohort studies used in this analysis. However, the PM mortality results derived from the expert elicitation do take into account premature mortality effects of short term exposures.

[d] May result in benefits or disbenefits.

[e] Many of the key hydrocarbons related to this rule are also hazardous air pollutants listed in the Clean Air Act.

D. What Are the Significant Limitations of the Benefit-Cost Analysis?

Every benefit-cost analysis examining the potential effects of a change in environmental protection requirements is limited to some extent by data gaps, limitations in model capabilities (such as geographic coverage), and uncertainties in the underlying scientific and economic studies used to configure the benefit and cost models. Limitations of the scientific literature often result in the inability to estimate quantitative changes in health and environmental effects, such as potential increases in premature mortality associated with increased exposure to carbon monoxide. Deficiencies in the economics literature often result in the inability to assign economic values even to those health and environmental outcomes which can be quantified. These general uncertainties in the underlying scientific and economics literature, which can lead to valuations that are higher or lower, are discussed in detail in the RIA and its supporting references. Key uncertainties that have a bearing on the results of the benefit-cost analysis of the proposed standards include the following:

- The exclusion of potentially significant and unquantified benefit categories (such as health, odor, and ecological benefits of reduction in air toxics, ozone, and PM);
- Errors in measurement and projection for variables such as population growth;
- Uncertainties in the estimation of future year emissions inventories and air quality;
- Uncertainty in the estimated relationships of health and welfare effects to changes in pollutant concentrations including the shape of the C–R function, the size of the effect estimates, and the relative toxicity of the many components of the PM mixture;
- Uncertainties in exposure estimation; and
- Uncertainties associated with the effect of potential future actions to limit emissions.

As Table VI–3 indicates, total benefits are driven primarily by the reduction in premature fatalities each year. Some key assumptions underlying the premature mortality estimates include the following, which may also contribute to uncertainty:

- Inhalation of fine particles is causally associated with premature death at concentrations near those experienced by most Americans on a daily basis. Although biological mechanisms for this effect have not yet been completely established, the weight of the available epidemiological, toxicological, and experimental evidence supports an assumption of causality. The impacts of including a probabilistic representation of causality were explored in the expert elicitation-based results of the recently published PM NAAQS RIA. Consistent with that analysis, we discuss the implications of these results in the draft RIA for the proposed standards.
- All fine particles, regardless of their chemical composition, are equally potent in causing premature mortality. This is an important assumption, because PM produced via transported precursors emitted from locomotive and marine engines may differ significantly from PM precursors released from electric generating units and other industrial sources. However, no clear scientific grounds exist for supporting differential effects estimates by particle type.
- The C–R function for fine particles is approximately linear within the range of ambient concentrations under consideration (above the assumed threshold of 10 µg/m3). Thus, the estimates include health benefits from reducing fine particles in areas with varied concentrations of PM, including both regions that may be in attainment with $PM_{2.5}$ standards and those that are at risk of not meeting the standards.

Despite these uncertainties, we believe this benefit-cost analysis provides a conservative estimate of the estimated economic benefits of the proposed standards in future years because of the exclusion of potentially significant benefit categories. Acknowledging benefits omissions and uncertainties, we present a best estimate of the total benefits based on our interpretation of the best available scientific literature and methods supported by EPA's technical peer review panel, the Science Advisory Board's Health Effects Subcommittee (SAB–HES). EPA has also addressed many of the comments made by the National Academy of Sciences (NAS) in a September 26, 2002 report on its review of the Agency's methodology for analyzing the health benefits of measures taken to reduce air pollution in our analysis of the final PM NAAQS.[160] The analysis of the proposed standards incorporates this most recent work to the extent possible.

E. Benefit-Cost Analysis

In estimating the net benefits of the proposed standards, the appropriate cost measure is 'social costs.' Social costs represent the welfare costs of a rule to society. These costs do not consider transfer payments (such as taxes) that are simply redistributions of wealth. Table VI–5 contains the estimates of monetized benefits and estimated social welfare costs for the proposed rule and each of the proposed control programs. The annual social welfare costs of all provisions of this proposed rule are described more fully in section V of this preamble.[161]

The results in Table VI–5 suggest that the 2020 monetized benefits of the proposed standards are greater than the expected social welfare costs. Specifically, the annual benefits of the total program would be $4.4 + B billion annually in 2020 using a three percent discount rate (or $4.2 billion assuming a 7 percent discount rate), compared to estimated social costs of approximately $250 million in that same year. These benefits are expected to increase to $12 + B billion annually in 2030 using a three percent discount rate (or $11 billion assuming a 7 percent discount rate), while the social costs are estimated to be approximately $600 million. Though there are a number of health and environmental effects associated with the proposed standards that we are unable to quantify or monetize (represented by ''+B''; see Table VI–4), the benefits of the proposed standards far outweigh the projected costs. When we examine the benefit-to-

[160] U.S. Environmental Protection Agency. October 2006. Final Regulatory Impact Analysis (RIA) for the Proposed National Ambient Air Quality Standards for Particulate Matter. *Prepared by:* Office of Air and Radiation. Available at *HTTP://www.epa.gov/ttn/ecas/ria.html.*

[161] The estimated 2030 social welfare cost of 267.3 million is based on an earlier version of the engineering costs of the rule which estimated $568.3 million engineering costs in 2030 (see table 5–17). The current engineering cost estimate for 2030 is $605 million. See Section V.C.5 for an explanation of the difference. The estimated social costs of the program will be updated for the final rule.

cost comparison for the rule standards separately, we also find that the benefits of the specific engine standards far outweigh their projected costs.

TABLE VI–5.—SUMMARY OF ANNUAL BENEFITS, COSTS, AND NET BENEFITS OF THE PROPOSED LOCOMOTIVE AND MARINE ENGINE STANDARDS

(Millions, 2005$)[a]

Description	2020	2030
Estimated Social Costs [b]		
Locomotive	$150	$380
Marine	100	220
Total Social Costs	250	605
Estimated Health Benefits of the ProposedStandards[c d e]		
Locomotive		
3 percent discount rate	2,300+B	4,700+B
7 percent discount rate	2,100+B	4,300+B
Marine		
3 percent discount rate	2,100+B	7,100+B
7 percent discount rate	1,900+B	$6,400+B
Total Benefits		
3 percent discount rate	4,400+B	12,000+B
7 percent discount rate	4,000+B	11,000+B
Annual Net Benefits (Total Benefits—Total Costs)		
3 percent discount rate	4,150+B	11,000+B
7 percent discount rate	3,750+B	10,000+B

[a] All estimates represent annualized benefits and costs anticipated for the years 2020 and 2030. Totals may not sum due to rounding.
[b] The calculation of annual costs does not require amortization of costs over time. Therefore, the estimates of annual cost do not include a discount rate or rate of return assumption (see Chapter 7 of the RIA). In Section D, however, we do use both a 3 percent and 7 percent social discount rate to calculate the net present value of total social costs consistent with EPA and OMB guidelines for preparing economic analyses.
[c] Annual benefits analysis results reflect the use of a 3 percent and 7 percent discount rate in the valuation of premature mortality and nonfatal myocardial infarctions, consistent with EPA and OMB guidelines for preparing economic analyses (U.S. EPA, 2000 and OMB, 2003).[162 163]
[d] Valuation of premature mortality based on long-term PM exposure assumes discounting over the SAB recommended 20-year segmented lag structure described in the Regulatory Impact Analysis for the Final Clean Air Interstate Rule (March, 2005). Note that the benefits in this table reflect PM mortality derived from the ACS (Pope et al., 2002) study.
[e] Not all possible benefits or disbenefits are quantified and monetized in this analysis. B is the sum of all unquantified benefits and disbenefits. Potential benefit categories that have not been quantified and monetized are listed in Table V–13.

VII. Alternative Program Options

The program we have described in this proposal represents a broad and comprehensive approach to reduce emissions from locomotive and marine diesel engines. As we have developed this proposal, we have evaluated a number of alternatives with regard to the scope and timing of the standards. We have also examined an alternative that would require emission reductions from a significant fraction of the existing marine diesel engine fleet. This section presents a summary of our analysis of these alternative control scenarios. We are interested in comments on all of the alternatives presented. For a more detailed description of our analysis of these alternatives, including a year by year breakout of expected costs and emission reductions, please refer to Chapter 8 of the draft RIA prepared for this rulemaking.

A. Summary of Alternatives

We have developed emission inventory impacts, cost estimates and benefit estimates for two types of alternatives. The first type looks at the impacts of varying the timing and scope of our proposed standards. The second considers a programmatic alternative that would set emission standards for existing marine diesel engines.

(1) Alternatives Regarding Timing, Scope

(a) *Alternative 1:* Exclusion of Locomotive Remanufacturing

Alternative 1 examines the potential impacts of the locomotive remanufacturing program by excluding it from the analysis (see section III.C.(1)(a)(i) for more details on the remanufacturing standards). Compared to the primary program, this analysis shows that through 2040 the locomotive remanufacturing program by itself would reduce $PM_{2.5}$ emissions by 65,000 tons NPV 3% (35,000 tons NPV 7%) and NO_X emissions by nearly 690,000 tons NPV 3% (400,000 tons NPV 7%) at a cost of $800 million NPV 3% ($530 million NPV 7%). The monetized health and welfare benefits of the locomotive remanufacturing program in 2030 are $2.9 billion at a 3% discount rate (DR) or $2.7 at a 7% DR. While this alternative could have the advantage of enabling industry to focus its resources on Tier 3 and Tier 4 technology development, given its substantial benefits in the early years of the program which are critical for NAAQS achievement and maintenance, we have decided to retain the locomotive remanufacturing program in our proposal.

(b) *Alternative 2:* Tier 4 Advanced One Year

Alternative 2 considers the possibility of pulling ahead the Tier 4 standards by one year for both the locomotive and marine programs, while leaving the rest of the proposed program unchanged. This alternative represents a more environmentally protective set of standards, and we have given strong consideration to proposing it. However, our review of the technical challenges to introduce the Tier 4 program, especially considering the locomotive remanufacturing program and the Tier 3 standards which go before it, leads us to

[162] U.S. Environmental Protection Agency, 2000. Guidelines for Preparing Economic Analyses. *www.yosemite1.epa.gov/ee/epa/eed/hsf/pages/Guideline.html.*

[163] Office of Management and Budget, The Executive Office of the President, 2003. Circular A–4. *http://www.whitehouse.gov/omb/circulars.*

conclude that introducing Tier 4 a year earlier is not feasible. We have included this alternative analysis here because of the strong consideration we have given it, and to provide commenters with an opportunity to comment on the timing of the Tier 4 standards within the context of the additional benefits that such a pull ahead could realize. Our analysis suggests that introducing Tier 4 one year earlier than our proposal could reduce emissions by an additional 9,000 tons of $PM_{2.5}$ NPV 3% (5,000 tons NPV 7%) and 420,000 tons of NO_X NPV 3% (210,000 tons NPV 7%) through 2040. We are unable to make an accurate estimate of the cost for such an approach since we do not believe it to be feasible at this time. However, we have reported a cost in the summary table reflecting the same cost estimation method we have used for our primary case and have denoted unestimated additional costs as 'C'. These additional unestimated costs would include costs for additional engine test cells, engineering staff, and engineering facilities necessary to introduce Tier 4 one year earlier. While we are unable to conclude that this alternative is feasible at this time, we request comment on that aspect of this alternative including what additional costs might be incurred in order to have Tier 4 start one year earlier.

(c) *Alternative 3:* Tier 4 Exclusively in 2013

Alternative 3 most closely reflects the program we described in our Advanced Notice of Proposed Rulemaking, whereby we would set new aftertreatment based emission standards as soon as possible. In this case, we believe the earliest that such standards could logically be started is in 2013 (3 months after the introduction of 15 ppm ULSD in this sector). Alternative 3 eliminates our proposed Tier 3 standards and locomotive remanufacturing standards, while pulling the Tier 4 standards ahead to 2013 for all portions of the Tier 4 program. As with alternative 2, we are concerned that it may not be feasible to introduce Tier 4 technologies on locomotive and marine diesel engines earlier than the proposal specifies. However, eliminating the technical work necessary to develop the Tier 3 and locomotive remanufacturing programs would certainly go a long way towards making such an approach possible. This alternative would actually result in substantially higher PM emissions than our primary case although it would provide additional reductions in NO_X emissions. Through 2040 this alternative would decrease $PM_{2.5}$ reductions by more than 60,000 NPV 3% tons (31,000 NPV 7%) while only adding approximately 180,000 additional tons NPV 3% (100,000 NPV 7%) of NO_X reductions. As a result in 2030 alone, this alternative realizes approximately $0.6 billion less at a 3% DR ($0.5 billion less at a 7% DR) in public health and welfare benefits than does our proposal. As was the case with alternative 2, we have used the same cost estimation approach for this alternative as that of our proposal, and have denoted the unestimated costs that are necessary to accelerate the development of Tier 4 technologies with a 'C' in the summary tables. While alternative 3 could have been considered the Agency's leading option going into this rulemaking process, our review of the technical challenges necessary to introduce Tier 4 technologies and the substantial additional benefits that a more comprehensive solution can provide has lead us to drop this approach in favor of the comprehensive proposal we have laid out today.

(d) Alternative 4: Elimination of Tier 4

Alternative 4 would eliminate the Tier 4 standards and retain the Tier 3 and locomotive remanufacturing requirements. This alternative allows us to consider the value of combining the Tier 3 and locomotive remanufacturing standards together as one program, and conversely, allows us to see the additional benefits gained when combining them with the Tier 4 standards. As a stand-alone alternative, the combined Tier 3 and locomotive remanufacturing program is very attractive, resulting in large emission reductions through 2040 of 207,000 tons of $PM_{2.5}$ NPV 3% (94,000 NPV 7%) and 2,910,000 tons NPV 3% (1,310,000 NPV 7%) of NO_X at an estimated cost of $950 million NPV 3% ($650 million NPV 7%) through the same time period. In 2030 alone, such a program is projected to realize health and welfare benefits of $6.2 billion at a 3% DR ($5.7 billion at a 7% DR). Yet, this alternative falls well short of the total benefits that our comprehensive program is expected to realize. Elimination of Tier 4 would result in the loss of 108,000 tons NPV 3% (41,000 tons at NPV 7%) of $PM_{2.5}$ reductions and almost 4,960,000 tons NPV 3% (1,870,000 tons at NPV 7%) of NO_X reductions as compared to our proposal through 2040. Through the addition of the Tier 4 standards, the estimated health and welfare benefits are nearly doubled in 2030. As these alternatives show, each element of our comprehensive program: The locomotive remanufacturing program, the Tier 3 emission standards, and the Tier 4 emission standards, represent a valuable emission control program on its own, while the collective program results in the greatest emission reductions we believe to be possible giving consideration to all of the elements described in today's proposal.

(2) Standards for Engines on Existing Vessels

We are also considering a fifth alternative that would address emissions from certain marine diesel engines installed on vessels that are currently in the fleet. Many of the large marine diesel engines installed on commercial vessels remain in the fleet in excess of 20 years and the contribution of these engines to air pollution inventories can be substantial. This alternative seeks to reduce these impacts.

This section describes the background for such a program and discusses how it could be designed. While this is an alternative under active consideration, we are seeking further information about this market to develop a complete regulatory program. We obtained information from marine transportation stakeholders about their remanufacturing practices that leads us to believe that, for engines above 800 hp, these practices are very similar to those in the rail transportation sector. However, the information we have about the structure of marine remanufacturing market does not provide a complete picture regarding the economic response of the market to such a program. Therefore, we request comment on the characteristics of the marine remanufacturing market with regard to its sensitivity to price changes. We also encourage comments on all aspects of the program described below, including the need for it and the design of its components.

(a) Background

As discussed in section III.C.(1)(b), we currently regulate remanufactured locomotive engines under section 213(a)(5) of the Clean Air Act as new locomotive engines. Specifically, in our 1998 rule we defined "new locomotive" and "new locomotive engine" to mean a locomotive or locomotive engine which has been remanufactured. Remanufactured was defined as meaning (i) to replace, or inspect and qualify each and every power assembly of a locomotive or locomotive engine, whether during a single maintenance event or cumulatively within a five-year period; or (ii) to upgrade a locomotive or locomotive engine; or (iii) to convert a locomotive or locomotive engine to enable it to operate using a fuel other than it was originally manufactured to use; or (iv) to install a remanufactured engine or a freshly manufactured engine into a previously used locomotive. As we explained in that rule, any of these events would result in a locomotive that is essentially new.

We believe a similar situation exists for large marine diesel engines installed on certain types of commercial marine vessels, including tugs, towboats, ferries, crewboats, and supply boats. The engines used for propulsion power in these vessels are often large and are used at high load to provide power for pulling or pushing barges or for assisting ocean-going vessels in harbor. These engines tend to be integral to the vessel and are therefore designed to last the life of the vessel, often 30 or more years. These engines are also relatively expensive, costing from tens of thousands of dollars for a small tug or ferry to several hundred thousand dollars for larger tugs, ferries, and cargo vessels. Because it is very difficult to remove the engines from these vessels (the engines are typically below deck and replacement requires cutting the hull or the deck), owners insist that these marine diesel engines last as long as the vessel. Therefore, these engines are usually characterized by an extremely durable engine block and internal parts.

Marine propulsion engines are frequently remanufactured to provide dependable power, and it is not unusual for an older vessel to have its original propulsion engines which have been remanufactured. Those parts or systems that experience high wear rates are designed to be easily replaced so as to minimize the time that the unit is out of service for repair or remanufacture. This includes power assemblies, which consists of the pistons, piston rings, cylinder liners, fuel injectors and controls, fuel injection pump(s) and controls, and valves. The power assemblies can be remanufactured to bring them back to as-new condition or they can be upgraded to incorporate the latest design configuration for that engine. As part of the routine remanufacturing process, power assemblies and key engine components are disassembled and replaced or requalified (i.e. determined to be within original manufacturing tolerances).

Marine engine remanufacturing procedures have improved to the point that engine performance for rebuilt engines is equivalent to that of new engines. Therefore, we believe it may be appropriate to consider a program that would set emission requirements for certain types of marine diesel engines that would apply when they are remanufactured. The program under consideration is described below. We request comment on whether marine remanufacturing processes should subject remanufactured engines to standards under the Act. We also request comment on any and all aspects of the program described below, including the appropriateness of applying such a program, the standards, and its certification and compliance procedures.

(b) Other Marine Engine Remanufacture Programs

The impact of engines on existing vessels on ambient air quality was recognized in MARPOL Annex VI. Although not specifically referred to as a remanufacturing program, Regulation 13 contains requirements for existing engines by requiring that the Regulation 13 NO_X limits apply to any engine above 130 kW that undergoes a major conversion on or after January 1, 2000. Major conversion is defined as (i) replacing the engine with a new engine (i.e., a repower); (ii) increasing the maximum continuous rating of the engine by more than 10 percent; or (iii) making a substantial modification to the engine (i.e., a change to the engine that would alter its emission characteristics).

EPA also recognized the importance of the inventory contribution from existing marine engines in our 1999 rule, and we requested comment on national requirements for existing marine diesel engines that would be similar to the locomotive remanufacturing program.[164] While we noted the potential advantages of such a program, we did not finalize a remanufacturing program for existing marine diesel engines. At the time we did not have a good understanding of the differences between the large marine diesel engines used on tugs, towboats, crew and supply boats, cargo boats, and ferries and the smaller engines used on fishing vessels and patrol boats, and the lack of uniformity in the remanufacturing practices used by owners of smaller engines led us to conclude that the industry was too fractured to allow a remanufactured engine program. However, we acknowledged the continuing importance of the contribution of existing marine diesel engines and noted in section VI of our 1999 rule (Areas for Future Action) that we would consider this issue again in the future.

Since we finalized our 1999 rule many states have continued to express concern about emissions from existing marine diesel engines and the impact of these emissions on their ability to attain and maintain their air quality goals. More recently, these states submitted comments to the ANPRM and letters to the Agency expressing the need for controlling existing engines. California is considering a program that would require all existing harborcraft (including tug/tow, ferries, crew, supply, pilot, work, and other vessels) to repower with an engine certified to the then-applicable federal standards. They are considering effective dates from 2008 through 2014, depending on the age of an existing vessel and its size. Alternatively, California would allow vessel owners to apply a retrofit technology that achieves equivalent emission reductions, or adopt an alternative compliance plan. The requirements under consideration for fishing vessels would be less stringent and phase in from 2011 through 2018.

We've also received information from vessel owner groups that suggests that the obstacles to a marine diesel engine remanufacturing program we noted in our 1999 rule may be less than critical, particularly for larger engines. Specifically, as noted above, many owners of large marine diesel engines have their engines rebuilt on a routine schedule and this maintenance is often performed by companies that also remanufacture locomotive engines. In addition, many owners of marinized locomotive engines use parts from the same remanufacturing kits that would apply to locomotives. Various retrofit programs, such as the Carl Moyer program in California, the TERP program in Texas, and EPA's retrofit program, may also make it easier to identify and install retrofit technologies on existing marine engines when they are remanufactured.

(c) Marine Diesel Engines To Be Included in the Program

The program for remanufactured marine diesel engines described below would apply to engines above 800 hp. We believe this threshold is appropriate because discussions with various user groups have indicated that these engines are most likely to be subject to the regular remanufacturing events described above. Engines below 800 hp are more likely to be installed on vessels used in fishing or recreational applications. These vessels often do not

[164] Pursuant to 40 CFR 92.2, remanufacture means "(1)(i) to replace, or inspect and qualify, each and every power assembly of a locomotive or locomotive engine, whether during a single maintenance event or cumulatively within a five-year period; or (ii) to upgrade a locomotive or locomotive engine; or (iii) to convert nally manufactured to use; or (iv) to install a remanufactured engine or a freshly manufactured engine into a previously used locomotive."

have the intense usage as tug/tow/pushboats, ferries, crew/supply vessels or cargo vessels. Maintenance is more likely to be ad hoc and performed only when there is a problem with the performance of the engine. These vessels are also most likely to be owner operated, and any maintenance that occurs may be performed by the owner. In addition, as explained elsewhere in this preamble, marine diesel engines above 800 hp are the largest contributors to national inventories of NO_X and PM emissions. Many of the vessels that use these engines, including tugs, ferries, crew and supply boats and cargo vessels, are in direct competition with locomotives, providing transportation services for passengers or bulk goods and materials.

A random sample of nearly 400 vessels from the Inland River Record (2006) suggests that the average age of vessels in that fleet is 30 years (with vessels built between 1944 and 2004), and the average horsepower of these vessels is 1709 hp (with a range of 165 to 9,180 hp). About 72 percent of the vessels have horsepower at or above 800 hp, with about 75% of those being built after 1973. In addition, about 60 percent of the vessels with engines at or above 800 hp have engines derived from locomotive engines. This suggests that there are significant emission reductions that may be achieved by setting requirements similar to the locomotive program for these engines.

Although the analysis of this alternative includes all engines above 800 hp, this remanufacturing program for marine diesel engines could further be limited to a subset of engines above 800 hp, for example those manufactured after 1973. The locomotive remanufacturing program has this age limitation, reflecting the fact that older locomotives are expected to be retired out of the Class I line haul fleet relatively soon. However, this may not make sense in the marine sector as there are a lot of vessels older than 1973 in the fleet (about 130 in our sample of about 400 vessels), and they are not systematically retired to lower use applications.

On the other hand, this option could be expanded to include other marine diesel engines including those below 800 horsepower. We do not believe this expansion is appropriate, for the reasons outlined above (i.e., maintenance may be more ad hoc and performed by the owner/operator instead of by a professional remanufacturer at a shipyard). However, we request comment on this issue.

The program described in this alternative could be further modified by specifying that all engines on a vessel would be considered to be subject to the remanufacturing requirements if the main propulsion engine falls under the scope of the program. In essence, this approach would treat all engines onboard a vessel as a system. While remanufacture kits may not be available for smaller auxiliary engines, it may be possible to retrofit them with emission controls that will achieve the 25 percent PM reduction. In addition, repowering auxiliary engines onboard these vessels may not be a limiting factor as these engines are often removed to be rebuilt and other engines installed in their place. We request comment on this aspect of expanding the program.

(d) Alternative 5: Existing Engines

Due to the impact of marine diesel engines on the environment, the need for reductions for states to achieve their attainment goals, and our better understanding of the marine remanufacturing sector, we are considering a programmatic alternative that would set emission requirements for marine diesel engines on existing vessels when they are remanufactured.

The program under consideration in this alternative would apply to marine diesel engines above 800 hp. We believe this is a reasonable threshold because of the long hours of use of these engines, often at high load, and their long service lives. The program would draw on features of the locomotive remanufacturing program, in that it would apply when a marine diesel engine is remanufactured. It would also draw on the certification requirements of the urban bus retrofit program (see 58 FR 21359 (April 21, 1993), 63 FR 14626 (March 26, 1998), 40 CFR part 85 subpart O), in that the standard would in part be a function of the emissions from the base engine and that the standard might be subject to a cost threshold.

This marine engine remanufacturing alternative consists of a two-part program. In the first part, which could begin as early as 2008, vessel owners and rebuilders (also called remanufacturers) would be required to use a certified kit when the engine is rebuilt (or remanufactured) if such a kit is available. Initially, these kits would be expected to be locomotive kits and therefore applicable only to those engines derived from similar locomotive engines. Eventually, however, it is expected that the large engine manufacturers would also provide kits for their engines. Kit availability would be expected to track the relative share of models to the total population of engines, so that kits for the most popular engine models would be made available first. Because the potential for emission reductions are expected to be quite varied across the diverse range of existing marine diesel engines, we could consider setting a multi-stepped emission standard similar to the Urban Bus program. For example, the program could set standards based on reductions of 60%, 40% and 20% with a requirement that a rebuilder must use a certified kit meeting the most stringent of these three standards if available. If no kit is available meeting the 60% reduction, then the rebuilder can use one meeting the 40% reduction, and similarly, if no kits are available meeting the 40% or 60% standards, then the rebuilder can use a kit meeting the 20% reduction. In this way, engines which can achieve a 60% reduction are likely to realize that reduction because a kit builder will be motivated to develop a kit meeting the most stringent standard possible. We request comment regarding the appropriateness of such an approach, and were we to adopt such a structure, the need for greater or less stratification across the potential emission standards.

In the second part, which could begin in 2013, the remanufacturer/owner of a marine diesel engine identified by the EPA as a high-sales volume engine model would have to meet specified emission requirements when the engine is remanufactured. Specifically, the remanufacturer or owner would be required to use a system certified to meet the standard; if no certified system is available, he or she would need to either retrofit an emission reduction technology for the engine that demonstrates at least a 25 percent reduction or repower (replace the engine with a new one). The mandatory use of an available kit is intended to create a market for kits to help ensure their development over the initial five years of the program.

To ensure that the program results in the expected emission reductions, an emission threshold could be set as well such that the retrofit technology would be required to demonstrate a 25 percent reduction with emissions not to exceed 0.22 g/kW-hr PM (equivalent to the new Tier 0/1 PM limit). We believe a threshold, if one is included, should focus on PM emissions over NO_X because PM reductions can be accomplished through the use of improved engine components, for example changing cylinder rings or liners to reduce oil consumption and PM emissions. We do not believe a NO_X threshold is appropriate because technologies to reduce NO_X may not be as amenable to a remanufacturing kit approach. However, we would welcome comments regarding the need for a threshold, and the limit at which it should be set, and the appropriateness of a NO_X standard as well.

The second part of the program is contingent on EPA developing a list of high volume marine diesel engines for which a remanufacture certificate must be available by 2013. EPA will continue to work with engine manufactures and other interested stakeholders to develop such a list, and seeks comment on the engine models that should be included. The goal of this list is to identify those engine models that occur frequently enough in the market to justify the development of a remanufacture kit; engine models with just a few units in the population may not be required to comply with the requirements.

Finally, the second step of the program could be made subject to a technical review in 2011. The object of such a review would be for EPA to assess the current and future availability of certified kits and to determine if any adjustments are necessary for the program including the effective date of the mandatory repower requirement and whether any change in the list of high-volume engine models is warranted due to new information.

With regard to technological feasibility, we believe engine manufacturers would utilize incremental improvements to existing engine components. Because such a remanufactured marine engine program would parallel our existing remanufactured locomotive program, we expect a direct transfer of emissions control technology from locomotives to marine engines for similar engines. In fact, in our discussions with vessel operators, they indicated that they are sometimes already using the EPA-certified lower emissions remanufacturing kits that are currently on the market to meet our locomotive remanufacturing program.

Engines that do not have a locomotive counterpart will in many cases start at a cleaner baseline than locomotive-based marine engines. Therefore, the same total reduction that could be expected from the locomotive remanufacture kits could not be expected from these engines. However, we would expect that similar PM emissions control technologies would be used to meet the requirements of the program. Technologies to achieve PM reductions include existing low-oil-consumption piston ring-pack designs and existing closed crankcase systems. Our discussions with marine diesel engine manufacturers suggest reductions of 25 percent with emissions not to exceed 0.22 g/kW-hr PM are feasible. These technologies would provide significant near-term PM reductions. Because all of the aforementioned technologies to reduce emissions already exist or can be developed and introduced into the market within a very short time period, we believe some of this technology could be implemented on a limited basis as early as 2008 on remanufactured marine engines. We also believe that these technologies could be fully implemented in a marine remanufacturing program by the end of 2012. In addition, it may be possible to include NO_X emission control technologies in these kits to achieve greater reductions.

To help ensure the remanufacturer's solutions are reasonably priced, the program could set a limit on the price the owner/remanufacturer could be expected to pay for the kit, similar to the urban bus program. Such a limit may be necessary because a program that would require the use of a certified kit may provide a potential short-term monopoly for kit certifiers, at least until other kits are certified. Such a monopoly environment may create the potential for kit prices to be unrelated to actual kit cost. However, unlike the urban bus program, the diverse nature of marine diesel engines makes setting a single cost limit per engine unreasonable. Instead, we would look to develop a factor that corresponds to engine size, power, or emissions. For example, we could consider setting a limit based on the PM reduction (the cost per ton of PM reduced). We could consider a limit of $45,000 per ton of PM reduced. This cost is far below the monetized health and welfare benefits we have estimated will be realized from a reduction in diesel PM emissions. We request comment on such an approach for setting a reasonable cost threshold.

As in the locomotive remanufacturing program, anyone could certify a remanufacturing kit, but only certified kits may be used to comply with the requirement. We expect this to be primarily engine manufacturers or aftermarket part manufacturers. However, a fleet owner with several vessels with the same model engine could choose to certify a kit, the use of which would then become mandatory for all engines of that model, unless another equivalent kit is also available for that model. In addition, certification could be streamlined for kit manufacturers. We would look to the Agency's past practices with the Urban Bus Program and the Voluntary Retrofit Verification Program when designing a certification procedure. However, as in the locomotive remanufacture program, the certifier is deemed to be a ''manufacturer'' subject to the emission standards and as such would be subject to all of the obligations on such an entity under our primary program, including warranty, recall, in-use liability, among others. With regard to the retrofit requirement, we request comment on how we could streamline the certification for these technologies such that their use will not impose a larger certification burden on the owner of the vessel. We welcome comments on all aspects of the implementation of this possible remanufacturing program.

The costs and benefits of a program as outlined above are included in Table VII–1 and Table VII–2. We estimate that the compliance costs for the marine remanufacturing program would be around $10 million per year in 2030. Using the benefits transfer approach from the primary control scenario to estimate the benefits of these inventory reductions, the additional monetized benefits would be expected to be about $0.3 billion at a 3% DR ($0.3 at a 7% DR) in 2030.

With regard to benefits, the application of locomotive remanufacture kits to similar marine diesel engines would be expected to result in similar reductions in PM and NO_X emissions. In some cases, this could be as much as 60 percent reduction for PM and 25 percent reduction for NO_X. However, because many marine diesel engines start at a cleaner baseline, we would not expect to accomplish the same reductions from all engines that would be subject to the program. Based on a minimal control case of a 25 percent PM reduction from existing marine diesel engines above 800 hp, we estimate about an additional 27,000 tons NPV 3% (16,000 tons at NPV 7%) of $PM_{2.5}$ reductions, and an additional 320,000 tons NPV 3% (220,000 tons at NPV 7%) of NO_X reductions through 2040.

B. Summary of Results

A summary of the five alternatives is contained in Table VII–1 and Table VII–2 below. Table VII–1 includes the expected emission reductions associated with each alternative, including: the estimated PM and NO_X reductions through 2040 for each alternative expressed as a net present value (NPV) using discounting rates of 3% and 7%. It also includes the estimated costs through 2040 associated with each alternative again expressed at 3% NPV and 7% NPV. For additional comparison, Table VII–2 shows the PM and NO_X inventory reductions, costs, and benefits of each alternative estimated for the year 2030.

TABLE VII–1.—SUMMARY OF INVENTORY AND COSTS AT NPV 3% AND 7%

Alternatives	Standards	Estimated $PM_{2.5}$ reductions 2006–2040 NPV 3% (7%)	Estimated NO_X reductions 2006–2040 NPV 3% (7%)	Total costs millions 2006–2040 NPV 3% (7%) [a]
Primary Case	• Locomotive Remanufacturing	315,000	7,870,000	$7,230
	• Tier 3 Near-term program	(135,000)	(3,180,000)	($3,230)
	• Tier 4 Long-term standards			
Alternative 1: Exclusion of Locomotive Remanufacturing.	• Tier 3 Near-term program	250,000	7,180,000	$6,430
	• Tier 4 Long-term standards	(100,000)	(2,780,000)	($2,700)
Alternative 2: Tier 4 Advanced One Year	• Locomotive Remanufacturing	324,000	8,290,000	$7,590+C
	• Tier 3 Near-term program	(140,000)	(3,390,000)	($3,440)+C
	• Tier 4 Long-term standards advanced one year.			
Alternative 3: Tier 4 Exclusively in 2013	• Tier 4 Long-term standards only in 2013	255,000	8,050,000	$7,410+C
		(104,000)	(3,280,000)	($3,220)+C
Alternative 4: Elimination of Tier 4	• Locomotive Remanufacturing	207,000	2,910,000	$950
	• Tier 3 Near-term program	(94,000)	(1,310,000)	($650)
Alternative 5: Inclusion of Marine Remanufacturing.	• Locomotive Remanufacturing	342,000	8,190,000	$7,650
	• Tier 3 Near-term program	(151,000)	(3,400,000)	($3,510)
	• Tier 4 Long-term standards			
	• Addition of Marine Remanufacturing			

[a] 'C' represents the additional costs necessary to accelerate the introduction of Tier 4 technologies that we are unable to estimate at this time.

TABLE VII–2.—INVENTORY, COSTS AND BENEFITS FOR 2030

	2030 $PM_{2.5}$ Emissions reductions (tons)	2030 NO_X Emissions reductions (tons)	2030 Total costs (millions)	2030 Benefits [a b] (billions) $PM_{2.5}$ only 3% (7%)
Primary Case	28,000	770,000	$610	$12 ($11)
Alternative 1: Exclusion of Locomotive Remanufacturing	25,000	740,000	$580	$8.8 ($8.0)
Alternative 2: Tier 4 Advanced One Year	28,000	790,000	$620	$12 ($11)
Alternative 3: Tier 4 Exclusively in 2013	25,000	770,000	$630	$11 ($10)
Alternative 4: Elimination of Tier 4	17,000	240,000	$22	$6.2 ($5.7)
Alternative 5: Inclusion of Marine Remanufacturing	29,000	770,000	$620	$12 ($11)

[a] Note that the range of PM-related benefits reflects the use of an empirically-derived estimate of PM mortality benefits, based on the ACS cohort study (Pope et al., 2002).
[b] Annual benefits analysis results reflect the use of a 3 percent and 7 percent discount rate in the valuation of premature mortality and nonfatal myocardial infarctions, consistent with EPA and OMB guidelines for preparing economic analyses (US EPA, 2000 and OMB, 2003). U.S. Environmental Protection Agency, 2000. Guidelines for Preparing Economic Analyses. *http://yosemite.epa.gov/ee/epa/eed.nsf/webpages/Guidelines.html*.

VIII. Public Participation

We request comment on all aspects of this proposal. This section describes how you can participate in this process.

A. How Do I Submit Comments?

We are opening a formal comment period by publishing this document. We will accept comments during the period indicated in the **DATES** section at the beginning of this document. If you have an interest in the proposed emission control program described in this document, we encourage you to comment on any aspect of this rulemaking. We also request comment on specific topics identified throughout this proposal.

Your comments will be most useful if you include appropriate and detailed supporting rationale, data, and analysis. Commenters are especially encouraged to provide specific suggestions for any changes to any aspect of the regulations that they believe need to be modified or improved. You should send all comments, except those containing proprietary information, to our Air Docket (see **ADDRESSES** located at the beginning of this document) before the end of the comment period.

You may submit comments electronically, by mail, or through hand delivery/courier. To ensure proper receipt by EPA, identify the appropriate docket identification number in the subject line on the first page of your comment. Please ensure that your comments are submitted within the specified comment period. Comments received after the close of the comment period will be marked ''late.'' EPA is not required to consider these late comments. If you wish to submit Confidential Business Information (CBI) or information that is otherwise protected by statute, please follow the instructions in section VIII.B.

B. How Should I Submit CBI to the Agency?

Do not submit information that you consider to be CBI electronically through the electronic public docket, *http://www.regulations.gov*, or by e-mail. Send or deliver information identified as CBI only to the following address: U.S. Environmental Protection Agency, Assessment and Standards Division, 2000 Traverwood Drive, Ann Arbor, MI 48105, Attention Docket ID EPA–HQ–OAR–2005–0036. You may claim information that you submit to EPA as CBI by marking any part or all of that information as CBI (if you submit CBI on disk or CD ROM, mark the outside of the disk or CD ROM as CBI and then identify electronically within the disk or CD ROM the specific information that is CBI). Information so marked will not be disclosed except in accordance with procedures set forth in 40 CFR part 2.

In addition to one complete version of the comment that includes any information claimed as CBI, a copy of the comment that does not contain the information claimed as CBI must be submitted for inclusion in the public docket. If you submit the copy that does not contain CBI on disk or CD ROM, mark the outside of the disk or CD ROM clearly that it does not contain CBI. Information not marked as CBI will be included in the public docket without prior notice. If you have any questions about CBI or the procedures for claiming CBI, please consult the person identified in the **FOR FURTHER INFORMATION CONTACT** section at the beginning of this document.

C. Will There Be a Public Hearing?

We will hold a public hearing on Tuesday, May 8, 2007 at the Hilton Seattle Airport & Conference Center, 17620 International Boulevard, Seattle, WA 98188–4001, *Telephone:* 206–244–4800. We will also hold a public hearing on Thursday, May 10, 2007 at the Sheraton Gateway Suites Chicago O'Hare, 6501 North Mannheim Road, Rosemont, IL 60018, *Telephone:* 847–699–6300. These hearings will both start at 10 a.m. local time and continue until everyone has had a chance to speak.

If you would like to present testimony at the public hearing, we ask that you notify the contact person listed under **FOR FURTHER INFORMATION CONTACT** at least ten days before the hearing. You should estimate the time you will need for your presentation and identify any needed audio/visual equipment. We suggest that you bring copies of your statement or other material for the EPA panel and the audience. It would also be helpful if you send us a copy of your statement or other materials before the hearing.

We will make a tentative schedule for the order of testimony based on the notifications we receive. This schedule will be available on the morning of the hearing. In addition, we will reserve a block of time for anyone else in the audience who wants to give testimony.

We will conduct the hearing informally, and technical rules of evidence won't apply. We will arrange for a written transcript of the hearing and keep the official record of the hearing open for 30 days to allow you to submit supplementary information. You may make arrangements for copies of the transcript directly with the court reporter.

D. Comment Period

The comment period for this rule will end on July 2, 2007.

E. What Should I Consider as I Prepare My Comments for EPA?

You may find the following suggestions helpful for preparing your comments:

- Explain your views as clearly as possible.
- Describe any assumptions that you used.
- Provide any technical information and/or data you used that support your views.
- If you estimate potential burden or costs, explain how you arrived at your estimate.
- Provide specific examples to illustrate your concerns.
- Offer alternatives.
- Make sure to submit your comments by the comment period deadline identified.
- To ensure proper receipt by EPA, identify the appropriate docket identification number in the subject line on the first page of your response. It would also be helpful if you provided the name, date, and **Federal Register** citation related to your comments.

IX. Statutory and Executive Order Reviews

A. Executive Order 12866: Regulatory Planning and Review

Under section 3(f)(1) of Executive Order (EO) 12866 (58 FR 51735, October 4, 1993), this action is an ''economically significant regulatory action'' because it is likely to have an annual effect on the economy of $100 million or more. Accordingly, EPA submitted this action to the Office of Management and Budget (OMB) for review under EO 12866 and any changes made in response to OMB recommendations have been documented in the docket for this action.

In addition, EPA prepared an analysis of the potential costs and benefits associated with this action. This analysis is contained in the draft Regulatory Impact Analysis that was prepared, and is available in the docket for this rulemaking and at the docket internet address listed under **ADDRESSES** above.

B. Paperwork Reduction Act

The information collection requirements in this proposed rule have been submitted for approval to the Office of Management and Budget (OMB) under the *Paperwork Reduction Act,* 44 U.S.C. 3501 *et seq.* The Information Collection Request (ICR) document prepared by EPA has been assigned EPA ICR numbers 1800.04 for locomotives and 1684.10 for marine diesels.

Section 208(a) of the Clean Air Act requires that manufacturers provide information the Administrator may reasonably require to determine compliance with the regulations; submission of the information is therefore mandatory. We will consider confidential all information meeting the requirements of section 208(c) of the Clean Air Act. Recordkeeping and reporting requirements for manufacturers would be pursuant to the authority of section 208 of the Clean Air Act.

The total annual burden associated with this proposal is about 25,209 hours for locomotives and 35,030 hours for marine diesels; $2,724,503 for locomotives, based on a projection of 7 respondents; and $2,018,607 for marine diesels based on a projection of 13 respondents. The estimated burden is a total estimate for both new and existing reporting requirements. Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information.

An agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. The OMB control numbers for EPA's regulations in 40 CFR are listed in 40 CFR part 9.

To comment on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including the use of automated collection techniques, EPA has established a public docket for this rule, which includes this ICR, under Docket ID number EPA–HQ–OAR–2003–0190. Submit any comments related to the ICR for this proposed rule to EPA and OMB. See **ADDRESSES** section at the beginning of this notice for where to submit comments to EPA. Send comments to OMB at the Office of Information and Regulatory Affairs, Office of Management and Budget, 725 17th Street, NW., Washington, DC 20503, Attention: Desk Office for EPA. Since OMB is required to make a decision concerning the ICR between 30 and 60 days after April 3, 2007, a comment to OMB is best assured of having its full effect if OMB receives it by May 3, 2007. The final rule will respond to any OMB or public comments on the information collection requirements contained in this proposal.

C. Regulatory Flexibility Act

(1) Certification

The Regulatory Flexibility Act (RFA) generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

For purposes of assessing the impacts of this action on small entities, small entity is defined as: (1) A small business that meets the default definition for small business (based on SBA size standards), as described in Table IX–1; (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field. The following table provides an overview of the primary SBA small business categories potentially affected by this regulation.

TABLE IX–1.—PRIMARY SBA SMALL BUSINESS CATEGORIES POTENTIALLY AFFECTED BY THIS REGULATION

Industry	NAICS [a] Codes	Defined by SBA as a small business if less than or equal to: [b]
Locomotive:		
Manufacturers, remanufacturers and importers of locomotives and locomotive engines.	333618, 336510	1,000 employees.
Railroad owners and operators	482110, 482111, 482112	1,500 employees. 500 employees.
Engine repair and maintenance	488210	$6.5 million annual sales.
Marine:		
Manufacturers of new marine diesel engines	333618	1,000 employees.
Ship and boat building; ship building and repairing	336611, 346611	1,000 employees.
Engine repair and maintenance	811310	$6.5 million annual sales.
Water transportation, freight and passenger	483	500 employees.
Boat building (watercraft not built in shipyards and typically of the type suitable or intended for personal use).	336612	500 employees.

Notes:
[a] North American Industry Classification System.
[b] According to SBA's regulations (13 CFR 121), businesses with no more than the listed number of employees or dollars in annual receipts are considered "small entities" for RFA purposes.

The proposed regulations would apply to the business sectors shown in Table IX–1 and not to small governmental jurisdictions or small non-profit organizations.

After considering the economic impacts of this proposed rule on small entities, I certify that this action will not have a significant economic impact on a substantial number of small entities. (Our analysis of the impacts of the proposal on small entities can be found in the docket for this rulemaking.[165]) We have determined that about six small entities representing less than one percent of the total number of companies affected will have an estimated impact exceeding one percent of their annual sales revenues. About four of these small companies will have an estimated impact exceeding three percent of their annual sales revenues.

Although this proposed rule will not have a significant economic impact on a substantial number of small entities, EPA nonetheless has tried to reduce the impact of this rule on small entities, as described in section IX.C.(2) below.

We continue to be interested in the potential impacts of the proposed rule on small entities and welcome comments on issues related to such impacts.

(2) Outreach Efforts and Special Compliance Provisions for Small Entities

We sought the input of a number of small entities, which would be affected by the proposed rule, on potential regulatory flexibility provisions and the needs of small businesses. For marine diesel engine manufacturers, we had separate meetings with the four small companies in this sector, which are post-manufacture marinizers (companies that purchase a complete or semi-complete engine from an engine manufacturer and modify it for use in the marine environment by changing the engine in ways that may affect emissions). We also met individually with one small commercial vessel builder and a few vessel trade associations whose members include small vessel builders. For locomotive manufacturers and remanufacturers, we met separately with the three small businesses in these sectors, which are remanufacturers. In addition, we met with a railroad trade association whose members include small railroads. For nearly all meetings, EPA provided each small business with an outreach packet that included background information on this proposed rulemaking; and a document outlining some flexibility provisions for small businesses that we have implemented in past rulemakings. (This outreach packet and a complete summary of our discussions with small entities can be found in the docket for this rulemaking.)[166]

[165] U.S. EPA, Assessment and Standards Division, Memorandum from Chester J. France to Alexander Cristofaro of U.S. EPA's Office of Policy, Economics, and Innovation, Locomotive and Marine Diesel RFA/SBREFA Screening Analysis, September 25, 2006.

[166] U.S. EPA, Summary of Small Business Outreach for Locomotive and Marine Diesel NPRM, Memorandum to Docket EPA–HQ–OAR–2003–0190 from Bryan Manning, January 18, 2007.

The primary feedback we received from small entities was to continue the flexibility provisions that we have provided to small entities in earlier locomotive and marine diesel rulemakings; and a number of these provisions are listed below. Therefore, we propose to largely continue the existing flexibility provisions finalized in the 1998 Locomotive and Locomotive Engines Rule (April 16,1998; 63 FR 18977); our 1999 Commercial Marine Diesel Engines Rule (December 29,1999; 64 FR 73299) and our 2002 Recreational Diesel Marine program (November 8, 2002; 67 FR 68304). For a complete description of the flexibilities be proposed in this notice, please refer to the Certification and Compliance Program, section IV.A.(14)—Small Business Provisions.

(a) *Transition Flexibilities*

(i) *Locomotive Sector*

- Small locomotive remanufacturers would be granted a waiver from production-line and in-use testing for up to five calendar years after this proposed program becomes effective.
- Railroads qualifying as small businesses would be exempt from new Tier 0, 1, and 2 remanufacturing requirements for locomotives in their existing fleets.
- Railroads qualifying as small businesses would continue being exempt from the in-use testing program.

(ii) *Marine Sector*

- Post-manufacture marinizers and small-volume manufacturers (annual worldwide production of fewer than 1,000 engines) would be allowed to group all engines into one engine family based on the worst-case emitter.
- Small-volume manufacturers producing engines less than or equal to 800 hp (600 kW) would be exempted from production-line and deterioration testing (assigned deterioration factors) for Tier 3 standards.
- Post-manufacture marinizers qualifying as small businesses and producing engines less than or equal to 800 hp (600 kW) would be permitted to delay compliance with the Tier 3 standards by one model year.
- Post-manufacture marinizers qualifying as small businesses and producing engines less than or equal to 800 hp (600 kW) could delay compliance with the Not-to-Exceed requirements for Tier 3 standards by up to three model years.
- Marine engine dressers (modify base engine without affecting the emission characteristics of the engine) would be exempted from certification and compliance requirements.
- Post-manufacture marinizers, small-volume manufacturers, and small-volume boat builders (less than 500 employees and annual worldwide production of fewer than 100 boats) would have hardship relief provisions—i.e., apply for additional time.

EPA invites comments on all aspects of the proposal and its impacts on the regulated small entities.

D. Unfunded Mandates Reform Act

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), P.L. 104–4, establishes requirements for Federal agencies to assess the effects of their regulatory actions on State, local, and tribal governments and the private sector. Under section 202 of the UMRA, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with ''Federal mandates'' that may result in expenditures to State, local, and tribal governments, in the aggregate, or to the private sector, of $100 million or more in any one year. Before promulgating an EPA rule for which a written statement is needed, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective or least burdensome alternative if the Administrator publishes with the final rule an explanation why that alternative was not adopted. Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including tribal governments, it must have developed under section 203 of the UMRA a small government agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant Federal intergovernmental mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements.

This rule contains no federal mandates for state, local, or tribal governments as defined by the provisions of Title II of the UMRA. The rule imposes no enforceable duties on any of these governmental entities. Nothing in the rule would significantly or uniquely affect small governments. EPA has determined that this rule contains federal mandates that may result in expenditures of more than $100 million to the private sector in any single year. Accordingly, EPA has evaluated under section 202 of the UMRA the potential impacts to the private sector. EPA believes that the proposal represents the least costly, most cost-effective approach to achieve the statutory requirements of the rule. The costs and benefits associated with the proposal are included in the Draft Regulatory Impact Analysis, as required by the UMRA. EPA has determined that this rule contains no regulatory requirements that might significantly or uniquely affect small governments.

E. Executive Order 13132: (Federalism)

Executive Order 13132, entitled ''Federalism'' (64 FR 43255, August 10, 1999), requires EPA to develop an accountable process to ensure ''meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications.'' ''Policies that have federalism implications'' is defined in the Executive Order to include regulations that have ''substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government.''

This proposed rule does not have federalism implications. It will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132. Although section 6 of Executive Order 13132 does not apply to this rule, EPA did consult with representatives of various State and local governments in developing this rule. EPA consulted with representatives from the National Association of Clean Air Agencies (NACAA, formerly STAPPA/ALAPCO), the Northeast States for Coordinated Air Use Management (NESCAUM), and the California Air Resources Board (CARB).

In the spirit of Executive Order 13132, and consistent with EPA policy to promote communications between EPA and State and local governments, EPA specifically solicits comment on this proposed rule from State and local officials.

F. Executive Order 13175 (Consultation and Coordination With Indian Tribal Governments)

Executive Order 13175, entitled ''Consultation and Coordination with Indian Tribal Governments'' (65 FR 67249, November 9, 2000), requires EPA to develop an accountable process to ensure ''meaningful and timely input by tribal officials in the development of regulatory policies that have tribal implications.'' This proposed rule does not have tribal implications, as specified in Executive Order 13175. The rule will be implemented at the Federal level and impose compliance costs only on manufacturers of locomotives, locomotive engines, marine engines, and marine vessels. Tribal governments will be affected only to the extent they purchase and use the regulated engines and vehicles. Thus, Executive Order 13175 does not apply to this rule.

EPA specifically solicits additional comment on this proposed rule from tribal officials.

G. Executive Order 13045: Protection of Children From Environmental Health and Safety Risks

Executive Order 13045: ''Protection of Children from Environmental Health Risks and Safety Risks'' (62 FR 19885, April 23, 1997) applies to any rule that: (1) Is determined to be ''economically significant'' as defined under Executive Order 12866, and (2) concerns an environmental health or safety risk that EPA has reason to believe may have a disproportionate effect on children. If the regulatory action meets both criteria, the Agency must evaluate the environmental health or safety effects of the planned rule on children, and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by the Agency.

This proposed rule is not subject to Executive Order 13045 because the Agency does not have reason to believe the environmental health risks or safety risks addressed by this action present a disproportionate risk to children. Nonetheless, we have evaluated the environmental health or safety effects of emissions from locomotive and marine diesels on children. The results of this evaluation are contained in the draft RIA for this proposed rule, which has been placed in the public docket under Docket ID number EPA–HQ–OAR–2003–0190.

The public is invited to submit or identify peer-reviewed studies and data, of which EPA may not be aware, that assessed results of early life exposure to the pollutants addressed by this rule.

H. Executive Order 13211: Actions That Significantly Affect Energy Supply, Distribution, or Use

Executive Order 13211, ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use'' (66 FR 28355 (May 22, 2001)), requires EPA to prepare and submit a Statement of Energy Effects to the Office of Information and Regulatory Affairs, Office of Management and Budget, for certain actions identified as ''significant energy actions.'' This proposed rule's potential effects on energy supply, distribution, or use have been analyzed and are discussed in detail in section 5.9 of the draft RIA. In summary, while we project that this proposed rule would result in an energy effect that exceeds the 4,000 barrel per day threshold noted in E.O. 13211 in or around the year 2026 and thereafter, the program consists of performance based standards with averaging, banking, and trading provisions that make it likely that our estimated impact is overstated. Further, the fuel consumption estimates upon which we are basing this energy effect analysis, which are discussed in full in section 5.4.3 of the draft RIA, do not reflect the potential fuel savings associated with automatic engine stop/start (AESS) systems or other idle reduction technologies. Such technologies can provide significant fuel savings which could offset our projected estimates of increased fuel consumption. Nonetheless, our projections show that the proposed rule could result in energy usage exceeding the 4,000 barrel per day threshold noted in E.O. 13211.

I. National Technology Transfer Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (''NTTAA''), Public Law No. 104–113, 12(d) (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (*e.g.*, materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. The NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

The proposed rulemaking involves technical standards. Therefore, the Agency conducted a search to identify potentially applicable voluntary consensus standards. The International Organization for Standardization (ISO) has a voluntary consensus standard that can be used to test engines. However, the test procedures in this proposal reflect a level of development that goes substantially beyond the ISO or other published procedures. The proposed procedures incorporate new specifications for transient emission measurements, measuring PM emissions at very low levels, measuring emissions using field-testing procedures. The procedures we adopt in this rule will form the working template for ISO and national and state governments to define test procedures for measuring engine emissions. As such, we have worked extensively with the representatives of other governments, testing organizations, and the affected industries.

EPA welcomes comments on this aspect of the proposed rulemaking and, specifically, invites the public to identify potentially-applicable voluntary consensus standards and to explain why such standards should be used in this regulation.

X. Statutory Provisions and Legal Authority

Statutory authority for the controls proposed in today's document can be found in sections 213 (which specifically authorizes controls on emissions from nonroad engines and vehicles), 203–209, 216, and 301 of the Clean Air Act (CAA), 42 U.S.C. 7547, 7522, 7523, 7424, 7525, 7541, 7542, 7543, 7550, and 7601.

List of Subjects

40 CFR Part 92

Environmental protection, Administrative practice and procedure, Air pollution control, Confidential business information, Imports, Incorporation by reference, Labeling, Penalties, Railroads, Reporting and recordkeeping requirements, Warranties.

40 CFR Part 94

Environmental protection, Administrative practice and procedure, Air pollution control, Confidential business information, Imports, Incorporation by reference, Labeling, Penalties, Vessels, Reporting and recordkeeping requirements, Warranties.

40 CFR Part 1033

Environmental protection, Administrative practice and procedure, Confidential business information, Incorporation by reference, Labeling, Penalties, Reporting and recordkeeping requirements.

40 CFR Part 1039

Environmental protection, Administrative practice and procedure, Air pollution control, Confidential business information, Imports, Incorporation by reference, Labeling, Penalties, Vessels, Railroads, Reporting and recordkeeping requirements, Warranties.

40 CFR Part 1042

Environmental protection, Administrative practice and procedure, Air pollution control, Confidential business information, Imports, Incorporation by reference, Labeling, Penalties, Vessels, Reporting and recordkeeping requirements, Warranties.

40 CFR Part 1065

Confidential business information, Penalties, Research, Reporting and recordkeeping requirements.

40 CFR Part 1068

Confidential business information, Penalties, Reporting and recordkeeping requirements, Warranties.

Dated: March 1, 2007.

Stephen L. Johnson,

Administrator.

For the reasons set forth in the preamble, chapter I of title 40 of the Code of Federal Regulations is proposed to be amended as follows:

PART 92—CONTROL OF AIR POLLUTION FROM LOCOMOTIVES AND LOCOMOTIVE ENGINES

1. The authority citation for part 92 continues to read as follows:

Authority: 42 U.S.C. 7401—7671q.

2. Section 92.1 is amended by revising paragraph (a) introductory text and adding paragraph (e) to read as follows:

§ 92.1 Applicability.

(a) Except as noted in paragraphs (b), (d) and (e) of this section, the provisions of this part apply to manufacturers, remanufacturers, owners and operators of:

* * * * *

(e) The provisions of this part do not apply for locomotives that are subject to the emissions standards of 40 CFR part 1033.

3. Section 92.12 is amended by revising paragraph (b) and adding paragraphs (i) and (j) to read as follows:

§ 92.12 Interim provisions.

* * * * *

(b) *Production line and in-use testing.* (1) The requirements of Subpart F of this part (i.e., production line testing) do not apply prior to January 1, 2002.

(2) The requirements of Subpart F of this part (*i.e.*, production line testing) do not apply to small remanufacturers prior to January 1, 2013.

(3) The requirements of Subpart G of this part (*i.e.*, in-use testing) only apply for locomotives and locomotive engines that become new on or after January 1, 2002.

(4) For locomotives and locomotive engines that are covered by a small business certificate of conformity, the requirements of Subpart G of this part (*i.e.*, in-use testing) only apply for locomotives and locomotive engines that become new on or after January 1, 2007. We will also not require small remanufacturers to perform any in-use testing prior to January 1, 2013.

* * * * *

(i) *Diesel test fuels.* Manufacturers and remanufacturers may use LSD or ULSD test fuel to certify to the standards of this part, instead of the otherwise specified test fuel, provided PM emissions are corrected as described in this paragraph (i). Measure your PM emissions and determine your cycle-weighted emission rates as specified in subpart B of this part. If you test using LSD or ULSD, add 0.07 g/bhp-hr to these weighted emission rates to determine your official emission result.

(j) *Subchapter U provisions.* For model years 2008 through 2012, certain locomotives will be subject to the requirements of this part 92 while others will be subject to the requirements of 40 CFR subchapter U. This paragraph (j) describes allowances for manufacturers or remanufacturers to ask for flexibility in transitioning to the new regulations.

(1) You may ask to use a combination of the test procedures of this part and those of 40 CFR part 1033. We will approve your request only if you show us that it does not affect your ability to show compliance with the applicable emission standards. Generally this requires that the combined procedures would result in emission measurements at least as high as those that would be measured using the procedures specified in this part. Alternatively, you may demonstrate that the combined effects of the procedures is small relative to your compliance margin (the degree to which your locomotives are below the applicable standards).

(2) You may ask to comply with the administrative requirements of 40 CFR part 1033 and 1068 instead of the equivalent requirements of this part.

4. Section 92.208 is amended by revising paragraph (a) to read as follows:

§ 92.208 Certification.

(a) This paragraph (a) applies to manufacturers of new locomotives and new locomotive engines. If, after a review of the application for certification, test reports and data acquired from a freshly manufactured locomotive or locomotive engine or from a development data engine, and any other information required or obtained by EPA, the Administrator determines that the application is complete and that the engine family meets the requirements of the Act and this part, he/she will issue a certificate of conformity with respect to such engine family except as provided by paragraph (c)(3) of this section. The certificate of conformity is valid for each engine family starting with the indicated effective date, but it is not valid for any production after December 31 of the model year for which it is issued (except as specified in § 92.12). The certificate of conformity is valid upon such terms and conditions as the Administrator deems necessary or appropriate to ensure that the production engines covered by the certificate will meet the requirements of the Act and of this part.

* * * * *

PART 94—CONTROL OF EMISSIONS FROM MARINE COMPRESSION-IGNITION ENGINES

5. The authority citation for part 94 continues to read as follows:

Authority: 42 U.S.C. 7401—7671q.

6. Section 94.1 is amended by adding paragraph (b)(3) to read as follows:

§ 94.1 Applicability.

(b) * * *

(3) Marine engines subject to the standards of 40 CFR part 1042.

* * * * *

7. In § 94.2, paragraph (b) is amended by adding definitions for ''Nonroad'' and ''Nonroad engine'' in alphabetical order to read as follows:

§ 94.2 Definitions.

* * * * *

(b) * * *

Nonroad means relating to nonroad engines, or vessels, or equipment that includes nonroad engines.

Nonroad engine has the meaning given in 40 CFR 1068.30. In general, this means all internal-combustion engines except motor vehicle engines, stationary engines, engines used solely for competition, or engines used in aircraft.

* * * * *

8. Section 94.12 is amended by adding paragraph (i) to read as follows:

§ 94.12 Interim provisions.

* * * * *

(i) *Subchapter U provisions.* For model years 2009 through 2013, certain marine engines will be subject to the requirements of this part 94 while others will be subject to the requirements of 40 CFR subchapter U.

This paragraph (j) describes allowances for manufacturers to ask for flexibility in transitioning to the new regulations.

(1) You may ask to use a combination of the test procedures of this part and those of 40 CFR part 1033. We will approve your request only if you show us that it does not affect your ability to show compliance with the applicable emission standards. Generally this requires that the combined procedures would result in emission measurements at least as high as those that would be measured using the procedures specified in this part. Alternatively, you may demonstrate that the combined effects of the procedures is small relative to your compliance margin (the degree to which your locomotive are below the applicable standards).

(2) You may ask to comply with the administrative requirements of 40 CFR part 1033 and 1068 instead of the equivalent requirements of this part.

9. Section 94.108 is amended by revising paragraph (d) to read as follows:

§ 94.108 Test fuels.

* * * * *

(d) Correction for sulfur. (1) High sulfur fuel. (i) Particulate emission measurements from Category 1 or Category 2 engines without exhaust aftertreatment obtained using a diesel fuel containing more than 0.40 weight percent sulfur may be adjusted to a sulfur content of 0.40 weight percent.

(ii) Adjustments to the particulate measurement for using high sulfur fuel shall be made using the following equation:

$$PMadj = PM - [BSFC * 0.0917 * (FSF - 0.0040)]$$

Where:

PMadj = Adjusted measured PM level [g/kW-hr].
PM = Measured weighted PM level [g/KW-hr].
BSFC = Measured brake specific fuel consumption [g/KW-hr].
FSF = Fuel sulfur weight fraction.

(2) Low sulfur fuel. (i) Particulate emission measurements from Category 1 or Category 2 engines without exhaust aftertreatment obtained using diesel fuel containing less than 0.03 weight percent sulfur may be adjusted to a sulfur content of 0.20 weight percent.

(ii) Adjustments to the particulate measurement for using ultra low sulfur fuel shall be made using the following equation:

$$PMadj = PM + [BSFC * 0.0917 * (0.0020 - FSF)]$$

Where:

PMadj = Adjusted measured PM level [g/kW-hr].
PM = Measured weighted PM level [g/KW-hr].
BSFC = Measured brake specific fuel consumption [g/KW-hr].
FSF = Fuel sulfur weight fraction.

* * * * *

10. Section 94.208 is amended by revising paragraph (a) to read as follows:

§ 94.208 Certification.

(a) If, after a review of the application for certification, test reports and data acquired from an engine or from a development data engine, and any other information required or obtained by EPA, the Administrator determines that the application is complete and that the engine family meets the requirements of the Act and this part, he/she will issue a certificate of conformity with respect to such engine family, except as provided by paragraph (c)(3) of this section. The certificate of conformity is valid for each engine family starting with the indicated effective date, but it is not valid for any production after December 31 of the model year for which it is issued. The certificate of conformity is valid upon such terms and conditions as the Administrator deems necessary or appropriate to ensure that the production engines covered by the certificate will meet the requirements of the Act and of this part.

* * * * *

11. Section 94.209 is amended by revising paragraph (a) introductory text to read as follows:

§ 94.209 Special provisions for post-manufacture marinizers and small-volume manufacturers.

* * * * *

(a) *Broader engine families.* Instead of the requirements of § 94.204, an engine family may consist of any engines all of a manufacturers engines within a given category. This does not change any of the requirements of this part for showing that an engine family meets emission standards. To be eligible to use the provisions of this paragraph (a), the manufacturer must demonstrate one of the following:

* * * * *

12. A new part 1033 is added to subchapter U of chapter I to read as follows:

PART 1033—CONTROL OF EMISSIONS FROM LOCOMOTIVES

Sec.

Subpart A—Overview and Applicability

1033.1 Applicability
1033.5 Exemptions and exclusions.
1033.10 Organization of this part.
1033.15 Do any other regulation parts apply to me?

Subpart B—Emission Standards and Related Requirements

1033.101 Exhaust emission standards.
1033.102 Transition to the standards of this part for model years before 2015.
1033.110 Emission diagnostics—general requirements.
1033.112 Emission diagnostics for SCR systems.
1033.115 Other requirements.
1033.120 Emission-related warranty requirements.
1033.125 Maintenance instructions.
1033.130 Instructions for engine remanufacturing or engine installation.
1033.135 Labeling.
1033.140 Rated power.
1033.150 Interim provisions.

Subpart C—Certifying Engine Families

1033.201 General requirements for obtaining a certificate of conformity.
1033.205 Applying for a certificate of conformity.
1033.210 Preliminary approval.
1033.220 Amending maintenance instructions.
1033.225 Amending applications for certification.
1033.230 Grouping locomotives into engine families.
1033.235 Emission testing required for certification.
1033.240 Demonstrating compliance with exhaust emission standards.
1033.245 Deterioration factors.
1033.250 Reports and recordkeeping.
1033.255 EPA decisions.

Subpart D—Manufacturer and Remanufacturer Production Line Testing and Audit Programs

1033.301 Applicability.
1033.305 General Requirements
1033.310 Sample selection for testing.
1033.315 Test procedures.
1033.325 Calculation and reporting of test results.
1033.330 Maintenance of records; submittal of information.
1033.335 Compliance with criteria for production line testing.
1033.340 Remanufactured locomotives: installation audit requirements.
1033.345 Suspension and revocation of certificates of conformity.

Subpart E—In-use Testing

1033.401 Applicability.
1033.405 General provisions.
1033.410 In-use test procedure.
1033.415 General testing requirements.
1033.420 Maintenance, procurement and testing of in-use locomotives.
1033.425 In-use test program reporting requirements.

Subpart F—Test Procedures

1033.501 General test provisions.
1033.503 Test conditions.
1033.505 Locomotive and engine testing.
1033.510 Ramped modal testing.
1033.520 Duty cycles and idle calculation.
1033.525 Adjusting emission levels to account for infrequently regenerating aftertreatment devices.

Subpart G—Special Compliance Provisions

1033.601 General compliance provisions.
1033.610 Small railroad provisions.
1033.615 Voluntarily subjecting locomotives to the standards of this part.
1033.620 Hardship provisions for manufacturers and remanufacturers.
1033.625 Design certification for non-locomotive-specific engines.
1033.630 Staged-assembly exemption.
1033.640 Provisions for repowered and refurbished locomotives.
1033.650 Incidental use exemption for Canadian and Mexican locomotives.

Subpart H—Averaging, Banking, and Trading for Certification.

1033.701 General provisions.
1033.705 Calculate emission credits.
1033.710 Averaging emission credits.
1033.715 Banking emission credits.
1033.720 Trading emission credits.
1033.722 Transferring emission credits.
1033.725 Requirements for your application for certification.
1033.730 ABT reports.
1033.735 Required records.
1033.740 Credit restrictions.
1033.745 Compliance with the provisions of this subpart.
1033.750 Changing a locomotive's FEL at remanufacture.

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Authority: 42 U.S.C. 7401–7671q.

Subpart A—Overview and Applicability

§ 1033.1 Applicability.

The regulations in this part 1033 apply for all new locomotives and all locomotives containing a new locomotive engine, except as provided in § 1033.5.

(a) Standards begin to apply each time a locomotive or locomotive engine is originally manufactured or otherwise becomes new (defined in § 1033.901). The requirements of this part continue to apply as specified after locomotives cease to be new.

(b) Standards apply to the locomotive. However, in certain cases, the manufacturer/remanufacturer is allowed to test a locomotive engine instead of a complete locomotive, such as for certification.

(c) Standards apply based on the year in which the locomotive was originally manufactured. The date of original manufacture is generally the date on which assembly is completed for the first time. For example, all locomotives originally manufactured in calendar years 2002, 2003, and 2004 are subject to the Tier 1 emission standards for their entire service lives.

(d) The following provisions apply when there are multiple persons meeting the definition of manufacturer or remanufacturer:

(1) Each person meeting the definition of manufacturer must comply with the requirements of this part that apply to manufacturers; and each person meeting the definition of remanufacturer must comply with the requirements of this part that apply to remanufacturers. However, if one person complies with a specific requirement for a given locomotive, then all manufacturers/remanufacturers are be deemed to have complied with that specific requirement.

(2) We will apply the requirements of subparts C, D, and E of this part to the manufacturer/remanufacturer that obtains the certificate of conformity. Other manufacturers and remanufacturers are required to comply with the requirements of subparts C, D, and E of this part only when notified by us. In our notification, we will specify a reasonable time period in which you need to comply with the requirements identified in the notice. See § 1033.601 for the applicability of 40 CFR part 1068 to these other manufacturers and remanufacturers.

(3) For example, we may require a railroad that installs certified kits but does not hold the certificate to perform production line testing or auditing of the locomotives that it remanufactures. However, if we did, we would allow the railroad a reasonable amount of time to develop the ability to perform such testing or auditing.

(e) The provisions of this part apply as specified for locomotives manufactured or remanufactured on or after January 1, 2008. See § 1033.102 to determine the whether the standards of this part or the standards of 40 CFR part 92 apply for model years 2008 through 2012. For example, for a locomotive that was originally manufactured in 2007 and remanufactured on April 10, 2014, the provisions of this part begin to apply on April 10, 2014.

§ 1033.5 Exemptions and exclusions.

(a) Subpart G of this part exempts certain locomotives from the standards of this part.

(b) The definition of ''locomotive'' in § 1033.901 excludes certain vehicles. In general, the engines used in such excluded equipment are subject to standards under other regulatory parts. For example, see 40 CFR part 1039 for requirements that apply to diesel engines used in equipment excluded from the definition of ''locomotive'' in § 1033.901. The following locomotives are also excluded from the provisions of this part 1033:

(1) Historic locomotives powered by steam engines. To be excluded under this paragraph (b)(1), a locomotive may not use any internal combustion engines and must be used only for historical purposes such as at a museum or similar public attraction.

(2) Locomotives powered only by an external source of electricity.

(c) The provisions of this part do not apply for any locomotive that has not become a ''new locomotive'' (as defined in § 1033.901) after December 31, 2007.

§ 1033.10 Organization of this part.

The regulations in this part 1033 contain provisions that affect locomotive manufacturers, remanufacturers, and others. However, the requirements of this part are generally addressed to the locomotive manufacturer/remanufacturer. The term ''you'' generally means the manufacturer/remanufacturer, as defined in § 1033.901. This part 1033 is divided into the following subparts:

(a) Subpart A of this part defines the applicability of part 1033 and gives an overview of regulatory requirements.

(b) Subpart B of this part describes the emission standards and other requirements that must be met to certify locomotives under this part. Note that § 1033.150 discusses certain interim requirements and compliance provisions that apply only for a limited time.

(c) Subpart C of this part describes how to apply for a certificate of conformity.

(d) Subpart D of this part describes general provisions for testing and auditing production locomotives.

(e) Subpart E of this part describes general provisions for testing in-use locomotives.

(f) Subpart F of this part 40 CFR part 1065 describe how to test your locomotives.

(g) Subpart G of this part and 40 CFR part 1068 describe requirements, prohibitions, exemptions, and other provisions that apply to locomotive manufacturer/remanufacturers, owners, operators, and all others.

(h) Subpart H of this part describes how you may generate and use emission credits to certify your locomotives.

(i) Subpart I of this part describes provisions for locomotive owners and operators.

(j) Subpart J of this part contains definitions and other reference information.

§ 1033.15 Do any other regulation parts apply to me?

(a) Part 1065 of this chapter describes procedures and equipment specifications for testing engines. Subpart F of this part 1033 describes how to apply the provisions of part 1065 of this chapter to test locomotives to determine whether they meet the emission standards in this part.

(b) The requirements and prohibitions of part 1068 of this chapter apply to everyone, including anyone who manufactures, remanufactures, imports, maintains, owns, or operates any of the locomotives subject to this part 1033. See § 1033.601 to determine how to apply the part 1068 regulations for locomotives. Part 1068 of this chapter describes general provisions, including these seven areas:

(1) Prohibited acts and penalties for locomotive manufacturer/ remanufacturers and others.

(2) Exclusions and exemptions for certain locomotives.

(3) Importing locomotives.

(4) Selective enforcement audits of your production.

(5) Defect reporting and recall.

(6) Procedures for hearings.

(c) Other parts of this chapter apply if referenced in this part.

Subpart B—Emission Standards and Related Requirements

§ 1033.101 Exhaust emission standards.

See §§ 1033.102 and 1033.150 to determine the model years for which emission standards of this section apply before 2015.

(a) *Emission standards for line-haul locomotives.* Exhaust emissions from your new locomotives may not exceed the applicable emission standards in Table 1 of this section during the useful life of the locomotive. (Note: § 1033.901 defines locomotives to be ''new'' when originally manufactured and when remanufactured.) Measure emissions using the applicable test procedures described in subpart F of this part.

TABLE 1 OF § 1033.101.—LINE-HAUL LOCOMOTIVE EMISSION STANDARDS

Year of original manufacture	Tier of standards	Standards (g/bhp-hr)			
		NO_X	PM	HC	CO
1973–1992 [f]	Tier 0 [a]	8.0	0.22	1.00	5.0
1993 [f]–2004	Tier 1 [a]	7.4	0.22	0.55	2.2
2005–2011	Tier 2 [a]	5.5	0.10 [d]	0.30	1.5
2012–2014	Tier 3 [b]	5.5	0.10	0.30	1.5
2015 or later	Tier 4	1.3 [c]	0.03	0.14 [e]	1.5

[a] Line-haul locomotives subject to the Tier 0 through Tier 2 emission standards must also meet switch standards of the same tier.
[b] Tier 3 line-haul locomotives must also meet Tier 2 switch standards.
[c] Model year 2015 and 2016 Tier 4 line-haul locomotives are subject to the Tier 3 NO_X standard at the time of initial manufacture (instead of the Tier 4 NO_X standard), but must meet the Tier 4 NO_X standard at the time of any remanufacture after January 1, 2017.
[d] The PM standard for new Tier 2 line-haul locomotives is 0.20 g/bhp-hr until January 1, 2013.
[e] Manufacturers may elect to meet a combined NO_X+HC standard of 1.3 g/bhp-hr instead of the otherwise applicable Tier 4 NO_X and HC standards, as described in paragraph (j) of this section. For model years, 2015 and 2016, manufacturers may elect to meet a combined NO_X+HC standard of 5.5 g/bhp-hr instead of the otherwise applicable NO_X and HC standards.
[f] Locomotive models that were originally manufactured in model years 1993 through 2001, but that were not originally equipped with a separate coolant system for intake air are subject to the Tier 0 rather than the Tier 1 standards.

(b) *Emission standards for switch locomotives.* Exhaust emissions from your new locomotives may not exceed the applicable emission standards in Table 2 of this section during the useful life of the locomotive.

(**Note:** § 1033.901 defines locomotives to be ''new'' when originally manufactured and when remanufactured.) Measure emissions using the applicable test procedures described in subpart F of this part.

TABLE 2 OF § 1033.101.—SWITCH LOCOMOTIVE EMISSION STANDARDS

Year of original manufacture	Tier of standards	Standards (g/bhp-hr)			
		NO_X	PM	HC	CO
1973–2001	Tier 0	11.8	0.26	2.10	8.0
2002–2004	Tier 1 [a]	11.0	0.26	1.20	2.5
2005–2010	Tier 2 [a]	8.1	0.13 [d]	0.60	2.4
2011–2014	Tier 3	5.0	0.10	0.60	2.4
2015 or later	Tier 4	1.3 [c]	0.03	0.14 [c]	2.4

[a] Switch locomotives subject to the Tier 1 through Tier 2 emission standards must also meet line-haul standards of the same tier.
[b] The PM standard for new Tier 2 switch locomotives is 0.24 g/bhp-hr until January 1, 2013.
[c] Manufacturers may elect to meet a combined NO_X+HC standard of 1.3 g/bhp-hr instead of the otherwise applicable Tier 4 NO_X and HC standards, as described in paragraph (j) of this section.

(c) *Smoke standards.* The smoke opacity standards specified in Table 3 of this section apply only for locomotives certified to one or more PM standards or FELs greater than 0.05 g/bhp-hr. Smoke emissions, when measured in accordance with the provisions of Subpart F of this part, shall not exceed these standards.

TABLE 3 OF § 1033.101.—SMOKE STANDARDS FOR LOCOMOTIVES (PERCENT OPACITY)

	Steady-state	30-sec peak	3-sec peak
Tier 0	30	40	50
Tier 1	25	40	50
Tier 2 and later	20	40	50

(d) *Averaging, banking, and trading.* You may generate or use emission credits under the averaging, banking, and trading (ABT) program as described in subpart H of this part to comply with the NO_X and/or PM standards of this part. You may also use ABT to comply with the Tier 4 HC standards of this part as described in paragraph (j) of this section. Generating or using emission credits requires that you specify a family emission limit (FEL) for each pollutant you include in the ABT program for each engine family. These FELs serve as the emission standards for the engine family with respect to all required testing instead of the standards specified in paragraphs (a) and (b) of this section. No FEL may be higher than the previously applicable Tier of standards. For example, no FEL for a Tier 1 locomotive may be higher than the Tier 0 standard.

(e) *Notch standards.* (1) Exhaust emissions from locomotives may not exceed the notch standards specified in paragraph (e)(2) of this section, except as allowed in paragraph (e)(3) of this section, when measured using any test procedures under any test conditions.

(2) Except as specified in paragraph (e)(5) of this section, calculate the applicable notch standards for each pollutant for each notch from the certified notch emission rate as follows:

$$\text{Notch standard} = (E_i) \times (1.1 + (1 - ELH_i/\text{std}))$$

Where:

E_i = The deteriorated brake-specific emission rate (for pollutant I) for the notch (*i.e.*, the brake-specific emission rate calculated under subpart F of this part, adjusted by the deterioration factor in the application for certification); where x is NO_X, HC (or NMHC or THCE, as applicable), CO or PM.

ELH_i = The deteriorated line-haul duty-cycle weighted brake-specific emission rate for pollutant I, as reported in the application for certification, except for Tier 3 or later switch locomotives, where ELH_i equals the deteriorated switch duty-cycle weighted brake-specific emission rate for pollutant I.

std = The applicable line-haul duty-cycle standard or FEL, except for Tier 3 or later switch locomotives, where std equals the switch duty-cycle standard for pollutant I.

(3) Exhaust emissions that exceed the notch standards specified in paragraph (e)(2) of this section are allowed only if one of the following is true:

(i) The same emission controls are applied during the test conditions causing the noncompliance as were applied during certification test conditions (and to the same degree).

(ii) The exceedance result from a design feature that was described (including its effect on emissions) in the approved application for certification, and is:

(A) Necessary for safety;

(B) Addresses infrequent regeneration of an aftertreatment device; or

(C) Otherwise allowed by this part.

(4) Since you are only required to test your locomotive at the highest emitting dynamic brake point, the notch caps that you calculate for the dynamic brake point that you test also applies for other dynamic brake points.

(5) No PM notch caps apply for locomotives certified to a PM standard or FEL of 0.05 g/bhp-hr or lower.

(f) *Fuels.* The exhaust emission standards in this section apply for locomotives using the fuel type on which the locomotives in the engine family are designed to operate.

(1) You must meet the numerical emission standards for HC in this section based on the following types of hydrocarbon emissions for locomotives powered by the following fuels:

(i) Alcohol-fueled locomotives: THCE emissions for Tier 3 and earlier locomotives and NMHCE for Tier 4.

(ii) Gaseous-fueled locomotives: NMHC emissions.

(iii) Diesel-fueled and other locomotives: THC emissions for Tier 3 and earlier locomotives and NMHC for Tier 4.

(2) You must certify your diesel-fueled locomotives to use the applicable grades of diesel fuel as follows:

(i) Certify your Tier 4 and later diesel-fueled locomotives for operation with only Ultra Low Sulfur Diesel (ULSD) fuel. Use ULSD as the test fuel for these locomotives.

(ii) Certify your Tier 3 and earlier diesel-fueled locomotives for operation with only ULSD fuel if they include sulfur-sensitive technology and you demonstrate compliance using a ULSD test fuel.

(iii) Certify your Tier 3 and earlier diesel-fueled locomotives for operation with either ULSD fuel or Low Sulfur Diesel (LSD) fuel if they do not include sulfur-sensitive technology or if you demonstrate compliance using an LSD test fuel.

(iv) For Tier 2 and earlier diesel-fueled locomotives, if you demonstrate compliance using a ULSD test fuel, you must adjust the measured PM emissions upward by 0.01 g/bhp-hr to make them equivalent to tests with LSD.

(g) *Useful life.* The emission standards and requirements in this subpart apply to the emissions from new locomotives for their useful life. The useful life is generally specified as MW-hrs and years, and ends when either of the values (MW-hrs or years) is exceeded or the locomotive is remanufactured.

(1) The minimum useful life in terms of MW-hrs is equal to the product of the rated horsepower multiplied by 7.50. The minimum useful life in terms of years is ten years. For locomotives originally manufactured before January 1, 2000 and not equipped with MW-hr meters, the minimum useful life is equal to 750,000 miles or ten years, whichever is reached first.

(2) You must specify a longer useful life if the locomotive or locomotive engine is designed to last longer than the applicable minimum useful life. Recommending a time to remanufacture that is longer than the minimum useful life is one indicator of a longer design life.

(3) Manufacturers/remanufacturers of locomotive with non-locomotive-specific engines (as defined in § 1033.901) may ask us (before certification) to allow a shorter useful life for an engine family containing only non-locomotive-specific engines. This petition must include the full rationale behind the request together with any other supporting evidence. Based on this or other information, we may allow a shorter useful life.

(4) Remanufacturers of locomotive or locomotive engine configurations that have been previously certified under paragraph (g)(3) of this section to a useful life that is shorter than the value specified in paragraph (g)(1) of this section may certify to that same shorter useful life value without request.

(h) *Applicability for testing.* The emission standards in this subpart apply to all testing, including certification testing, production-line testing, selective enforcement audits, and in-use testing.

(i) *Alternate CO standards.* Manufacturers/remanufacturers may certify Tier 0, Tier 1, or Tier 2 locomotives to an alternate CO emission standard of 10.0 g/bhp-hr instead of the otherwise applicable CO standard if they also certify those locomotives to alternate PM standards less than or equal to one-half of the otherwise applicable PM standard. For example, a manufacturer certifying Tier 1 locomotives to a 0.11 g/bhp-hr PM standard may certify those locomotives to the alternate CO standard of 10.0 g/bhp-hr.

(j) *Alternate NO_X+NMHC standards for Tier 4.* Manufacturers/remanufacturers may certify Tier 4 locomotives to an alternate NO_X+NMHC emission standard of 1.3 g/bhp-hr (instead of the otherwise applicable NO_X and NMHC standards). You may use NO_X credits to show compliance with this standard by certifying your family to a NO_X+NMHC FEL. Calculate the NO_X credits needed as specified in subpart H of this part using the NO_X+NMHC emission standard and FEL in the calculation instead of the otherwise applicable NO_X standard and FEL.

§ 1033.102 Transition to the standards of this part for model years before 2015.

(a) Except as specified in § 1033.150(a), the Tier 0 and Tier 1 standards of § 1033.101 apply for new locomotives beginning January 1, 2010, except as specified in § 1033.150(a). The Tier 0 and Tier 1 standards of 40 CFR part 92 apply for earlier model years.

(b) Except as specified in § 1033.150(a), the Tier 2 standards of § 1033.101 apply for new locomotives beginning January 1, 2013. The Tier 2 standards of 40 CFR part 92 apply for earlier model years.

(c) The Tier 3 and Tier 4 standards of § 1033.101 apply for the model years specified in that section.

§ 1033.110 Emission diagnostics—general requirements.

The provisions of this section apply if you equip your locomotives with a diagnostic system that will detect significant malfunctions in its emission-control system. See § 1033.420 for information about how to select and maintain diagnostic-equipped locomotives for in-use testing. Notify the owner/operator that the presence of this diagnostic system affects their maintenance obligations under § 1033.815.

(a) Use a malfunction-indicator light (MIL). The MIL must be readily visible to the operator. When the MIL goes on, it must display ''Check Emission Controls'' or a similar message that we approve. You may use sound in addition to the light signal.

(b) You may only illuminate the MIL for malfunctions that require maintenance action by the owner/operator. To ensure that owner/operators consider MIL illumination seriously, you may not illuminate it for malfunctions that would not otherwise require maintenance. This section does not limit your ability to display other indicator lights or messages, as long as they are clearly distinguishable from MILs affecting the owner/operator's maintenance obligations under § 1033.815.

(c) Control when the MIL can go out. If the MIL goes on to show a malfunction, it must remain on during all later engine operation until servicing corrects the malfunction. If the engine is not serviced, but the malfunction does not recur during the next 24 hours, the MIL may stay off during later engine operation.

(d) Record and store in computer memory any diagnostic trouble codes showing a malfunction that should illuminate the MIL. The stored codes must identify the malfunctioning system or component as uniquely as possible. Make these codes available through the data link connector as described in paragraph (e) of this section. You may store codes for conditions that do not turn on the MIL. The system must store a separate code to show when the diagnostic system is disabled (from malfunction or tampering). Provide instructions to the owner/operator regarding how to interpret malfunction codes.

(e) Make data, access codes, and devices accessible. Make all required data accessible to us without any access codes or devices that only you can supply. Ensure that anyone servicing your locomotive can read and understand the diagnostic trouble codes stored in the onboard computer with generic tools and information.

(f) Follow standard references for formats, codes, and connections.

§ 1033.112 Emission diagnostics for SCR systems.

Engines equipped with SCR systems must meet the requirements of this section in addition to the requirements of § 1033.110.

(a) The diagnostic system must monitor urea quality and tank levels and alert operators to the need to refill the urea tank before it is empty using a malfunction-indicator light (MIL) as specified in § 1033.110 and an audible alarm. You do not need to separately monitor urea quality if you include an exhaust NO_X sensor (or other sensor) that allows you to determine inadequate urea quality.

(b) Your onboard computer must record in nonvolatile computer memory all incidents of engine operation with inadequate urea injection or urea quality.

§ 1033.115 Other requirements.

Locomotives that are required to meet the emission standards of this part must meet the requirements of this section. These requirements apply when the locomotive is new (for freshly manufactured or remanufactured locomotives) and continue to apply throughout the useful life.

(a) *Crankcase emissions*. Crankcase emissions may not be discharged directly into the ambient atmosphere from any locomotive, except as follows:

(1) Locomotives may discharge crankcase emissions to the ambient atmosphere if the emissions are added to the exhaust emissions (either physically or mathematically) during all emission testing. If you take advantage of this exception, you must do the following things:

(i) Manufacture the locomotives so that all crankcase emissions can be routed into the applicable sampling systems specified in 40 CFR part 1065, consistent with good engineering judgment.

(ii) Account for deterioration in crankcase emissions when determining exhaust deterioration factors.

(2) For purposes of this paragraph (a), crankcase emissions that are routed to the exhaust upstream of exhaust aftertreatment during all operations are not considered to be discharged directly into the ambient atmosphere.

(b) *Adjustable parameters*. Locomotives that have adjustable parameters must meet all the requirements of this part for any adjustment in the approved adjustable range. You must specify in your application for certification the adjustable range of each adjustable parameter on a new locomotive or new locomotive engine to:

(1) Ensure that safe locomotive operating characteristics are available within that range, as required by section 202(a)(4) of the Clean Air Act (42 U.S.C. 7521(a)(4)), taking into consideration the production tolerances.

(2) Limit the physical range of adjustability to the maximum extent practicable to the range that is necessary

for proper operation of the locomotive or locomotive engine.

(c) *Prohibited controls*. You may not design or produce your locomotives with emission control devices, systems, or elements of design that cause or contribute to an unreasonable risk to public health, welfare, or safety while operating. For example, this would apply if the locomotive emits a noxious or toxic substance it would otherwise not emit that contributes to such an unreasonable risk.

(d) *Evaporative and refueling controls*. For locomotives fueled with a volatile fuel you must design and produce them to minimize evaporative emissions during normal operation, including periods when the engine is shut down. You must also design and produce them to minimize the escape of fuel vapors during refueling. Hoses used to refuel gaseous-fueled locomotives may not be designed to be bled or vented to the atmosphere under normal operating conditions. No valves or pressure relief vents may be used on gaseous-fueled locomotives except as emergency safety devices that do not operate at normal system operating flows and pressures.

(e) *Altitude requirements*. All locomotives prior to sale, introduction into service, or return to service, must be designed to include features that compensate for changes in altitude to ensure that the locomotives will comply with the applicable emission standards when operated at any altitude less than 7000 feet above sea level.

(f) *Defeat devices*. You may not equip your locomotives with a defeat device. A defeat device is an auxiliary emission control device (AECD) that reduces the effectiveness of emission controls under conditions that the locomotive may reasonably be expected to encounter during normal operation and use.

(1) This does not apply to AECDs you identify in your certification application if any of the following is true:

(i) The conditions of concern were substantially included in the applicable duty cycle test procedures described in subpart F of this part.

(ii) You show your design is necessary to prevent locomotive damage or accidents.

(iii) The reduced effectiveness applies only to starting the locomotive.

(iv) The locomotive emissions when the AECD is functioning are at or below the notch caps of § 1033.101.

(v) The AECD reduces urea flow for an SCR aftertreatment system and meets the requirements of this paragraph (f)(1)(v). For operation outside the range of ambient test conditions specified in § 1033.503 where emissions exceed one or more notch caps, your SCR system must function so that at least one of the following conditions is met at all applicable speeds and loads:

(A) You maintain the mass flow of urea into the catalyst in the same proportion as the same notch point under test conditions.

(B) You maintain the mass flow of urea into the catalyst at the highest level possible without emitting ammonia at excessive levels (excessive levels would generally be levels higher than would occur at other operations at the same notch point under test conditions).

(C) The temperature of the exhaust is too low to allow urea to be converted to ammonia (consistent with good engineering judgment).

(2) If your locomotive is designed to allow operation at points other than those included as test points, the provisions of paragraphs (f)(1)(iv) and (v) of this section apply as specified for the most similar test point.

(g) *Idle controls*. All new locomotives must be equipped with automatic engine stop/start as described in this paragraph (g). All new locomotives must be designed to allow the engine(s) to be restarted at least six times per day without engine damage.

(1) Except as allowed by paragraph (g)(2) of this section, the stop/start systems must shut off the main locomotive engine(s) after 30 minutes of idling (or less) and must prevent the engine(s) from being restarted to resume extended idling.

(2) Stop/start systems may restart or continue idling for the following reasons:

(i) To prevent engine damage such as to prevent the engine coolant from freezing.

(ii) To maintain air brake pressure.

(iii) To perform necessary maintenance.

(iv) To otherwise comply with federal regulations.

(3) You may ask to use alternate stop/start systems that will achieve equivalent idle control.

§ 1033.120 Emission-related warranty requirements.

(a) *General requirements*. You must warrant to the ultimate purchaser and each subsequent purchaser that the new locomotive, including all parts of its emission control system, meets two conditions:

(1) It is designed, built, and equipped so it conforms at the time of sale to the ultimate purchaser with the requirements of this part.

(2) It is free from defects in materials and workmanship that may keep it from meeting these requirements.

(b) *Warranty period*. Except as specified in this paragraph, the minimum warranty period is one-third of the useful life. Your emission-related warranty must be valid for at least as long as the minimum warranty periods listed in this paragraph (b) in MW-hrs of operation and years, whichever comes first. You may offer an emission-related warranty more generous than we require. The emission-related warranty for the locomotive may not be shorter than any published warranty you offer without charge for the locomotive. Similarly, the emission-related warranty for any component may not be shorter than any published warranty you offer without charge for that component. If you provide an extended warranty to individual owners for any components covered in paragraph (c) of this section for an additional charge, your emission-related warranty must cover those components for those owners to the same degree. If the locomotive does not record MW-hrs, we base the warranty periods in this paragraph (b) only on years. The warranty period begins when the locomotive is placed into service, or back into service after remanufacture.

(c) *Components covered*. The emission-related warranty covers all components whose failure would increase a locomotive's emissions of any pollutant. This includes components listed in 40 CFR part 1068, Appendix I, and components from any other system you develop to control emissions. The emission-related warranty covers these components even if another company produces the component. Your emission-related warranty does not cover components whose failure would not increase a locomotive's emissions of any pollutant.

(d) *Limited applicability*. You may deny warranty claims under this section if the operator caused the problem through improper maintenance or use, as described in 40 CFR 1068.115.

(e) *Owners manual*. Describe in the owners manual the emission-related warranty provisions from this section that apply to the locomotive.

§ 1033.125 Maintenance instructions.

Give the owner of each new locomotive written instructions for properly maintaining and using the locomotive, including the emission-control system. Include in the instructions a notification that owners and operators must comply with the requirements of subpart I of this part 1033. The maintenance instructions also apply to any service accumulation on your emission-data locomotives, as described in § 1033.245 and in 40 CFR part 1065.

§ 1033.130 Instructions for engine remanufacturing or engine installation.

(a) If you do not complete assembly of the new locomotive (such as selling a kit that allows someone else to remanufacture a locomotive under your certificate), give the assembler instructions for completing assembly consistent with the requirements of this part. Include all information necessary to ensure that the locomotive will be assembled in its certified configuration.

(b) Make sure these instructions have the following information:

(1) Include the heading: ‘‘Emission-related assembly instructions’’.

(2) Describe any instructions necessary to make sure the assembled locomotive will operate according to design specifications in your application for certification.

(3) State one of the following as applicable:

(i) ‘‘Failing to follow these instructions when remanufacturing a locomotive or locomotive engine violates federal law (40 CFR 1068.105(b)), and may subject you to fines or other penalties as described in the Clean Air Act.’’.

(ii) ‘‘Failing to follow these instructions when installing this locomotive engine violates federal law (40 CFR 1068.105(b)), and may subject you to fines or other penalties as described in the Clean Air Act.’’.

(c) You do not need installation instructions for locomotives you assemble.

(d) Provide instructions in writing or in an equivalent format. For example, you may post instructions on a publicly available Web site for downloading or printing. If you do not provide the instructions in writing, explain in your application for certification how you will ensure that each assembler is informed of the assembly requirements.

§ 1033.135 Labeling.

As described in this section, each locomotive must have a label on the locomotive and a separate label on the engine. The label on the locomotive stays on the locomotive throughout its service life. It generally identifies the original certification of the locomotive, which is when it was originally manufactured for Tier 1 and later locomotives. The label on the engine is replaced each time the locomotive is remanufactured and identifies the most recent certification.

(a) *Serial numbers.* At the point of original manufacture, assign each locomotive and locomotive engine a serial number or other unique identification number and permanently affix, engrave, or stamp the number on the locomotive and engine in a legible way.

(b) *Locomotive labels.* (1) Locomotive labels meeting the specifications of paragraph (b)(2) of this section must be applied as follows:

(i) The manufacturer must apply a locomotive label at the point of original manufacture.

(ii) The remanufacturer must apply a locomotive label at the point of original remanufacture, unless the locomotive was labeled by the original manufacturer.

(iii) Any remanufacturer certifying a locomotive to an FEL or standard different from the previous FEL or standard to which the locomotive was previously certified must apply a locomotive label.

(2) The locomotive label must meet all of the following criteria:

(i) The label must be permanent and legible and affixed to the locomotive in a position in which it will remain readily visible. Attach it to a locomotive chassis part necessary for normal operation and not normally requiring replacement during the service life of the locomotive. You may not attach this label to the engine or to any equipment that is easily detached from the locomotive. Attach the label so that it cannot be removed without destroying or defacing the label. The label may be made up of more than one piece, as long as all pieces are permanently attached to the same locomotive part.

(ii) The label must be lettered in the English language using a color that contrasts with the background of the label.

(iii) The label must include all the following information:

(A) The label heading: ‘‘ORIGINAL LOCOMOTIVE EMISSION CONTROL INFORMATION.’’ Manufacturers/remanufacturers may add a subheading to distinguish this label from the engine label described in paragraph (c) of this section.

(B) Full corporate name and trademark of the manufacturer (or remanufacturer).

(C) The applicable engine family and configuration identification. In the case of locomotive labels applied by the manufacturer at the point of original manufacture, this will be the engine family and configuration identification of the certificate applicable to the freshly manufactured locomotive. In the case of locomotive labels applied by a remanufacturer during remanufacture, this will be the engine family and configuration identification of the certificate under which the remanufacture is being performed.

(D) Date of original manufacture of the locomotive, as defined in § 1033.901.

(E) The standards/FELs to which the locomotive was certified and the following statement: ‘‘THIS LOCOMOTIVE MUST COMPLY WITH THESE EMISSION LEVELS EACH TIME THAT IT IS REMANUFACTURED, EXCEPT AS ALLOWED BY 40 CFR 1033.750.’’.

(3) Label diesel-fueled locomotives near the fuel inlet to identify the allowable fuels, consistent with § 1033.101. For example, Tier 4 locomotives should be labeled ‘‘ULTRA LOW SULFUR DIESEL FUEL ONLY’’. You do not need to label Tier 3 and earlier locomotives certified for use with both LSD and ULSD.

(c) *Engine labels.* (1) Engine labels meeting the specifications of paragraph (c)(2) of this section shall be applied by:

(i) Every manufacturer at the point of original manufacture; and

(ii) Every remanufacturer at the point of remanufacture (including the original remanufacture and subsequent remanufactures).

(2) The engine label must meet all of the following criteria:

(i) The label must be durable throughout the useful life of the engine, be legible and affixed to the engine in a position in which it will be readily visible after installation of the engine in the locomotive. Attach it to an engine part necessary for normal operation and not normally requiring replacement during the useful life of the locomotive. You may not attach this label to any equipment that is easily detached from the engine. Attach the label so it cannot be removed without destroying or defacing the label. The label may be made up of more than one piece, as long as all pieces are permanently attached to the same locomotive part.

(ii) The label must be lettered in the English language using a color that contrasts with the background of the label.

(iii) The label must include all the following information:

(A) The label heading: ‘‘ENGINE EMISSION CONTROL INFORMATION.’’. Manufacturers/remanufacturers may add a subheading to distinguish this label from the locomotive label described in paragraph (b) of this section.

(B) Full corporate name and trademark of the manufacturer/remanufacturer.

(C) Engine family and configuration identification as specified in the certificate under which the locomotive is being manufactured or remanufactured.

(D) A prominent unconditional statement of compliance with U.S. Environmental Protection Agency regulations which apply to locomotives, as applicable:

(*1*) "This locomotive conforms to U.S. EPA regulations applicable to Tier 0 switch locomotives.".

(*2*) "This locomotive conforms to U.S. EPA regulations applicable to Tier 0 line-haul locomotives.".

(*3*) "This locomotive conforms to U.S. EPA regulations applicable to Tier 1 locomotives.".

(*4*) "This locomotive conforms to U.S. EPA regulations applicable to Tier 2 locomotives.".

(*5*) "This locomotive conforms to U.S. EPA regulations applicable to Tier 3 switch locomotives.".

(*6*) "This locomotive conforms to U.S. EPA regulations applicable to Tier 3 line-haul locomotives.".

(*7*) "This locomotive conforms to U.S. EPA regulations applicable to Tier 4 switch locomotives.".

(*8*) "This locomotive conforms to U.S. EPA regulations applicable to Tier 4 line-haul locomotives.".

(E) The useful life of the locomotive.

(F) The standards/FELS to which the locomotive was certified.

(G) Engine tune-up specifications and adjustments, as recommended by the manufacturer/remanufacturer, in accordance with the applicable emission standards. This includes but is not limited to idle speed(s), injection timing or ignition timing (as applicable), and valve lash (as applicable).

(H) Other critical operating instructions such as those related to urea use for SCR systems.

(d) Manufacturers/remanufacturers may also provide other information on the labels that they deem necessary for the proper operation and maintenance of the locomotive. Manufacturers/remanufacturers may also include other features to prevent counterfeiting of labels.

(e) You may ask us to approve modified labeling requirements in this part 1033 if you show that it is necessary or appropriate. We will approve your request if your alternate label is consistent with the requirements of this part.

§ 1033.140 Rated power.

This section describes how to determine the rated power of a locomotive for the purposes of this part. Note that rated power is used as the maximum test power in subpart F of this part for testing of locomotives and locomotive engines.

(a) A locomotive configuration's rated power is the maximum brake power point on the nominal power curve for the locomotive configuration, as defined in this section. See § 1033.901 for the definition of brake power. Round the power value to the nearest whole horsepower. Generally, this will be the brake power of the engine in notch 8.

(b) The nominal power curve of a locomotive configuration is its maximum available brake power at each possible operator demand setpoint or "notch". See 40 CFR 1065.1001 for the definition of operator demand. The maximum available power at each operator demand setpoint is based on your design and production specifications for that locomotive. The nominal power curve does not include any operator demand setpoints that are not achievable during in-use operation. For example, for a locomotive with only eight discrete operator demand setpoints, or notches, the nominal power curve would be a series of eight power points versus notch, rather than a continuous curve.

(c) The nominal power curve must be within the range of the actual power curves of production locomotives considering normal production variability. If after production begins it is determined that your nominal power curve does not represent production locomotives, we may require you to amend your application for certification under § 1033.225.

§ 1033.150 Interim provisions.

The provisions of this section apply instead of other provisions of this part for a limited time. This section describes when these provisions apply.

(a) *Early availability of Tier 0, Tier 1, or Tier 2 systems.* For model years 2008 and 2009, you may remanufacture locomotives to meet the applicable standards in 40 CFR part 92 only if no remanufacture system has been certified to meet the standards of this part and is available at a reasonable cost at least three months prior to the completion of the remanufacture. For model years 2008 through 2012, you may remanufacture Tier 2 locomotives to meet the applicable standards in 40 CFR part 92 only if no remanufacture system has been certified to meet the standards of this part and is available at a reasonable cost at least three months prior to the completion of the remanufacture. For the purpose of this paragraph (a), available at a reasonable cost means available for use where all of the following are true:

(1) The total incremental cost to the owner and operators of the locomotive due to meeting the new standards (including initial hardware, increased fuel consumption, and increased maintenance costs) during the useful life of the locomotive is less than $220,000.

(2) The initial incremental hardware costs are reasonably related to the technology included in the remanufacturing system and are less than $125,000.

(3) The remanufactured locomotive will have reliability throughout its useful life that is similar to the reliability the locomotive would have had if it had been remanufactured without the certified remanufacture system.

(4) The remanufacturer must demonstrate at the time of certification that the system meets the requirements of this paragraph (a).

(b) *Delayed NO_X standards for Tier 4.* For model years 2015 and 2016, freshly manufactured locomotives are not required to meet the Tier 4 NO_X standards, but must comply with all other applicable standards and requirements. Model year 2015 and 2016 locomotives must comply with all Tier 4 requirements when remanufactured on or after January 1, 2017.

(c) *Locomotive labels for transition to new standards.* This paragraph (c) applies when you remanufacture a locomotive that was previously certified under 40 CFR part 92. You must remove the old locomotive label and replace it with the locomotive label specified in § 1033.135.

(d) *Small manufacturer/remanufacturer provisions.* The production-line testing/auditing requirements and in-use testing requirements of this part do not apply until January 1, 2013 for manufacturers/remanufacturers that qualify as small manufacturers under § 1033.901

(e) *Producing switch locomotives using certified nonroad engines.* You may use the provisions of this paragraph (e) to produce new switch locomotives in model years 2008 through 2017. Locomotives produced under this paragraph (e) are exempt from the standards and requirements of this part and 40 CFR part 92 subject to the following provisions:

(1) All of the engines on the switch locomotive must be covered by a certificate of conformity issued under 40 CFR part 89 or 1039 for model year 2008 or later. Engines over 750 hp certified to the Tier 4 standards for non-generator set engines are not eligible for this allowance after 2014.

(2) You must reasonably project that more of the engines will be sold and used for non-locomotive use than for use in locomotives.

(3) You may not generate or use locomotive credits under this part for these locomotives.

(f) *In-use compliance limits*. For purposes of determining compliance after title or custody of a new Tier 4 locomotive has transferred to the ultimate purchaser (or the locomotive has been placed into service), calculate the applicable in-use compliance limits by adjusting the applicable standards/FELs. (Note that this means that these adjustments do not apply for certification or production-line testing.) The PM adjustment applies only for model year 2015–2017 locomotives and does not apply for locomotives with a PM FEL higher than 0.03 g/bhp-hr. The NO_X adjustment applies only for model year 2017–2019 line-haul locomotives and 2015–2017 switch locomotives and does not apply for locomotives with a NO_X FEL higher than 2.0 g/bhp-hr. Add the applicable adjustments in Tables 1 or 2 of this section (which follow) to the otherwise applicable standards (or FELs) and notch caps.

TABLE 1 OF § 1033.150—IN-USE ADJUSTMENTS FOR TIER 4 LINE-HAUL LOCOMOTIVES

Fraction of useful life already used	In-use adjustments (g/bhp-hr)	
	For model year 2017–2019 Tier 4 NO_X standards	For model year 2015–2017 Tier 4 PM standards
0 < MW-hrs = 50% of UL	0.7	0.01
50 < MW-hrs = 75% of UL	1.0	
75 < MW-hrs = 100% of UL	1.3	

TABLE 2 OF § 1033.150.—IN-USE ADJUSTMENTS FOR TIER 4 SWITCH LOCOMOTIVES

Fraction of useful life already used	In-use adjustments (g/bhp-hr)	
	For model year 2015–2017 Tier 4 NO_X standards	For model year 2015–2017 Tier 4 PM standards
0 < useful life = 50%	0.7	0.01
50 < useful life = 75%	1.0	
75 < useful life = 100%	1.3	

(g) *Test procedures*. You are generally required to use the test procedures specified in subpart F of this part (including the applicable test procedures in 40 CFR part 1065). As specified in this paragraph (g), you may use a combination of the test procedures specified in this part and the test procedures specified in 40 CFR part 92 prior to January 1, 2015. After this date, you must use only the test procedures specified in this part.

(1) Prior to January 1, 2015, you may ask to use some or all of the procedures specified in 40 CFR part 92 for locomotives certified under this part 1033.

(2) If you ask to rely on a combination of procedures under this paragraph (g), we will approve your request only if you show us that it does not affect your ability to demonstrate compliance with the applicable emission standards. Generally this requires that the combined procedures would result in emission measurements at least as high as those that would be measured using the procedures specified in this part. Alternatively, you may demonstrate that the combined effects of the different procedures is small relative to your compliance margin (the degree to which your locomotives are below the applicable standards).

Subpart C—Certifying Engine Families

§ 1033.201 General requirements for obtaining a certificate of conformity.

Certification is the process by which you demonstrate to us that your freshly manufactured or remanufactured locomotives will meet the applicable emission standards throughout their useful lives (explaining to us how you plan to manufacture or remanufacture locomotives, and providing test data showing that such locomotives will comply with all applicable emission standards.) Anyone meeting the definition of manufacturer in § 1033.901 may apply for a certificate of conformity for freshly manufactured locomotives. Anyone meeting the definition of remanufacturer in § 1033.901 may apply for a certificate of conformity for remanufactured locomotives.

(a) You must send us a separate application for a certificate of conformity for each engine family. A certificate of conformity is valid starting with the indicated effective date, but it is not valid for any production after December 31 of the model year for which it is issued.

(b) The application must contain all the information required by this part and must not include false or incomplete statements or information (see § 1033.255).

(c) We may ask you to include less information than we specify in this subpart, as long as you maintain all the information required by § 1033.250.

(d) You must use good engineering judgment for all decisions related to your application (see 40 CFR 1068.5).

(e) An authorized representative of your company must approve and sign the application.

(f) See § 1033.255 for provisions describing how we will process your application.

(g) We may require you to deliver your test locomotives to a facility we designate for our testing (see § 1033.235(c)).

(h) By applying for a certificate of conformity, you are accepting responsibility for the in-use emission performance of all properly maintained and used locomotives covered by your certificate. This responsibility applies without regard to whether you physically manufacture or remanufacture the entire locomotive. If you do not physically manufacture or remanufacture the entire locomotive, you must take reasonable steps (including those specified by this part) to ensure that the locomotives produced under your certificate conform to the specifications of your application for certification.

§ 1033.205 Applying for a certificate of conformity.

(a) Send the Designated Compliance Officer a complete application for each engine family for which you are requesting a certificate of conformity.

(b) The application must be approved and signed by the authorized representative of your company.

(c) You must update and correct your application to accurately reflect your production, as described in § 1033.225.

(d) Include the following information in your application:

(1) A description of the basic engine design including, but not limited to, the engine family specifications listed in § 1033.230. For freshly manufactured locomotives, a description of the basic locomotive design. For remanufactured locomotives, a description of the basic locomotive designs to which the remanufacture system will be applied. Include in your description, a list of distinguishable configurations to be included in the engine family.

(2) An explanation of how the emission control system operates, including detailed descriptions of:

(i) All emission control system components.

(ii) Injection or ignition timing for each notch (*i.e.*, degrees before or after top-dead-center), and any functional dependence of such timing on other operational parameters (*e.g.*, engine coolant temperature).

(iii) Each auxiliary emission control device (AECD).

(iv) All fuel system components to be installed on any production or test locomotives.

(v) Diagnostics.

(3) A description of the test locomotive.

(4) A description of the test equipment and fuel used. Identify any special or alternate test procedures you used.

(5) A description of the operating cycle and the period of operation necessary to accumulate service hours on the test locomotive and stabilize emission levels. You may also include a Green Engine Factor that would adjust emissions from zero-hour engines to be equivalent to stabilized engines.

(6) A description of all adjustable operating parameters (including, but not limited to, injection timing and fuel rate), including the following:

(i) The nominal or recommended setting and the associated production tolerances.

(ii) The intended adjustable range, and the physically adjustable range.

(iii) The limits or stops used to limit adjustable ranges.

(iv) Production tolerances of the limits or stops used to establish each physically adjustable range.

(v) Information relating to why the physical limits or stops used to establish the physically adjustable range of each parameter, or any other means used to inhibit adjustment, are the most effective means possible of preventing adjustment of parameters to settings outside your specified adjustable ranges on in-use engines.

(7) Projected U.S. production information for each configuration. If you are projecting substantially different sales of a configuration than you had previously, we may require you to explain why you are projecting the change.

(8) All test data obtained by the manufacturer/remanufacturer on each test engine or locomotive. As described in § 1033.235, we may allow you to demonstrate compliance based on results from previous emission tests, development tests, or other testing information.

(9) The intended deterioration factors for the engine family, in accordance with § 1033.245. If the deterioration factors for the engine family were developed using procedures that we have not previously approved, you should request preliminary approval under § 1033.210.

(10) The intended useful life period for the engine family, in accordance with § 1033.101(g). If the useful life for the engine family was determined using procedures that we have not previously approved, you should request preliminary approval under § 1033.210.

(11) Copies of your proposed emission control label(s), maintenance instructions, and installation instructions (where applicable).

(12) An unconditional statement certifying that all locomotives included the engine family comply with all requirements of this part and the Clean Air Act.

(e) If we request it, you must supply such additional information as may be required to evaluate the application.

(f) Provide the information to read, record, and interpret all the information broadcast by a locomotive's onboard computers and electronic control units. State that, upon request, you will give us any hardware, software, or tools we would need to do this. You may reference any appropriate publicly released standards that define conventions for these messages and parameters. Format your information consistent with publicly released standards.

(g) Include the information required by other subparts of this part. For example, include the information required by § 1033.725 if you participate in the ABT program.

(h) Include other applicable information, such as information specified in this part or part 1068 of this chapter related to requests for exemptions.

(i) Name an agent for service located in the United States. Service on this agent constitutes service on you or any of your officers or employees for any action by EPA or otherwise by the United States related to the requirements of this part.

(j) For imported locomotives, identify the following:

(1) The port(s) at which you will import your engines.

(2) The names and addresses of the agents you have authorized to import your engines.

(3) The location of test facilities in the United States where you can test your engines if we select them for testing under a selective enforcement audit, as specified in 40 CFR part 1068, subpart E.

§ 1033.210 Preliminary approval.

(a) If you send us information before you finish the application, we will review it and make any appropriate determinations for questions related to engine family definitions, auxiliary emission-control devices, deterioration factors, testing for service accumulation, maintenance, and useful lives.

(b) Decisions made under this section are considered to be preliminary approval, subject to final review and approval. We will generally not reverse a decision where we have given you preliminary approval, unless we find new information supporting a different decision.

(c) If you request preliminary approval related to the upcoming model year or the model year after that, we will make best-efforts to make the appropriate determinations as soon as practicable. We will generally not provide preliminary approval related to a future model year more than three years ahead of time.

(d) You must obtain preliminary approval for your plan to develop deterioration factors prior to the start of any service accumulation to be used to develop the factors.

§ 1033.220 Amending maintenance instructions.

You may amend your emission-related maintenance instructions after you submit your application for certification, as long as the amended instructions remain consistent with the provisions of § 1033.125. You must send the Designated Compliance Officer a request to amend your application for certification for an engine family if you want to change the emission-related maintenance instructions in a way that could affect emissions. In your request, describe the proposed changes to the maintenance instructions. We will disapprove your request if we determine that the amended instructions are inconsistent with maintenance you performed on emission-data locomotives. If owners/operators follow the original maintenance instructions rather than the newly specified maintenance, this does not allow you to disqualify those locomotives from in-use testing or deny a warranty claim.

(a) If you are decreasing the specified maintenance, you may distribute the new maintenance instructions to your customers 30 days after we receive your request, unless we disapprove your request. This would generally include replacing one maintenance step with another. We may approve a shorter time or waive this requirement.

(b) If your requested change would not decrease the specified maintenance, you may distribute the new maintenance instructions anytime after you send your request. For example, this paragraph (b) would cover adding instructions to increase the frequency of filter changes for locomotives in severe-duty applications.

(c) You do not need to request approval if you are making only minor corrections (such as correcting typographical mistakes), clarifying your maintenance instructions, or changing instructions for maintenance unrelated to emission control. We may ask you to send us copies of maintenance instructions revised under this paragraph (c).

§ 1033.225 Amending applications for certification.

Before we issue you a certificate of conformity, you may amend your application to include new or modified locomotive configurations, subject to the provisions of this section. After we have issued your certificate of conformity, you may send us an amended application requesting that we include new or modified locomotive configurations within the scope of the certificate, subject to the provisions of this section.

You must also amend your application if any changes occur with respect to any information included in your application. For example, you must amend your application if you determine that your actual production variation for an adjustable parameter exceeds the tolerances specified in your application.

(a) You must amend your application before you take either of the following actions:

(1) Add a locomotive configuration to an engine family. In this case, the locomotive added must be consistent with other locomotives in the engine family with respect to the criteria listed in § 1033.230. For example, you must amend your application if you want to produce 12-cylinder versions of the 16-cylinder locomotives you described in your application.

(2) Change a locomotive already included in an engine family in a way that may affect emissions, or change any of the components you described in your application for certification. This includes production and design changes that may affect emissions any time during the locomotive's lifetime. For example, you must amend your application if you want to change a part supplier if the part was described in your original application and is different in any material respect than the part you described.

(3) Modify an FEL for an engine family as described in paragraph (f) of this section.

(b) To amend your application for certification, send the Designated Compliance Officer the following information:

(1) Describe in detail the addition or change in the locomotive model or configuration you intend to make.

(2) Include engineering evaluations or data showing that the amended engine family complies with all applicable requirements. You may do this by showing that the original emission-data locomotive is still appropriate with respect to showing compliance of the amended family with all applicable requirements.

(3) If the original emission-data locomotive for the engine family is not appropriate to show compliance for the new or modified locomotive, include new test data showing that the new or modified locomotive meets the requirements of this part.

(c) We may ask for more test data or engineering evaluations. You must give us these within 30 days after we request them.

(d) For engine families already covered by a certificate of conformity, we will determine whether the existing certificate of conformity covers your new or modified locomotive. You may ask for a hearing if we deny your request (see § 1033.920).

(e) For engine families already covered by a certificate of conformity, you may start producing the new or modified locomotive anytime after you send us your amended application, before we make a decision under paragraph (d) of this section. However, if we determine that the affected locomotives do not meet applicable requirements, we will notify you to cease production of the locomotives and may require you to recall the locomotives at no expense to the owner. Choosing to produce locomotives under this paragraph (e) is deemed to be consent to recall all locomotives that we determine do not meet applicable emission standards or other requirements and to remedy the nonconformity at no expense to the owner. If you do not provide information required under paragraph (c) of this section within 30 days, you must stop producing the new or modified locomotives.

(f) You may ask us to approve a change to your FEL in certain cases after the start of production. The changed FEL may not apply to locomotives you have already introduced into U.S. commerce, except as described in this paragraph (f). If we approve a changed FEL after the start of production, you must include the new FEL on the emission control information label for all locomotives produced after the change. You may ask us to approve a change to your FEL in the following cases:

(1) You may ask to raise your FEL for your engine family at any time. In your request, you must show that you will still be able to meet the emission standards as specified in subparts B and H of this part. If you amend your application by submitting new test data to include a newly added or modified locomotive, as described in paragraph (b)(3) of this section, use the appropriate FELs with corresponding production volumes to calculate your production-weighted average FEL for the model year, as described in subpart H of this part. If you amend your application without submitting new test data, you must use the higher FEL for the entire family to calculate your production-weighted average FEL under subpart H of this part.

(2) You may ask to lower the FEL for your emission family only if you have test data from production locomotives

showing that emissions are below the proposed lower FEL. The lower FEL applies only to engines or fuel-system components you produce after we approve the new FEL. Use the appropriate FELs with corresponding production volumes to calculate your production-weighted average FEL for the model year, as described in subpart H of this part.

§ 1033.230 Grouping locomotives into engine families.

(a) Divide your product line into engine families of locomotives that are expected to have similar emission characteristics throughout the useful life. Your engine family is limited to a single model year. Freshly manufactured locomotives may not be included in the same engine family as remanufactured locomotives, except as allowed by paragraph (f) of this section.

(b) This paragraph (b) applies for all locomotives other than Tier 0 locomotives. Group locomotives in the same engine family if they are the same in all the following aspects:

(1) The combustion cycle (*e.g.*, diesel cycle).

(2) The type of engine cooling employed and procedure(s) employed to maintain engine temperature within desired limits (thermostat, on-off radiator fan(s), radiator shutters, etc.).

(3) The bore and stroke dimensions.

(4) The approximate intake and exhaust event timing and duration (valve or port).

(5) The location of the intake and exhaust valves (or ports).

(6) The size of the intake and exhaust valves (or ports).

(7) The overall injection or ignition timing characteristics (*i.e.*, the deviation of the timing curves from the optimal fuel economy timing curve must be similar in degree).

(8) The combustion chamber configuration and the surface-to-volume ratio of the combustion chamber when the piston is at top dead center position, using nominal combustion chamber dimensions.

(9) The location of the piston rings on the piston.

(10) The method of air aspiration (turbocharged, supercharged, naturally aspirated, Roots blown).

(11) The general performance characteristics of the turbocharger or supercharger (*e.g.*, approximate boost pressure, approximate response time, approximate size relative to engine displacement).

(12) The type of air inlet cooler (air-to-air, air-to-liquid, approximate degree to which inlet air is cooled).

(13) The intake manifold induction port size and configuration.

(14) The type of fuel and fuel system configuration.

(15) The configuration of the fuel injectors and approximate injection pressure.

(16) The type of fuel injection system controls (*i.e.*, mechanical or electronic).

(17) The type of smoke control system.

(18) The exhaust manifold port size and configuration.

(19) The type of exhaust aftertreatment system (oxidation catalyst, particulate trap), and characteristics of the aftertreatment system (catalyst loading, converter size vs. engine size).

(c) Group Tier 0 locomotives in the same engine family if they are the same in all the following aspects:

(1) The combustion cycle (*e.g.*, diesel cycle).

(2) The type of engine cooling employed and procedure(s) employed to maintain engine temperature within desired limits (thermostat, on-off radiator fan(s), radiator shutters, etc.).

(3) The approximate bore and stroke dimensions.

(4) The approximate location of the intake and exhaust valves (or ports).

(5) The combustion chamber general configuration and the approximate surface-to-volume ratio of the combustion chamber when the piston is at top dead center position, using nominal combustion chamber dimensions.

(6) The method of air aspiration (turbocharged, supercharged, naturally aspirated, Roots blown).

(7) The type of air inlet cooler (air-to-air, air-to-liquid, approximate degree to which inlet air is cooled).

(8) The type of fuel and general fuel system configuration.

(9) The general configuration of the fuel injectors and approximate injection pressure.

(10) The type of fuel injection system control (electronic or mechanical).

(d) You may subdivide a group of locomotives that is identical under paragraph (b) or (c) of this section into different engine families if you show the expected emission characteristics are different during the useful life. For the purposes of determining whether an engine family is a small engine family in § 1033.405(a)(2), we will consider the number of locomotives that could have been classed together under paragraph (b) or (c) of this section, instead of the number of locomotives that are included in a subdivision allowed by this paragraph (d).

(e) In unusual circumstances, you may group locomotives that are not identical with respect to the things listed in paragraph (b) or (c) of this section in the same engine family if you show that their emission characteristics during the useful life will be similar.

(f) During the first five calendar years after a new tier of standards become applicable, remanufactured engines may be included in the same engine family as freshly manufactured locomotives, provided such engines are used for locomotive models included in the engine family.

§ 1033.235 Emission testing required for certification.

This section describes the emission testing you must perform to show compliance with the emission standards in § 1033.101.

(a) Test your emission-data locomotives using the procedures and equipment specified in subpart F of this part.

(b) Select an emission-data locomotive (or engine) from each engine family for testing. It may be a low mileage locomotive, or a development engine (that is equivalent in design to the engines of the locomotives being certified), or another low hour engine. Use good engineering judgment to select the locomotive configuration that is most likely to exceed (or have emissions nearest to) an applicable emission standard or FEL. In making this selection, consider all factors expected to affect emission control performance and compliance with the standards, including emission levels of all exhaust constituents, especially NO_X and PM.

(c) We may measure emissions from any of your test locomotives or other locomotives from the engine family.

(1) We may decide to do the testing at your plant or any other facility. If we do this, you must deliver the test locomotive to a test facility we designate. If we do the testing at your plant, you must schedule it as soon as possible and make available the instruments, personnel, and equipment we need.

(2) If we measure emissions from one of your test locomotives, the results of that testing become the official emission results for the locomotive. Unless we later invalidate these data, we may decide not to consider your data in determining if your engine family meets applicable requirements.

(3) Before we test one of your locomotives, we may set its adjustable parameters to any point within the adjustable ranges (see § 1033.115(b)).

(4) Before we test one of your locomotives, we may calibrate it within normal production tolerances for anything we do not consider an adjustable parameter.

(d) You may ask to use emission data from a previous model year instead of doing new tests if all the following are true:

(1) The engine family from the previous model year differs from the current engine family only with respect to model year, or other factors not related to emissions. You may include additional configurations subject to the provisions of § 1033.225.

(2) The emission-data locomotive from the previous model year remains the appropriate emission-data locomotive under paragraph (b) of this section.

(3) The data show that the emission-data locomotive would meet all the requirements that apply to the engine family covered by the application for certification.

(e) We may require you to test a second locomotive of the same or different configuration in addition to the locomotive tested under paragraph (b) of this section.

(f) If you use an alternate test procedure under 40 CFR 1065.10 and later testing shows that such testing does not produce results that are equivalent to the procedures specified in subpart F of this part, we may reject data you generated using the alternate procedure.

§ 1033.240 Demonstrating compliance with exhaust emission standards.

(a) For purposes of certification, your engine family is considered in compliance with the applicable numerical emission standards in § 1033.101 if all emission-data locomotives representing that family have test results showing deteriorated emission levels at or below these standards.

(1) If you include your locomotive in the ABT program in subpart H of this part, your FELs are considered to be the applicable emission standards with which you must comply.

(2) If you do not include your locomotive in the ABT program in subpart H of this part, but it was previously included in the ABT program in subpart H of this part, the previous FELs are considered to be the applicable emission standards with which you must comply.

(b) Your engine family is deemed not to comply if any emission-data locomotive representing that family has test results showing a deteriorated emission level above an applicable FEL or emission standard from § 1033.101 for any pollutant. Use the following steps to determine the deteriorated emission level for the test locomotive:

(1) Collect emission data using measurements with enough significant figures to calculate the cycle-weighted emission rate to at least one more decimal place than the applicable standard. Apply any applicable humidity corrections before weighting emissions.

(2) Apply the regeneration factors if applicable. At this point the emission rate is generally considered to be an official emission result.

(3) Apply the deterioration factor to the official emission result, as described in § 1033.245, then round the adjusted figure to the same number of decimal places as the emission standard. This adjusted value is the deteriorated emission level. Compare these emission levels from the emission-data locomotive with the applicable emission standards. In the case of NO_X+NMHC standards, apply the deterioration factor to each pollutant and then add the results before rounding.

(4) The highest deteriorated emission levels for each pollutant are considered to be the certified emission levels.

§ 1033.245 Deterioration factors.

Establish deterioration factors for each pollutant to determine whether your locomotives will meet emission standards for each pollutant throughout the useful life, as described in §§ 1033.101 and 1033.240. Determine deterioration factors as described in this section, either with an engineering analysis, with pre-existing test data, or with new emission measurements. The deterioration factors are intended to reflect the deterioration expected to result during the useful life of a locomotive maintained as specified in § 1033.125. If you perform durability testing, the maintenance that you may perform on your emission-data locomotive is limited to the maintenance described in § 1033.125.

(a) Your deterioration factors must take into account any available data from in-use testing with similar locomotives, consistent with good engineering judgment. For example, it would not be consistent with good engineering judgment to use deterioration factors that predict emission increases over the useful life of a locomotive or locomotive engine that are significantly less than the emission increases over the useful life observed from in-use testing of similar locomotives.

(b) Deterioration factors may be additive or multiplicative.

(1) *Additive deterioration factor for exhaust emissions.* Except as specified in paragraph (b)(2) of this section, use an additive deterioration factor for exhaust emissions. An additive deterioration factor for a pollutant is the difference between exhaust emissions at the end of the useful life and exhaust emissions at the low-hour test point. In these cases, adjust the official emission results for each tested locomotive at the selected test point by adding the factor to the measured emissions. The deteriorated emission level is intended to represent the highest emission level during the useful life. Thus, if the factor is less than zero, use zero. Additive deterioration factors must be specified to one more decimal place than the applicable standard.

(2) *Multiplicative deterioration factor for exhaust emissions.* Use a multiplicative deterioration factor if good engineering judgment calls for the deterioration factor for a pollutant to be the ratio of exhaust emissions at the end of the useful life to exhaust emissions at the low-hour test point. For example, if you use aftertreatment technology that controls emissions of a pollutant proportionally to engine-out emissions, it is often appropriate to use a multiplicative deterioration factor. Adjust the official emission results for each tested locomotive at the selected test point by multiplying the measured emissions by the deterioration factor. The deteriorated emission level is intended to represent the highest emission level during the useful life. Thus, if the factor is less than one, use one.

A multiplicative deterioration factor may not be appropriate in cases where testing variability is significantly greater than locomotive-to-locomotive variability. Multiplicative deterioration factors must be specified to one more significant figure than the applicable standard.

(c) Deterioration factors for smoke are always additive.

(d) If your locomotive vents crankcase emissions to the exhaust or to the atmosphere, you must account for crankcase emission deterioration, using good engineering judgment. You may use separate deterioration factors for crankcase emissions of each pollutant (either multiplicative or additive) or include the effects in combined deterioration factors that include exhaust and crankcase emissions together for each pollutant.

(e) Include the following information in your application for certification:

(1) If you use test data from a different engine family, explain why this is appropriate and include all the emission measurements on which you base the deterioration factor.

(2) If you determine your deterioration factors based

onengineering analysis, explain why this is appropriate and include a statement that all data, analyses, evaluations, and other information you used are available for our review upon request.

(3) If you do testing to determine deterioration factors, describe the form and extent of service accumulation, including a rationale for selecting the service-accumulation period and the method you use to accumulate hours.

§ 1033.250 Reporting and recordkeeping.

(a) Within 45 days after the end of the model year, send the Designated Compliance Officer a report describing the following information about locomotives you produced during the model year:

(1) Report the total number of locomotives you produced in each engine family by locomotive model and engine model.

(2) If you produced exempted locomotives, report the number of exempted locomotives you produced for each locomotive model and identify the buyer or shipping destination for each exempted locomotive.

(b) Organize and maintain the following records:

(1) A copy of all applications and any summary information you send us.

(2) Any of the information we specify in § 1033.205 that you were not required to include in your application.

(3) A detailed history of each emission-data locomotive. For each locomotive, describe all of the following:

(i) The emission-data locomotive's construction, including its origin and buildup, steps you took to ensure that it represents production locomotives, any components you built specially for it, and all the components you include in your application for certification.

(ii) How you accumulated locomotive operating hours (service accumulation), including the dates and the number of hours accumulated.

(iii) All maintenance, including modifications, parts changes, and other service, and the dates and reasons for the maintenance.

(iv) All your emission tests, including documentation on routine and standard tests, as specified in part 40 CFR part 1065, and the date and purpose of each test.

(v) All tests to diagnose locomotive or emission control performance, giving the date and time of each and the reasons for the test.

(vi) Any other significant events.

(4) If you test a development engine for certification, you may omit information otherwise required by paragraph (b)(3) of this section that is unrelated to emissions and emission-related components.

(5) Production figures for each engine family divided by assembly plant.

(6) Keep a list of locomotive identification numbers for all the locomotives you produce under each certificate of conformity.

(c) Keep data from routine emission tests (such as test cell temperatures and relative humidity readings) for one year after we issue the associated certificate of conformity. Keep all other information specified in paragraph (a) of this section for eight years after we issue your certificate.

(d) Store these records in any format and on any media, as long as you can promptly send us organized, written records in English if we ask for them. You must keep these records readily available. We may review them at any time.

(e) Send us copies of any locomotive maintenance instructions or explanations if we ask for them.

§ 1033.255 EPA decisions.

(a) If we determine your application is complete and shows that the engine family meets all the requirements of this part and the Clean Air Act, we will issue a certificate of conformity for your engine family for that model year. We may make the approval subject to additional conditions.

(b) We may deny your application for certification if we determine that your engine family fails to comply with emission standards or other requirements of this part or the Clean Air Act. Our decision may be based on a review of all information available to us. If we deny your application, we will explain why in writing.

(c) In addition, we may deny your application or suspend or revoke your certificate if you do any of the following:

(1) Refuse to comply with any testing or reporting requirements.

(2) Submit false or incomplete information (paragraph (e) of this section applies if this is fraudulent).

(3) Render inaccurate any test data.

(4) Deny us from completing authorized activities. This includes a failure to provide reasonable assistance.

(5) Produce locomotives for importation into the United States at a location where local law prohibits us from carrying out authorized activities.

(6) Fail to supply requested information or amend your application to include all locomotives being produced.

(7) Take any action that otherwise circumvents the intent of the Clean Air Act or this part.

(d) We may void your certificate if you do not keep the records we require or do not give us information when we ask for it.

(e) We may void your certificate if we find that you intentionally submitted false or incomplete information.

(f) If we deny your application or suspend, revoke, or void your certificate, you may ask for a hearing (see § 1033.920).

Subpart D—Manufacturer and Remanufacturer Production Line Testing and Audit Programs

§ 1033.301 Applicability.

The requirements of this subpart of this part apply to manufacturers/remanufacturers of locomotives certified under this part, with the following exceptions:

(a) The requirements of §§ 1033.310 1033.315, 1033.320, 1033.325, and 1033.335 apply only to manufacturers of freshly manufactured locomotives or locomotive engines (including those used for repowering). We may also apply these requirements to remanufacturers of any locomotives for which there is reason to believe production problems exist that could affect emission performance. When we make a determination that production problems may exist that could affect emission performance, we will notify the remanufacturer(s). The requirements of §§ 1033.305, 1033.310, 1033.315, 1033.320, 1033.325, and 1033.335 will apply as specified in the notice.

(b) The requirements of § 1033.340 apply only to remanufacturers.

(c) As specified in § 1033.1(d), we may apply the requirements of this subpart to manufacturers/remanufacturers that do not certify the locomotives. However, unless we specify otherwise, the requirements of this subpart apply to manufacturers/remanufacturers that hold the certificates for the locomotives.

§ 1033.305 General requirements.

(a) Manufacturers (and remanufacturers, where applicable) are required to test production line locomotives using the test procedures specified in § 1033.315. While this subpart refers to locomotive testing, you may test locomotive engines instead of testing locomotives, unless we specifically require you to conduct production line testing on locomotives. If we determine that locomotive testing is required, we will notify you and will specify how to complete the testing (including specifying the time period in which you must complete the testing).

(b) Remanufacturers are required to conduct audits according to the requirements of § 1033.340 to ensure that remanufactured locomotives comply with the requirements of this part.

(c) If you certify an engine family with carryover emission data, as described in § 1033.235, and these equivalent engine families consistently pass the production-line testing requirements over the preceding two-year period, you may ask for a reduced testing rate for further production-line testing for that family. If we reduce your testing rate, we may limit our approval to any number of model years. In determining whether to approve your request, we may consider the number of locomotives that have failed emission tests.

(d) You may ask to use an alternate program for testing production-line locomotives. In your request, you must show us that the alternate program gives equal assurance that your locomotives meet the requirements of this part. If we approve your alternate program, we may waive some or all of this subpart's requirements.

§ 1033.310 Sample selection for testing.

(a) At the start of each model year, begin randomly selecting locomotives from each engine family for production line testing at a rate of one percent. Make the selection of the test locomotive after it has been assembled. Perform the testing throughout the entire model year to the extent possible.

(1) The required sample size for an engine family (provided that no engine tested fails to meet applicable emission standards) is the lesser of five tests per model year or one percent of projected annual production, with a minimum sample size for an engine family of one test per model year. See paragraph (d) of this section to determine the required number of test locomotives if any locomotives fail to comply with any standards.

(2) You may elect to test additional locomotives. All additional locomotives must be tested in accordance with the applicable test procedures of this part.

(b) You must assemble the test locomotives using the same production process that will be used for locomotives to be introduced into commerce. You may ask us to allow special assembly procedures for catalyst equipped locomotives.

(c) Unless we approve it, you may not use any quality control, testing, or assembly procedures that you do not use during the production and assembly of all other locomotives of that family. This applies for any test locomotive or any portion of a locomotive, including engines, parts, and subassemblies.

(d) If one or more locomotives fail a production line test, then you must test two additional locomotives from the next fifteen produced in that engine family for each locomotive that fails. For example, if you are required to test four locomotives under paragraph (a) of this section and the second locomotive fails to comply with one or more standards, then you must test two additional locomotives from the next fifteen produced in that engine family. If both of those locomotive pass all standards, you are required to test two additional locomotive. If they both pass, you are done with testing for that family for the year since you tested six locomotives (the four originally required plus the two additional locomotives).

§ 1033.315 Test procedures.

(a) *Test procedures.* Use the test procedures described in subpart F of this part, except as specified in this section.

(1) You may ask to use test other procedures. We will approve your request if we determine that it is not possible to perform satisfactory testing using the specified procedures. We may also approve alternate test procedures under § 1033.305(d).

(2) If you used test procedures other than those in subpart F of this part during certification for the engine family (other than alternate test procedures necessary for testing a development engine or a low hour engine instead of a low mileage locomotive), use the same test procedures for production line testing that you used in certification.

(b) *Modifying a test locomotive.* Once an engine is selected for testing, you may adjust, repair, maintain, or modify it or check its emissions only if one of the following is true:

(1) You document the need for doing so in your procedures for assembling and inspecting all your production engines and make the action routine for all the engines in the engine family.

(2) This subpart otherwise specifically allows your action.

(3) We approve your action in advance.

(c) *Adjustable parameters.* (1) Confirm that adjustable parameters are set to values or positions that are within the range recommended to the ultimate purchaser.

(2) We may require to be adjusted any adjustable parameter to any setting within the specified adjustable range of that parameter prior to the performance of any test.

(d) *Stabilizing emissions.* You may stabilize emissions from the locomotives to be tested through service accumulation by running the engine through a typical duty cycle. Emissions are considered stabilized after 300 hours of operation. You may accumulate fewer hours, consistent with good engineering judgment. You may establish a green engine factor for each regulated pollutant for each engine family, instead of (or in combination with) accumulating actual operation, to be used in calculating emissions test results. You must obtain our approval prior to using a green engine factor.

(e) *Adjustment after shipment.* If a locomotive is shipped to a facility other than the production facility for production line testing, and an adjustment or repair is necessary because of such shipment, you may perform the necessary adjustment or repair only after the initial test of the locomotive, unless we determine that the test would be impossible to perform or would permanently damage the locomotive.

(f) *Malfunctions.* If a locomotive cannot complete the service accumulation or an emission test because of a malfunction, you may request that we authorize either the repair of that locomotive or its deletion from the test sequence.

(g) *Retesting.* If you determine that any production line emission test of a locomotive is invalid, you must retest it in accordance with the requirements of this subpart. Report emission results from all tests to us, including test results you determined are invalid. You must also include a detailed explanation of the reasons for invalidating any test in the quarterly report required in § 1033.325(e). In the event a retest is performed, you may ask us within ten days of the end of the production quarter for permission to substitute the after-repair test results for the original test results. We will respond to the request within ten working days of our receipt of the request.

§ 1033.325 Calculation and reporting of test results.

(a) Calculate initial test results using the applicable test procedure specified in § 1033.315(a). Include applicable non-deterioration adjustments such as a green engine factor or regeneration adjustment factor. Round the results to the number of decimal places in the applicable emission standard expressed to one additional significant figure.

(b) If you conduct multiple tests on any locomotives, calculate final test results by summing the initial test results derived in paragraph (a) of this section for each test locomotive, dividing by the number of tests conducted on the locomotive, and rounding to the same number of decimal places in the applicable standard expressed to one additional significant figure.

(c) Calculate the final test results for each test locomotive by applying the appropriate deterioration factors, derived in the certification process for the engine family, to the final test results, and rounding to the same number of decimal places in the applicable standard expressed to one additional significant figure.

(d) If, subsequent to an initial failure of a production line test, the average of the test results for the failed locomotive and the two additional locomotives tested, is greater than any applicable emission standard or FEL, the engine family is deemed to be in non-compliance with applicable emission standards, and you must notify us within ten working days of such noncompliance.

(e) Within 45 calendar days of the end of each quarter, you must send to the Designated Compliance Officer a report with the following information:

(1) The location and description of the emission test facilities which you used to conduct your testing.

(2) Total production and sample size for each engine family tested.

(3) The applicable standards against which each engine family was tested.

(4) For each test conducted, include all of the following:

(i) A description of the test locomotive, including:

(A) Configuration and engine family identification.

(B) Year, make, and build date.

(C) Engine identification number.

(D) Number of megawatt-hours (or miles if applicable) of service accumulated on locomotive prior to testing.

(E) Description of green engine factor; how it is determined and how it is applied.

(ii) Location(s) where service accumulation was conducted and description of accumulation procedure and schedule, if applicable.

(iii) Test number, date, test procedure used, initial test results before and after rounding, and final test results for all production line emission tests conducted, whether valid or invalid, and the reason for invalidation of any test results, if applicable.

(iv) A complete description of any adjustment, modification, repair, preparation, maintenance, and testing which was performed on the test locomotive, has not been reported pursuant to any other paragraph of this subpart, and will not be performed on other production locomotives.

(v) Any other information we may ask you to add to your written report so we can determine whether your new engines conform with the requirements of this subpart.

(5) For each failed locomotive as defined in § 1033.335(a), a description of the remedy and test results for all retests as required by § 1033.345(g).

(6) The following signed statement and endorsement by an authorized representative of your company:

We submit this report under sections 208 and 213 of the Clean Air Act. Our production-line testing conformed completely with the requirements of 40 CFR part 1033. We have not changed production processes or quality-control procedures for the test locomotives in a way that might affect emission controls. All the information in this report is true and accurate to the best of my knowledge. I know of the penalties for violating the Clean Air Act and the regulations. (Authorized Company Representative)

§ 1033.330 Maintenance of records; submittal of information.

(a) You must establish, maintain, and retain the following adequately organized and indexed test records:

(1) A description of all equipment used to test locomotives. The equipment requirements in subpart F of this part apply to tests performed under this subpart. Maintain these records for each test cell that can be used to perform emission testing under this subpart.

(2) Individual test records for each production line test or audit including:

(i) The date, time, and location of each test or audit.

(ii) The method by which the green engine factor was calculated or the number of hours of service accumulated on the test locomotive when the test began and ended.

(iii) The names of all supervisory personnel involved in the conduct of the production line test or audit;

(iv) A record and description of any adjustment, repair, preparation or modification performed on test locomotives, giving the date, associated time, justification, name(s) of the authorizing personnel, and names of all supervisory personnel responsible for the conduct of the action.

(v) If applicable, the date the locomotive was shipped from the assembly plant, associated storage facility or port facility, and the date the locomotive was received at the testing facility.

(vi) A complete record of all emission tests or audits performed under to this subpart (except tests performed directly by us), including all individual worksheets and/or other documentation relating to each test, or exact copies thereof, according to the record requirements specified in subpart F of this part and 40 CFR part 1065.

(vii) A brief description of any significant events during testing not otherwise described under this paragraph (a)(2), commencing with the test locomotive selection process and including such extraordinary events as engine damage during shipment.

(b) Keep all records required to be maintained under this subpart for a period of eight years after completion of all testing. Store these records in any format and on any media, as long as you can promptly provide to us organized, written records in English if we ask for them and all the information is retained.

(c) Send us the following information with regard to locomotive production if we ask for it:

(1) Projected production for each configuration within each engine family for which certification has been requested and/or approved.

(2) Number of locomotives, by configuration and assembly plant, scheduled for production.

(d) Nothing in this section limits our authority to require you to establish, maintain, keep or submit to us information not specified by this section.

(e) Send all reports, submissions, notifications, and requests for approval made under this subpart to the Designated Compliance Officer using an approved format.

(f) You must keep a copy of all reports submitted under this subpart.

§ 1033.335 Compliance with criteria for production line testing.

There are two types of potential failures: failure of an individual locomotive to comply with the standards, and a failure of an engine family to comply with the standards.

(a) A failed locomotive is one whose final test results pursuant to § 1033.325(c), for one or more of the applicable pollutants, exceed an applicable emission standard or FEL.

(b) An engine family is deemed to be in noncompliance, for purposes of this subpart, if at any time throughout the model year, the average of an initial failed locomotive and the two additional locomotives tested, is greater than any applicable emission standard or FEL.

§ 1033.340 Remanufactured locomotives: installation audit requirements.

The section specifies the requirements for certifying remanufacturers to audit the remanufacture of locomotives covered by their certificates of conformity for proper components, component settings and component installations on randomly chosen locomotives in an engine family.

(a) You must ensure that all emission related components are properly installed on the locomotive and are set to the proper specification as indicated in your instructions. You may summit audits performed by the owners or operators of the locomotives, provided the audits are performed in accordance with the provisions of this section.

(b) Audit at least five percent of your annual sales per model year per installer or ten per engine family per installer, whichever is less. You must perform more audits if there are any failures. Randomly select the locomotives to be audited after the remanufacture is complete. We may allow you to select locomotives prior to the completion of the remanufacture, if the preselection would not have the potential to affect the manner in which the locomotive was remanufactured (*e.g.*, where the installer is not aware of the selection prior to the completion of the remanufacture).

(c) The remanufactured locomotive may accumulate no more than 10,000 miles prior to an audit.

(d) A locomotive fails if any emission related components are found to be improperly installed, improperly adjusted or incorrectly used.

(e) If a remanufactured locomotive fails an audit, then you must audit two additional locomotives from the next ten remanufactured in that engine family by that installer.

(f) An engine family is determined to have failed an audit, if at any time during the model year, you determine that the three locomotives audited are found to have had any improperly installed, improperly adjusted or incorrectly used components. You must notify us within 2 working days of a determination of an engine family audit failure.

(g) Within 30 calendar days of the end of each quarter, each remanufacturer must send the Designated Compliance Officer a report which includes the following information:

(1) The location and description of your audit facilities which were utilized to conduct auditing reported pursuant to this section;

(2) Total production and sample size for each engine family;

(3) The applicable standards and/or FELs against which each engine family was audited;

(4) For each audit conducted:

(i) A description of the audited locomotive, including:

(A) Configuration and engine family identification;

(B) Year, make, build date, and remanufacture date; and

(C) Engine identification number;

(ii) Any other information we request relevant to the determination whether the new locomotives being remanufactured do in fact conform with the regulations with respect to which the certificate of conformity was issued;

(5) For each failed locomotive as defined in paragraph (d) of this section, a description of the remedy as required by § 1033.345(g);

(6) The following signed statement and endorsement by your authorized representative:

We submit this report under sections 208 and 213 of the Clean Air Act. Our production-line auditing conformed completely with the requirements of 40 CFR part 1033. We have not changed production processes or quality-control procedures for the audited locomotives in a way that might affect emission controls. All the information in this report is true and accurate to the best of my knowledge. I know of the penalties for violating the Clean Air Act and the regulations. (Authorized Company Representative)

§ 1033.345 Suspension and revocation of certificates of conformity.

(a) A certificate can be suspended for an individual locomotive as follows:

(1) The certificate of conformity is automatically suspended for any locomotive that fails a production line test pursuant to § 1033.335(a), effective from the time the testing of that locomotive is completed.

(2) The certificate of conformity is automatically suspended for any locomotive that fails an audit pursuant to § 1033.340(d), effective from the time that auditing of that locomotive is completed.

(b) A certificate can be suspended for an engine family as follows:

(1) We may suspend the certificate of conformity for an engine family that is in noncompliance pursuant to § 1033.335(b), thirty days after the engine family is deemed to be in noncompliance.

(2) We may suspend the certificate of conformity for an engine family that is determined to have failed an audit pursuant to § 1033.340(f). This suspension will not occur before thirty days after the engine family is deemed to be in noncompliance.

(c) If we suspend your certificate of conformity for an engine family, the suspension may apply to all facilities producing engines from an engine family, even if you find noncompliant engines only at one facility.

(d) We may revoke a certificate of conformity for any engine family in whole or in part if:

(1) You fail to comply with any of the requirements of this subpart.

(2) You submit false or incomplete information in any report or information provided to us under this subpart.

(3) You render inaccurate any test data submitted under this subpart.

(4) An EPA enforcement officer is denied the opportunity to conduct activities authorized in this subpart.

(5) An EPA enforcement officer is unable to conduct authorized activities for any reason.

(e) We will notify you in writing of any suspension or revocation of a certificate of conformity in whole or in part; a suspension or revocation is effective upon receipt of such notification or thirty days from the time an engine family is deemed to be in noncompliance under §§ 1033.325(d), 1033.335(a), 1033.335(b), or 1033.340(f) is made, whichever is earlier, except that the certificate is immediately suspended with respect to any failed locomotives as provided for in paragraph (a) of this section.

(f) We may revoke a certificate of conformity for an engine family when the certificate has been suspended under paragraph (b) or (c) of this section if the remedy is one requiring a design change or changes to the locomotive, engine and/or emission control system as described in the application for certification of the affected engine family.

(g) Once a certificate has been suspended for a failed locomotive, as provided for in paragraph (a) of this section, you must take all the following actions before the certificate is reinstated for that failed locomotive:

(1) Remedy the nonconformity.

(2) Demonstrate that the locomotive conforms to applicable standards or family emission limits by retesting, or reauditing if applicable, the locomotive in accordance with this part.

(3) Submit a written report to us after successful completion of testing (or auditing, if applicable) on the failed locomotive, which contains a description of the remedy and testing (or auditing) results for each locomotive in addition to other information that may be required by this part.

(h) Once a certificate for a failed engine family has been suspended pursuant to paragraph (b) or (c) of this section, you must take the following actions before we will consider reinstating the certificate:

(1) Submit a written report to us identifying the reason for the noncompliance of the locomotives,

describing the remedy, including a description of any quality control measures you will use to prevent future occurrences of the problem, and stating the date on which the remedies will be implemented.

(2) Demonstrate that the engine family for which the certificate of conformity has been suspended does in fact comply with the regulations of this part by testing (or auditing) locomotives selected from normal production runs of that engine family. Such testing (or auditing) must comply with the provisions of this subpart. If you elect to continue testing (or auditing) individual locomotives after suspension of a certificate, the certificate is reinstated for any locomotive actually determined to be in conformance with the applicable standards or family emission limits through testing (or auditing) in accordance with the applicable test procedures, provided that we have not revoked the certificate under paragraph (f) of this section.

(i) If the certificate has been revoked for an engine family, you must take the following actions before we will issue a certificate that would allow you to continue introduction into commerce of a modified version of that family:

(1) If we determine that the change(s) in locomotive design may have an effect on emission deterioration, we will notify you within five working days after receipt of the report in paragraph (h) of this section, whether subsequent testing/auditing under this subpart will be sufficient to evaluate the change(s) or whether additional testing (or auditing) will be required.

(2) After implementing the change or changes intended to remedy the nonconformity, you must demonstrate that the modified engine family does in fact conform with the regulations of this part by testing locomotives (or auditing for remanufactured locomotives) selected from normal production runs of that engine family. When both of these requirements are met, we will reissue the certificate or issue a new certificate. If this subsequent testing (or auditing) reveals failing data the revocation remains in effect.

(j) At any time subsequent to an initial suspension of a certificate of conformity for a test or audit locomotive pursuant to paragraph (a) of this section, but not later than 30 days (or such other period as we may allow) after the notification, our decision to suspend or revoke a certificate of conformity in whole or in part pursuant to paragraphs (b), (c), or (f) of this section, you may request a hearing as to whether the tests or audits have been properly conducted or any sampling methods have been properly applied. (See § 1033.920.)

(k) Any suspension of a certificate of conformity under paragraphs (a) through (d) of this section will be made only after you have been offered an opportunity for a hearing conducted in accordance with § 1033.920. It will not apply to locomotives no longer in your possession.

(l) If we suspend, revoke, or void a certificate of conformity, and you believe that our decision was based on erroneous information, you may ask us to reconsider our decision before requesting a hearing. If you demonstrate to our satisfaction that our decision was based on erroneous information, we will reinstate the certificate.

(m) We may conditionally reinstate the certificate for that family so that you do not have to store non-test locomotives while conducting subsequent testing or auditing of the noncomplying family subject to the following condition: you must commit to recall all locomotives of that family produced from the time the certificate is conditionally reinstated if the family fails subsequent testing, or auditing if applicable, and must commit to remedy any nonconformity at no expense to the owner.

Subpart E—In-use Testing

§ 1033.401 Applicability.

The requirements of this subpart are applicable to certificate holders for locomotives subject to the provisions of this part. These requirements may also be applied to other manufacturers/remanufacturers as specified in § 1033.1(d).

§ 1033.405 General provisions.

(a) Each year, we will identify engine families and configurations within families that you must test according to the requirements of this section.

(1) We may require you to test one engine family each year for which you have received a certificate of conformity. If you are a manufacturer that holds certificates of conformity for both freshly manufactured and remanufactured locomotive engine families, we may require you to test one freshly manufactured engine family and one remanufactured engine family. We may require you to test additional engine families if we have reason to believe that locomotives in such families do not comply with emission standards in use.

(2) For engine families of less than 10 locomotives per year, no in-use testing will be required, unless we have reason to believe that those engine families are not complying with the applicable emission standards in use.

(b) Test a sample of in-use locomotives from an engine family, as specified in § 1033.415. We will use these data, and any other data available to us, to determine the compliance status of classes of locomotives, including for purposes of recall under 40 CFR part 1068, and whether remedial action is appropriate.

§ 1033.410 In-use test procedure.

(a) You must test the complete locomotives; you may not test engines that are not installed in locomotives at the time of testing.

(b) Test the locomotive according to the test procedures outlined in subpart F of this part, except as provided in this section.

(c) Use the same test procedures for in-use testing as were used for certification, except for cases in which certification testing was not conducted with a locomotive, but with a development engine or other engine. In such cases, we will specify deviations from the certification test procedures as appropriate. We may allow or require other alternate procedures, with advance approval.

(d) Set all adjustable locomotive or engine parameters to values or positions that are within the range specified in the certificate of conformity. We may require you to set these parameters to specific values.

(e) We may waive portions of the applicable test procedure that are not necessary to determine in-use compliance.

§ 1033.415 General testing requirements.

(a) *Number of locomotives to be tested.* Determine the number of locomotives to be tested by the following method:

(1) Test a minimum of 2 locomotives per engine family, except as provided in paragraph (a)(2) of this section. You must test additional locomotives if any locomotives fail to meet any standard. Test 2 more locomotives for each failing locomotive, but stop testing if the total number of locomotives tested equals 10.

(2) If an engine family has been certified using carry over emission data from a family that has been previously tested under paragraph (a)(1) of this section (and we have not ordered or begun to negotiate remedial action of that family), you need to test only one locomotive per engine family. If that locomotive fails to meet applicable standards for any pollutant, testing for that engine family must be conducted as outlined under paragraph (a)(1) of this section.

(3) You may ask us to allow you to test more locomotives than the minimum number described above or may concede failure before testing 10 locomotives.

(b) *Compliance criteria.* We will consider failure rates, average emission levels and the existence of any defects among other factors in determining whether to pursue remedial action. We may order a recall pursuant to 40 CFR part 1068 before testing reaches the tenth locomotive.

(c) *Collection of in-use locomotives.* Procure in-use locomotives that have been operated for 50 to 75 percent of the locomotive's useful life for testing under this subpart. Complete testing required by this section for any engine family before useful life of the locomotives in the engine family passes.

(**Note:** § 1033.820 specifies that railroads must make reasonable efforts to enable you to perform this testing.)

§ 1033.420 Maintenance, procurement and testing of in-use locomotives.

(a) A test locomotive must have a maintenance history that is representative of actual in-use conditions, and identical or equivalent to your recommended emission-related maintenance requirements.

(1) When procuring locomotives for in-use testing, ask the end users about the accumulated usage, maintenance, operating conditions, and storage of the test locomotives.

(2) Your selection of test locomotives is subject to our approval. Maintain the information you used to procure locomotives for in-use testing in the same manner as is required in § 1033.250.

(b) You may perform minimal set-to-spec maintenance on a test locomotive before conducting in-use testing. Maintenance may include only that which is listed in the owner's instructions for locomotives with the amount of service and age of the acquired test locomotive. Maintain documentation of all maintenance and adjustments.

(c) If the locomotive selected for testing is equipped with emission diagnostics as described in § 1033.110 and the MIL is illuminated, you may read the code and repair the malfunction to the degree that an owner/operator would be required to repair the malfunction under § 1033.815.

(d) Results of at least one valid set of emission tests using the test procedure described in subpart F of this part are required for each in-use locomotive.

(e) If in-use testing results show that an in-use locomotive fails to comply with any applicable emission standards, you must determine the reason for noncompliance and report your findings in the quarterly in-use test result report described in § 1033.425.

§ 1033.425 In-use test program reporting requirements.

(a) Within 90 days of completion of testing, send us all emission test results generated from the in-use testing program. Report all of the following information for each locomotive tested:

(1) Engine family, and configuration.

(2) Locomotive and engine models.

(3) Locomotive and engine serial numbers.

(4) Date of manufacture or remanufacture, as applicable.

(5) Megawatt-hours of use (or miles, as applicable).

(6) Date and time of each test attempt.

(7) Results of all emission testing.

(8) Results (if any) of each voided or failed test attempt.

(9) Summary of all maintenance and/or adjustments performed.

(10) Summary of all modifications and/or repairs.

(11) Determinations of noncompliance.

(12) The following signed statement and endorsement by an authorized representative of your company.

We submit this report under sections 208 and 213 of the Clean Air Act. Our in-use testing conformed completely with the requirements of 40 CFR part 1033. All the information in this report is true and accurate to the best of my knowledge. I know of the penalties for violating the Clean Air Act and the regulations. (Authorized Company Representative)

(b) Report to us within 90 days of completion of testing the following information for each engine family tested:

(1) The serial numbers of all locomotives that were excluded from the test sample because they did not meet the maintenance requirements of § 1033.420.

(2) The owner of each locomotive identified in paragraph (b)(1) of this section (or other entity responsible for the maintenance of the locomotive).

(3) The specific reasons why the locomotives were excluded from the test sample.

(c) Submit the information outlined in paragraphs (a) and (b) of this section electronically using an approved format. We may exempt you from this requirement upon written request with supporting justification.

(d) Send all testing reports and requests for approvals to the Designated Compliance Officer.

Subpart F—Test Procedures

§ 1033.501 General provisions.

(a) Except as specified in this subpart, use the equipment and procedures for compression-ignition engines in 40 CFR part 1065 to determine whether your locomotives meet the duty-cycle emission standards in § 1033.101. Use the applicable duty cycles specified in this subpart. Measure emissions of all the pollutants we regulate in § 1033.101. The general test procedure is the procedure specified in 40 CFR part 1065 for steady-state discrete-mode cycles. However, if you use the optional ramped modal cycle in § 1033.514, follow the procedures for ramped modal testing in 40 CFR part 1065. The following exceptions from the 1065 procedures apply:

(1) You must average power and emissions over the sampling periods specified in this subpart for both discrete-mode testing and ramped modal testing.

(2) The test cycle is considered to be steady-state with respect to operator demand rather than engine speed and load.

(3) The provisions related to engine mapping and duty cycle generation (40 CFR 1065.510 and 1065.512) are not applicable to testing of complete locomotives or locomotive engines because locomotive operation and locomotive duty cycles are based on operator demand via locomotive notch settings rather than engine speeds and loads. The cycle validation criteria (40 CFR 1065.514) are not applicable to testing of complete locomotives but do apply for dynamometer testing of engines.

(b) [Reserved]

(c) This part allows (with certain limits) testing of either a complete locomotive or a separate uninstalled engine. When testing a locomotive, you must test the complete locomotive in its in-use configuration, except that you may disconnect the power output and fuel input for the purpose of testing.

(d) For locomotives subject to smoke standards, measure smoke emissions using the procedures in § 1033.520.

(e) Use the applicable fuel listed in 40 CFR part 1065, subpart H, to perform valid tests.

(1) For diesel-fueled locomotives, use the appropriate diesel fuel specified in 40 CFR part 1065, subpart H, for emission testing. The applicable diesel test fuel is either the ultra low-sulfur diesel or low-sulfur diesel fuel, as specified in § 1033.101. Identify the test fuel in your application for certification and ensure that the fuel inlet label is consistent with your selection of the test

fuel (see §§ 1033.101 and 1033.135). For example, do not test with ultra low-sulfur diesel fuel if you intend to label your locomotives to allow use of diesel fuel with sulfur concentrations up to 500 ppm.

(2) You may ask to use as a test fuel commercially available diesel fuel similar but not identical to the applicable fuel specified in 40 CFR part 1065, subpart H. If your locomotive uses sulfur-sensitive technology, you may not use an in-use fuel that has a lower sulfur content than the range specified for the otherwise applicable test fuel in 40 CFR part 1065. If your locomotive does not use sulfur-sensitive technology, we may allow you to use an in-use fuel that has a lower sulfur content than the range specified for the otherwise applicable test fuel in 40 CFR part 1065, but may require that you correct PM emissions to account for the sulfur differences.

(3) For service accumulation, use the test fuel or any commercially available fuel that is representative of the fuel that in-use locomotives will use.

(f) See § 1033.504 for information about allowable ambient testing conditions for testing.

(g) You may use special or alternate procedures to the extent we allow as them under 40 CFR 1065.10. In some cases, we allow you to use procedures that are less precise or less accurate than the specified procedures if they do not affect your ability to show that your locomotives comply with the applicable emission standards. This generally requires emission levels to be far enough below the applicable emission standards so that any errors caused by greater imprecision or inaccuracy do not affect your ability to state unconditionally that the locomotives meet all applicable emission standards.

(h) This subpart is addressed to you as a manufacturer/remanufacturer, but it applies equally to anyone who does testing for you, and to us when we perform testing to determine if your locomotives meet emission standards.

(i) We may also perform other testing as allowed by the Clean Air Act.

(j) For passenger locomotives that can generate hotel power from the main propulsion engine, the locomotive must comply with the emission standards when in either hotel or non-hotel setting.

§ 1033.503 Auxiliary power units.

If your locomotive is equipped with an auxiliary power unit (APU) that operates during an idle shutdown mode, you must account for the APU's emissions rates as specified in this section.

(a) Adjust the locomotive main engine's idle emission rate (g/hr) as specified in § 1033.520. Add the APU emission rate (g/hr) that you determine under paragraph (b) of this section. Use the locomotive main engine's idle power as specified in § 1033.520.

(b) Determine the representative emission rate for the APU using one of the following methods.

(1) *Installed APU tested separately.* If you separately measure emission rates (g/hr) for each pollutant from the APU installed in the locomotive, you may use the measured emissions rates (g/hr) as the locomotive's idle emissions rates when the locomotive is shutdown and the APU is operating. For all testing other than in-use testing, apply appropriate deterioration factors to the measured emission rates. You may ask to carryover APU emission data for a previous test, or use data for the same APU installed on locomotives in another engine family.

(2) *Uninstalled APU tested separately.* If you separately measure emission rates (g/hr) over an appropriate duty-cycle for each pollutant from the APU when it is not installed in the locomotive, you may use the measured emissions rates (g/hr) as the locomotive's idle emissions rates when the locomotive is shutdown and the APU is operating. For the purpose of this paragraph (2), an appropriate duty-cycle is one that approximates the APU engine's cycle-weighted power when operating in the locomotive. Apply appropriate deterioration factors to the measured emission rates. You may ask to carryover APU emission data for a previous test, or use data for the same APU installed on locomotives in another engine family.

(3) *APU engine certification data.* If the engine used for the APU has been certified to EPA emission standards you may calculate the APU's emissions based upon existing EPA-certification information about the APU's engine. In this case, calculate the APU's emissions as follows:

(i) For each pollutant determine the brake-specific standard/FEL to which the APU engine was originally EPA-certified.

(ii) Determine the APU engine's cycle-weighted power when operating in the locomotive.

(iii) Multiply each of the APU's applicable brake-specific standards/FELs by the APU engine's cycle-weighted power. The results are the APU's emissions rates (in g/hr).

(iv) Use these emissions rates as the locomotive's idle emissions rates when the locomotive is shutdown and the APU is running. Do not apply a deterioration factor to these values.

(4) *Other.* You may ask us to approve an alternative means to account for APU emissions.

§ 1033.504 Ambient conditions.

This section specifies the allowable ambient conditions of temperature, pressure, and humidity under which testing may be performed to determine compliance with the emission standards of § 1068.101. Manufacturers/remanufacturers may ask to perform testing at conditions other than those allowed by this section. We will allow such testing provided it does not affect your ability to demonstrate compliance with the applicable standards. See §§ 1033.101 and 1033.115 for more information about the requirements that apply at other conditions.

(a) *Temperature.* Testing may be performed with ambient temperatures from 15.5 °C (60 °F) to 40.5 °C (105 °F). Do not correct emissions for temperature effects within this range. If we allow you to perform testing at lower ambient temperatures, you must correct NO_X emissions for temperature effects, consistent with good engineering judgment. For example, if the intake air temperature (at the manifold) is lower at the test temperature than at 15.5 °C, you generally will need to adjust your measured NO_X emissions upward to account for the effect of the lower intake air temperature. However, if you maintain a constant manifold air temperature, you will generally not need to correct emissions.

(b) *Altitude/pressure.* Testing may be performed with ambient pressures from 88.000 kPa to 103.325 kPa. This is intended to correspond to altitudes up to 4000 feet above sea level. Do not correct emissions for pressure effects within this range.

(c) *Humidity.* Testing may be performed with any ambient humidity level. Correct NO_X emissions as specified in 40 CFR 1065.670. Do not correct any other emissions for humidity effects.

(d) *Wind.* If you test outdoors, use good engineering judgment to ensure that excessive wind does not affect your emission measurements. Winds are excessive if they disturb the size, shape, or location of the exhaust plume in the region where exhaust samples are drawn or where the smoke plume is measured, or otherwise cause any dilution of the exhaust. Tests may be conducted if wind shielding is placed adjacent to the exhaust plume to prevent bending, dispersion, or any other distortion of the exhaust plume as it passes through the optical unit or through the sample probe.

§ 1033.510 Discrete-mode steady-state emission tests of locomotives and locomotive engines.

This section describes how to test locomotives at each notch setting so that emissions can be weighted according to either the line-haul duty cycle or the switch duty cycle. The locomotive test cycle consists of a warm-up followed by a sequence of nominally steady-state discrete test modes, as described in Table 1 of this section. The test modes are steady-state with respect to operator demand, which is the notch setting for the locomotive. Engine speeds and loads are not necessarily steady-state.

(a) Follow the provisions of 40 CFR part 1065, subpart F for general pre-test procedures (including engine and sampling system pre-conditioning which is included as engine warm-up). You may operate the engine in any way you choose to warm it up prior to beginning the sample preconditioning specified in 40 CFR part 1065.

(b) Begin the test by operating the locomotive over the pre-test portion of the cycle specified in Table 1 of this section.

(c) Measure emissions during the rest of the test cycle.

(1) Each test mode begins when the operator demand to the locomotive or engine is set to the applicable notch setting.

(2) Start measuring gaseous emissions, power, and fuel consumption at the start of the test mode A and continue until the completion of test mode 8.

(i) The sample period over which emissions for the mode are averaged generally begins when the operator demand is changed to start the test mode and ends within 5 seconds of the minimum sampling time for the test mode is reached. However, you need to shift the sampling period to account for sample system residence times. Follow the provisions of 40 CFR 1065.308 and 1065.309 to time align emission and work measurements.

(ii) The sample period is 300 seconds for all test modes except mode 10. The sample period for test mode 8 is 600 seconds.

(3) If gaseous emissions are sampled using a batch-sampling method, begin proportional sampling at the beginning of each sampling period and terminate sampling once the minimum time in each test mode is reached, ± 5 seconds.

(4) If applicable, begin the smoke test at the start of the test mode A. Continue collecting smoke data until the completion of test mode 8. Refer to § 1033.101 to determine applicability of smoke testing and § 1033.515 for details on how to conduct a smoke test.

(5) Begin proportional sampling of PM emissions at the beginning of each sampling period and terminate sampling once the minimum time in each test mode is reached, ± 5 seconds.

(6) Proceed through each test mode in the order specified in Table 1 of this section until the locomotive test cycle is completed.

(7) At the end of each numbered test mode, you may continue to operate sampling and dilution systems to allow corrections for the sampling system's response time.

(8) Following the completion of Mode 8, conduct the post sampling procedures in § 1065.530. Note that cycle validation criteria do not apply to testing of complete locomotives.

TABLE 1 OF § 1033.510.—LOCOMOTIVE TEST CYCLE

Test mode	Notch setting	Time in mode (minutes) [1]	Sample averaging period for emissions [1]
Pre-test idle	Lowest idle setting	10 to 15	Not applicable
A	Low idle [2]	5 to 10	300 ± 5 seconds
B	Normal idle	5 to 10	300 ± 5 seconds
C	Dynamic brake [2]	5 to 10	300 ± 5 seconds
1	Notch 1	5 to 10	300 ± 5 seconds
2	Notch 2	5 to 10	300 ± 5 seconds
3	Notch 3	5 to 10	300 ± 5 seconds
4	Notch 4	5 to 10	300 ± 5 seconds
5	Notch 5	5 to 10	300 ± 5 seconds
6	Notch 6	5 to 10	300 ± 5 seconds
7	Notch 7	5 to 10	300 ± 5 seconds
8	Notch 8	10 to 15	600 ± 5 seconds

[1] The time in each notch and sample averaging period may be extended as needed to allow for collection of a sufficiently large PM sample.
[2] Omit if not so equipped.

(f) There are two approaches for sampling PM emissions during discrete-mode steady-state testing as described in this paragraph (f).

(1) *Engines certified to a PM standard/FEL 0.05 g/bhp-hr.* Use a separate PM filter sample for each test mode of the locomotive test cycle according to the procedures specified in paragraphs (a) through (e) of this section. You may ask to use a shorter sampling period if the total mass expected to be collected would cause unacceptably high pressure drop across the filter before reaching the end of the required sampling time. We will not allow sampling times less than 60 seconds. When we conduct locomotive emission tests, we will adhere to the time limits for each of the numbered modes in Table 1 of § 1033.510.

(2) *Engines certified to a PM standard/FEL < 0.05 g/bhp-hr.* (i) You may use separate PM filter samples for each test mode as described in paragraph (f)(1) of this section; however, we recommend that you do not do so. The low rate of sample filter loading will result in very long sampling times and the large number of filter samples may induce uncertainty stack-up that will lead to unacceptable PM measurement accuracy. Instead, we recommend that you measure PM emissions as specified in paragraph (f)(2)(ii) of this section.

(ii) You may use a single PM filter for sampling PM over all of the test modes of the locomotive test cycle as specified in this paragraph. Vary the sample time to be proportional the applicable line-haul or switch weighting factors specified in § 1033.520 for each mode. The minimum sampling time for each mode is 400 seconds multiplied by the weighting factor. For example, for a mode with a weighting factor of 0.030, the minimum sampling time is 12.0 seconds. PM sampling in each mode must be proportional to engine exhaust flow as specified in 40 CFR part 1065. Begin proportional sampling of PM emissions at the beginning of each test mode as is specified in paragraph (c) of this section. End the sampling period for each test mode so that sampling times are proportional to the weighting factors for the applicable duty cycles. If necessary, you may extend the time limit for each of the test modes beyond the sampling times in Table 1 of § 1033.510 to increase the sampled mass of PM emissions or to account for proper weighting of the PM emission sample over the entire cycle, using good engineering judgment.

(g) This paragraph (g) describes how to test locomotive engines when not installed in a locomotive. Note that the test procedures for dynamometer engine testing of locomotive engines are intended to produce emission measurements that are essentially identical to emission measurements produced during testing of complete locomotives using the same engine configuration. The following requirements apply for all engine tests:

(1) Specify a second-by-second set of engine speed and load points that are representative of in-use locomotive operation for each of the set-points of the locomotive test cycle described in Table 1 of § 1033.510, including transitions from one notch to the next. This is your reference cycle for validating your cycle. You may ignore points between the end of the sampling period for one mode and the point at which you change the notch setting to begin the next mode.

(2) Keep the temperature of the air entering the engine after any charge air cooling to within5 °C of the typical intake air temperature when the engine is operated in the locomotive under similar ambient conditions.

(3) Proceed with testing as specified for testing complete locomotives as specified in paragraphs (a) through (f) of this section.

§ 1033.514 Alternative ramped modal cycles.

(a) Locomotive testing over a ramped modal cycle is intended to improve measurement accuracy at low emission levels by allowing the use of batch sampling of PM and gaseous emissions over multiple locomotive notch settings. Ramped modal cycles combine multiple test modes of a discrete-mode steady-state into a single sample period. Time in notch is varied to be proportional to weighting factors. The ramped modal cycle for line-haul locomotives is shown in Table 1 of this section. The ramped modal cycle for switch locomotives is shown in Table 2 of this section. Both ramped modal cycles consist of a warm-up followed by three test phases that are each weighted in a manner that maintains the duty cycle weighting of the line-haul and switch locomotive duty cycles in § 1033.520. You may use ramped modal cycle testing for any locomotives certified under this part.

(b) Ramped modal testing requires continuous gaseous analyzers and three separate PM filters (one for each phase). You may collect a single batch sample for each test phase, but you must also measure gaseous emissions continuously to allow calculation of notch caps as required under § 1033.101.

(c) You may operate the engine in any way you choose to warm it up. Then follow the provisions of 40 CFR part 1065, subpart F for general pre-test procedures (including engine and sampling system pre-conditioning).

(d) Begin the test by operating the locomotive over the pre-test portion of the cycle.

(e) Start the test according to 40 CFR 1065.530.

(1) Each test phase begins when operator demand is set to the first operator demand setting of each test phase of the ramped modal cycle. Each test phase ends when the time in mode is reached for the last mode in the test phase.

(2) For PM emissions (and other batch sampling), the sample period over which emissions for the phase are averaged generally begins within 10 seconds after the operator demand is changed to start the test phase and ends within 5 seconds of the sampling time for the test mode is reached. (See Table 1 of this section.) You may ask to delay the start of the sample period to account for sample system residence times longer than 10 seconds.

(3) Use good engineering judgment when transitioning between phases.

(i) You should come as close as possible to simultaneously:

(A) Ending batch sampling of the previous phase.

(B) Starting batch sampling of the next phase.

(C) Changing the operator demand to the notch setting for the first mode in the next phase.

(ii) Avoid the following:

(A) Overlapping batch sampling of the two phases.

(B) An unnecessarily long delay before starting the next phase.

(iii) For example, the following sequence would generally be appropriate:

(A) End batch sampling for phase 2 after 240 seconds in notch 7.

(B) Switch the operator demand to notch 8 one second later.

(C) Begin batch sampling for phase 3 one second after switching to notch 8.

(4) If applicable, begin the smoke test at the start of the first test phase of the applicable ramped modal cycle. Continue collecting smoke data until the completion of final test phase. Refer to § 1033.101 to determine applicability of the smoke standards and § 1033.515 for details on how to conduct a smoke test.

(5) Proceed through each test phase of the applicable ramped modal cycle in the order specified until the test is completed.

(6) If you must void a test phase you may repeat the phase. To do so, begin with a warm engine operating at the notch setting for the last mode in the previous phase. You do not need to repeat later phases if they were valid. (Note: you must report test results for all voided tests and test phases.)

(7) Following the completion of the third test phase of the applicable ramped modal cycle, conduct the post sampling procedures specified in 40 CFR 1065.530.

TABLE 1 OF § 1033.514.—LINE-HAUL LOCOMOTIVE RAMPED MODAL CYCLE

RMC Test phase	Weighting factor	RMC mode	Time in mode (seconds)	Notch setting
Pre-test idle	NA	NA	600 to 900	Lowest idle setting
Phase 1	0.380	A	600	Low Idle [1]
(Idle test)		B	600	Normal Idle
Phase Transition				
		C	1000	Dynamic Brake [2]
		1	520	Notch 1
		2	520	Notch 2
Phase 2	0.458	3	416	Notch 3

TABLE 1 OF § 1033.514.—LINE-HAUL LOCOMOTIVE RAMPED MODAL CYCLE—Continued

RMC Test phase	Weighting factor	RMC mode	Time in mode (seconds)	Notch setting
	....	4	352	Notch 4
	....	5	304	Notch 5
	....	6	312	Notch 6
	....	7	240	Notch 7
Phase Transition				
Phase 3	0.162	8	600	Notch 8

[1] Operate at normal idle for modes A and B if not equipped with multiple idle settings.
[2] Operate at normal idle if not equipped with a dynamic brake.

TABLE 2 OF § 1033.514.—SWITCH LOMOTIVE RAMPED MODAL CYCLE

RMC Test phase	Weighting factor	RMC mode	Time in mode (seconds)	Notch setting
Pre-test idle	NA	NA	600 to 900	Lowest idle setting
Phase 1	0.598	A	600	Low Idle [1]
(Idle test)	....	B	600	Normal Idle
Phase Transition				
	....	1	868	Notch 1
	....	2	861	Notch 2
Phase 2	0.377	3	406	Notch 3
	....	4	252	Notch 4
	....	5	252	Notch 5
Phase Transition				
	....	6	1080	Notch 6
Phase 3	0.025	7	144	Notch 7
	....	8	576	Notch 8

[1] Operate at normal idle for modes A and B if not equipped with multiple idle settings.

§ 1033.515 Smoke testing.

This section describes the equipment and procedures for testing for smoke emissions when required.

(a) This section specifies how to measure smoke emissions using a full-flow, open path light extinction smokemeter. A light extinction meter consists of a built-in light beam that traverses the exhaust smoke plume that issues from the exhaust duct. The light beam must be at right angles to the axis of the plume. Where the exhaust is not circular at its discharge, align the light beam to go through the plume along the hydraulic diameter, which is defined in 1065.1001. The light extinction meter must meet the requirements of paragraph (b) of this section and the following requirements:

(1) Use an incandescent light source with a color temperature range of 2800K to 3250K, or a light source with a spectral peak between 550 and 570 nanometers.

(2) Collimate the light beam to a nominal diameter of 3 centimeters and an angle of divergence within a 6 degree included angle.

(3) Use a photocell or photodiode light detector. If the light source is an incandescent lamp, use a detector that has a spectral response similar to the photopic curve of the human eye (a maximum response in the range of 550 to 570 nanometers, to less than four percent of that maximum response below 430 nanometers and above 680 nanometers).

(4) Attach a collimating tube to the detector with apertures equal to the beam diameter to restrict the viewing angle of the detector to within a 16 degree included angle.

(5) Amplify the detector signal corresponding to the amount of light.

(6) You may use an air curtain across the light source and detector window assemblies to minimize deposition of smoke particles on those surfaces, provided that it does not measurably affect the opacity of the plume.

(7) Minimize distance from the optical centerline to the exhaust outlet; in no case may it be more than 3.0 meters. The maximum allowable distance of unducted space upstream of the optical centerline is 0.5 meters. Center the full flow of the exhaust stream between the source and detector apertures (or windows and lenses) and on the axis of the light beam.

(8) You may use light extinction meters employing substantially identical measurement principles and producing substantially equivalent results, but which employ other electronic and optical techniques.

(b) All smokemeters must meet the following specifications:

(1) A full-scale deflection response time of 0.5 second or less.

(2) You may attenuate signal responses with frequencies higher than 10 Hz with a separate low-pass electronic filter with the following performance characteristics:

(i) Three decibel point: 10 Hz.

(ii) Insertion loss: 0 ″0.5 dB.

(iii) Selectivity: 12 dB down at 40 Hz minimum.

(iv) Attenuation: 27 dB down at 40 Hz minimum.

(c) Perform the smoke test by continuously recording smokemeter response over the entire locomotive test cycle in percent opacity to within one percent resolution and also simultaneously record operator demand set point (*e.g.*, notch position). Compare the recorded opacities, uncorrected for path length, to the smoke standards applicable to your locomotive.

(d) You may use a partial flow sampling smokemeter if you correct for the path length of your exhaust plume. If you use a partial flow sampling meter, follow the instrument manufacturer's installation, calibration, operation, and maintenance procedures.

§ 1033.520 Duty cycles and calculations.

This section describes how to apply the duty cycle to measured emission rates to calculate cycle-weighted average emission rates.

(a) *Standard duty cycles and calculations.* Tables 1 and 2 of this section show the duty cycle to use to calculate cycle-weighted average emission rates for locomotives equipped with two idle settings, eight propulsion notches, and at least one dynamic brake notch and tested using the Locomotive Test Cycle. Use the appropriate weighting factors for your locomotive application and calculate cycle-weighted average emissions as specified in 40 CFR part 1065, subpart G.

TABLE 1 OF § 1033.520.—STANDARD DUTY CYCLE WEIGHTING FACTORS FOR CALCULATING EMISSION RATES FOR LOCOMOTIVES WITH MULTIPLE IDLE SETTINGS

Notch setting	Test mode	Line-haul weighting factors	Line-haul weighting factors (no dynamic brake)	Switch weighting factors
Low Idle	A	0.190	0.190	0.299
Normal Idle	B	0.190	0.315	0.299
Dynamic	C	0.125	NA	0.000
Brake				
Notch 1	1	0.065	0.065	0.124
Notch 2	2	0.065	0.065	0.123
Notch 3	3	0.052	0.052	0.058
Notch 4	4	0.044	0.044	0.036
Notch 5	5	0.038	0.038	0.036
Notch 6	6	0.039	0.039	0.015
Notch 7	7	0.030	0.030	0.002
Notch 8	8	0.162	0.162	0.008

TABLE 2 OF § 1033.520.—STANDARD DUTY CYCLE WEIGHTING FACTORS FOR CALCULATING EMISSION RATES FOR LOCOMOTIVES WITH MULTIPLE IDLE SETTINGS

Notch setting	Test mode	Line-haul weighting factors	Line-haul weighting factors (no dynamic brake)	Switch weighting factors
Normal Idle	A	0.380	0.505	0.598
Dynamic	C	0.125	NA	0.000
Brake				
Notch 1	1	0.065	0.065	0.124
Notch 2	2	0.065	0.065	0.123
Notch 3	3	0.052	0.052	0.058
Notch 4	4	0.044	0.044	0.036
Notch 5	5	0.038	0.038	0.036
Notch 6	6	0.039	0.039	0.015
Notch 7	7	0.030	0.030	0.002
Notch 8	8	0.162	0.162	0.008

(b) *Idle and dynamic brake notches.* If your locomotive is equipped with two idle settings and is not equipped with dynamic brake, use a normal idle weighting factor of 0.315 for the line-haul cycle. If your locomotive is equipped with only one idle setting and no dynamic brake, use an idle weighting factor of 0.505 for the line-haul cycle.

(c) *Nonstandard notches or no notches.* If your locomotive is equipped with more or less than 8 propulsion notches, recommend an alternate test cycle based on the in-use locomotive configuration. Unless you have data demonstrating that your locomotive will be operated differently from conventional locomotives, recommend weighting factors that are consistent with the power weightings of the specified duty cycle. For example, the average load factor for your recommended cycle (cycle-weighted power divided by rated power) should be equivalent to those of conventional locomotives. We may also allow the use of the standard power levels shown in Table 3 of this section for nonstandard locomotive testing subject to our prior approval.

TABLE 3 OF § 1033.520.—STANDARD NOTCH POWER LEVELS EXPRESSED AS A PERCENTAGE OF MAXIMUM TEST POWER

Normal Idle	0.00%
Dynamic Brake	0.00%
Notch 1	4.50%
Notch 2	11.50%
Notch 3	23.50%
Notch 4	35.00%
Notch 5	48.50%
Notch 6	64.00%
Notch 7	85.00%
Notch 8	100.00%

(d) *Optional Ramped Modal Cycle Testing.* Tables 1 and 2 of § 1033.514 show the weighting factors to use to calculate cycle-weighted average emission rates for the applicable locomotive ramped modal cycle. Use the weighting factors for the ramped modal cycle for your locomotive application and calculate cycle-weighted average emissions as specified in 40 CFR part 1065, subpart G.

(e) *Automated Start-Stop.* For locomotive equipped with features that shut the engine off after prolonged periods of idle, multiply the measured idle mass emission rate over the idle portion of the applicable test cycles by a factor equal to one minus the estimated fraction reduction in idling time that will result in use from the shutdown feature. Do not apply this factor to the weighted idle power. Application of this adjustment is subject to our approval.

(f) *Multi-engine locomotives.* This paragraph (f) applies for locomotives using multiple engines where all engines are identical in all material respects. In cases where we allow engine dynamometer testing, you may test a single engine consistent with good engineering judgment, as long as you test it all operating points at which any of the engines will operate when installed in the locomotive. Weight the results to reflect the power demand/power-sharing of the in-use configuration for each notch setting.

§ 1033.525 Adjusting emission levels to account for infrequently regenerating aftertreatment devices.

This section describes how to adjust emission results from locomotives using aftertreatment technology with infrequent regeneration events that occur during testing. See paragraph (e) of this section for how to adjust ramped modal testing. See paragraph (f) of this section for how to adjust discrete-mode testing. For this section, ''regeneration'' means an intended event during which emission levels change while the system restores aftertreatment performance. For example, hydrocarbon emissions may increase temporarily while oxidizing accumulated particulate matter in a trap. Also for this section, ''infrequent'' refers to regeneration events that are expected to occur on average less than once per sample period.

(a) *Developing adjustment factors.* Develop an upward adjustment factor and a downward adjustment factor for each pollutant based on measured emission data and observed regeneration frequency. Adjustment factors should generally apply to an entire engine family, but you may develop separate adjustment factors for different configurations within an engine family. If you use adjustment factors for certification, you must identify the frequency factor, F, from paragraph (b) of this section in your application for certification and use the adjustment factors in all testing for that engine family. You may use carryover or carry-across data to establish adjustment factors for an engine family, as described in § 1033.235, consistent with good engineering judgment. All adjustment factors for regeneration are additive. Determine adjustment factors separately for different test segments as described in paragraphs (e) and (f) of this section. You may use either of the following different approaches for locomotives that use aftertreatment with infrequent regeneration events:

(1) You may disregard this section if you determine that regeneration does not significantly affect emission levels for an engine family (or configuration) or if it is not practical to identify when regeneration occurs. If you do not use adjustment factors under this section, your locomotives must meet emission standards for all testing, without regard to regeneration.

(2) You may ask us to approve an alternate methodology to account for regeneration events. We will generally limit approval to cases in which your locomotives use aftertreatment technology with extremely infrequent regeneration and you are unable to apply the provisions of this section.

(b) *Calculating average emission factors.* Calculate the average emission factor (EFA) based on the following equation:

$$EF_A = (F)(EF_H) + (1 - F)(EF_L)$$

Where:

F = The frequency of the regeneration event in terms of the fraction of tests during which the regeneration occurs. You may determine F from in-use operating data or running replicate tests.

EF_H = Measured emissions from a test segment in which the regeneration occurs.

EF_L = Measured emissions from a test segment in which the regeneration does not occur.

(c) *Applying adjustment factors.* Apply adjustment factors based on whether regeneration occurs during the test run. You must be able to identify regeneration in a way that is readily apparent during all testing.

(1) If regeneration does not occur during a test segment, add an upward adjustment factor to the measured emission rate. Determine the upward adjustment factor (UAF) using the following equation:

$$UAF = EF_A - EF_L$$

(2) If regeneration occurs or starts to occur during a test segment, subtract a downward adjustment factor from the measured emission rate. Determine the downward adjustment factor (DAF) using the following equation:

$$DAF = EF_H - EF_A$$

(d) *Sample calculation.* If EF_L is 0.10 g/bhp-hr, EF_H is 0.50 g/bhp-hr, and F is 0.1 (the regeneration occurs once for each ten tests), then:

EF_A = (0.1)(0.5 g/bhp-hr) + (1.0 − 0.1)(0.1 g/bhp-hr) = 0.14 g/bhp-hr.

UAF = 0.14 g/bhp-hr − 0.10 g/bhp-hr = 0.04 g/bhp-hr.

DAF = 0.50 g/bhp-hr − 0.14 g/bhp-hr = 0.36 g/bhp-hr.

(e) *Ramped modal testing.* Develop separate adjustment factors for each test phase. If a regeneration has started but has not been completed when you reach the end of a test phase, use good engineering judgment to reduce your downward adjustments to be proportional to the emission impact that occurred in the test phases.

(f) *Discrete-mode testing.* Develop separate adjustment factors for each test mode. If a regeneration has started but has not been completed when you reach the end of the sampling time for a test mode extend the sampling period for that mode until the regeneration is completed.

Subpart G—Special Compliance Provisions

§ 1033.601 General compliance provisions.

Locomotive manufacturer/remanufacturers, as well as owners and operators of locomotives subject to the requirements of this part, and all other persons, must observe the provisions of this part, the requirements and prohibitions in 40 CFR part 1068, and the provisions of the Clean Air Act. The provisions of 40 CFR part 1068 apply for locomotives as specified in that part, except as otherwise specified in this section.

(a) *Meaning of manufacturer.* When used in 40 CFR part 1068, the term ''manufacturer'' means manufacturer and/or remanufacturer.

(b) *Engine rebuilding.* The provisions of 40 CFR 1068.120 do not apply when remanufacturing locomotives.

(c) *Exemptions.* (1) The exemption provisions of 40 CFR 1068.240, 1068.250, 1068.255, and 1068.260 do not apply for domestic or imported locomotives.

(2) The provisions for importing engines and equipment under the identical configuration exemption of 40 CFR 1068.315(i) do not apply for locomotives.

(3) The provisions for importing engines and equipment under the ancient engine exemption of 40 CFR 1068.315(j) do not apply for locomotives.

(d) *SEAs, defect reporting, and recall.* The provisions of 40 CFR part 1068, subparts E and F, apply to certificate holders for locomotives as specified in that part. When there are multiple persons meeting the definition of manufacturer or remanufacturer, each person meeting the definition of manufacturer or remanufacturer must comply with the requirements of 40 CFR part 1068, subparts E and F, as needed so that the certificate holder can fulfill its obligations under those subparts.

(e) *Introduction into commerce.* The placement of a new locomotive or new locomotive engine back into service following remanufacturing is a violation of 40 CFR 1068.101(a)(1), unless it has a valid certificate of conformity for its model year and the required label.

§ 1033.610 Small railroad provisions.

In general, the provisions of this part apply for all locomotives, including those owned by Class II and Class III railroads. This section describes how these provisions apply for railroads meeting the definition of ''small railroad'' in § 1033.901. (Note: The term ''small railroad'' excludes some Class II and Class III railroads, such as those owned by large parent companies.)

(a) Locomotives become subject to the provisions of this part when they become ''new'' as defined in § 1033.901. Under that definition, a locomotive is ''new'' when first assembled, and generally becomes ''new'' again when remanufactured. As an exception to this general concept, locomotives that are owned and operated by railroads meeting the definition of ''small railroad'' in § 1033.901 do not become ''new'' when remanufactured, unless they were previously certified to EPA emission standards.

(b) The provisions of subpart I of this part apply to all owners and operators of locomotives subject to this part 1033. However, the regulations of that subpart specify some provisions that apply only for Class I freight railroads, and others that apply differently to Class I freight railroads and other railroads.

(c) We may exempt new locomotives that are owned and operated by small railroads from the prohibition against remanufacturing a locomotive without a certificate of conformity as specified in this paragraph (c). This exemption is only available in cases where no certified remanufacturing system is available for the locomotive. For example, it is possible that no remanufacturer will certify a system for very old locomotive models that comprise a tiny fraction of the fleet and that are remanufactured infrequently. Send your request for such exemptions to the Designated Compliance Officer. We may consider the issue of excessive costs in determining the availability of certified systems. If we grant this exemption, you are required to return the locomotive to its previously certified configuration.

§ 1033.615 Voluntarily subjecting locomotives to the standards of this part.

The provisions of this section specify the cases in which an owner or manufacturer of a locomotive or similar piece of equipment can subject it to the standards and requirements of this part. Once the locomotive or equipment becomes subject to the locomotive standards and requirements of this part, it remains subject to the standards and requirements of this part for the remainder of its service life.

(a) *Equipment excluded from the definition of ''locomotive''.* (1) Manufacturers/remanufacturers of equipment that is excluded from the definition of ''locomotive'' because of its total power, but would otherwise meet the definition of locomotive may ask to have it considered to be a locomotive. To do this, submit an application for certification as specified in subpart C of this part, explaining why it should be considered to be a locomotive. If we approve your request, it will be deemed to be a locomotive for the remainder of its service life.

(2) In unusual circumstances, we may deem other equipment to be locomotives (at the request of the owner or manufacturer/remanufacturer) where such equipment does not conform completely to the definition of locomotive, but is functionally equivalent to a locomotive.

(b) *Locomotives excluded from the definition of ''new''.* Owners of remanufactured locomotives excluded from the definition of ''new'' in § 1033.901 under paragraph (2) of that definition may choose to upgrade their locomotives to subject their locomotives to the standards and requirements of this part by complying with the specifications of a certified remanufacturing system, including the labeling specifications of § 1033.135.

§ 1033.620 Hardship provisions for manufacturers and remanufacturers.

(a) If you qualify for the economic hardship provisions specified in 40 CFR 1068.245, we may approve a period of delayed compliance for up to one model year total.

(b) The provisions of this paragraph (b) are intended to address problems that could occur near the date on which more stringent emission standards become effective, such as the transition from the Tier 2 standards to the Tier 3 standards for line-haul locomotives on January 1, 2012.

(1) In appropriate extreme and unusual circumstances that are clearly outside the control of the manufacturer and could not have been avoided by the exercise of prudence, diligence, and due care, we may permit you, for a brief period, to introduce into commerce locomotives which do not comply with the applicable emission standards if all of the following conditions apply:

(i) You cannot reasonably manufacture the locomotives in such a manner that they would be able to comply with the applicable standards.

(ii) The manufacture of the locomotives was substantially completed prior to the applicability date of the standards from which you seek relief.

(iii) Manufacture of the locomotives was previously scheduled to be completed at such a point in time that locomotives would have been included in the previous model year, such that they would have been subject to less stringent standards, and that such schedule was feasible under normal conditions.

(iv) You demonstrate that the locomotives comply with the less stringent standards that applied to the previous model year's production described in paragraph (b)(1)(iii) of this section, as prescribed by subpart C of this part (*i.e.*, that the locomotives are identical to locomotives certified in the previous model year).

(v) You exercised prudent planning, were not able to avoid the violation, and have taken all reasonable steps to minimize the extent of the nonconformity.

(vi) We approve your request before you introduce the locomotives into commerce.

(2) You must notify us as soon as you become aware of the extreme or unusual circumstances.

(3)(i) Include locomotives for which we grant relief under this section in the engine family for which they were originally intended to be included.

(ii) Where the locomotives are to be included in an engine family that was certified to an FEL above the applicable standard, you must reserve credits to cover the locomotives covered by this allowance and include the required information for these locomotives in the end-of-year report required by subpart H of this part.

(c) In granting relief under this section, we may also set other conditions as appropriate, such as requiring payment of fees to negate an economic gain that such relief would otherwise provide.

§ 1033.625 Special certification provisions for non-locomotive-specific engines.

You may certify freshly manufactured or remanufactured locomotives using non-locomotive-specific engines (as defined in § 1033.901) using the normal certification procedures of this part. Locomotives certified in that way are generally treated the same as other locomotives, except where specified otherwise. The provisions of this section provide for design certification to the locomotive standards in this part for locomotives using engines included in engine families certified under 40 CFR part 1039 (or part 89) in limited circumstances.

(a) Remanufactured or freshly manufactured switch locomotives powered by non-locomotive-specific engines may be certified by design without the test data required by § 1033.235 if all of the following are true:

(1) Before being installed in the locomotive, the engines were covered by a certificate of conformity issued under 40 CFR Part 1039 (or part 89) that is effective for the calendar year in which the manufacture or remanufacture occurs. You may use engines certified during the previous year if it is subject to the same standards. You may not make any modifications to the engines unless we approve them.

(2) The engines were certified to standards that are numerically lower then the applicable locomotive standards of this part.

(3) More engines are reasonably projected to be sold and used under the certificate for non-locomotive use than for use in locomotives.

(4) The number of such locomotives certified under this section does not exceed 15 in any three-year period. We may waive this sales limit for locomotive models that have previously demonstrated compliance with the locomotive standards of § 1033.101 in-use.

(5) We approved the application as specified in paragraph (d) of this section.

(b) To certify your locomotives by design under this section, submit your application as specified in § 1033.205, except include the following instead of the locomotive test data otherwise required:

(1) A description of the engines to be used, including the name of the engine manufacturer and engine family identifier for the engines.

(2) A brief engineering analysis describing how the engine's emission controls will function when installed in the locomotive throughout the locomotive's useful life.

(3) The emission data submitted under 40 CFR part 1039 (or part 89).

(c) Locomotives certified under this section are subject to all of the same requirements of this part unless specified otherwise in this section. The engines used in such locomotives are not considered to be included in the otherwise applicable engines family of 40 CFR part 1039 (or part 89).

(d) We will approve or deny the application as specified in subpart C of this part. For example, we will deny your application for certification by design under this section in any case where we have evidence that your locomotives will not conform to the requirements of this part throughout their useful lives.

§ 1033.630 Staged-assembly exemption.

You may ask us to provide a temporary exemption to allow you to complete production of your engines and locomotives at different facilities, as long as you maintain control of the engines until they are in their certified configuration. We may require you to take specific steps to ensure that such locomotives are in their certified configuration before reaching the ultimate purchaser. You may request an exemption under this section in your application for certification, or in a separate submission.

§ 1033.640 Provisions for repowered and refurbished locomotives.

The provisions of this section apply for locomotives that are produced from an existing locomotive so that the new locomotive contains both previously used parts and parts that have never been used before. A single existing locomotive cannot be divided into parts and combined with new parts to create more than one remanufactured locomotive.

(a) Repowered locomotives are used locomotives in which a freshly manufactured propulsion engine is installed. Refurbished locomotives are new locomotives that are produced using more unused parts than previously used parts, as described in paragraph (b) of this section.

(b) The relative amount of previously used parts is determined as follows:

(1) Identify the parts in the fully assembled locomotive that have been previously used and those that have never been used before.

(2) Weight the unused parts and previously used parts by the dollar value of the parts. For example, a single part valued at $1200 would count the same as six parts valued at $200 each. Group parts by system where possible (such as counting the engine as one part) if either all the parts in that system are used or all the parts in that system are unused.

(3) Sum the values of the unused parts. Also sum the values of the previously used parts. The relative fraction of used parts is the total value of previously used parts divided by the combined value of the unused parts and previously used parts.

(c) If the weighted fraction of the locomotive that is comprised of previously used parts is less than 50 percent, then the locomotive is considered to be a refurbished locomotive.

(d) If the weighted fraction of the locomotive that is comprised of previously used parts is less than 25 percent, then the locomotive is considered to be a freshly manufactured locomotive and the date of original manufacture is the most recent date on which the locomotive was assembled using less than 25 percent previously used parts. (Note: If the weighted fraction of the locomotive that is comprised of previously used parts is greater than or equal to 25 percent, then the date of original manufacture is unchanged.) For example:

(1) If you produce a new locomotive that includes a used frame, but all other parts are unused, then the locomotive is considered to be a freshly manufactured locomotive because the value of the frame would be less than 25 percent of the total value of the locomotive. Its date of original manufacture is the date on which you complete its assembly.

(2) If you produce a new locomotive by replacing the engine in a 1990 locomotive with a freshly manufactured engine, but all other parts are used, then the locomotive is considered to be a remanufactured locomotive and its date of original manufacture is the date on which assembly was completed in 1990.

(**Note:** Such a locomotive would also be considered to be a repowered locomotive.)

§ 1033.650 Incidental use exemption for Canadian and Mexican locomotives.

You may ask us to exempt from the requirements and prohibitions of this part locomotives that are operated primarily outside of the United States and that enter the United States temporarily from Canada or Mexico. We will approve this exemption only where we determine that the locomotive's operation within the United States will not be extensive and will be incidental to its primary operation. For example, we would generally exempt locomotives that will not operate more than 25 miles from the border and will operate in the United States less than 5 percent of their operating time. For existing operations, you must request this exemption before January 1, 2011. In your request, identify the locomotives for which you are requesting an exemption, and describe their projected use in the United States. We may grant the exemption broadly or limit the exemption to specific locomotives and/or specific geographic areas. However, we will typically approve exemptions for specific rail facilities rather than specific locomotives. In unusual circumstances, such as cases in which new rail facilities are created, we may approve requests submitted after January 1, 2011.

Subpart H—Averaging, Banking, and Trading for Certification

§ 1033.701 General provisions.

(a) You may average, bank, and trade (ABT) emission credits for purposes of certification as described in this subpart to show compliance with the standards of this part. Participation in this program is voluntary.

(b) Section 1033.740 restricts the use of emission credits to certain averaging sets.

(c) The definitions of Subpart J of this part apply to this subpart. The following definitions also apply:

(1) *Actual emission credits* means emission credits you have generated that we have verified by reviewing your final report.

(2) *Averaging set* means a set of locomotives in which emission credits may be exchanged only with other locomotives in the same averaging set.

(3) *Broker* means any entity that facilitates a trade of emission credits between a buyer and seller.

(4) *Buyer* means the entity that receives emission credits as a result of a trade.

(5) *Reserved emission credits* means emission credits you have generated that we have not yet verified by reviewing your final report.

(6) *Seller* means the entity that provides emission credits during a trade.

(7) *Standard* means the emission standard that applies under subpart B of this part for locomotives not participating in the ABT program of this subpart.

(8) *Trade* means to exchange emission credits, either as a buyer or seller.

(9) *Transfer* means to convey control of credits generated for an individual locomotive to the purchaser, owner or operator of the locomotive at the time of manufacture or remanufacture; or to convey control of previously generated credits from the purchaser, owner or operator of an individual locomotive to the manufacturer/remanufacturer at the time of manufacture/remanufacture.

(d) You may not use emission credits generated under this subpart to offset any emissions that exceed an FEL or standard. This applies for all testing, including certification testing, in-use testing, selective enforcement audits, and other production-line testing. However, if emissions from a locomotive exceed an FEL or standard (for example, during a selective enforcement audit), you may use emission credits to recertify the engine family with a higher FEL that applies only to future production.

(e) Engine families that use emission credits for one or more pollutants may not generate positive emission credits for another pollutant.

(f) Emission credits may be used in the model year they are generated or in future model years. Emission credits may not be used for past model years.

(g) You may increase or decrease an FEL during the model year by amending your application for certification under § 1033.225. The new FEL may apply only to locomotives you have not already introduced into commerce. Each locomotive's emission control information label must include the applicable FELs. You must conduct production line testing to verify that the emission levels are achieved.

(h) Credits may be generated by any certifying manufacturer/remanufacturer and may be held by any of the following entities:

(1) Locomotive or engine manufacturers.

(2) Locomotive or engine remanufacturers.

(3) Locomotive owners.

(4) Locomotive operators.

(5) Other entities after notification to EPA.

(i) All locomotives that are certified to an FEL that is different from the emission standard that would otherwise apply to the locomotives are required to comply with that FEL for the remainder of their service lives, except as allowed by § 1033.750.

(1) Manufacturers must notify the purchaser of any locomotive that is certified to an FEL that is different from the emission standard that would otherwise apply that the locomotive is required to comply with that FEL for the remainder of its service life.

(2) Remanufacturers must notify the owner of any locomotive or locomotive engine that is certified to an FEL that is different from the emission standard that would otherwise apply that the locomotive (or the locomotive in which the engine is used) is required to comply with that FEL for the remainder of its service life.

(j) The FEL to which the locomotive is certified must be included on the locomotive label required in § 1033.135. This label must include the notification specified in paragraph (i) of this section.

§ 1033.705 Calculate emission credits.

The provisions of this section apply separately for calculating emission credits for NO_X or PM.

(a) Calculate positive emission credits for an engine family that has an FEL below the otherwise applicable standard. Calculate negative emission credits for an engine family that has an FEL above the otherwise applicable standard.

(b) For each participating engine family, calculate positive or negative emission credits relative to the otherwise applicable emission standard. Prior to the end of year report, round calculated emission credits to the nearest one hundredth of a Megagram (0.01 Mg). Round your end of year emission credit balance to the nearest Megagram (Mg). Use consistent units throughout the calculation. When useful life is expressed in terms of megawatt-hrs, calculate credits for each engine family from the following equation:

$$\text{Emission credits} = (\text{Std}-\text{FEL}) \times (1.341) \times (\text{UL}) \times (\text{Production}) \times (F_P) \times (10^{-3}\ \text{kW-Mg/MW-g}).$$

Where:

Std = The applicable locomotive and locomotive engine NO_X or PM emission standard in g/bhp-hr (except that Std = previous FEL in g/bhp-hr for locomotives that were certified under this part to an FEL other than the standard during the previous useful life).

FEL = The family emission limit for the engine family in g/bhp-hr.

UL = The sales-weighted average useful life in megawatt-hours (or the subset of the engine family for which credits are being calculated), as specified in the application for certification.

Production = The number of locomotives participating in the averaging, banking, and trading program within the given engine family during the calendar year (or the number of locomotives in the subset of the engine family for which credits are being calculated). Quarterly production projections are used for initial certification. Actual applicable production/sales volumes are used for end-of-year compliance determination.

F_P = The proration factor as determined in paragraph (d) of this section.

(c) When useful life is expressed in terms of miles, calculate the useful life in terms of megawatt-hours (UL) by dividing the useful life in miles by 100,000, and multiplying by the sales-weighted average rated power of the engine family. For example, if your useful life is 800,000 miles for a family with an average rated power of 3500 hp, then your equivalent MW-hr useful life would be 28,000 MW-hrs. Credits are calculated using this UL value in the equations of paragraph (b) of this section.

(d) The proration factor is an estimate of the fraction of a locomotive's service life that remains as a function of age. The proration factor is 1.00 for freshly manufactured locomotives.

(1) The locomotive's age is the length of time in years from the date of original manufacture to the date at which the remanufacture (for which credits are being calculated) is completed, rounded to the next higher year.

(2) The proration factors for line-haul locomotives ages 1 through 20 are specified in Table 1 of this section. For line-haul locomotives more than 20 years old, use the proration factor for 20 year old locomotives. The proration factors for switch locomotives ages 1 through 40 are specified in Table 2 of this section. For switch locomotives more than 40 years old, use the proration factor for 40 year old locomotives.

(3) For replacement or repower engines, the proration factor is based on the age of the locomotive chassis, not the age of the engine, except for remanufactured switch locomotives that qualify as refurbished. Use a proration factor of 0.60 for remanufactured switch locomotives meting the definition of refurbished. (Note: The proration factor is 1.00 for all refurbished locomotives that also meet the definition of freshly manufactured.)

TABLE 1 OF § 1033.705.—PRORATION FACTORS FOR LINE-HAUL LOCOMOTIVES

Locomotive age (years)	Proration factor (F_P)
1	0.96
2	0.92
3	0.88
4	0.84
5	0.81
6	0.77
7	0.73
8	0.69
9	0.65
10	0.61
11	0.57
12	0.54
13	0.50
14	0.47
15	0.43
16	0.40
17	0.36
18	0.33
19	0.30
20	0.27

TABLE 2 OF § 1033.705.—PRORATION FACTORS FOR SWITCH LOCOMOTIVES

Locomotive age (years)	Proration factor
1	0.98
2	0.96
3	0.94
4	0.92
5	0.9
6	0.88
7	0.86
8	0.84
9	0.82
10	0.8
11	0.78
12	0.76
13	0.74
14	0.72
15	0.7
16	0.68
17	0.66
18	0.64
19	0.62
20	0.6
21	0.58
22	0.56
23	0.54
24	0.52
25	0.5
26	0.48
27	0.46
28	0.44
29	0.42
30	0.4
31	0.38
32	0.36
33	0.34
34	0.32
35	0.3
36	0.28
37	0.26
38	0.24
39	0.22
40	0.2

(e) In your application for certification, base your showing of compliance on projected production volumes for locomotives that will be placed into service in the United States. As described in § 1033.730, compliance with the requirements of this subpart is determined at the end of the model year based on actual production volumes for locomotives that will be placed into service in the United States. Do not include any of the following locomotives to calculate emission credits:

(1) Locomotives exempted under subpart G of this part or under 40 CFR part 1068.

(2) Exported locomotives. You may ask to include locomotives sold to Mexican or Canadian railroads if they will likely operate within the United States and you include all such locomotives (both credit using and credit generating locomotives).

(3) Locomotives not subject to the requirements of this part, such as those excluded under § 1033.5.

(4) [Reserved]

(5) Any other locomotives, where we indicate elsewhere in this part 1033 that they are not to be included in the calculations of this subpart.

§ 1033.710 Averaging emission credits.

(a) Averaging is the exchange of emission credits among your engine families. You may average emission credits only as allowed by § 1033.740.

(b) You may certify one or more engine families to an FEL above the applicable standard, subject to the FEL caps and other provisions in subpart B of this part, if you show in your application for certification that your projected balance of all emission-credit transactions in that model year is greater than or equal to zero.

(c) If you certify an engine family to an FEL that exceeds the otherwise applicable standard, you must obtain enough emission credits to offset the engine family's deficit by the due date for the final report required in § 1033.730. The emission credits used to address the deficit may come from your other engine families that generate emission credits in the same model year, from emission credits you have banked, or from emission credits you obtain through trading or by transfer.

§ 1033.715 Banking emission credits.

(a) Banking is the retention of emission credits by the manufacturer/remanufacturer generating the emission credits (or owner/operator, in the case of transferred credits) for use in averaging, trading, or transferring in future model years. You may use banked emission credits only as allowed by § 1033.740.

(b) In your application for certification, designate any emission credits you intend to bank. These emission credits will be considered reserved credits. During the model year and before the due date for the final report, you may redesignate these emission credits for averaging or trading.

(c) You may use banked emission credits from the previous model year for averaging, trading, or transferring before we verify them, but we may revoke these emission credits if we are unable to verify them after reviewing your reports or auditing your records.

(d) Reserved credits become actual emission credits only when we verify them after reviewing your final report.

§ 1033.720 Trading emission credits.

(a) Trading is the exchange of emission credits between certificate holders. You may use traded emission credits for averaging, banking, or further trading transactions. Traded emission credits may be used only as allowed by § 1033.740.

(b) You may trade actual emission credits as described in this subpart. You may also trade reserved emission credits, but we may revoke these emission credits based on our review of your records or reports or those of the company with which you traded emission credits.

(c) If a negative emission credit balance results from a transaction, both the buyer and seller are liable, except in cases we deem to involve fraud. See § 1033.255(e) for cases involving fraud. We may void the certificates of all engine families participating in a trade that results in a manufacturer/remanufacturer having a negative balance of emission credits. See § 1033.745.

§ 1033.722 Transferring emission credits.

(a) Credit transfer is the conveying of control over credits, either:

(1) From a certifying manufacturer/remanufacturer to an owner/operator.

(2) From an owner/operator to a certifying manufacturer/remanufacturer.

(b) Transferred credits can be:

(1) Used by a certifying manufacturer/remanufacturer in averaging.

(2) Transferred again within the model year.

(3) Reserved for later banking. Transferred credits may not be traded unless they have been previously banked.

(c) Owners/operators participating in credit transfers must submit the reports specified in § 1033.730.

§ 1033.725 Requirements for your application for certification.

(a) You must declare in your application for certification your intent to use the provisions of this subpart for each engine family that will be certified using the ABT program. You must also declare the FELs you select for the engine family for each pollutant for which you are using the ABT program. Your FELs must comply with the specifications of subpart B of this part, including the FEL caps. FELs must be expressed to the same number of decimal places as the applicable standards.

(b) Include the following in your application for certification:

(1) A statement that, to the best of your belief, you will not have a negative balance of emission credits for any averaging set when all emission credits are calculated at the end of the year.

(2) Detailed calculations of projected emission credits (positive or negative) based on projected production volumes. If your engine family will generate positive emission credits, state specifically where the emission credits will be applied (for example, to which engine family they will be applied in averaging, whether they will be traded, or whether they will be reserved for banking). If you have projected negative emission credits for an engine family, state the source of positive emission credits to offset the negative emission credits. Describe whether the emission credits are actual or reserved and whether they will come from averaging, banking, trading, transferring or a combination of these. Identify from which of your engine families or from which manufacturer/remanufacturer the emission credits will come.

§ 1033.730 ABT reports.

(a) If any of your engine families are certified using the ABT provisions of this subpart, you must send an end-of-year report within 90 days after the end of the model year and a final report within 270 days after the end of the model year. We may waive the requirement to send the end-of-year report, as long as you send the final report on time.

(b) Your end-of-year and final reports must include the following information for each engine family participating in the ABT program:

(1) Engine family designation.

(2) The emission standards that would otherwise apply to the engine family.

(3) The FEL for each pollutant. If you changed an FEL during the model year, identify each FEL you used and calculate the positive or negative emission credits under each FEL. Also, describe how the applicable FEL can be identified for each locomotive you produced. For example, you might keep a list of locomotive identification numbers that correspond with certain FEL values.

(4) The projected and actual production volumes for the model year that will be placed into service in the United States as described in § 1033.705. If you changed an FEL during the model year, identify the actual production volume associated with each FEL.

(5) Rated power for each locomotive configuration, and the sales-weighted average locomotive power for the engine family.

(6) Useful life.

(7) Calculated positive or negative emission credits for the whole engine family. Identify any emission credits that you traded or transferred, as described in paragraph (d)(1) or (e) of this section.

(c) Your end-of-year and final reports must include the following additional information:

(1) Show that your net balance of emission credits from all your engine families in each averaging set in the applicable model year is not negative.

(2) State whether you will reserve any emission credits for banking.

(3) State that the report's contents are accurate.

(d) If you trade emission credits, you must send us a report within 90 days after the transaction, as follows:

(1) As the seller, you must include the following information in your report:

(i) The corporate names of the buyer and any brokers.

(ii) A copy of any contracts related to the trade.

(iii) The engine families that generated emission credits for the trade, including the number of emission credits from each family.

(2) As the buyer, you must include the following information in your report:

(i) The corporate names of the seller and any brokers.

(ii) A copy of any contracts related to the trade.

(iii) How you intend to use the emission credits, including the number of emission credits you intend to apply to each engine family (if known).

(e) If you transfer emission credits, you must send us a report within 90 days after the first transfer to an owner/operator, as follows:

(1) Include the following information:

(i) The corporate names of the owner/operator receiving the credits.

(ii) A copy of any contracts related to the trade.

(iii) The serial numbers and engine families for the locomotive that generated the transferred emission credits and the number of emission credits from each family.

(2) The requirements of this paragraph (e) apply separately for each owner/operator.

(3) We may require you to submit additional 90-day reports under this paragraph (e).

(f) Send your reports electronically to the Designated Compliance Officer using an approved information format. If you want to use a different format, send us a written request with justification for a waiver.

(g) Correct errors in your end-of-year report or final report as follows:

(1) You may correct any errors in your end-of-year report when you prepare the final report, as long as you send us the final report by the time it is due.

(2) If you or we determine within 270 days after the end of the model year that errors mistakenly decrease your balance of emission credits, you may correct the errors and recalculate the balance of emission credits. You may not make these corrections for errors that are determined more than 270 days after the end of the model year. If you report a negative balance of emission credits, we may disallow corrections under this paragraph (g)(2).

(3) If you or we determine anytime that errors mistakenly increase your balance of emission credits, you must correct the errors and recalculate the balance of emission credits.

(h) We may modify these requirements for owners/operators required to submit reports because of their involvement in credit transferring.

§ 1033.735 Required records.

(a) You must organize and maintain your records as described in this section. We may review your records at any time.

(b) Keep the records required by this section for eight years after the due date for the end-of-year report. You may not use emission credits on any engines if you do not keep all the records required under this section. You must therefore keep these records to continue to bank valid credits. Store these records in any format and on any media, as long as you can promptly send us organized, written records in English if we ask for them. You must keep these records readily available. We may review them at any time.

(c) Keep a copy of the reports we require in § 1033.725 and § 1033.730.

(d) Keep the following additional records for each locomotive you produce that generates or uses emission credits under the ABT program:

(1) Engine family designation.

(2) Locomotive identification number.

(3) FEL.

(4) Rated power and useful life.

(5) Build date and assembly plant.

(6) Purchaser and destination.

(e) We may require you to keep additional records or to send us relevant information not required by this section.

§ 1033.740 Credit restrictions.

Use of emission credits generated under this part 1033 or 40 CFR part 92 is restricted depending on the standards against which they were generated.

(a) *Credits from 40 CFR part 92.* (1) PM credits generated under 40 CFR part 92 may not be used under this part.

(2) NO_X credits generated under 40 CFR part 92 may be used under this part in the same manner as NO_X credits generated under this part.

(b) *General cycle restriction.* Locomotives subject to both switch cycle standards and line-haul cycle standards (such as Tier 2 locomotives) may generate both switch and line-haul credits. Except as specified in paragraph (c) of this section, such credits may only be used to show compliance with standards for the same cycle for which they were generated. For example, a Tier 2 locomotive that is certified to a switch cycle NO_X FEL below the applicable switch cycle standard and a line-haul cycle NO_X FEL below the applicable line-haul cycle standard may generate switch cycle NO_X credits for use in complying with switch cycle NO_X standards and line-haul cycle NO_X credits for use in complying with line-haul cycle NO_X standards.

(c) *Single cycle locomotives.* As specified in § 1033.101, Tier 0 switch locomotives, Tier 3 and later switch locomotives, and Tier 4 and later line-haul locomotives are not subject to both switch cycle and line-haul cycle standards.

(1) When using credits generated by locomotives covered by paragraph (b) of this section for single cycle locomotives covered by this paragraph (c), you must use both switch and line-haul credits as described in this paragraph (c)(1).

(i) For locomotives subject only to switch cycle standards, calculate the negative switch credits for the credit using locomotive as specified in § 1033.705. Such locomotives also generate an equal number of negative line-haul cycle credits (in Mg).

(ii) For locomotives subject only to line-haul cycle standards, calculate the negative line-haul credits for the credit using locomotive as specified in § 1033.705. Such locomotives also generate an equal number of negative switch cycle credits (in Mg).

(2) Credits generated by Tier 0, Tier 3, or Tier 4 switch locomotives may be used to show compliance with any switch cycle or line-haul cycle standards.

(3) Credits generated by any line-haul locomotives may not be used by Tier 3 or later switch locomotives.

(d) *Tier 4 credit use.* The number of Tier 4 locomotives that can be certified using credits in any year may not exceed 50 percent of the total number of Tier 4 locomotives you produce in that year for U.S. sales.

(e) *Other restrictions.* Other sections of this part may specify additional restrictions for using emission credits under certain special provisions.

§ 1033.745 Compliance with the provisions of this subpart.

The provisions of this section apply to certificate holders.

(a) For each engine family participating in the ABT program, the certificate of conformity is conditional upon full compliance with the provisions of this subpart during and after the model year. You are responsible to establish to our satisfaction that you fully comply with applicable requirements. We may void the certificate of conformity for an engine family if you fail to comply with any provisions of this subpart.

(b) You may certify your engine family to an FEL above an applicable standard based on a projection that you will have enough emission credits to offset the deficit for the engine family. However, we may void the certificate of conformity if you cannot show in your final report that you have enough actual emission credits to offset a deficit for any pollutant in an engine family.

(c) We may void the certificate of conformity for an engine family if you fail to keep records, send reports, or give us information we request.

(d) You may ask for a hearing if we void your certificate under this section (see § 1033.920).

§ 1033.750 Changing a locomotive's FEL at remanufacture.

Locomotives are generally required to be certified to the previously applicable standard or FEL when remanufactured. This section describes provisions that allow a remanufactured locomotive to be certified to a different FEL (higher or lower).

(a) A remanufacturer may choose to certify a remanufacturing system to change the FEL of a locomotive from a previously applicable FEL or standard. Any locomotives remanufactured using that system are required to comply with the revised FEL for the remainder of their service lives, unless it is changed again under this section during a later remanufacture. Remanufacturers must notify the owner of the locomotive that it is required to comply with that FEL for the remainder of its service life.

(b) Calculate the credits needed or generated as specified in § 1033.705, except as specified in this paragraph. If the locomotive was previously certified to an FEL for the pollutant, use the previously applicable FEL as the standard.

Subpart I—Requirements for Owners and Operators

§ 1033.801 Applicability.

The requirements of this subpart are applicable to railroads and all other owners and operators of locomotives subject to the provisions of this part, except as otherwise specified. The prohibitions related to maintenance in § 1033.815 also applies to anyone performing maintenance on a locomotive subject to the provisions of this part.

§ 1033.805 Remanufacturing requirements.

(a) See the definition of remanufacture in § 1033.901 to determine if you are remanufacturing your locomotive or engine. (Note: Replacing power assemblies one at a time may qualify as remanufacturing, depending on the interval between replacement.)

(b) See the definition of ''new'' in § 1033.901 to determine if remanufacturing your locomotive makes it subject to the requirements of this part. If the locomotive is considered to be new, it is subject to the certification requirements of this part, unless it is exempt under subpart G of this part. The standards to which your locomotive is subject will depend on factors such as the following:

(1) Its date of original manufacture.

(2) The FEL to which it was previously certified.

(3) Its power rating (whether it is above or below 2300 hp).

(4) The calendar year in which it is being remanufactured.

(c) You may comply with the certification requirements of this part for your remanufactured locomotive by either obtaining your own certificate of conformity as specified in subpart C of this part or by having a certifying remanufacturer include your locomotive under its certificate of conformity. In either case, your remanufactured locomotive must be covered by a certificate before it is reintroduced into service.

(d) Contact a certifying remanufacturer to have your locomotive included under its certificate of conformity. You must comply with the certificate holder's emission-related installation instructions.

(e) Failure to comply with this section is a violation of 40 CFR 1068.101(a)(1).

§ 1033.810 In-use testing program.

(a) *Applicability.* This section applies to all Class I freight railroads. It does not apply to other owner/operators.

(b) *Testing requirements.* Annually test a sample of locomotives in your fleet. For purposes of this section, your fleet includes both the locomotives that you own and the locomotives that you are leasing. Use the test procedures in subpart F of this part, unless we approve different procedures.

(1) Except for the cases described in paragraph (b)(2) of this section, test at least 0.15 percent of the average number of locomotives in your fleet during the previous calendar year (*i.e.*, determine the number to be tested by multiplying the number of locomotives in the fleet by 0.0015 and rounding up to the next whole number).

(2) In certain cases, you may test fewer locomotives:

(i) If during the previous 5 years, no new locomotive emission standards have taken effect, the locomotive emission controls have not changed fundamentally (in any manner that could reasonably be expected to have the potential to significantly affect emissions durability), and testing has shown that the degree of compliance for tested locomotives is sufficiently high, then you are only required to test 0.10 percent of the locomotives in your fleet.

(ii) If during the previous 5 years, no new locomotive emission standards have taken effect, the locomotive emission controls have not changed fundamentally (in any manner that could reasonably be expected to have the potential to significantly affect emissions durability), testing has shown that the degree of compliance for tested locomotives is sufficiently high, and you have fewer than 500 locomotives in your fleet, then you are not required to test any locomotives.

(iii) We may allow you to test a smaller number of locomotives if we determine that the number of tests otherwise required by this section is not necessary.

(c) *Test locomotive selection.* To the extent possible, select locomotives from each manufacturer and remanufacturer, and from each tier level (*e.g.*, Tier 0, Tier 1 and Tier 2) in proportion to their numbers in the your fleet. Exclude locomotives tested during the previous year. You may not exclude locomotives because of visible smoke, a history of durability problems, or other evidence of malmaintenance.

(1) If possible, select locomotives that have been certified in compliance with requirements in this part (or 40 CFR part 92), and that have been operated for at least 100 percent of their useful lives. If the number of certified locomotives that have been operated for at least 100 percent of their useful lives is not large enough to fulfill the testing requirement, test locomotives still within their useful lives as follows:

(i) Test locomotives in your fleet that are nearest to the end of their useful lives. You may identify such locomotives as a range of values representing the fraction of the useful life already used up for the locomotives.

(ii) For example, you may determine that 20 percent of your fleet has been operated for at least 75 percent of their useful lives. In such a case, select locomotives for testing that have been operated for at least 75 percent of their useful lives.

(2) We may require that you test specific locomotives, including locomotives that do not meet the criteria specified in paragraph (c)(1) of this section. Otherwise, where there are multiple locomotives meeting the requirements of this paragraph (c), randomly select the locomotives to be tested from among those locomotives.

(d) *Reporting requirements.* Report all testing done in compliance with the provisions of this section to us within 30 calendar days after the end of each calendar year. At a minimum, include the following:

(1) Your full corporate name and address.

(2) For each locomotive tested, all the following:

(i) Corporate name of the manufacturer and last remanufacturer(s) of the locomotive (including both certificate holder and installer, where different), and the corporate name of the manufacturer or last remanufacturer(s) of the engine if different than that of the manufacturer/remanufacturer(s) of the locomotive.

(ii) Year (and month if known) of original manufacture of the locomotive and the engine, and the manufacturer's model designation of the locomotive and manufacturer's model designation of the engine, and the locomotive identification number.

(iii) Year (and month if known) that the engine last underwent remanufacture, the engine remanufacturer's designation that reflects (or most closely reflects) the engine after the last remanufacture, and the engine family identification.

(iv) The number of MW-hrs and miles (where available) the locomotive has been operated since its last remanufacture.

(v) The emission test results for all measured pollutants.

(e) You do not have to submit a report for any year in which you performed no emission testing under this section.

(f) You may submit equivalent emission data collected for other purposes instead of some or all of the test data required by this section. If we allow it in advance, you may report emission data collected using other testing or sampling procedures instead of some or all of the data specified by this section.

(g) Submit all reports to the Designated Compliance Officer.

(h) Failure to comply fully with this section is a violation of 40 CFR 1068.101(a)(2).

§ 1033.815 Maintenance, operation, and repair.

(a) Unless we allow otherwise, all owners of locomotives subject to the provisions of this part must ensure that all emission-related maintenance is performed on the locomotives, as specified in the maintenance instructions provided by the certifying manufacturer/remanufacturer in compliance with § 1033.125 (or maintenance that is equivalent to the maintenance specified by the certifying manufacturer/remanufacturer in terms of maintaining emissions performance).

(b) Use good engineering judgment when performing maintenance of locomotives subject to the provisions of this part. You must perform all maintenance and repair such that you have a reasonable technical basis for believing the locomotive will continue (after the maintenance or repair) to meet the applicable emission standards and FELs to which it was certified.

(c) The owner of the locomotive must keep records of all maintenance and repairs that could reasonably affect the emission performance of any locomotive subject to the provisions of this part. Keep these records for eight years.

(d) In addition, for locomotives equipped with emission controls requiring the use of specific fuels, lubricants, or other fluids, you must comply with the manufacturer/remanufacturer's specifications for such fluids when operating the locomotives. For locomotives equipped with SCR systems requiring the use of urea or other reductants, you must report to us within 30 days of any operation of such locomotives without the appropriate urea other reductants.

(e) Failure to fully comply with this section is a violation of 40 CFR 1068.101(b).

§ 1033.820 In-use locomotives.

(a) We may require you to supply in-use locomotives to us for testing. We will specify a reasonable time and place at which you must supply the locomotives and a reasonable period during which we will keep them for testing. We will make reasonable allowances for you to schedule the supply of locomotives to minimize disruption of your operations. The number of locomotives that you must supply is limited as follows:

(1) We will not require a Class I railroad to supply more than five locomotives per railroad per calendar year.

(2) We will not require a non-Class I railroad (or other entity subject to the provisions of this subpart) to supply more than two locomotives per railroad per calendar year. We will request locomotives under this paragraph (a)(2) only for purposes that cannot be accomplished using locomotives supplied under paragraph (a)(1) of this section.

(b) You must make reasonable efforts to supply manufacturers and remanufacturers of locomotives with the test locomotives needed to fulfill the in-use testing requirements in subpart E of this part.

(c) Failure to fully comply with this section is a violation of 40 CFR 1068.101(a)(2).

§ 1033.825 Refueling requirements.

(a) If your locomotive operates using a volatile fuel, your refueling equipment must be designed and used to minimize the escape of fuel vapors. This means you may not use refueling equipment in a way that renders any refueling emission controls inoperative or reduces their effectiveness.

(b) If your locomotive operates using a gaseous fuel, the hoses used to refuel it may not be designed to be bled or vented to the atmosphere under normal operating conditions.

(c) Failing to fully comply with the requirements of this section is a violation of 40 CFR 1068.101(b).

Subpart J—Definitions and Other Reference Information

§ 1033.901 Definitions.

The following definitions apply to this part. The definitions apply to all subparts unless we note otherwise. All undefined terms have the meaning the Clean Air Act gives to them. The definitions follow:

Adjustable parameter means any device, system, or element of design that someone can adjust (including those which are difficult to access) and that, if adjusted, may affect emissions or locomotive performance during emission testing or normal in-use operation. This includes, but is not limited to, parameters related to injection timing and fueling rate. You may ask us to exclude a parameter if you show us that it will not be adjusted in a way that affects emissions during in-use operation.

Aftertreatment means relating to a catalytic converter, particulate filter, or any other system, component, or technology mounted downstream of the exhaust valve (or exhaust port), whose design function is to reduce emissions in the locomotive exhaust before it is exhausted to the environment. Exhaust-gas recirculation (EGR) is not aftertreatment.

Alcohol fuel means a fuel consisting primarily (more than 50 percent by weight) of one or more alcohols: *e.g.*, methyl alcohol, ethyl alcohol.

Alternator/generator efficiency means the ratio of the electrical power output from the alternator/generator to the mechanical power input to the alternator/generator at the operating point. Note that the alternator/generator efficiency may be different at different operating points.

Applicable emission standard or *applicable standard* means a standard to which a locomotive is subject; or, where a locomotive has been or is being certified to another standard or FEL, the FEL or other standard to which the locomotive has been or is being certified is the applicable standard. This definition does not apply to Subpart H of this part.

Auxiliary emission control device means any element of design that senses temperature, motive speed, engine RPM, transmission gear, or any other parameter for the purpose of activating, modulating, delaying, or deactivating the operation of any part of the emission-control system.

Auxiliary engine means a nonroad engine that provides hotel power or power during idle, but does not provide power to propel the locomotive.

Auxiliary power means the power provided by the main propulsion engine to operate accessories such as cooling fans.

Averaging means the exchange of emission credits among engine families within a given manufacturer's, or remanufacturer's product line.

Banking means the retention of emission credits by a credit holder for use in future calendar year averaging or trading as permitted by the regulations in this part.

Brake power means the sum of the alternator/generator input power and the mechanical accessory power, excluding any power required to fuel, lubricate, heat, or cool the engine or to operate aftertreatment devices.

Calibration means the set of specifications, including tolerances, specific to a particular design, version, or application of a component, or components, or assembly capable of functionally describing its operation over its working range.

Certification means the process of obtaining a certificate of conformity for an engine family that complies with the emission standards and requirements in this part, or relating to that process.

Certified emission level means the highest deteriorated emission level in an engine family for a given pollutant from a given test cycle.

Class I freight railroad means a Class I railroad that primarily transports freight rather than passengers.

Class I railroad means a railroad that has been classified as a Class I railroad by the Surface Transportation Board.

Class II railroad means a railroad that has been classified as a Class II railroad by the Surface Transportation Board.

Class III railroad means a railroad that has been classified as a Class III railroad by the Surface Transportation Board.

Clean Air Act means the Clean Air Act, as amended, 42 U.S.C. 7401–7671q.

Configuration means a unique combination of locomotive hardware and calibration within an engine family. Locomotives within a single configuration differ only with respect to normal production variability (or factors unrelated to engine performance or emissions).

Crankcase emissions means airborne substances emitted to the atmosphere from any part of the locomotive crankcase's ventilation or lubrication systems. The crankcase is the housing for the crankshaft and other related internal parts.

Design certify or *certify by design* means to certify a locomotive based on inherent design characteristics rather than your test data, such as allowed under § 1033.625. All other requirements of this part apply for such locomotives.

Designated Compliance Officer means the Manager, Heavy Duty and Nonroad Engine Group (6403–), U.S. Environmental Protection Agency, 1200 Pennsylvania Ave., NW., Washington, DC 20460.

Designated Enforcement Officer means the Director, Air Enforcement Division (2242A), U.S. Environmental Protection Agency, 1200 Pennsylvania Ave., NW., Washington, DC 20460.

Deteriorated emission level means the emission level that results from applying the appropriate deterioration factor to the official emission result of the emission-data locomotive.

Deterioration factor means the relationship between emissions at the end of useful life and emissions at the low-hour test point, expressed in one of the following ways:

(1) For multiplicative deterioration factors, the ratio of emissions at the end of useful life to emissions at the low-hour test point.

(2) For additive deterioration factors, the difference between emissions at the end of useful life and emissions at the low-hour test point.

Discrete-mode means relating to the discrete-mode type of steady-state test described in § 1033.510.

Emission control system means any device, system, or element of design that controls or reduces the regulated emissions from a locomotive.

Emission credits represent the amount of emission reduction or exceedance, by a locomotive engine family, below or above the emission standard, respectively. Emission reductions below the standard are considered as ''positive credits,'' while emission exceedances above the standard are considered as ''negative credits.'' In addition, ''projected credits'' refer to emission credits based on the projected applicable production/sales volume of the engine family. ''Reserved credits'' are emission credits generated within a calendar year waiting to be reported to EPA at the end of the calendar year. ''Actual credits'' refer to emission credits based on actual applicable production/sales volume as contained in the end-of-year reports submitted to EPA.

Emission-data locomotive means a locomotive or engine that is tested for certification. This includes locomotives tested to establish deterioration factors.

Emission-related maintenance means maintenance that substantially affects emissions or is likely to substantially affect emission deterioration.

Engine family has the meaning given in § 1033.230.

Engine used in a locomotive means an engine incorporated into a locomotive or intended for incorporation into a locomotive.

Engineering analysis means a summary of scientific and/or engineering principles and facts that support a conclusion made by a manufacturer/remanufacturer, with respect to compliance with the provisions of this part.

EPA Enforcement Officer means any officer or employee of the Environmental Protection Agency so designated in writing by the Administrator or his/her designee.

Exempted means relating to a locomotive that is not required to meet otherwise applicable standards. Exempted locomotives must conform to regulatory conditions specified for an exemption in this part 1033 or in 40 CFR part 1068. Exempted locomotives are deemed to be ''subject to'' the standards of this part, even though they are not required to comply with the otherwise applicable requirements. Locomotives exempted with respect to a certain tier of standards may be required to comply with an earlier tier of standards as a condition of the exemption; for example, locomotives exempted with respect to Tier 3 standards may be required to comply with Tier 2 standards.

Excluded means relating to a locomotive that either has been determined not to be a locomotive (as defined in this section) or otherwise excluded under section § 1033.5. Excluded locomotives are not subject to the standards of this part

Exhaust emissions means substances (i.e., gases and particles) emitted to the atmosphere from any opening downstream from the exhaust port or exhaust valve of a locomotive engine.

Exhaust-gas recirculation means a technology that reduces emissions by routing exhaust gases that had been exhausted from the combustion chamber(s) back into the locomotive to be mixed with incoming air before or during combustion. The use of valve timing to increase the amount of residual exhaust gas in the combustion chamber(s) that is mixed with incoming air before or during combustion is not considered exhaust-gas recirculation for the purposes of this part.

Freshly manufactured locomotive means a new locomotive that contains fewer than 25 percent previously used parts (weighted by the dollar value of the parts) as described in § 1033.640.

Freshly manufactured engine means a new engine that has not been remanufactured. An engine becomes freshly manufactured when it is originally manufactured.

Family emission limit (FEL) means an emission level declared by the manufacturer/remanufacturer to serve in place of an otherwise applicable emission standard under the ABT program in subpart H of this part. The family emission limit must be expressed to the same number of decimal places as the emission standard it replaces. The family emission limit serves as the emission standard for the engine family with respect to all required testing.

Fuel system means all components involved in transporting, metering, and mixing the fuel from the fuel tank to the combustion chamber(s), including the fuel tank, fuel tank cap, fuel pump, fuel filters, fuel lines, carburetor or fuel-injection components, and all fuel-system vents.

Fuel type means a general category of fuels such as diesel fuel or natural gas. There can be multiple grades within a single fuel type, such as high-sulfur or low-sulfur diesel fuel.

Gaseous fuel means a fuel which is a gas at standard temperature and pressure. This includes both natural gas and liquefied petroleum gas.

Good engineering judgment means judgments made consistent with generally accepted scientific and engineering principles and all available relevant information. See 40 CFR 1068.5 for the administrative process we use to evaluate good engineering judgment.

Green engine factor means a factor that is applied to emission measurements from a locomotive or locomotive engine that has had little or no service accumulation. The green engine factor adjusts emission measurements to be equivalent to emission measurements from a locomotive or locomotive engine that has had approximately 300 hours of use.

High-altitude means relating to an altitude greater than 4000 feet (1220 meters) and less than 7000 feet (2135 meters), or equivalent observed barometric test conditions (approximately 79 to 88 kPa).

High-sulfur diesel fuel means one of the following:

(1) For in-use fuels, high-sulfur diesel fuel means a diesel fuel with a maximum sulfur concentration greater than 500 parts per million.

(2) For testing, high-sulfur diesel fuel has the meaning given in 40 CFR part 1065.

Hotel power means the power provided by an engine on a locomotive to operate equipment on passenger cars of a train; *e.g.*, heating and air conditioning, lights, etc.

Hydrocarbon (HC) means the hydrocarbon group (THC, NMHC, or THCE) on which the emission standards are based for each fuel type as described in § 1033.101.

Identification number means a unique specification (for example, a model number/serial number combination) that allows someone to distinguish a particular locomotive from other similar locomotives.

Idle speed means the speed, expressed as the number of revolutions of the crankshaft per unit of time (e.g., rpm), at which the engine is set to operate when not under load for purposes of propelling the locomotive. There are typically one or two idle speeds on a locomotive as follows:

(1) *Normal idle speed* means the idle speed for the idle throttle-notch position for locomotives that have one throttle-notch position, or the highest idle speed for locomotives that have two idle throttle-notch positions.

(2) *Low idle speed* means the lowest idle speed for locomotives that have two idle throttle-notch positions.

Inspect and qualify means to determine that a previously used component or system meets all applicable criteria listed for the component or system in a certificate of conformity for remanufacturing (such as to determine that the component or system is functionally equivalent to one that has not been used previously).

Installer means an individual or entity that assembles remanufactured locomotives or locomotive engines.

Liquefied petroleum gas means the commercial product marketed as propane or liquefied petroleum gas.

Locomotive means a self-propelled piece of on-track equipment designed for moving or propelling cars that are designed to carry freight, passengers or other equipment, but which itself is not designed or intended to carry freight, passengers (other than those operating the locomotive) or other equipment. The following other equipment are not locomotives (see 40 CFR parts 86, 89, and 1039 for this diesel-powered equipment):

(1) Equipment which is designed for operation both on highways and rails is not a locomotive.

(2) Specialized railroad equipment for maintenance, construction, post-accident recovery of equipment, and repairs; and other similar equipment, are not locomotives.

(3) Vehicles propelled by engines with total rated power of less than 750 kW (1006 hp) are not locomotives, unless the owner (which may be a manufacturer) chooses to have the equipment certified to meet the requirements of this part (under § 1033.615). Where equipment is certified as a locomotive pursuant to this paragraph (3), it is subject to the requirements of this part for the remainder of its service life. For locomotives propelled by two or more engines, the total rated power is the sum of the rated power of each engine.

Low-hour means relating to a locomotive with stabilized emissions and represents the undeteriorated emission level. This would generally involve less than 300 hours of operation.

Low mileage locomotive means a locomotive during the interval between the time that normal assembly operations and adjustments are completed and the time that either 10,000 miles of locomotive operation or 300 additional operating hours have been accumulated (including emission testing if performed).

Low-sulfur diesel fuel means one of the following:

(1) For in-use fuels, low-sulfur diesel fuel means a diesel fuel marketed as low-sulfur fuel with a sulfur concentration of 15 to 500 parts per million.

(2) For testing, low-sulfur diesel fuel has the meaning given in 40 CFR part 1065.

Malfunction means a condition in which the operation of a component in a locomotive or locomotive engine occurs in a manner other than that specified by the certifying manufacturer/remanufacturer (*e.g.*, as specified in the application for certification); or the operation of the locomotive or locomotive engine in that condition.

Manufacture means the physical and engineering process of designing, constructing, and assembling a locomotive or locomotive engine.

Manufacturer has the meaning given in section 216(1) of the Clean Air Act with respect to freshly manufactured locomotives or engines. In general, this term includes any person who manufactures a locomotive or engine for sale in the United States or otherwise introduces a new locomotive or engine into commerce in the United States. This includes importers who import locomotives or engines for resale.

Manufacturer/remanufacturer means the manufacturer of a freshly manufactured locomotive or the remanufacturer of a remanufactured locomotive, as applicable.

Model year means a calendar year in which a locomotive is manufactured or remanufactured.

New when relating to a locomotive or engine has the meaning given in paragraph (1) of this definition, except as specified in paragraph (2) of this definition:

(1) A locomotive or engine is new if its equitable or legal title has never been transferred to an ultimate purchaser. Where the equitable or legal title to a locomotive or engine is not transferred prior to its being placed into service, the locomotive or engine ceases to be new when it is placed into service. A locomotive or engine also becomes new if it is remanufactured (as defined in this section). A remanufactured locomotive or engine ceases to be new when placed back into service. With respect to imported locomotives or locomotive engines, the term ''new locomotive'' or ''new locomotive engine'' also means a locomotive or locomotive engine that is not covered by a certificate of conformity under this part at the time of importation, and that was manufactured or remanufactured

after the effective date of the emission standards in this part which is applicable to such locomotive or engine (or which would be applicable to such locomotive or engine had it been manufactured or remanufactured for importation into the United States). Note that replacing an engine in one locomotive with an unremanufactured used engine from a different locomotive does not make a locomotive new.

(2) The provisions of paragraph (1) of this definition do not apply for the following cases:

(i) Locomotives and engines that were originally manufactured before January 1, 1973 are not considered to become new when remanufactured unless they have been upgraded (as defined in this section). The provisions of paragraph (1) of this definition apply for locomotives that have been upgraded.

(ii) Locomotives that are owned and operated by a small railroad and that have never been remanufactured into a certified configuration are not considered to become new when remanufactured. The provisions of paragraph (1) of this definition apply for locomotives that have been remanufactured into a certified configuration.

Nonconforming means relating to a locomotive that is not covered by a certificate of conformity prior to importation or being offered for importation (or for which such coverage has not been adequately demonstrated to EPA); or a locomotive which was originally covered by a certificate of conformity, but which is not in a certified configuration, or otherwise does not comply with the conditions of that certificate of conformity. (Note: Domestic locomotives and locomotive engines not covered by a certificate of conformity prior to their introduction into U.S. commerce are considered to be noncomplying locomotives and locomotive engines.)

Non-locomotive-specific engine means an engine that is sold for and used in non-locomotive applications much more than for locomotive applications.

Nonmethane hydrocarbon has the meaning given in 40 CFR 1065.1001. This generally means the difference between the emitted mass of total hydrocarbons and the emitted mass of methane.

Nonroad means relating to a nonroad engines as defined in 40 CFR 1068.30.

Official emission result means the measured emission rate for an emission-data locomotive on a given duty cycle before the application of any deterioration factor, but after the application of regeneration adjustment factors, green engine factors, and/or humidity correction factors.

Opacity means the fraction of a beam of light, expressed in percent, which fails to penetrate a plume of smoke, as measured by the procedure specified in § 1033.515.

Oxides of nitrogen has the meaning given in 40 CFR part 1065.

Original manufacture means the event of freshly manufacturing a locomotive or locomotive engine. The date of original manufacture is the date of final assembly, except as provided in § 1033.655. Where a locomotive is manufactured under § 1033.620(b), the date of original manufacture is the date on which the final assembly of locomotive was originally scheduled. See also § 1033.640

Original remanufacture means the first remanufacturing of a locomotive at which the locomotive is subject to the emission standards of this part.

Owner/operator means the owner and/or operator of a locomotive.

Owners manual means a written or electronic collection of instructions provided to ultimate purchasers to describe the basic operation of the locomotive.

Particulate trap means a filtering device that is designed to physically trap all particulate matter above a certain size.

Passenger locomotive means a locomotive designed and constructed for the primary purpose of propelling passenger trains, and providing power to the passenger cars of the train for such functions as heating, lighting and air conditioning.

Petroleum fuel means gasoline or diesel fuel or another liquid fuel primarily derived from crude oil.

Placed into service means put into initial use for its intended purpose after becoming new.

Power assembly means the components of an engine in which combustion of fuel occurs, and consists of the cylinder, piston and piston rings, valves and ports for admission of charge air and discharge of exhaust gases, fuel injection components and controls, cylinder head and associated components.

Primary fuel means the type of fuel (*e.g.*, diesel fuel) that is consumed in the greatest quantity (mass basis) when the locomotive is operated in use.

Produce means to manufacture or remanufacture. Where a certificate holder does not actually assemble the locomotives or locomotive engines that it manufactures or remanufactures, produce means to allow other entities to assemble locomotives under the certificate holder's certificate.

Railroad means a commercial entity that operates locomotives to transport passengers or freight.

Ramped-modal means relating to the ramped-modal type of testing in subpart F of this part.

Rated power has the meaning given in § 1033.140.

Refurbish has the meaning given in § 1033.640.

Remanufacture means one of the following:

(1)(i) To replace, or inspect and qualify, each and every power assembly of a locomotive or locomotive engine, whether during a single maintenance event or cumulatively within a five year period.

(ii) To upgrade a locomotive or locomotive engine.

(iii) To convert a locomotive or locomotive engine to enable it to operate using a fuel other than it was originally manufactured to use.

(iv) To install a remanufactured engine or a freshly manufactured engine into a previously used locomotive.

(v) To repair a locomotive engine that does not contain power assemblies to a condition that is equivalent to or better than its original condition with respect to reliability and fuel consumption.

(2) Remanufacture also means the act of remanufacturing.

Remanufacture system or *remanufacturing system* means all components (or specifications for components) and instructions necessary to remanufacture a locomotive or locomotive engine in accordance with applicable requirements of this part or 40 CFR part 92.

Remanufactured locomotive means either a locomotive powered by a remanufactured locomotive engine, or a repowered locomotive.

Remanufactured locomotive engine means a locomotive engine that has been remanufactured.

Remanufacturer has the meaning given to ''manufacturer'' in section 216(1) of the Clean Air Act with respect to remanufactured locomotives. (See §§ 1033.1 and 1033.601 for applicability of this term.) This term includes:

(1) Any person that is engaged in the manufacture or assembly of remanufactured locomotives or locomotive engines, such as persons who:

(i) Design or produce the emission-related parts used in remanufacturing.

(ii) Install parts in an existing locomotive or locomotive engine to remanufacture it.

(iii) Own or operate the locomotive or locomotive engine and provide specifications as to how an engine is to be remanufactured (*i.e.*, specifying who will perform the work, when the work is to be performed, what parts are to be used, or how to calibrate the adjustable parameters of the engine).

(2) Any person who imports remanufactured locomotives or remanufactured locomotive engines.

Repower means replacement of the engine in a previously used locomotive with a freshly manufactured locomotive engine. See § 1033.640.

Repowered locomotive means a locomotive that has been repowered with a freshly manufactured engine.

Revoke has the meaning given in 40 CFR 1068.30. In general this means to terminate the certificate or an exemption for an engine family.

Round means to round numbers as specified in 40 CFR 1065.1001.

Service life means the total life of a locomotive. Service life begins when the locomotive is originally manufactured and continues until the locomotive is permanently removed from service.

Small railroad means a railroad meeting the criterion of paragraph (1) or (2) of this definition, but not the criterion of paragraph (3) of this definition. For the purpose of this part, the number of employees includes all employees of the railroad's parent company, if applicable.

(1) Line-haul railroads with 1,500 or fewer employees are small railroads.

(2) Local and terminal railroads with 500 or fewer employees are small railroads.

(3) Intercity passenger and commuter railroads are excluded from this definition of small railroad.

Small manufacturer means a manufacturer/remanufacturer with 1,000 or fewer employees. For purposes of this part, the number of employees includes all employees of the manufacturer/remanufacturer's parent company, if applicable.

Specified adjustable range means the range of allowable settings for an adjustable component specified by a certificate of conformity.

Specified by a certificate of conformity or *specified in a certificate of conformity* means stated or otherwise specified in a certificate of conformity or an approved application for certification.

Sulfur-sensitive technology means an emission-control technology that experiences a significant drop in emission control performance or emission-system durability when a locomotive is operated on low-sulfur fuel (*i.e.*, fuel with a sulfur concentration of 300 to 500 ppm) as compared to when it is operated on ultra low-sulfur fuel (*i.e.*, fuel with a sulfur concentration less than 15 ppm). Exhaust-gas recirculation is not a sulfur-sensitive technology.

Suspend has the meaning given in 40 CFR 1068.30. In general this means to temporarily discontinue the certificate or an exemption for an engine family.

Switch locomotive means a locomotive that is powered by an engine with a maximum rated power (or a combination of engines having a total rated power) of 2300 hp or less.

Test locomotive means a locomotive or engine in a test sample.

Test sample means the collection of locomotives or engines selected from the population of an engine family for emission testing. This may include testing for certification, production-line testing, or in-use testing.

Tier 1 means relating to the Tier 1 emission standards, as shown in § 1033.101.

Tier 2 means relating to the Tier 2 emission standards, as shown in § 1033.101.

Tier 3 means relating to the Tier 3 emission standards, as shown in § 1033.101.

Tier 4 means relating to the Tier 4 emission standards, as shown in § 1033.101.

Total hydrocarbon has the meaning given in 40 CFR 1065.1001. This generally means the combined mass of organic compounds measured by the specified procedure for measuring total hydrocarbon, expressed as a hydrocarbon with a hydrogen-to-carbon mass ratio of 1.85:1.

Total hydrocarbon equivalent has the meaning given in 40 CFR 1065.1001. This generally means the sum of the carbon mass contributions of non-oxygenated hydrocarbons, alcohols and aldehydes, or other organic compounds that are measured separately as contained in a gas sample, expressed as exhaust hydrocarbon from petroleum-fueled locomotives. The hydrogen-to-carbon ratio of the equivalent hydrocarbon is 1.85:1.

Ultimate purchaser means the first person who in good faith purchases a new locomotive for purposes other than resale.

Ultra low-sulfur diesel fuel means one of the following:

(1) For in-use fuels, ultra low-sulfur diesel fuel means a diesel fuel with a maximum sulfur concentration of 15 parts per million.

(2) For testing, ultra low-sulfur diesel fuel has the meaning given in 40 CFR part 1065.

Upcoming model year means for an engine family the model year after the one currently in production.

Upgrade means to modify a locomotive that was originally manufactured prior to January 1, 1973 (or a locomotive that was originally manufactured on or after January 1, 1973, and that is not subject to the emission standards of this part), such that it is intended to comply with the Tier 0 standards. Upgrading is a type of remanufacturing. See § 1033.615.

U.S.-directed production volume means the number of locomotives, subject to the requirements of this part, produced by a manufacturer/remanufacturer for which the manufacturer/remanufacturer has a reasonable assurance that sale was or will be made to ultimate purchasers in the United States.

Useful life means the period during which the locomotive engine is designed to properly function in terms of reliability and fuel consumption, without being remanufactured, specified as work output or miles. It is the period during which a new locomotive is required to comply with all applicable emission standards. See § 1033.101(g).

Void has the meaning given in 40 CFR 1068.30. In general this means to invalidate a certificate or an exemption both retroactively and prospectively.

Volatile fuel means a volatile liquid fuel or any fuel that is a gas at atmospheric pressure. Gasoline, natural gas, and LPG are volatile fuels.

Volatile liquid fuel means any liquid fuel other than diesel or biodiesel that is a liquid at atmospheric pressure and has a Reid Vapor Pressure higher than 2.0 pounds per square inch.

We (us, our) means the Administrator of the Environmental Protection Agency and any authorized representatives.

§ 1033.905 Symbols, acronyms, and abbreviations.

The following symbols, acronyms, and abbreviations apply to this part:

AECD	auxiliary emission control device.
CFR	Code of Federal Regulations.
CO	carbon monoxide.
CO_2	carbon dioxide.
EPA	Environmental Protection Agency.
FEL	Family Emission Limit.
g/bhp-hr	grams per brake horsepower-hour.
HC	hydrocarbon.
hp	horsepower.
LPG	liquefied petroleum gas.
LSD	low sulfur diesel.
MW	megawatt.
NIST	National Institute of Standards and Technology.
NMHC	nonmethane hydrocarbons.
NO_X	oxides of nitrogen.
PM	particulate matter.
rpm	revolutions per minute.
SAE	Society of Automotive Engineers.
SCR	selective catalytic reduction.

SEA	Selective Enforcement Audit.
THC	total hydrocarbon.
THCE	total hydrocarbon equivalent.
ULSD	ultra low sulfur diesel.
U.S.C.	United States Code.

§ 1033.915 Confidential information.

(a) Clearly show what you consider confidential by marking, circling, bracketing, stamping, or some other method.

(b) We will store your confidential information as described in 40 CFR part 2. Also, we will disclose it only as specified in 40 CFR part 2. This applies both to any information you send us and to any information we collect from inspections, audits, or other site visits.

(c) If you send us a second copy without the confidential information, we will assume it contains nothing confidential whenever we need to release information from it.

(d) If you send us information without claiming it is confidential, we may make it available to the public without further notice to you, as described in 40 CFR 2.204.

§ 1033.920 How to request a hearing.

(a) You may request a hearing under certain circumstances, as described elsewhere in this part. To do this, you must file a written request, including a description of your objection and any supporting data, within 30 days after we make a decision.

(b) For a hearing you request under the provisions of this part, we will approve your request if we find that your request raises a substantial factual issue.

(c) If we agree to hold a hearing, we will use the procedures specified in 40 CFR part 1068, subpart G.

13. A new part 1042 is added to subchapter U of chapter I to read as follows:

PART 1042—CONTROL OF EMISSIONS FROM NEW AND IN-USE MARINE COMPRESSION-IGNITION ENGINES AND VESSELS

Sec.

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Subpart B—Emission Standards and Related Requirements

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1042.107 Evaporative emission standards.
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1042.201 General requirements for obtaining a certificate of conformity.
1042.205 Application requirements.
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Appendix I to Part 1042—Summary of Previous Emission Standards

Appendix II to Part 1042—Steady-State Duty Cycles

Appendix III to Part 1042—Not-to-Exceed Zones

Authority: 42 U.S.C. 7401—7671q.

Subpart A—Overview and Applicability

§ 1042.1 Applicability.

Except as provided in § 1042.5, the regulations in this part 1042 apply for all new compression-ignition marine engines with per-cylinder displacement below 30.0 liters per cylinder and vessels containing such engines. See § 1042.801 for the definitions of engines and vessels considered to be new. This part 1042 applies as follows:

(a) This part 1042 applies starting with the model years noted in the following tables:

TABLE 1 OF § 1042.1.—PART 1042 APPLICABILITY BY MODEL YEAR

Engine category	Maximum engine power	Displacement (L/cyl)	Model year
	kW <75	All	2009
	75 ≤ kW < 3700	disp.<0.9	2012
Category 1[a]		0.9 ≤ disp. <1.2	2013
		1.2 ≤ disp. <2.5	2014
		2.5 ≤ disp. <3.5	2013
		3.5 ≤ disp. <7.0	2012
	kW ≤ 3700	7.0 ≤ disp. <15.0	2013
Category 2	kW > 3700		2014
	All	15 ≤ disp. < 30	2014

[a] This part 1042 applies to commercial Category 1 engines with power density above 35 kW/L starting in the 2017 model year for engines above 600 kW and below 1400 kW, and in the 2016 model year for engines at or above 1400 kW and at or below 3700 kW.

(b) [Reserved]

(c) See 40 CFR part 94 for requirements that apply to engines with maximum engine power at or above 37 kW not yet subject to the requirements of this part 1042. See 40 CFR part 89 for requirements that apply to engines with maximum engine power below 37 kW not yet subject to the requirements of this part 1042.

(d) The provisions of §§ 1042.620 and 1042.801 apply for new engines used solely for competition beginning January 1, 2009.

§ 1042.2 Who is responsible for compliance?

The regulations in this part 1042 contain provisions that affect both engine manufacturers and others. However, the requirements of this part are generally addressed to the engine manufacturer. The term ''you'' generally means the engine manufacturer, as defined in § 1042.801, especially for issues related to certification (including production-line testing, reporting, etc.).

§ 1042.5 Exclusions.

This part does not apply to the following marine engines:

(a) *Foreign vessels.* The requirements and prohibitions of this part do not apply to engines installed on foreign vessels, as defined in § 1042.801.

(b) *Hobby engines.* Engines with per-cylinder displacement below 50 cubic centimeters are not subject to the provisions of this part 1042.

§ 1042.10 Organization of this part.

This part 1042 is divided into the following subparts:

(a) Subpart A of this part defines the applicability of this part 1042 and gives an overview of regulatory requirements.

(b) Subpart B of this part describes the emission standards and other requirements that must be met to certify engines under this part. Note that § 1042.145 discusses certain interim requirements and compliance provisions that apply only for a limited time.

(c) Subpart C of this part describes how to apply for a certificate of conformity.

(d) Subpart D of this part describes general provisions for testing production-line engines.

(e) Subpart E of this part describes general provisions for testing in-use engines.

(f) Subpart F of this part and 40 CFR 1065 describe how to test your engines.

(g) Subpart G of this part and 40 CFR part 1068 describe requirements, prohibitions, and other provisions that apply to engine manufacturers, vessel manufacturers, owners, operators, rebuilders, and all others.

(h) Subpart H of this part describes how you may generate and use emission credits to certify your engines.

(i) Subpart I of this part contains definitions and other reference information.

§ 1042.15 Do any other regulation parts apply to me?

(a) The evaporative emission requirements of part 1060 of this chapter apply to vessels that include installed engines fueled with a volatile liquid fuel as specified in § 1042.107.

(**Note:** Conventional diesel fuel is not considered to be a volatile liquid fuel.)

(b) Part 1065 of this chapter describes procedures and equipment specifications for testing engines. Subpart F of this part 1042 describes how to apply the provisions of part 1065 of this chapter to determine whether engines meet the emission standards in this part.

(c) The requirements and prohibitions of part 1068 of this chapter apply to everyone, including anyone who manufactures, imports, installs, owns, operates, or rebuilds any of the engines subject to this part 1042, or vessels containing these engines. Part 1068 of this chapter describes general provisions, including these seven areas:

(1) Prohibited acts and penalties for engine manufacturers, vessel manufacturers, and others.

(2) Rebuilding and other aftermarket changes.

(3) Exclusions and exemptions for certain engines.

(4) Importing engines.

(5) Selective enforcement audits of your production.

(6) Defect reporting and recall.

(7) Procedures for hearings.

(d) Other parts of this chapter apply if referenced in this part.

Subpart B—Emission Standards and Related Requirements

§ 1042.101 Exhaust emission standards.

(a) Exhaust emissions from your engines may not exceed emission standards, as follows:

(1) Measure emissions using the test procedures described in subpart F of this part.

(2) The CO emission standards in this paragraph (a)(2) apply starting with the applicable model year shown for Tier 3 standards in Table 1 of this section. These standards continue to apply for Tier 4 engines. The following CO emission standards apply:

(i) 8.0 g/kW-hr for engines below 8 kW.

(ii) 6.6 g/kW-hr for engines at or above 8 kW and below 19 kW.

(iii) 5.5 g/kW-hr for engines at or above 19 kW and below 37 kW.

(iv) 5.0 g/kW-hr for engines at or above 37 kW.

(3) Except as described in paragraph (a)(4) of this section, the Tier 3 standards for PM and NO_X+HC emissions are described in Tables 1 and 2 of this section, which follow.

TABLE 1 OF 1042.101.—TIER 3 STANDARDS FOR CATEGORY 1 ENGINES

Power density and application	Displacement (L/cyl)	Maximum engine power	Model year	PM (g/kW-hr)	NO_X+HC (g/kW-hr)
		kW < 19	2009	0.40	7.5
all	disp. < 0.9	19 ≤ kW < 75	2009	0.30	7.5
			2014	0.30	4.7
	disp. < 0.9	kW ≥ 75	2012	0.14	5.4
	0.9 ≤ disp. < 1.2	all	2013	0.12	5.4
	1.2 ≤ disp. < 2.5	kW < 600	2014	0.11	5.6
			2018	0.10	5.6
		600 ≤ kW < 3700	2014	0.11	5.6
Commercial engines with kW/L 35	2.5 ≤ disp. < 3.5	kW < 600	2013	0.11	5.6
			2018	0.10	5.6
		600 ≤ kW ≤ 3700	2013	0.11	5.6
	3.5 ≤ disp. ≤ 7.0	kW < 600	2012	0.11	5.8
			2018	0.10	5.8
		600 ≤ kW ≤ 3700	2012	0.11	5.8
Commercial engines with kW/L > 35 and all recreational engines.	disp. < 0.9	kW ≡ 75	2012	0.15	5.8
	0.9 ≤ disp. < 1.2	kW ≡ 75	2013	0.14	5.8
	1.2 ≤ disp. < 2.5	kW ≡ 75	2014	0.12	5.8
	2.5 ≤ disp. < 3.5	kW ≡ 75	2013	0.12	5.8
	3.5 ≤ disp. < 7.0	kW ≡ 75	2012	0.12	5.4

(4) For Tier 3 engines with displacement below 0.9 L/cyl and maximum engine power above 19 kW and at or below 75 kW, you may certify to a PM emission standard of 0.20 g/kW-hr and a NO_X+HC emission standard of 5.8 g/kW-hr for 2014 and later model years.

TABLE 2 OF 1042.101.—TIER 3 STANDARDS FOR CATEGORY 2 ENGINES [a]

Displacement (L/cyl)	Maximum engine power	Model year	PM (g/kW-hr)	NO_X+HC (g/kW-hr)
7.0 ≤ disp. < 15.0	kW ≤ 3700	2013	0.14	6.2
15.0 ≤ disp. < 20.0	kW ≤ 3300	2014	0.34	7.0
	3300 < kW ≤ 3700	2014	0.27	8.7
20.0 ≤ disp. < 25.0	kW ≤ 3700	2014	0.27	9.8
25.0 < disp. < 30.0	kW ≤ 3700	2014	0.27	11.0

[a] No Tier 3 standards apply for engines above 3700 kW. See § 1042.1(c) for the standards that apply for these engines.

(5) Except as described in paragraph (a)(6) of this section, the Tier 4 standards for PM, NO_X, and HC emissions are described in the following table:

TABLE 3 OF 1042.101.—TIER 4 STANDARDS FOR CATEGORY 1 AND CATEGORY 2 ENGINES [a]

Application	Maximum engine power	Displacement (L/cyl)	Model year	PM (g/kW-hr)	NO_X (g/kW-hr)	HC (g/kW-hr)
Commercial only	600 ≤ kW < 1400	all	2017	0.04	1.8	0.19
Commercial only	1400 ≤ kW ≤ 2000	all	2016	0.04	1.8	0.19
Commercial and recreational.	2000 < kW ≤ 3700	all	2016	0.04	1.8	0.19
		disp. < 15.0	2014	0.12	1.8	0.19
Commercial and recreational.	kW > 3700	15.0 ≤ disp. ≤ 30.0	2014	0.25	1.8	0.19
		all	2016	0.06	1.8	0.19

[a] No Tier 4 standards apply for recreational engines at or below 2000 kWor for commercial engines below 600 kW. The Tier 3 standards continue to apply for these engines.

(6) The following optional provisions apply for complying with the Tier 4 standards specified in paragraph (a)(5) of this section:

(i) You may certify Tier 4 engines to a NO_X+HC emission standard of 1.8 g/kW-hr instead of the NO_X and HC standards that would otherwise apply.

(ii) For engines below 1000 kW, you may delay complying with the Tier 4 standards in the 2017 model year for up to nine months, but you must comply no later than October 1, 2017.

(iii) For engines above 3700 kW, you may delay complying with the Tier 4 standards in the 2016 model year for up to twelve months, but you must comply no later than December 31, 2016.

(iv) For Category 2 engines with displacement below 15.0 L/cyl and with maximum engine power at or below 3700 kW, you may alternatively comply with the Tier 4 PM and HC standards in the 2015 model year and delay complying with the Tier 4 NO_X standard until the 2017 model year. In the 2015 and 2016 model years, these engines must also comply with the Tier 3 NO_X+HC standard.

(b) *Averaging, banking, and trading.* You may generate or use emission credits under the averaging, banking, and trading (ABT) program as described in subpart H of this part for demonstrating compliance with NO_X, NO_X+HC, and PM emission standards for Category 1 and Category 2 engines. You may also use NO_X or NO_X+HC emission credits to comply with the alternate NO_X+HC standards in paragraph (a)(6)(i) of this section. Generating or using emission credits requires that you specify a family emission limit (FEL) for each pollutant you include in the ABT program for each engine family. These FELs serve as the emission standards for the engine family with respect to all required testing instead of the standards specified in paragraph (a) of this section. The FELs determine the not-to-exceed standards for your engine family, as specified in paragraph (c) of this section. The following FEL caps apply:

(1) FELs for Tier 3 engines may not be higher than the Tier 2 standards specified in Appendix I of this part.

(2) FELs for Tier 4 engines may not be higher than the Tier 3 standards specified in paragraph (a)(3) of this section.

(c) *Not-to-exceed standards.* Exhaust emissions from your propulsion or auxiliary engines may not exceed the not-to-exceed (NTE) standards, as described in this paragraph (c).

(1) Use the following equation to determine the NTE standards:

(i) NTE standard for each pollutant = $STD \times M$

Where:

STD = The standard specified for that pollutant in this section if you certify without using ABT for that pollutant; or the FEL for that pollutant if you certify using ABT.

M = The NTE multiplier for that pollutant, as defined in Appendix III of this part 1042.

(ii) Round each NTE standard to the same number of decimal places as the emission standard.

(2) Determine the applicable NTE zone and subzones. The NTE zone and subzones for an engine family are defined in Appendix III of this part 1042, according to the applicable certification duty cycle(s). For an engine family certified to multiple duty cycles, the broadest applicable NTE zone applies for that family at the time of certification. Whenever an engine family is certified to multiple duty cycles and a specific engine from that family is tested for NTE compliance in-use, determine the applicable NTE zone for that engine according to that engine's in-use application. An engine family's NTE zone may be modified as follows:

(i) You may ask us to approve a narrower NTE zone for an engine family at the time of certification, based on information such as how that engine family is expected to normally operate in use. For example, if an engine family is always coupled to a pump or jet drive, the engine might be able to operate only within a narrow range of engine speed and power.

(ii) You may ask us to approve a Limited Testing Region (LTR). An LTR is a region of engine operation, within the applicable NTE zone, where you have demonstrated that your engine family operates for no more than 5.0 percent of its normal in-use operation, on a time-weighted basis. You must specify an LTR using boundaries based on engine speed and power (or torque), where the LTR boundaries must coincide with some portion of the boundary defining the overall NTE zone. Any emission data collected within an LTR for a time duration that exceeds 5.0 percent of the duration of its respective NTE sampling period (as defined in paragraph (c)(3) of this section) will be excluded when determining compliance with the applicable NTE standards. Any emission data collected within an LTR for a time duration of 5.0 percent or less of the duration of the respective NTE sampling period will be included when determining compliance with the NTE standards.

(iii) You must notify us if you design your engines for normal in-use operation outside the applicable NTE zone. If we learn that normal in-use operation for your engines includes other speeds and loads, we may specify a broader NTE zone, as long as the modified zone is limited to normal in-use operation for speeds greater than 70 percent of maximum test speed and loads greater than 30 percent of maximum power at maximum test speed (or 30 percent of maximum test torque, as appropriate).

(iv) You may exclude emission data based on ambient or engine parameter limit values as follows:

(A) *NO_X catalytic aftertreatment minimum temperature.* For an engine equipped with a catalytic NO_X aftertreatment system, exclude NO_X emission data that is collected when the exhaust temperature is less than 150 °C, as measured within 30 cm downstream of the last NO_X aftertreatment device that has the greatest exhaust flow. You may request that we approve a higher minimum exhaust temperature limit at the time of certification based on the normal in-use operation of the NO_X exhaust aftertreatment system for the engine family. We will generally not approve a minimum exhaust temperature for catalytic NO_X aftertreatment greater than 250 °C.

(B) *Hydrocarbon catalytic aftertreatment minimum temperature.* For an engine equipped with a catalytic hydrocarbon aftertreatment system, exclude hydrocarbon emission data that is collected when the exhaust temperature is less than 250 °C, as measured within 30 cm downstream of the last hydrocarbon aftertreatment device that has the greatest exhaust flow.

(C) *Other parameters.* You may request our approval for other minimum or maximum ambient or engine parameter limit values at the time of certification.

(3) The NTE standards apply to your engines whenever they operate within the NTE zone for an NTE sampling period of at least thirty seconds, during which only a single operator demand set point may be selected. Engine operation during a change in operator demand is excluded from any NTE sampling period. There is no maximum NTE sampling period.

(4) Collect emission data for determining compliance with the NTE standards using the procedures described in subpart F of this part.

(d) *Fuel types.* The exhaust emission standards in this section apply for engines using the fuel type on which the engines in the engine family are designed to operate.

(1) You must meet the numerical emission standards for hydrocarbons in this section based on the following types of hydrocarbon emissions for engines powered by the following fuels:

(i) Alcohol-fueled engines must comply with Tier 3 HC standards based on THCE emissions and with Tier 4 standards based on NMHCE emissions.

(ii) Natural gas-fueled engines must comply with HC standards based on NMHC emissions.

(iii) Diesel-fueled and other engines must comply with Tier 3 HC standards based on THC emissions and with Tier 4 standards based on NMHC emissions.

(2) Tier 3 and later engines must comply with the exhaust emission standards when tested using test fuels

containing 15 ppm or less sulfur (ultra low-sulfur diesel fuel).

(3) Engines designed to operate using residual fuel must comply with the standards and requirements of this part when operated using residual fuel in addition to complying with the requirements of this part when operated using diesel fuel.

(e) *Useful life.* Your engines must meet the exhaust emission standards of this section over their full useful life.

(1) The minimum useful life values are as follows, except as specified by paragraph (e)(2) or (3) of this section:

(i) 10 years or 1,000 hours of operation for recreational Category 1 engines.

(ii) 10 years or 10,000 hours of operation for commercial Category 1 engines.

(iii) 10 years or 20,000 hours of operation for Category 2 engines.

(iv) [Reserved]

(2) Specify a longer useful life in hours for an engine family under either of two conditions:

(i) If you design, advertise, or market your engine to operate longer than the minimum useful life (your recommended hours until rebuild indicates a longer design life).

(ii) If your basic mechanical warranty is longer than the minimum useful life.

(3) You may request in your application for certification that we approve a shorter useful life for an engine family. We may approve a shorter useful life, in hours of engine operation but not in years, if we determine that these engines will rarely operate longer than the shorter useful life. If engines identical to those in the engine family have already been produced and are in use, your demonstration must include documentation from such in-use engines. In other cases, your demonstration must include an engineering analysis of information equivalent to such in-use data, such as data from research engines or similar engine models that are already in production. Your demonstration must also include any overhaul interval that you recommend, any mechanical warranty that you offer for the engine or its components, and any relevant customer design specifications. Your demonstration may include any other relevant information. The useful life value may not be shorter than any of the following:

(i) 1,000 hours of operation.

(ii) Your recommended overhaul interval.

(iii) Your mechanical warranty for the engine.

(f) *Applicability for testing.* The duty-cycle emission standards in this subpart apply to all testing performed according to the procedures in § 1042.505, including certification, production-line, and in-use testing. The not-to-exceed standards apply for all testing performed according to the procedures of subpart F of this part.

§ 1042.107 Evaporative emission standards.

(a) There are no evaporative emission standards for diesel-fueled engines, or engines using other nonvolatile or nonliquid fuels (for example, natural gas).

(b) If an engine uses a volatile liquid fuel, such as methanol, the engine's fuel system and the vessel in which the engine is installed must meet the evaporative emission requirements of 40 CFR part 1045 that apply with respect to spark-ignition engines. Manufacturers subject to evaporative emission standards must meet the requirements of 40 CFR 1045.105 as described in 40 CFR part 1060 and do all the following things in the application for certification:

(1) Describe how evaporative emissions are controlled.

(2) Present test data to show that fuel systems and vessels meet the evaporative emission standards we specify in this section if you do not use design-based certification under 40 CFR 1060.240. Show these figures before and after applying deterioration factors, where applicable.

§ 1042.110 Recording urea use and other diagnostic functions.

(a) Engines equipped with SCR systems must meet the following requirements:

(1) The diagnostic system must monitor urea quality and tank levels and alert operators to the need to refill the urea tank using a malfunction-indicator light (MIL) and an audible alarm. You do not need to separately monitor urea quality if you include an exhaust NO_X sensor that allows you determine inadequate urea quality along with other SCR malfunctions.

(2) The onboard computer log must record in nonvolatile computer memory all incidents of engine operation with inadequate urea injection or urea quality.

(b) You may equip your engine with other diagnostic features. If you do, they must be designed to allow us to read and interpret the codes. Note that §§ 1042.115 and 1042.205 require that you provide us any information needed to read, record, and interpret all the information broadcast by an engine's onboard computers and electronic control units.

§ 1042.115 Other requirements.

Engines that are required to comply with the emission standards of this part must meet the following requirements:

(a) *Crankcase emissions.* Crankcase emissions may not be discharged directly into the ambient atmosphere from any engine throughout its useful life, except as follows:

(1) Engines may discharge crankcase emissions to the ambient atmosphere if the emissions are added to the exhaust emissions (either physically or mathematically) during all emission testing. If you take advantage of this exception, you must do the following things:

(i) Manufacture the engines so that all crankcase emissions can be routed into the applicable sampling systems specified in 40 CFR part 1065.

(ii) Account for deterioration in crankcase emissions when determining exhaust deterioration factors.

(2) For purposes of this paragraph (a), crankcase emissions that are routed to the exhaust upstream of exhaust aftertreatment during all operation are not considered to be discharged directly into the ambient atmosphere.

(b) *Torque broadcasting.* Electronically controlled engines must broadcast their speed and output shaft torque (in newton-meters). Engines may alternatively broadcast a surrogate value for determining torque. Engines must broadcast engine parameters such that they can be read with a remote device, or broadcast them directly to their controller area networks. This information is necessary for testing engines in the field (see § 1042.515).

(c) *EPA access to broadcast information.* If we request it, you must provide us any hardware or tools we would need to readily read, interpret, and record all information broadcast by an engine's on-board computers and electronic control modules. If you broadcast a surrogate parameter for torque values, you must provide us what we need to convert these into torque units. We will not ask for hardware or tools if they are readily available commercially.

(d) *Adjustable parameters.* An operating parameter is not considered adjustable if you permanently seal it or if it is not normally accessible using ordinary tools. The following provisions apply for adjustable parameters:

(1) Category 1 engines that have adjustable parameters must meet all the requirements of this part for any adjustment in the physically adjustable range. We may require that you set

adjustable parameters to any specification within the adjustable range during any testing, including certification testing, selective enforcement auditing, or in-use testing.

(2) Category 2 engines that have adjustable parameters must meet all the requirements of this part for any adjustment in the approved adjustable range. You must specify in your application for certification the adjustable range of each adjustable parameter on a new engine to—

(i) Ensure that safe engine operating characteristics are available within that range, as required by section 202(a)(4) of the Clean Air Act (42 U.S.C. 7521(a)(4)), taking into consideration the production tolerances.

(ii) Limit the physical range of adjustability to the maximum extent practicable to the range that is necessary for proper operation of the engine.

(e) *Prohibited controls.* You may not design your engines with emission-control devices, systems, or elements of design that cause or contribute to an unreasonable risk to public health, welfare, or safety while operating. For example, this would apply if the engine emits a noxious or toxic substance it would otherwise not emit that contributes to such an unreasonable risk.

(f) *Defeat devices.* You may not equip your engines with a defeat device. A defeat device is an auxiliary emission control device that reduces the effectiveness of emission controls under conditions that the engine may reasonably be expected to encounter during normal operation and use. This does not apply to auxiliary emission control devices you identify in your certification application if any of the following is true:

(1) The conditions of concern were substantially included in the applicable duty-cycle test procedures described in subpart F of this part (the portion during which emissions are measured). See paragraph (f)(4) of this section for other conditions.

(2) You show your design is necessary to prevent engine (or vessel) damage or accidents.

(3) The reduced effectiveness applies only to starting the engine.

(4) The auxiliary emission control device reduces urea flow for a selective catalytic reduction (SCR) aftertreatment system and meets the requirements of this paragraph (f)(4). For any operation meeting one of the conditions of paragraph (f)(4)(i) of this section, your SCR system must function so that at least one of the conditions of paragraph (ii) of this paragraph (f)(4)(ii) of this section is met at the applicable speed and loads.

(i) The provisions of this paragraph (f)(4) apply under either of the following conditions:

(A) The ambient test conditions are outside the range specified in § 1042.501.

(B) The operation is at a speed and/or load not included as a duty-cycle test point, including transient operation between test points.

(ii) Consistent with good engineering judgment, your AECD is not a defeat device where one of the following is true:

(A) You maintain the mass flow of urea into the catalyst at the highest level possible without emitting ammonia at levels higher than would occur at operation at test points under test conditions.

(B) The temperature of the exhaust is too low to allow urea to be converted to ammonia.

§ 1042.120 Emission-related warranty requirements.

(a) *General requirements.* You must warrant to the ultimate purchaser and each subsequent purchaser that the new engine, including all parts of its emission-control system, meets two conditions:

(1) It is designed, built, and equipped so it conforms at the time of sale to the ultimate purchaser with the requirements of this part.

(2) It is free from defects in materials and workmanship that may keep it from meeting these requirements.

(b) *Warranty period.* Your emission-related warranty must be valid for at least as long as the minimum warranty periods listed in this paragraph (b) in hours of operation and years, whichever comes first. You may offer an emission-related warranty more generous than we require. The emission-related warranty for the engine may not be shorter than any published warranty you offer without charge for the engine. Similarly, the emission-related warranty for any component may not be shorter than any published warranty you offer without charge for that component. If an engine has no hour meter, we base the warranty periods in this paragraph (b) only on the engine's age (in years). The warranty period begins when the engine is placed into service. The following minimum warranty periods apply:

(1) For Category 1 and Category 2 engines, your emission-related warranty must be valid for at least 50 percent of the engine's useful life in hours of operation or a number of years equal to at least 50 percent of the useful life in years, whichever comes first.

(2) [Reserved]

(c) *Components covered.* The emission-related warranty covers all components whose failure would increase an engine's emissions of any pollutant, including those listed in 40 CFR part 1068, Appendix I, and those from any other system you develop to control emissions. The emission-related warranty covers these components even if another company produces the component. Your emission-related warranty does not cover components whose failure would not increase an engine's emissions of any pollutant.

(d) *Limited applicability.* You may deny warranty claims under this section if the operator caused the problem through improper maintenance or use, as described in 40 CFR 1068.115.

(e) *Owner's manual.* Describe in the owner's manual the emission-related warranty provisions from this section that apply to the engine.

§ 1042.125 Maintenance instructions for Category 1 and Category 2 engines.

Give the ultimate purchaser of each new engine written instructions for properly maintaining and using the engine, including the emission-control system, as described in this section. The maintenance instructions also apply to service accumulation on your emission-data engines as described in § 1042.245 and in 40 CFR part 1065. This section applies only to Category 1 and Category 2 engines.

(a) *Critical emission-related maintenance.* Critical emission-related maintenance includes any adjustment, cleaning, repair, or replacement of critical emission-related components. This may also include additional emission-related maintenance that you determine is critical if we approve it in advance. You may schedule critical emission-related maintenance on these components if you meet the following conditions:

(1) You demonstrate that the maintenance is reasonably likely to be done at the recommended intervals on in-use engines. We will accept scheduled maintenance as reasonably likely to occur if you satisfy any of the following conditions:

(i) You present data showing that any lack of maintenance that increases emissions also unacceptably degrades the engine's performance.

(ii) You present survey data showing that at least 80 percent of engines in the field get the maintenance you specify at the recommended intervals.

(iii) You provide the maintenance free of charge and clearly say so in maintenance instructions for the customer.

(iv) You otherwise show us that the maintenance is reasonably likely to be done at the recommended intervals.

(2) For engines below 130 kW, you may not schedule critical emission-related maintenance more frequently than the following minimum intervals, except as specified in paragraphs (a)(4), (b), and (c) of this section:

(i) For EGR-related filters and coolers, PCV valves, and fuel injector tips (cleaning only), the minimum interval is 1,500 hours.

(ii) For the following components, including associated sensors and actuators, the minimum interval is 3,000 hours: fuel injectors, turbochargers, catalytic converters, electronic control units, particulate traps, trap oxidizers, components related to particulate traps and trap oxidizers, EGR systems (including related components, but excluding filters and coolers), and other add-on components. For particulate traps, trap oxidizers, and components related to either of these, maintenance is limited to cleaning and repair only.

(3) For Category 1 and Category 2 engines at or above 130 kW, you may not schedule critical emission-related maintenance more frequently than the following minimum intervals, except as specified in paragraphs (a)(4), (b), and (c) of this section:

(i) For EGR-related filters and coolers, PCV valves, and fuel injector tips (cleaning only), the minimum interval is 1,500 hours.

(ii) For the following components, including associated sensors and actuators, the minimum interval is 4,500 hours: fuel injectors, turbochargers, catalytic converters, electronic control units, particulate traps, trap oxidizers, components related to particulate traps and trap oxidizers, EGR systems (including related components, but excluding filters and coolers), and other add-on components. For particulate traps, trap oxidizers, and components related to either of these, maintenance is limited to cleaning and repair only.

(4) We may approve shorter maintenance intervals than those listed in paragraph (a)(3) of this section where technologically necessary for Category 2 engines.

(5) If your engine family has an alternate useful life under § 1042.101(e) that is shorter than the period specified in paragraph (a)(2) or (a)(3) of this section, you may not schedule critical emission-related maintenance more frequently than the alternate useful life, except as specified in paragraph (c) of this section.

(b) *Recommended additional maintenance.* You may recommend any additional amount of maintenance on the components listed in paragraph (a) of this section, as long as you state clearly that these maintenance steps are not necessary to keep the emission-related warranty valid. If operators do the maintenance specified in paragraph (a) of this section, but not the recommended additional maintenance, this does not allow you to disqualify those engines from in-use testing or deny a warranty claim. Do not take these maintenance steps during service accumulation on your emission-data engines.

(c) *Special maintenance.* You may specify more frequent maintenance to address problems related to special situations, such as atypical engine operation. You must clearly state that this additional maintenance is associated with the special situation you are addressing.

(d) *Noncritical emission-related maintenance.* Subject to the provisions of this paragraph (d), you may schedule any amount of emission-related inspection or maintenance that is not covered by paragraph (a) of this section (that is, maintenance that is neither explicitly identified as critical emission-related maintenance, nor that we approve as critical emission-related maintenance). Noncritical emission-related maintenance generally includes maintenance on the components we specify in 40 CFR part 1068, Appendix I. You must state in the owner's manual that these steps are not necessary to keep the emission-related warranty valid. If operators fail to do this maintenance, this does not allow you to disqualify those engines from in-use testing or deny a warranty claim. Do not take these inspection or maintenance steps during service accumulation on your emission-data engines.

(e) *Maintenance that is not emission-related.* For maintenance unrelated to emission controls, you may schedule any amount of inspection or maintenance. You may also take these inspection or maintenance steps during service accumulation on your emission-data engines, as long as they are reasonable and technologically necessary. This might include adding engine oil, changing air, fuel, or oil filters, servicing engine-cooling systems, and adjusting idle speed, governor, engine bolt torque, valve lash, or injector lash. You may perform this nonemission-related maintenance on emission-data engines at the least frequent intervals that you recommend to the ultimate purchaser (but not intervals recommended for severe service).

(f) *Source of parts and repairs.* State clearly on the first page of your written maintenance instructions that a repair shop or person of the owner's choosing may maintain, replace, or repair emission-control devices and systems. Your instructions may not require components or service identified by brand, trade, or corporate name. Also, do not directly or indirectly condition your warranty on a requirement that the engine be serviced by your franchised dealers or any other service establishments with which you have a commercial relationship. You may disregard the requirements in this paragraph (f) if you do one of two things:

(1) Provide a component or service without charge under the purchase agreement.

(2) Get us to waive this prohibition in the public's interest by convincing us the engine will work properly only with the identified component or service.

(g) *Payment for scheduled maintenance.* Owners are responsible for properly maintaining their engines. This generally includes paying for scheduled maintenance. However, manufacturers must pay for scheduled maintenance during the useful life if it meets all the following criteria:

(1) Each affected component was not in general use on similar engines before the applicable dates shown in paragraph (6) of the definition of *new marine engine* in § 1042.801.

(2) The primary function of each affected component is to reduce emissions.

(3) The cost of the scheduled maintenance is more than 2 percent of the price of the engine.

(4) Failure to perform the maintenance would not cause clear problems that would significantly degrade the engine's performance.

(h) *Owner's manual.* Explain the owner's responsibility for proper maintenance in the owner's manual.

§ 1042.130 Installation instructions for vessel manufacturers.

(a) If you sell an engine for someone else to install in a vessel, give the engine installer instructions for installing it consistent with the requirements of this part. Include all information necessary to ensure that an engine will be installed in its certified configuration.

(b) Make sure these instructions have the following information:

(1) Include the heading: "Emission-related installation instructions'.

(2) State: "Failing to follow these instructions when installing a certified engine in a vessel violates federal law (40 CFR 1068.105(b)), subject to fines or other penalties as described in the Clean Air Act.".

(3) Describe the instructions needed to properly install the exhaust system and any other components. Include instructions consistent with the requirements of § 1042.205(u).

(4) Describe any necessary steps for installing the diagnostic system described in § 1042.110.

(5) Describe any limits on the range of applications needed to ensure that the engine operates consistently with your application for certification. For example, if your engines are certified only for constant-speed operation, tell vessel manufacturers not to install the engines in variable-speed applications or modify the governor.

(6) Describe any other instructions to make sure the installed engine will operate according to design specifications in your application for certification. This may include, for example, instructions for installing aftertreatment devices when installing the engines.

(7) State: ''If you install the engine in a way that makes the engine's emission control information label hard to read during normal engine maintenance, you must place a duplicate label on the vessel, as described in 40 CFR 1068.105.''.

(8) Describe any vessel labeling requirements specified in § 1042.135.

(c) You do not need installation instructions for engines you install in your own vessels.

(d) Provide instructions in writing or in an equivalent format. For example, you may post instructions on a publicly available Web site for downloading or printing. If you do not provide the instructions in writing, explain in your application for certification how you will ensure that each installer is informed of the installation requirements.

§ 1042.135 Labeling.

(a) Assign each engine a unique identification number and permanently affix, engrave, or stamp it on the engine in a legible way.

(b) At the time of manufacture, affix a permanent and legible label identifying each engine. The label must be—

(1) Attached in one piece so it is not removable without being destroyed or defaced. However, you may use two-piece labels for engines below 19 kW if there is not enough space on the engine to apply a one-piece label.

(2) Secured to a part of the engine needed for normal operation and not normally requiring replacement.

(3) Durable and readable for the engine's entire life.

(4) Written in English.

(c) The label must—

(1) Include the heading ''EMISSION CONTROL INFORMATION''.

(2) Include your full corporate name and trademark. You may identify another company and use its trademark instead of yours if you comply with the provisions of § 1042.640.

(3) Include EPA's standardized designation for the engine family (and subfamily, where applicable).

(4) State the engine's category, displacement (in liters or L/cyl), maximum engine power (in kW), and power density (in kW/L) as needed to determine the emission standards for the engine family. You may specify displacement, maximum engine power, and power density as ranges consistent with the ranges listed in § 1042.101. See § 1042.140 for descriptions of how to specify per-cylinder displacement, maximum engine power, and power density.

(5) [Reserved]

(6) State the date of manufacture [MONTH and YEAR]; however, you may omit this from the label if you stamp or engrave it on the engine.

(7) State the FELs to which the engines are certified if you certified the engine using the ABT provisions of subpart H of this part.

(8) Identify the emission-control system. Use terms and abbreviations consistent with SAE J1930 (incorporated by reference in § 1042.810). You may omit this information from the label if there is not enough room for it and you put it in the owner's manual instead.

(9) Identify the application(s) for which the engine family is certified (such as constant-speed auxiliary, variable-speed propulsion engines used with fixed-pitch propellers, etc.). If the engine is certified as a recreational engine, state: ''INSTALLING THIS RECREATIONAL ENGINE IN A NONRECREATIONAL VESSEL VIOLATES FEDERAL LAW SUBJECT TO CIVIL PENALTY (40 CFR PART 1068).''.

(10) For engines requiring ULSD, state: ''ULTRA LOW SULFUR DIESEL FUEL ONLY'.

(11) Identify any additional requirements for fuel and lubricants that do not involve fuel-sulfur levels. You may omit this information from the label if there is not enough room for it and you put it in the owner's manual instead.

(12) State the useful life for your engine family.

(13) State: ''THIS ENGINE COMPLIES WITH U.S. EPA REGULATIONS FOR [MODEL YEAR] MARINE DIESEL ENGINES.''.

(14) For an engine that can be modified to operate on residual fuel, but has not been certified to meet the standards on such a fuel, include the statement: ''THIS ENGINE IS CERTIFIED FOR OPERATION ONLY WITH DIESEL FUEL. MODIFYING THE ENGINE TO OPERATE ON RESIDUAL OR INTERMEDIATE FUEL MAY BE A VIOLATION OF FEDERAL LAW SUBJECT TO CIVIL PENALTIES.''.

(d) You may add information to the emission control information label to identify other emission standards that the engine meets or does not meet (such as international standards). You may also add other information to ensure that the engine will be properly maintained and used.

(e) For engines requiring ULSD, create a separate label with the statement: ''ULTRA LOW SULFUR DIESEL FUEL ONLY''. Permanently attach this label to the vessel near the fuel inlet or, if you do not manufacture the vessel, take one of the following steps to ensure that the vessel will be properly labeled:

(1) Provide the label to each vessel manufacturer and include in the emission-related installation instructions the requirement to place this label near the fuel inlet.

(2) Confirm that the vessel manufacturers install their own complying labels.

(f) You may ask us to approve modified labeling requirements in this part 1042 if you show that it is necessary or appropriate. We will approve your request if your alternate label is consistent with the intent of the labeling requirements of this part.

(g) If you obscure the engine label while installing the engine in the vessel such that the label will be hard to read during normal maintenance, you must place a duplicate label on the vessel. If others install your engine in their vessels in a way that obscures the engine label, we require them to add a duplicate label on the vessel (see 40 CFR 1068.105); in that case, give them the number of duplicate labels they request and keep the following records for at least five years:

(1) Written documentation of the request from the vessel manufacturer.

(2) The number of duplicate labels you send for each family and the date you sent them.

§ 1042.140 Maximum engine power, displacement, and power density.

This section describes how to determine the maximum engine power, displacement, and power density of an engine for the purposes of this part. Note that maximum engine power may differ from the definition of maximum test power as defined in subpart F for testing engines.

(a) An engine configuration's maximum engine power is the maximum brake power point on the nominal power curve for the engine configuration, as defined in this section. Round the power value to the nearest whole kilowatt.

(b) The nominal power curve of an engine configuration is the relationship between maximum available engine brake power and engine speed for an engine, using the mapping procedures of 40 CFR part 1065, based on the manufacturer's design and production specifications for the engine. This information may also be expressed by a torque curve that relates maximum available engine torque with engine speed.

(c) An engine configuration's per-cylinder displacement is the intended swept volume of each cylinder. The swept volume of the engine is the product of the internal cross-section area of the cylinders, the stroke length, and the number of cylinders. Calculate the engine's intended swept volume from the design specifications for the cylinders using enough significant figures to allow determination of the displacement to the nearest 0.02 liters. Determine the final value by truncating digits to establish the per-cylinder displacement to the nearest 0.1 liters. For example, for an engine with circular cylinders having an internal diameter of 13.0 cm and a 15.5 cm stroke length, the rounded displacement would be: $(13.0/2)^2 \times (p) \times (15.5) \div 1000 = 2.0$ liters.

(d) The nominal power curve and intended swept volume must be within the range of the actual power curves and swept volumes of production engines considering normal production variability. If after production begins, it is determined that either your nominal power curve or your intended swept volume does not represent production engines, we may require you to amend your application for certification under § 1042.225.

(e) Throughout this part, references to a specific power value for an engine are based on maximum engine power. For example, the group of engines with maximum engine power above 600 kW may be referred to as engines above 600 kW.

(f) Calculate an engine family's power density in kW/L by dividing the unrounded maximum engine power by the engine's unrounded per-cylinder displacement, then dividing by the number of cylinders. Round the calculated value to the nearest whole number.

§ 1042.145 Interim provisions.

(a) *General.* The provisions in this section apply instead of other provisions in this part for Category 1 and Category 2 engines. This section describes when these interim provisions expire.

(b) *Delayed standards.* Post-manufacturer marinizers that are small-volume engine manufacturers may delay compliance with the Tier 3 standards for engines below 600 kW as follows:

(1) You may delay compliance with the Tier 3 standards for one model year, as long as the engines meet all the requirements that apply to Tier 2 engines.

(2) You may delay compliance with the NTE standards for Tier 3 standards for three model years beyond the one year delay otherwise allowed, as long as the engines meet all other requirements that apply to Tier 3 engines for the appropriate model year.

Subpart C—Certifying Engine Families

§ 1042.201 General requirements for obtaining a certificate of conformity.

(a) You must send us a separate application for a certificate of conformity for each engine family. A certificate of conformity is valid starting with the indicated effective date, but it is not valid for any production after December 31 of the model year for which it is issued.

(b) The application must contain all the information required by this part and must not include false or incomplete statements or information (see § 1042.255).

(c) We may ask you to include less information than we specify in this subpart, as long as you maintain all the information required by § 1042.250.

(d) You must use good engineering judgment for all decisions related to your application (see 40 CFR 1068.5).

(e) An authorized representative of your company must approve and sign the application.

(f) See § 1042.255 for provisions describing how we will process your application.

(g) We may require you to deliver your test engines to a facility we designate for our testing (see § 1042.235(c)).

(h) For engines that become new as a result of substantial modifications or for engines installed on imported vessels that become subject to the requirements of this part, we may specify alternate certification provisions consistent with the intent of this part. See the definition of "new" in § 1042.801.

§ 1042.205 Application requirements.

This section specifies the information that must be in your application, unless we ask you to include less information under § 1042.201(c). We may require you to provide additional information to evaluate your application.

(a) Describe the engine family's specifications and other basic parameters of the engine's design and emission controls. List the fuel type on which your engines are designed to operate (for example, ultra low-sulfur diesel fuel). List each distinguishable engine configuration in the engine family. For each engine configuration, list the maximum engine power and the range of values for maximum engine power resulting from production tolerances, as described in § 1042.140.

(b) Explain how the emission-control system operates. Describe in detail all system components for controlling exhaust emissions, including all auxiliary emission control devices (AECDs) and all fuel-system components you will install on any production or test engine. Identify the part number of each component you describe. For this paragraph (b), treat as separate AECDs any devices that modulate or activate differently from each other. Include all the following:

(1) Give a general overview of the engine, the emission-control strategies, and all AECDs.

(2) Describe each AECD's general purpose and function.

(3) Identify the parameters that each AECD senses (including measuring, estimating, calculating, or empirically deriving the values). Include vessel-based parameters and state whether you simulate them during testing with the applicable procedures.

(4) Describe the purpose for sensing each parameter.

(5) Identify the location of each sensor the AECD uses.

(6) Identify the threshold values for the sensed parameters that activate the AECD.

(7) Describe the parameters that the AECD modulates (controls) in response to any sensed parameters, including the range of modulation for each parameter, the relationship between the sensed parameters and the controlled parameters and how the modulation achieves the AECD's stated purpose. Use graphs and tables, as necessary.

(8) Describe each AECD's specific calibration details. This may be in the form of data tables, graphical representations, or some other description.

(9) Describe the hierarchy among the AECDs when multiple AECDs sense or modulate the same parameter. Describe

whether the strategies interact in a comparative or additive manner and identify which AECD takes precedence in responding, if applicable.

(10) Explain the extent to which the AECD is included in the applicable test procedures specified in subpart F of this part.

(11) Do the following additional things for AECDs designed to protect engines or vessels:

(i) Identify the engine and/or vessel design limits that make protection necessary and describe any damage that would occur without the AECD.

(ii) Describe how each sensed parameter relates to the protected components' design limits or those operating conditions that cause the need for protection.

(iii) Describe the relationship between the design limits/parameters being protected and the parameters sensed or calculated as surrogates for those design limits/parameters, if applicable.

(iv) Describe how the modulation by the AECD prevents engines and/or vessels from exceeding design limits.

(v) Explain why it is necessary to estimate any parameters instead of measuring them directly and describe how the AECD calculates the estimated value, if applicable.

(vi) Describe how you calibrate the AECD modulation to activate only during conditions related to the stated need to protect components and only as needed to sufficiently protect those components in a way that minimizes the emission impact.

(c) [Reserved]

(d) Describe the engines you selected for testing and the reasons for selecting them.

(e) Describe the test equipment and procedures that you used, including the duty cycle(s) and the corresponding engine applications. Also describe any special or alternate test procedures you used.

(f) Describe how you operated the emission-data engine before testing, including the duty cycle and the number of engine operating hours used to stabilize emission levels. Explain why you selected the method of service accumulation. Describe any scheduled maintenance you did.

(g) List the specifications of the test fuel to show that it falls within the required ranges we specify in 40 CFR part 1065.

(h) Identify the engine family's useful life.

(i) Include the maintenance and warranty instructions you will give to the ultimate purchaser of each new engine (see §§ 1042.120 and 1042.125).

(j) Include the emission-related installation instructions you will provide if someone else installs your engines in a vessel (see § 1042.130).

(k) Describe your emission control information label (see § 1042.135).

(l) Identify the emission standards and/or FELs to which you are certifying engines in the engine family.

(m) Identify the engine family's deterioration factors and describe how you developed them (see § 1042.245). Present any emission test data you used for this.

(n) State that you operated your emission-data engines as described in the application (including the test procedures, test parameters, and test fuels) to show you meet the requirements of this part.

(o) Present emission data for HC, NO_X, PM, and CO on an emission-data engine to show your engines meet emission standards as specified in § 1042.101. Show emission figures before and after applying adjustment factors for regeneration and deterioration factors for each pollutant and for each engine. If we specify more than one grade of any fuel type (for example, high-sulfur and low-sulfur diesel fuel), you need to submit test data only for one grade, unless the regulations of this part specify otherwise for your engine. Include emission results for each mode if you do discrete-mode testing under § 1042.505. Note that §§ 1042.235 and 1042.245 allows you to submit an application in certain cases without new emission data.

(p) For Category 1 and Category 2 engines, state that all the engines in the engine family comply with the not-to-exceed emission standards we specify in § 1042.101 for all normal operation and use when tested as specified in § 1042.515. Describe any relevant testing, engineering analysis, or other information in sufficient detail to support your statement.

(q) [Reserved]

(r) Report all test results, including those from invalid tests, whether or not they were conducted according to the test procedures of subpart F of this part. If you measure CO_2, report those emission levels. We may ask you to send other information to confirm that your tests were valid under the requirements of this part and 40 CFR part 1065.

(s) Describe all adjustable operating parameters (see § 1042.115(d)), including production tolerances. Include the following in your description of each parameter:

(1) The nominal or recommended setting.

(2) The intended physically adjustable range.

(3) The limits or stops used to establish adjustable ranges.

(4) For Category 1 engines, information showing why the limits, stops, or other means of inhibiting adjustment are effective in preventing adjustment of parameters on in-use engines to settings outside your intended physically adjustable ranges.

(5) For Category 2 engines, propose a range of adjustment for each adjustable parameter, as described in § 1042.115(d). Include information showing why the limits, stops, or other means of inhibiting adjustment are effective in preventing adjustment of parameters on in-use engines to settings outside your proposed adjustable ranges.

(t) Provide the information to read, record, and interpret all the information broadcast by an engine's onboard computers and electronic control units. State that, upon request, you will give us any hardware, software, or tools we would need to do this. If you broadcast a surrogate parameter for torque values, you must provide us what we need to convert these into torque units. You may reference any appropriate publicly released standards that define conventions for these messages and parameters. Format your information consistent with publicly released standards.

(u) Confirm that your emission-related installation instructions specify how to ensure that sampling of exhaust emissions will be possible after engines are installed in vessels and placed in service. Show how to sample exhaust emissions in a way that prevents diluting the exhaust sample with ambient air.

(v) State whether your certification is limited for certain engines. If this is the case, describe how you will prevent use of these engines in applications for which they are not certified. This applies for engines such as the following:

(1) Constant-speed engines.

(2) Variable-pitch.

(3) Recreational engines.

(w) Unconditionally certify that all the engines in the engine family comply with the requirements of this part, other referenced parts of the CFR, and the Clean Air Act.

(x) Include estimates of U.S.-directed production volumes. If these estimates are not consistent with your actual production volumes from previous years, explain why they are different.

(y) Include the information required by other subparts of this part. For example, include the information required by § 1042.725 if you participate in the ABT program.

(z) Include other applicable information, such as information specified in this part or 40 CFR part 1068 related to requests for exemptions.

(aa) Name an agent for service located in the United States. Service on this agent constitutes service on you or any of your officers or employees for any action by EPA or otherwise by the United States related to the requirements of this part.

(bb) For imported engines, identify the following:

(1) The port(s) at which you will import your engines.

(2) The names and addresses of the agents you have authorized to import your engines.

(3) The location of test facilities in the United States where you can test your engines if we select them for testing under a selective enforcement audit, as specified in 40 CFR part 1068, subpart E.

§ 1042.210 Preliminary approval.

If you send us information before you finish the application, we will review it and make any appropriate determinations, especially for questions related to engine family definitions, auxiliary emission control devices, deterioration factors, useful life, testing for service accumulation, maintenance, and compliance with not-to-exceed standards. Decisions made under this section are considered to be preliminary approval, subject to final review and approval. We will generally not reverse a decision where we have given you preliminary approval, unless we find new information supporting a different decision. If you request preliminary approval related to the upcoming model year or the model year after that, we will make best-efforts to make the appropriate determinations as soon as practicable. We will generally not provide preliminary approval related to a future model year more than two years ahead of time.

§ 1042.220 Amending maintenance instructions.

You may amend your emission-related maintenance instructions after you submit your application for certification, as long as the amended instructions remain consistent with the provisions of § 1042.125. You must send the Designated Compliance Officer a written request to amend your application for certification for an engine family if you want to change the emission-related maintenance instructions in a way that could affect emissions. In your request, describe the proposed changes to the maintenance instructions. We will disapprove your request if we determine that the amended instructions are inconsistent with maintenance you performed on emission-data engines. If operators follow the original maintenance instructions rather than the newly specified maintenance, this does not allow you to disqualify those engines from in-use testing or deny a warranty claim.

(a) If you are decreasing any specified maintenance, you may distribute the new maintenance instructions to your customers 30 days after we receive your request, unless we disapprove your request. We may approve a shorter time or waive this requirement.

(b) If your requested change would not decrease the specified maintenance, you may distribute the new maintenance instructions any time after you send your request. For example, this paragraph (b) would cover adding instructions to increase the frequency of a maintenance step for engines in severe-duty applications.

(c) You do not need to request approval if you are making only minor corrections (such as correcting typographical mistakes), clarifying your maintenance instructions, or changing instructions for maintenance unrelated to emission control.

§ 1042.225 Amending applications for certification.

Before we issue you a certificate of conformity, you may amend your application to include new or modified engine configurations, subject to the provisions of this section. After we have issued your certificate of conformity, you may send us an amended application requesting that we include new or modified engine configurations within the scope of the certificate, subject to the provisions of this section. You must amend your application if any changes occur with respect to any information included in your application.

(a) You must amend your application before you take any of the following actions:

(1) Add an engine configuration to an engine family. In this case, the engine configuration added must be consistent with other engine configurations in the engine family with respect to the criteria listed in § 1042.230.

(2) Change an engine configuration already included in an engine family in a way that may affect emissions, or change any of the components you described in your application for certification. This includes production and design changes that may affect emissions any time during the engine's lifetime.

(3) Modify an FEL for an engine family as described in paragraph (f) of this section.

(b) To amend your application for certification as specified in paragraph (a) of this section, send the Designated Compliance Officer the following information:

(1) Describe in detail the addition or change in the engine model or configuration you intend to make.

(2) Include engineering evaluations or data showing that the amended engine family complies with all applicable requirements. You may do this by showing that the original emission-data engine is still appropriate with respect to showing compliance of the amended family with all applicable requirements.

(3) If the original emission-data engine for the engine family is not appropriate to show compliance for the new or modified engine configuration, include new test data showing that the new or modified engine configuration meets the requirements of this part.

(c) We may ask for more test data or engineering evaluations. You must give us these within 30 days after we request them.

(d) For engine families already covered by a certificate of conformity, we will determine whether the existing certificate of conformity covers your newly added or modified engine. You may ask for a hearing if we deny your request (see § 1042.820).

(e) For engine families already covered by a certificate of conformity, you may start producing the new or modified engine configuration any time after you send us your amended application and before we make a decision under paragraph (d) of this section. However, if we determine that the affected engines do not meet applicable requirements, we will notify you to cease production of the engines and may require you to recall the engines at no expense to the owner. Choosing to produce engines under this paragraph (e) is deemed to be consent to recall all engines that we determine do not meet applicable emission standards or other requirements and to remedy the nonconformity at no expense to the owner. If you do not provide information required under paragraph (c) of this section within 30 days, you must stop producing the new or modified engines.

(f) You may ask us to approve a change to your FEL in certain cases after the start of production. The changed FEL may not apply to engines you have already introduced into U.S. commerce, except as described in this paragraph (f). If we approve a changed FEL after the start of production, you must include the new FEL on the emission control information label for all engines produced after the change. You may ask us to approve a change to your FEL in the following cases:

(1) You may ask to raise your FEL for your emission family at any time. In your request, you must show that you will still be able to meet the emission standards as specified in subparts B and H of this part. If you amend your application by submitting new test data to include a newly added or modified engine or fuel-system component, as described in paragraph (b)(3) of this section, use the appropriate FELs with corresponding production volumes to calculate your production-weighted average FEL for the model year, as described in subpart H of this part. If you amend your application without submitting new test data, you must use the higher FEL for the entire family to calculate your production-weighted average FEL under subpart H of this part.

(2) You may ask to lower the FEL for your emission family only if you have test data from production engines showing that emissions are below the proposed lower FEL. The lower FEL applies only to engines you produce after we approve the new FEL. Use the appropriate FELs with corresponding production volumes to calculate your production-weighted average FEL for the model year, as described in subpart H of this part.

§ 1042.230 Engine families.

(a) For purposes of certification, divide your product line into families of engines that are expected to have similar emission characteristics throughout the useful life as described in this section. You may not group Category 1 and Category 2 engines in the same family. Your engine family is limited to a single model year.

(b) For Category 1 engines, group engines in the same engine family if they are the same in all the following aspects:

(1) The combustion cycle and fuel (the fuels with which the engine is intended or designed to be operated).

(2) The cooling system (for example, raw-water vs. separate-circuit cooling).

(3) Method of air aspiration.

(4) Method of exhaust aftertreatment (for example, catalytic converter or particulate trap).

(5) Combustion chamber design.

(6) Bore and stroke.

(7) Number of cylinders (for engines with aftertreatment devices only).

(8) Cylinder arrangement (for engines with aftertreatment devices only).

(9) Method of control for engine operation other than governing (*i.e.*, mechanical or electronic).

(10) Application (commercial or recreational).

(11) Numerical level of the emission standards that apply to the engine, except as allowed under paragraphs (f) and (g) of this section.

(c) For Category 2 engines, group engines in the same engine family if they are the same in all the following aspects:

(1) The combustion cycle (*e.g.*, diesel cycle).

(2) The type of engine cooling employed (air-cooled or water-cooled), and procedure(s) employed to maintain engine temperature within desired limits (thermostat, on-off radiator fan(s), radiator shutters, etc.).

(3) The bore and stroke dimensions.

(4) The approximate intake and exhaust event timing and duration (valve or port).

(5) The location of the intake and exhaust valves (or ports).

(6) The size of the intake and exhaust valves (or ports).

(7) The overall injection, or as appropriate ignition, timing characteristics (*i.e.*, the deviation of the timing curves from the optimal fuel economy timing curve must be similar in degree).

(8) The combustion chamber configuration and the surface-to-volume ratio of the combustion chamber when the piston is at top dead center position, using nominal combustion chamber dimensions.

(9) The location of the piston rings on the piston.

(10) The method of air aspiration (turbocharged, supercharged, naturally aspirated, Roots blown).

(11) The turbocharger or supercharger general performance characteristics (*e.g.*, approximate boost pressure, approximate response time, approximate size relative to engine displacement).

(12) The type of air inlet cooler (air-to-air, air-to-liquid, approximate degree to which inlet air is cooled).

(13) The intake manifold induction port size and configuration.

(14) The type of fuel (the fuels with which the engine is intended or designed to be operated) and fuel system configuration.

(15) The configuration of the fuel injectors and approximate injection pressure.

(16) The type of fuel injection system controls (*i.e.*, mechanical or electronic).

(17) The type of smoke control system.

(18) The exhaust manifold port size and configuration.

(19) The type of exhaust aftertreatment system (oxidation catalyst, particulate trap), and characteristics of the aftertreatment system (catalyst loading, converter size vs engine size).

(d) [Reserved]

(e) You may subdivide a group of engines that is identical under paragraph (b) or (c) of this section into different engine families if you show the expected emission characteristics are different during the useful life. However, for the purpose of applying small volume family provisions of this part, we will consider the otherwise applicable engine family criteria of this section.

(f) You may group engines that are not identical with respect to the things listed in paragraph (b) or (c) of this section in the same engine family, as follows:

(1) In unusual circumstances, you may group such engines in the same engine family if you show that their emission characteristics during the useful life will be similar.

(2) If you are a small-volume engine manufacturer, you may group any Category 1 engines into a single engine family or you may group any Category 2 engines into a single engine family. This also applies if you are a post-manufacture marinizer modifying a base engine that has a valid certificate of conformity for any kind of nonroad or heavy-duty highway engine under this chapter.

(3) The provisions of this paragraph (f) do not exempt any engines from meeting the standards and requirements in subpart B of this part.

(g) If you combine engines that are subject to different emission standards into a single engine family under paragraph (f) of this section, you must certify the engine family to the more stringent set of standards for that model year.

§ 1042.235 Emission testing required for a certificate of conformity.

This section describes the emission testing you must perform to show compliance with the emission standards in § 1042.101(a). See § 1042.205(p) regarding emission testing related to the NTE standards. See §§ 1042.240 and 1042.245 and 40 CFR part 1065, subpart E, regarding service accumulation before emission testing.

(a) Test your emission-data engines using the procedures and equipment specified in subpart F of this part.

(b) Select an emission-data engine from each engine family for testing. For Category 2 or Category 3 engines, you may use a development engine that is equivalent in design to the engine being certified. Using good engineering judgment, select the engine configuration most likely to exceed an applicable emission standard over the useful life, considering all exhaust emission constituents and the range of installation options available to vessel manufacturers.

(c) We may measure emissions from any of your test engines or other engines from the engine family, as follows:

(1) We may decide to do the testing at your plant or any other facility. If we do this, you must deliver the test engine to a test facility we designate. The test engine you provide must include appropriate manifolds, aftertreatment devices, electronic control units, and other emission-related components not normally attached directly to the engine block. If we do the testing at your plant, you must schedule it as soon as possible and make available the instruments, personnel, and equipment we need.

(2) If we measure emissions from one of your test engines, the results of that testing become the official emission results for the engine. Unless we later invalidate these data, we may decide not to consider your data in determining if your engine family meets applicable requirements.

(3) Before we test one of your engines, we may set its adjustable parameters to any point within the specified adjustable ranges (see § 1042.115(d)).

(4) Before we test one of your engines, we may calibrate it within normal production tolerances for anything we do not consider an adjustable parameter.

(d) You may ask to use emission data from a previous model year instead of doing new tests, but only if all the following are true:

(1) The engine family from the previous model year differs from the current engine family only with respect to model year or other characteristics unrelated to emissions. You may also ask to add a configuration subject to § 1042.225.

(2) The emission-data engine from the previous model year remains the appropriate emission-data engine under paragraph (b) of this section.

(3) The data show that the emission-data engine would meet all the requirements that apply to the engine family covered by the application for certification. For engines originally tested under the provisions of 40 CFR part 94, you may consider those test procedures to be equivalent to the procedures we specify in subpart F of this part.

(e) We may require you to test a second engine of the same or different configuration in addition to the engine tested under paragraph (b) of this section.

(f) If you use an alternate test procedure under 40 CFR 1065.10 and later testing shows that such testing does not produce results that are equivalent to the procedures specified in subpart F of this part, we may reject data you generated using the alternate procedure.

§ 1042.240 Demonstrating compliance with exhaust emission standards.

(a) For purposes of certification, your engine family is considered in compliance with the emission standards in § 1042.101(a) if all emission-data engines representing that family have test results showing deteriorated emission levels at or below these standards. Note that your FELs are considered to be the applicable emission standards with which you must comply if you participate in the ABT program in subpart H of this part.

(b) Your engine family is deemed not to comply if any emission-data engine representing that family has test results showing a deteriorated emission level above an applicable emission standard for any pollutant.

(c) To compare emission levels from the emission-data engine with the applicable emission standards for Category 1 and Category 2 engines, apply deterioration factors to the measured emission levels for each pollutant. Section 1042.245 specifies how to test your engine to develop deterioration factors that represent the deterioration expected in emissions over your engines' full useful life. Your deterioration factors must take into account any available data from in-use testing with similar engines. Small-volume engine manufacturers and post-manufacture marinizers may use assigned deterioration factors that we establish. Apply deterioration factors as follows:

(1) *Additive deterioration factor for exhaust emissions.* Except as specified in paragraph (c)(2) of this section, use an additive deterioration factor for exhaust emissions. An additive deterioration factor is the difference between exhaust emissions at the end of the useful life and exhaust emissions at the low-hour test point. In these cases, adjust the official emission results for each tested engine at the selected test point by adding the factor to the measured emissions. If the deterioration factor is less than zero, use zero. Additive deterioration factors must be specified to one more decimal place than the applicable standard.

(2) *Multiplicative deterioration factor for exhaust emissions.* Use a multiplicative deterioration factor if good engineering judgment calls for the deterioration factor for a pollutant to be the ratio of exhaust emissions at the end of the useful life to exhaust emissions at the low-hour test point. For example, if you use aftertreatment technology that controls emissions of a pollutant proportionally to engine-out emissions, it is often appropriate to use a multiplicative deterioration factor. Adjust the official emission results for each tested engine at the selected test point by multiplying the measured emissions by the deterioration factor. If the deterioration factor is less than one, use one. A multiplicative deterioration factor may not be appropriate in cases where testing variability is significantly greater than engine-to-engine variability. Multiplicative deterioration factors must be specified to one more significant figure than the applicable standard.

(3) *Deterioration factor for crankcase emissions.* If your engine vents crankcase emissions to the exhaust or to the atmosphere, you must account for crankcase emission deterioration, using good engineering judgment. You may use separate deterioration factors for crankcase emissions of each pollutant (either multiplicative or additive) or include the effects in combined deterioration factors that include exhaust and crankcase emissions together for each pollutant.

(d) Collect emission data using measurements to one more decimal place than the applicable standard. Apply the deterioration factor to the official emission result, as described in paragraph (c) of this section, then round the adjusted figure to the same number of decimal places as the emission standard. Compare the rounded emission levels to the emission standard for each emission-data engine. In the case of NO_X+HC standards, apply the deterioration factor to each pollutant and then add the results before rounding.

§ 1042.245 Deterioration factors.

For Category 1 and Category 2 engines, establish deterioration factors to determine whether your engines will meet emission standards for each pollutant throughout the useful life, as described in §§ 1042.101 and 1042.240. This section describes how to determine deterioration factors, either with an engineering analysis, with pre-existing test data, or with new emission measurements.

(a) You may ask us to approve deterioration factors for an engine family with established technology based on engineering analysis instead of testing. Engines certified to a NO_X+HC standard or FEL greater than the Tier 2 NO_X+HC standard described in Appendix I of this part are considered to rely on established technology for gaseous emission control, except that this does not include any engines that use exhaust-gas recirculation or aftertreatment. In most cases, technologies used to meet the Tier 1 and Tier 2 emission standards would be considered to be established technology. We must approve your plan to establish a deterioration factor under this paragraph (a) before you submit your application for certification.

(b) You may ask us to approve deterioration factors for an engine family based on emission measurements from similar highway or nonroad engines (including locomotive engines or other marine engines) if you have already given us these data for certifying the other engines in the same or earlier model years. Use good engineering judgment to decide whether the two engines are similar. We must approve your plan to establish a deterioration factor under this paragraph (b) before you submit your application for certification. We will approve your request if you show us that the emission measurements from other engines reasonably represent in-use deterioration for the engine family for which you have not yet determined deterioration factors.

(c) If you are unable to determine deterioration factors for an engine family under paragraph (a) or (b) of this section, first get us to approve a plan for determining deterioration factors based on service accumulation and related testing. Your plan must involve measuring emissions from an emission-data engine at least three times with evenly spaced intervals of service accumulation such that the resulting measurements and calculations will represent the deterioration expected from in-use engines over the full useful life. You may use extrapolation to determine deterioration factors once you have established a trend of changing emissions with age for each pollutant. You may use an engine installed in a vessel to accumulate service hours instead of running the engine only in the laboratory. You may perform maintenance on emission-data engines as described in § 1042.125 and 40 CFR part 1065, subpart E.

(d) Include the following information in your application for certification:

(1) If you use test data from a different engine family, explain why this is appropriate and include all the emission measurements on which you base the deterioration factor.

(2) If you determine your deterioration factors based on engineering analysis, explain why this is appropriate and include a statement that all data, analyses, evaluations, and other information you used are available for our review upon request.

(3) If you do testing to determine deterioration factors, describe the form and extent of service accumulation, including a rationale for selecting the service-accumulation period and the method you use to accumulate hours.

§ 1042.250 Recordkeeping and reporting.

(a) If you produce engines under any provisions of this part that are related to production volumes, send the Designated Compliance Officer a report within 30 days after the end of the model year describing the total number of engines you produced in each engine family. For example, if you use special provisions intended for small-volume engine manufacturers, report your production volumes to show that you do not exceed the applicable limits.

(b) Organize and maintain the following records:

(1) A copy of all applications and any summary information you send us.

(2) Any of the information we specify in § 1042.205 that you were not required to include in your application.

(3) A detailed history of each emission-data engine. For each engine, describe all of the following:

(i) The emission-data engine's construction, including its origin and buildup, steps you took to ensure that it represents production engines, any components you built specially for it, and all the components you include in your application for certification.

(ii) How you accumulated engine operating hours (service accumulation), including the dates and the number of hours accumulated.

(iii) All maintenance, including modifications, parts changes, and other service, and the dates and reasons for the maintenance.

(iv) All your emission tests (valid and invalid), including documentation on routine and standard tests, as specified in part 40 CFR part 1065, and the date and purpose of each test.

(v) All tests to diagnose engine or emission-control performance, giving the date and time of each and the reasons for the test.

(vi) Any other significant events.

(4) Production figures for each engine family divided by assembly plant.

(5) Keep a list of engine identification numbers for all the engines you produce under each certificate of conformity.

(c) Keep data from routine emission tests (such as test cell temperatures and relative humidity readings) for one year after we issue the associated certificate of conformity. Keep all other information specified in paragraph (a) of this section for eight years after we issue your certificate.

(d) Store these records in any format and on any media, as long as you can promptly send us organized, written records in English if we ask for them. You must keep these records readily available. We may review them at any time.

(e) Send us copies of any engine maintenance instructions or explanations if we ask for them.

§ 1042.255 EPA decisions.

(a) If we determine your application is complete and shows that the engine family meets all the requirements of this part and the Clean Air Act, we will issue a certificate of conformity for your engine family for that model year. We may make the approval subject to additional conditions.

(b) We may deny your application for certification if we determine that your engine family fails to comply with emission standards or other requirements of this part or the Clean Air Act. Our decision may be based on a review of all information available to us. If we deny your application, we will explain why in writing.

(c) In addition, we may deny your application or suspend or revoke your certificate if you do any of the following:

(1) Refuse to comply with any testing or reporting requirements.

(2) Submit false or incomplete information (paragraph (e) of this section applies if this is fraudulent).

(3) Render inaccurate any test data.

(4) Deny us from completing authorized activities (see 40 CFR 1068.20). This includes a failure to provide reasonable assistance.

(5) Produce engines for importation into the United States at a location where local law prohibits us from carrying out authorized activities.

(6) Fail to supply requested information or amend your application to include all engines being produced.

(7) Take any action that otherwise circumvents the intent of the Clean Air Act or this part.

(d) We may void your certificate if you do not keep the records we require or do not give us information as required under this part or the Clean Air Act.

(e) We may void your certificate if we find that you intentionally submitted false or incomplete information.

(f) If we deny your application or suspend, revoke, or void your certificate, you may ask for a hearing (see § 1042.820).

Subpart D—Testing Production-Line Engines

§ 1042.301 General provisions.

(a) If you produce engines that are subject to the requirements of this part, you must test them as described in this subpart, except as follows:

(1) Small-volume engine manufacturers may omit testing under this subpart.

(2) We may exempt Category 1 engine families with a projected U.S.-directed production volume below 100 engines from routine testing under this subpart. Request this exemption in the application for certification and include your basis for projecting a production volume below 100 units. You must promptly notify us if your actual production exceeds 100 units during the model year. If you exceed the production limit or if there is evidence of a nonconformity, we may require you to test production-line engines under this subpart, or under 40 CFR part 1068, subpart D, even if we have approved an exemption under this paragraph (a)(2).

(3) [Reserved]

(b) We may suspend or revoke your certificate of conformity for certain engine families if your production-line engines do not meet the requirements of this part or you do not fulfill your obligations under this subpart (see §§ 1042.325 and 1042.340).

(c) Other requirements apply to engines that you produce. Other regulatory provisions authorize us to suspend, revoke, or void your certificate of conformity, or order recalls for engines families without regard to whether they have passed these production-line testing requirements. The requirements of this subpart do not affect our ability to do selective enforcement audits, as described in 40 CFR part 1068. Individual engines in families that pass these production-line testing requirements must also conform to all applicable regulations of this part and 40 CFR part 1068.

(d) You may ask to use an alternate program for testing production-line engines. In your request, you must show us that the alternate program gives equal assurance that your products meet the requirements of this part. We may waive some or all of this subpart's requirements if we approve your alternate program.

(e) If you certify an engine family with carryover emission data, as described in § 1042.235(d), and these equivalent engine families consistently pass the production-line testing requirements over the preceding two-year period, you may ask for a reduced testing rate for further production-line testing for that family. The minimum testing rate is one engine per engine family. If we reduce your testing rate, we may limit our approval to any number of model years. In determining whether to approve your request, we may consider the number of engines that have failed the emission tests.

(f) We may ask you to make a reasonable number of production-line engines available for a reasonable time so we can test or inspect them for compliance with the requirements of this part. See 40 CFR 1068.27.

§ 1042.305 Preparing and testing production-line engines.

This section describes how to prepare and test production-line engines. You must assemble the test engine in a way that represents the assembly procedures for other engines in the engine family. You must ask us to approve any deviations from your normal assembly procedures for other production engines in the engine family.

(a) *Test procedures.* Test your production-line engines using the applicable testing procedures in subpart F of this part to show you meet the duty-cycle emission standards in subpart B of this part. The not-to-exceed standards apply for this testing, but you need not do additional testing to show that production-line engines meet the not-to-exceed standards.

(b) *Modifying a test engine.* Once an engine is selected for testing (see § 1042.310), you may adjust, repair, prepare, or modify it or check its emissions only if one of the following is true:

(1) You document the need for doing so in your procedures for assembling and inspecting all your production engines and make the action routine for all the engines in the engine family.

(2) This subpart otherwise specifically allows your action.

(3) We approve your action in advance.

(c) *Engine malfunction.* If an engine malfunction prevents further emission testing, ask us to approve your decision to either repair the engine or delete it from the test sequence.

(d) *Setting adjustable parameters.* Before any test, we may require you to adjust any adjustable parameter on a Category 1 engine to any setting within its physically adjustable range. We may adjust or require you to adjust any adjustable parameter on a Category 2 engine to any setting within its approved adjustable range.

(1) We may require you to adjust idle speed outside the physically adjustable range as needed, but only until the engine has stabilized emission levels (see paragraph (e) of this section). We may ask you for information needed to establish an alternate minimum idle speed.

(2) We may specify adjustments within the physically adjustable range or the approved adjustable range by considering their effect on emission levels, as well as how likely it is someone will make such an adjustment with in-use engines.

(e) *Stabilizing emission levels.* You may stabilize emission levels (or establish a Green Engine Factor for Category 2 engines) before you test production-line engines, as follows:

(1) You may stabilize emission levels by operating the engine in a way that represents the way production engines will be used, using good engineering judgment, for no more than the greater of two periods:

(i) 300 hours.

(ii) The number of hours you operated your emission-data engine for certifying the engine family (see 40 CFR part 1065, subpart E, or the applicable regulations governing how you should prepare your test engine).

(2) For Category 2 engines, you may ask us to approve a Green Engine Factor for each regulated pollutant for each engine family. Use the Green Engine Factor to adjust measured emission levels to establish a stabilized low-hour emission level.

(f) *Damage during shipment.* If shipping an engine to a remote facility for production-line testing makes necessary an adjustment or repair, you must wait until after the initial emission test to do this work. We may waive this requirement if the test would be impossible or unsafe, or if it would permanently damage the engine. Report to us in your written report under § 1042.345 all adjustments or repairs you make on test engines before each test.

(g) *Retesting after invalid tests.* You may retest an engine if you determine an emission test is invalid under subpart F of this part. Explain in your written report reasons for invalidating any test and the emission results from all tests. If you retest an engine, you may ask us to substitute results of the new tests for the original ones. You must ask us within ten days of testing. We will generally answer within ten days after we receive your information.

§ 1042.310 Engine selection.

(a) Determine minimum sample sizes as follows:

(1) For Category 1 engines, the minimum sample size is one engine or one percent of the projected U.S.-directed production volume for all your Category 1 engine families, whichever is greater.

(2) For Category 2 engines, the minimum sample size is one engine or one percent of the projected U.S.-directed production volume for all your Category 2 engine families, whichever is greater.

(b) Randomly select one engine from each category early in the model year from the engine family with the highest projected U.S.-directed production volume. For further testing to reach the minimum sample size, randomly select a proportional sample from each engine family, with testing distributed evenly over the course of the model year.

(c) For each engine that fails to meet emission standards, test two engines from the same engine family from the next fifteen engines produced or within seven calendar days, which is later. If an engine fails to meet emission standards for any pollutant, count it as a failing engine under this paragraph (c).

(d) Continue testing until one of the following things happens:

(1) You test the number of engines specified in paragraphs (a) and (c) of this section.

(2) The engine family does not comply according to § 1042.315 or you choose to declare that the engine family does not comply with the requirements of this subpart.

(3) You test 30 engines from the engine family.

(e) You may elect to test more randomly chosen engines than we require under this section.

§ 1042.315 Determining compliance.

This section describes the pass-fail criteria for the production-line testing requirements. We apply these criteria on an engine-family basis. See § 1042.320 for the requirements that apply to individual engines that fail a production-line test.

(a) Calculate your test results as follows:

(1) *Initial and final test results.* Calculate the test results for each engine. If you do several tests on an engine, calculate the initial test results, then add them together and divide by the number of tests for the final test results on that engine. Include the Green Engine Factor to determine low-hour emission results, if applicable.

(2) *Final deteriorated test results.* Apply the deterioration factor for the engine family to the final test results (see § 1042.240(c)).

(3) *Round deteriorated test results.* Round the results to the number of decimal places in the emission standard expressed to one more decimal place.

(b) If a production-line engine fails to meet emission standards and you test two additional engines as described in § 1042.310, calculate the average emission level for each pollutant for the three engines. If the calculated average emission level for any pollutant exceeds the applicable emission standard, the engine family fails the production-line testing requirements of this subpart. Tell us within ten working days if this happens. You may request to amend the application for certification to raise the FEL of the engine family as described in § 1042.225(f).

§ 1042.320 What happens if one of my production-line engines fails to meet emission standards?

(a) If you have a production-line engine with final deteriorated test results exceeding one or more emission standards (see § 1042.315(a)), the certificate of conformity is automatically suspended for that failing engine. You must take the following actions before your certificate of conformity can cover that engine:

(1) Correct the problem and retest the engine to show it complies with all emission standards.

(2) Include in your written report a description of the test results and the remedy for each engine (see § 1042.345).

(b) You may request to amend the application for certification to raise the FEL of the entire engine family at this point (see § 1042.225).

§ 1042.325 What happens if an engine family fails the production-line testing requirements?

(a) We may suspend your certificate of conformity for an engine family if it fails under § 1042.315. The suspension may apply to all facilities producing engines from an engine family, even if you find noncompliant engines only at one facility.

(b) We will tell you in writing if we suspend your certificate in whole or in part. We will not suspend a certificate until at least 15 days after the engine family fails. The suspension is effective when you receive our notice.

(c) Up to 15 days after we suspend the certificate for an engine family, you may ask for a hearing (see § 1042.820). If we agree before a hearing occurs that we used erroneous information in deciding to suspend the certificate, we will reinstate the certificate.

(d) Section 1042.335 specifies steps you must take to remedy the cause of the engine family's production-line failure. All the engines you have produced since the end of the last test period are presumed noncompliant and should be addressed in your proposed remedy. We may require you to apply the remedy to engines produced earlier if we determine that the cause of the failure is likely to have affected the earlier engines.

(e) You may request to amend the application for certification to raise the FEL of the entire engine family as described in § 1051.225(f). We will approve your request if it is clear that you used good engineering judgment in establishing the original FEL.

§ 1042.330 Selling engines from an engine family with a suspended certificate of conformity.

You may sell engines that you produce after we suspend the engine family's certificate of conformity under § 1042.315 only if one of the following occurs:

(a) You test each engine you produce and show it complies with emission standards that apply.

(b) We conditionally reinstate the certificate for the engine family. We may do so if you agree to recall all the affected engines and remedy any noncompliance at no expense to the owner if later testing shows that the engine family still does not comply.

§ 1042.335 Reinstating suspended certificates.

(a) Send us a written report asking us to reinstate your suspended certificate. In your report, identify the reason for noncompliance, propose a remedy for the engine family, and commit to a date for carrying it out. In your proposed remedy include any quality control measures you propose to keep the problem from happening again.

(b) Give us data from production-line testing that shows the remedied engine family complies with all the emission standards that apply.

§ 1042.340 When may EPA revoke my certificate under this subpart and how may I sell these engines again?

(a) We may revoke your certificate for an engine family in the following cases:

(1) You do not meet the reporting requirements.

(2) Your engine family fails to comply with the requirements of this subpart and your proposed remedy to address a suspended certificate under § 1042.325 is inadequate to solve the problem or requires you to change the engine's design or emission-control system.

(b) To sell engines from an engine family with a revoked certificate of conformity, you must modify the engine family and then show it complies with the requirements of this part.

(1) If we determine your proposed design change may not control emissions for the engine's full useful life, we will tell you within five working days after receiving your report. In this case we will decide whether production-line testing will be enough for us to evaluate the change or whether you need to do more testing.

(2) Unless we require more testing, you may show compliance by testing production-line engines as described in this subpart.

(3) We will issue a new or updated certificate of conformity when you have met these requirements.

§ 1042.345 Reporting.

You must do all the following things unless we ask you to send us less information:

(a) Within 30 calendar days of the end of each quarter in which production-line testing occurs, send us a report with the following information:

(1) Describe any facility used to test production-line engines and state its location.

(2) State the total U.S.-directed production volume and number of tests for each engine family.

(3) Describe how you randomly selected engines.

(4) Describe each test engine, including the engine family's identification and the engine's model year, build date, model number, identification number, and number of hours of operation before testing. Also describe how you developed and applied the Green Engine Factor, if applicable.

(5) Identify how you accumulated hours of operation on the engines and describe the procedure and schedule you used.

(6) Provide the test number; the date, time and duration of testing; test procedure; initial test results before and after rounding; final test results; and final deteriorated test results for all tests. Provide the emission results for all measured pollutants. Include information for both valid and invalid tests and the reason for any invalidation.

(7) Describe completely and justify any nonroutine adjustment, modification, repair, preparation, maintenance, or test for the test engine if you did not report it separately under this subpart. Include the results of any emission measurements, regardless of the procedure or type of engine.

(8) Report on each failed engine as described in § 1042.320.

(9) Identify when the model year ends for each engine family.

(b) We may ask you to add information to your written report so we can determine whether your new engines conform with the requirements of this subpart.

(c) An authorized representative of your company must sign the following statement: We submit this report under sections 208 and 213 of the Clean Air Act. Our production-line testing conformed completely with the requirements of 40 CFR part 1042. We have not changed production processes or quality-control procedures for test engines in a way that might affect emission controls. All the information in this report is true and accurate to the best of my knowledge. I know of the penalties for violating the Clean Air Act and the regulations. (Authorized Company Representative)

(d) Send electronic reports of production-line testing to the Designated Compliance Officer using an approved information format. If you want to use a different format, send us a written request with justification for a waiver.

(e) We will send copies of your reports to anyone from the public who asks for them. See § 1042.815 for information on how we treat information you consider confidential.

§ 1042.350 Recordkeeping.

(a) Organize and maintain your records as described in this section. We may review your records at any time.

(b) Keep records of your production-line testing for eight years after you complete all the testing required for an engine family in a model year. You may use any appropriate storage formats or media.

(c) Keep a copy of the written reports described in § 1042.345.

(d) Keep the following additional records:

(1) A description of all test equipment for each test cell that you can use to test production-line engines.

(2) The names of supervisors involved in each test.

(3) The name of anyone who authorizes adjusting, repairing, preparing, or modifying a test engine and the names of all supervisors who oversee this work.

(4) If you shipped the engine for testing, the date you shipped it, the associated storage or port facility, and the date the engine arrived at the testing facility.

(5) Any records related to your production-line tests that are not in the written report.

(6) A brief description of any significant events during testing not otherwise described in the written report or in this section.

(7) Any information specified in § 1042.345 that you do not include in your written reports.

(e) If we ask, you must give us projected or actual production figures for an engine family. We may ask you to divide your production figures by maximum engine power, displacement, fuel type, or assembly plant (if you produce engines at more than one plant).

(f) Keep a list of engine identification numbers for all the engines you produce under each certificate of conformity. Give us this list within 30 days if we ask for it.

(g) We may ask you to keep or send other information necessary to implement this subpart.

Subpart E—In-use Testing

§ 1042.401 General Provisions.

We may perform in-use testing of any engine subject to the standards of this part.

Subpart F—Test Procedures

§ 1042.501 How do I run a valid emission test?

(a) Use the equipment and procedures for compression-ignition engines in 40 CFR part 1065 to determine whether Category 1 and Category 2 engines meet the duty-cycle emission standards in § 1042.101(a). Measure the emissions of all regulated pollutants as specified in 40 CFR part 1065. Use the applicable duty cycles specified in § 1042.505.

(b) Section 1042.515 describes the supplemental test procedures for evaluating whether engines meet the not-to-exceed emission standards in § 1042.101(c).

(c) Use the fuels and lubricants specified in 40 CFR part 1065, subpart H, for all the testing we require in this part, except as specified in § 1042.515.

(1) For service accumulation, use the test fuel or any commercially available fuel that is representative of the fuel that in-use engines will use.

(2) For diesel-fueled engines, use the appropriate diesel fuel specified in 40 CFR part 1065, subpart H, for emission testing. Unless we specify otherwise, the appropriate diesel test fuel is the ultra low-sulfur diesel fuel. If we allow you to use a test fuel with higher sulfur levels, identify the test fuel in your application for certification and ensure that the emission control information label is consistent with your selection of the test fuel (see § 1042.135(c)(10)). For Category 2 engines, you may ask to use commercially available diesel fuel similar but not necessarily identical to the applicable fuel specified in 40 CFR part 1065, subpart H.

(3) For Category 1 and Category 2 engines that are expected to use a type of fuel (or mixed fuel) other than diesel fuel (such as natural gas, methanol, or residual fuel), use a commercially available fuel of that type for emission testing. If an engine is designed to operate on different fuels, we may (at our discretion) require testing on each fuel. Propose test fuel specifications that take into account the engine design and the properties of commercially available fuels. Describe these test fuel specifications in the application for certification.

(4) [Reserved]

(d) You may use special or alternate procedures to the extent we allow them under 40 CFR 1065.10.

(e) This subpart is addressed to you as a manufacturer, but it applies equally to anyone who does testing for you, and to us when we perform testing to determine if your engines meet emission standards.

(f) Duty-cycle testing is limited to ambient temperatures of 20 to 30 °C. Atmospheric pressure must be between 91.000 and 103.325 kPa, and must be within ±5% of the value recorded at the time of the last engine map. Testing may be performed with any ambient humidity level. Correct duty-cycle NO_X emissions for humidity as specified in 40 CFR part 1065.

§ 1042.505 Testing engines using discrete-mode or ramped-modal duty cycles.

This section describes how to test engines under steady-state conditions. In some cases, we allow you to choose the appropriate steady-state duty cycle for an engine. In these cases, you must use the duty cycle you select in your application for certification for all testing you perform for that engine family. If we test your engines to confirm that they meet emission standards, we will use the duty cycles you select for your own testing. We may also perform other testing as allowed by the Clean Air Act.

(a) You may perform steady-state testing with either discrete-mode or ramped-modal cycles, as follows:

(1) For discrete-mode testing, sample emissions separately for each mode, then calculate an average emission level for the whole cycle using the weighting factors specified for each mode. Calculate cycle statistics for each mode and compare with the specified values in 40 CFR part 1065 to confirm that the test is valid. Operate the engine and sampling system as follows:

(i) *Engines with NO_X aftertreatment.* For engines that depend on aftertreatment to meet the NO_X emission standard, operate the engine for 5–6 minutes, then sample emissions for 1–3 minutes in each mode. You may extend the sampling time to improve measurement accuracy of PM emissions, using good engineering judgment. If you have a longer sampling time for PM emissions, calculate and validate cycle statistics separately for the gaseous and PM sampling periods.

(ii) *Engines without NO_X aftertreatment.* For other engines, operate the engine for at least 5 minutes, then sample emissions for at least 1 minute in each mode.

(2) For ramped-modal testing, start sampling at the beginning of the first mode and continue sampling until the end of the last mode. Calculate emissions and cycle statistics the same as for transient testing as specified in 40 CFR part 1065, subpart G.

(b) Measure emissions by testing the engine on a dynamometer with one of the following duty cycles (as specified) to determine whether it meets the emission standards in § 1042.101(a):

(1) *General cycle.* Use the 4-mode duty cycle or the corresponding ramped-modal cycle described in paragraph (a) of Appendix II of this part for commercial propulsion engines with maximum engine power at or above 19 kW that are used with (or intended to be used with) fixed-pitch propellers, and any other engines for which the other duty cycles of this section do not apply.

(2) *Recreational engines.* Use the 5-mode duty cycle or the corresponding ramped-modal cycle described in paragraph (b) of Appendix II of this part for recreational engines with maximum engine power at or above 19 kW.

(3) *Variable-pitch and electrically coupled propellers.* (i) Use the 4-mode duty cycle or the corresponding ramped-modal cycle described in paragraph (c) of Appendix II of this part for constant-speed propulsion engines that are used with (or intended to be used with) variable-pitch propellers or with electrically coupled propellers.

(ii) Use the 8-mode duty cycle or the corresponding ramped-modal cycle described in 40 CFR part 1039, Appendix IV for variable-speed propulsion engines with maximum engine power at or above 19 kW that are used with (or intended to be used with) variable-pitch propellers or with electrically coupled propellers.

(4) *Auxiliary engines.* (i) Use the 5-mode duty cycle or the corresponding ramped-modal cycle described in 40 CFR part 1039, Appendix II, for constant-speed auxiliary engines.

(ii) Use the 8-mode duty cycle or the corresponding ramped-modal cycle specified in paragraph (b)(3)(ii) of this section for variable-speed auxiliary engines with maximum engine power at or above 19 kW.

(5) *Engines below 19 kW.* Use the 6-mode duty cycle or the corresponding ramped-modal cycle described in 40 CFR part 1039, Appendix III for variable-speed engines with maximum engine power below 19 kW.

(c) During idle mode, operate the engine with the following parameters:

(1) Hold the speed within your specifications.

(2) Set the engine to operate at its minimum fueling rate.

(3) Keep engine torque under 5 percent of maximum test torque.

(d) For full-load operating modes, operate the engine at its maximum fueling rate. However, for constant-speed engines whose design prevents full-load operation for extended periods, you may ask for approval under 40 CFR 1065.10(c) to replace full-load operation with the maximum load for which the engine is designed to operate for extended periods.

(e) See 40 CFR part 1065 for detailed specifications of tolerances and calculations.

§ 1042.515 Test procedures related to not-to-exceed standards.

(a) This section describes the procedures to determine whether your engines meet the not-to-exceed emission standards in § 1042.101(c). These procedures may include any normal engine operation and ambient conditions that the engines may experience in use. Paragraphs (c) through (e) of this section define the limits of what we will consider normal engine operation and ambient conditions.

(b) Measure emissions with one of the following procedures:

(1) Remove the selected engines for testing in a laboratory. You may use an engine dynamometer to simulate normal operation, as described in this section. Use the equipment and procedures specified in 40 CFR part 1065 to conduct laboratory testing.

(2) Test the selected engines while they remain installed in a vessel. Use the equipment and procedures specified in 40 CFR part 1065 subpart J, to conduct field testing. Use fuel meeting the specifications of 40 CFR part 1065, subpart H, or a fuel typical of what you would expect the engine to use in service.

(c) Engine testing may occur under the following ranges of ambient conditions without correcting measured emission levels:

(1) Barometric pressure must be between 91.000 and 103.325 kPa.

(2) Ambient air temperature must be between 13 and 35 °C (or between 13 °C and 30 °C for engines not drawing intake air directly from a space that could be heated by the engine).

(3) Ambient water temperature must be between 5 and 27 °C.

(4) Ambient humidity between 7.1 and 10.7 grams of moisture per kilogram of dry air.

(d) Engine testing may occur at any conditions expected during normal operation but that are outside the conditions described in paragraph (b) of this section, as long as measured values are corrected to be equivalent to the nearest end of the specified range, using good engineering judgment. Correct NO_X emissions for humidity as specified in 40 CFR part 1065, subpart G.

(e) The sampling period may not begin until the engine has reached stable operating temperatures. For example, this would include only engine operation after starting and after the engine thermostat starts modulating the engine's coolant temperature. The sampling period may not include engine starting.

(f) For analyzing data to determine compliance with the NTE standards, refer to § 1042.101(c) and Appendix III of this part 1042 for the NTE standards and the NTE zones, subzones, and any other conditions where emission data may be included or excluded.

§ 1042.520 What testing must I perform to establish deterioration factors?

Sections 1042.240 and 1042.245 describe the required methods for testing to establish deterioration factors for an engine family.

§ 1042.525 How do I adjust emission levels to account for infrequently regenerating aftertreatment devices?

This section describes how to adjust emission results from engines using aftertreatment technology with infrequent regeneration events. See paragraph (e) of this section for how to adjust ramped modal testing. See paragraph (f) of this section for how to adjust discrete-mode testing. For this section, ''regeneration'' means an intended event during which emission levels change while the system restores aftertreatment performance. For example, exhaust gas temperatures may increase temporarily to remove sulfur from adsorbers or to oxidize accumulated particulate matter in a trap. For this section, ''infrequent'' refers to regeneration events that are expected to occur on average less than once over the applicable transient duty cycle or ramped-modal cycle, or on average less than once per typical mode in a discrete-mode test.

(a) *Developing adjustment factors.* Develop an upward adjustment factor and a downward adjustment factor for each pollutant based on measured emission data and observed regeneration frequency. Adjustment factors should generally apply to an entire engine family, but you may develop separate adjustment factors for different engine configurations within an engine family. If you use adjustment factors for certification, you must identify the frequency factor, F, from paragraph (b) of this section in your application for certification and use the adjustment factors in all testing for that engine family. You may use carryover or carry-across data to establish adjustment factors for an engine family, as described in § 1042.235(d), consistent with good engineering judgment. All adjustment factors for regeneration are additive. Determine adjustment factors separately for different test segments. For example, determine separate adjustment factors for different modes of a discrete-mode steady-state test. You may use either of the following different approaches for engines that use aftertreatment with infrequent regeneration events:

(1) You may disregard this section if regeneration does not significantly affect emission levels for an engine family (or configuration) or if it is not practical to identify when regeneration occurs. If you do not use adjustment factors under this section, your engines must meet emission standards for all testing, without regard to regeneration.

(2) If your engines use aftertreatment technology with extremely infrequent regeneration and you are unable to apply the provisions of this section, you may ask us to approve an alternate methodology to account for regeneration events.

(b) *Calculating average adjustment factors.* Calculate the average adjustment factor (EF_A) based on the following equation:

$$EF_A = (F)(EF_H) + (1 - F)(EF_L)$$

Where:

F = The frequency of the regeneration event in terms of the fraction of tests during which the regeneration occurs.

EF_H = Measured emissions from a test segment in which the regeneration occurs.

EF_L = Measured emissions from a test segment in which the regeneration does not occur.

(c) *Applying adjustment factors.* Apply adjustment factors based on whether regeneration occurs during the test run. You must be able to identify regeneration in a way that is readily apparent during all testing.

(1) If regeneration does not occur during a test segment, add an upward adjustment factor to the measured emission rate. Determine the upward adjustment factor (UAF) using the following equation:

$$UAF = EF_A - EF_L$$

(2) If regeneration occurs or starts to occur during a test segment, subtract a downward adjustment factor from the measured emission rate. Determine the downward adjustment factor (DAF) using the following equation:

$$DAF = EF_H - EF_A$$

(d) *Sample calculation.* If EF_L is 0.10 g/kW-hr, EF_H is 0.50 g/kW-hr, and F is 0.1 (the regeneration occurs once for each ten tests), then:

EF_A = (0.1)(0.5 g/kW-hr) + (1.0 − 0.1)(0.1 g/kW-hr) = 0.14 g/kW-hr.

UAF = 0.14 g/kW-hr − 0.10 g/kW-hr = 0.04 g/kW-hr.

DAF = 0.50 g/kW-hr − 0.14 g/kW-hr = 0.36 g/kW-hr.

(e) Ramped modal testing. Develop a single set of adjustment factors for the entire test. If a regeneration has started but has not been completed when you reach the end of a test, use good engineering judgment to reduce your downward adjustments to be proportional to the emission impact that occurred in the test.

(f) Discrete-mode testing. Develop separate adjustment factors for each test mode. If a regeneration has started but has not been completed when you reach the end of the sampling time for a test mode, extend the sampling period for that mode until the regeneration is completed.

Subpart G—Special Compliance Provisions

§ 1042.601 General compliance provisions for marine engines and vessels.

Engine and vessel manufacturers, as well as owners, operators, and rebuilders of engines and vessels subject to the requirements of this part, and all other persons, must observe the provisions of this part, the requirements and prohibitions in 40 CFR part 1068, and the provisions of the Clean Air Act. The provisions of 40 CFR part 1068 apply for marine compression-ignition engines as specified in that part, except as follows:

(a) Installing a recreational marine engine in a vessel that is not a recreational vessel is a violation of 40 CFR 1068.101(a)(1).

(b) In addition to the provisions listed for the national security exemption in

40 CFR 1068.225(b), your engine is exempt without a request if you produce it for a piece of equipment owned or used by an agency of the federal government responsible for national defense, where the equipment has specialized electronic warfare systems, unique stealth performance requirements, and/or unique combat maneuverability requirements.

(c) For replacement engines, apply the provisions of 40 CFR 1068.240(b)(3) as follows:

(1) Except as specified in paragraph (c)(2) of this section, this paragraph applies instead of the provisions of 40 CFR 1068.240(b)(3). The prohibitions in 40 CFR 1068.101(a)(1) do not apply to a new replacement engine if all of the following are true:

(i) We determine that no engine certified to the requirements of this part is produced by any manufacturer with the appropriate physical or performance characteristics to repower a vessel.

(ii) The replacement engine meets the most stringent standards possible, and at least as stringent as those of the original engine. For example, if at a time in which Tier 3 standards apply, an engine originally certified as a Tier 1 engine is being replaced, the replacement must meet the Tier 2 requirements if we determine that a Tier 2 engine can be used as a replacement; otherwise it must meet the Tier 1 requirements.

(iii) The engine manufacturer must take possession of the original engine or make sure it is destroyed.

(iv) The replacement engine must be clearly labeled to show that it does not comply with the standards and that sale or installation of the engine for any purpose other than as a replacement engine is a violation of federal law and subject to civil penalty.

(2) The provisions of 40 CFR 1068.240(b)(3) for replacement engines apply only if a new engine is needed to replace an engine that has experienced catastrophic failure. If this occurs, the engine manufacturer must keep records for eight years explaining why a certified engine was not available and make these records available upon request. Modifying a vessel to significantly increase its value within six months after installing replacement engines under this paragraph (c)(2) is a violation of 40 CFR 1068.101(a)(1).

(d) Misfueling a marine engine labeled as requiring the use of ultra low-sulfur diesel with higher-sulfur fuel is a violation of 40 CFR 1068.101(b)(1). It is also a violation of 40 CFR 1068.101(b)(1) if an engine installer or vessel manufacturer fails to follow the engine manufacturer's installation instructions when installing a certified engine in a marine vessel.

(e) The provisions of 40 CFR 1068.120 apply when rebuilding marine engines. The following additional requirements also apply when rebuilding marine engines equipped with exhaust aftertreatment:

(1) Follow all instructions from the engine manufacturer and aftertreatment manufacturer for checking, repairing, and replacing aftertreatment components. For example, you must replace the catalyst if the catalyst assembly is stamped with a build date more than ten years ago and the manufacturer's instructions state that catalysts over ten years old must be replaced when the engine is rebuilt.

(2) Measure pressure drop across the catalyst assembly to ensure that it is neither higher than nor lower than the manufacturer's specifications.

(3) For urea-based SCR systems equipped with exhaust sensors, verify that sensor outputs are within the manufacturer's recommended range and repair or replace any malfunctioning components (sensors, catalysts, or other components).

§ 1042.605 Dressing engines already certified to other standards for nonroad or heavy-duty highway engines for marine use.

(a) *General provisions.* If you are an engine manufacturer (including someone who marinizes a land-based engine), this section allows you to introduce new marine engines into U.S. commerce if they are already certified to the requirements that apply to compression-ignition engines under 40 CFR parts 85 and 86 or 40 CFR part 89, 92, 1033, or 1039 for the appropriate model year. If you comply with all the provisions of this section, we consider the certificate issued under 40 CFR part 86, 89, 92, 1033, or 1039 for each engine to also be a valid certificate of conformity under this part 1042 for its model year, without a separate application for certification under the requirements of this part 1042.

(b) *Boat-builder provisions.* If you are not an engine manufacturer, you may install an engine certified for the appropriate model year under 40 CFR part 86, 89, 92, 1033, or 1039 in a marine vessel as long as you do not make any of the changes described in paragraph (d)(3) of this section and you meet the requirements of paragraph (e) of this section. If you modify the non-marine engine in any of the ways described in paragraph (d)(3) of this section, we will consider you a manufacturer of a new marine engine. Such engine modifications prevent you from using the provisions of this section.

(c) *Liability.* Engines for which you meet the requirements of this section are exempt from all the requirements and prohibitions of this part, except for those specified in this section. Engines exempted under this section must meet all the applicable requirements from 40 CFR parts 85 and 86 or 40 CFR part 89, 92, 1033, or 1039. This paragraph (c) applies to engine manufacturers, boat builders who use such an engine, and all other persons as if the engine were used in its originally intended application. The prohibited acts of 40 CFR 1068.101(a)(1) apply to these new engines and vessels; however, we consider the certificate issued under 40 CFR part 86, 89, 92, 1033, or 1039 for each engine to also be a valid certificate of conformity under this part 1042 for its model year. If we make a determination that these engines do not conform to the regulations during their useful life, we may require you to recall them under 40 CFR part 85, 89, 92, or 1068.

(d) *Specific criteria and requirements.* If you are an engine manufacturer and meet all the following criteria and requirements regarding your new marine engine, the engine is eligible for an exemption under this section:

(1) You must produce it by marinizing an engine covered by a valid certificate of conformity from one of the following programs:

(i) Heavy-duty highway engines (40 CFR part 86).

(ii) Land-based nonroad diesel engines (40 CFR part 89 or 1039).

(iii) Locomotives (40 CFR part 92 or 1033). To be eligible to be dressed under this section, the engine must be from a locomotive certified to standards that are at least as stringent as either the standards applicable to new marine engines or freshly manufactured locomotives in the model year that the engine is being dressed.

(2) The engine must have the label required under 40 CFR part 86, 89, 92, 1033, or 1039.

(3) You must not make any changes to the certified engine that could reasonably be expected to increase its emissions. For example, if you make any of the following changes to one of these engines, you do not qualify for the engine dressing exemption:

(i) Change any fuel system parameters from the certified configuration, or change, remove, or fail to properly install any other component, element of design, or calibration specified in the engine manufacturer's application for certification. This includes aftertreatment devices and all related components.

(ii) Replacing an original turbocharger, except that small-volume engine manufacturers may replace an original turbocharger on a recreational engine with one that matches the performance of the original turbocharger.

(iii) Modify or design the marine engine cooling or aftercooling system so that temperatures or heat rejection rates are outside the original engine manufacturer's specified ranges.

(4) You must show that fewer than 10 percent of the engine family's total sales in the United States are used in marine applications. This includes engines used in any application, without regard to which company manufactures the vessel or equipment. Show this as follows:

(i) If you are the original manufacturer of the engine, base this showing on your sales information.

(ii) In all other cases, you must get the original manufacturer of the engine to confirm this based on its sales information.

(e) *Labeling and documentation.* If you are an engine manufacturer or boat builder using this exemption, you must do all of the following:

(1) Make sure the original engine label will remain clearly visible after installation in the vessel.

(2) Add a permanent supplemental label to the engine in a position where it will remain clearly visible after installation in the vessel. In your engine label, do the following:

(i) Include the heading: ''Marine Engine Emission Control Information''.

(ii) Include your full corporate name and trademark.

(iii) State: ''This engine was marinized without affecting its emission controls.''.

(iv) State the date you finished marinizing the engine (month and year).

(3) Send the Designated Compliance Officer a signed letter by the end of each calendar year (or less often if we tell you) with all the following information:

(i) Identify your full corporate name, address, and telephone number.

(ii) List the engine models for which you expect to use this exemption in the coming year and describe your basis for meeting the sales restrictions of paragraph (d)(4) of this section.

(iii) State: ''We prepare each listed engine model for marine application without making any changes that could increase its certified emission levels, as described in 40 CFR 1042.605.''.

(f) *Failure to comply.* If your engines do not meet the criteria listed in paragraph (d) of this section, they will be subject to the standards, requirements, and prohibitions of this part 1042 and the certificate issued under 40 CFR part 86, 89, 92, 1033, or 1039 will not be deemed to also be a certificate issued under this part 1042. Introducing these engines into U.S. commerce as marine engines without a valid exemption or certificate of conformity under this part violates the prohibitions in 40 CFR 1068.101(a)(1).

(g) *Data submission.* (1) If you are both the original manufacturer and marinizer of an exempted engine, you must send us emission test data on the appropriate marine duty cycles. You can include the data in your application for certification or in the letter described in paragraph (e)(3) of this section.

(2) If you are the original manufacturer of an exempted engine that is marinized by a post-manufacture marinizer, you may be required to send us emission test data on the appropriate marine duty cycles. If such data are requested you will be allowed a reasonable amount of time to collect the data.

(h) *Participation in averaging, banking and trading.* Engines adapted for marine use under this section may not generate or use emission credits under this part 1042. These engines may generate credits under the ABT provisions in 40 CFR part 86, 89, 92, 1033, or 1039, as applicable. These engines must use emission credits under 40 CFR part 86, 89, 92, 1033, or 1039 as applicable if they are certified to an FEL that exceeds an emission standard.

(i) *Operator requirements.* The requirements specified for vessel manufacturers, owners, and operators in this subpart (including requirements in 40 CFR part 1068) apply to these engines whether they are certified under this part 1042 or another part as allowed by this section.

§ 1042.610 Certifying auxiliary marine engines to land-based standards.

This section applies to auxiliary marine engines that are identical to certified land-based engines. See § 1042.605 for provisions that apply to propulsion marine engines or auxiliary marine engines that are modified for marine applications.

(a) *General provisions.* If you are an engine manufacturer, this section allows you to introduce new marine engines into U.S. commerce if they are already certified to the requirements that apply to compression-ignition engines under 40 CFR part 89 or 1039 for the appropriate model year. If you comply with all the provisions of this section, we consider the certificate issued under 40 CFR part 89 or 1039 for each engine to also be a valid certificate of conformity under this part 1042 for its model year, without a separate application for certification under the requirements of this part 1042.

(b) *Boat builder provisions.* If you are not an engine manufacturer, you may install an engine certified for land-based applications in a marine vessel as long as you meet all the qualifying criteria and requirements specified in paragraphs (d) and (e) of this section. If you modify the non-marine engine, we will consider you a manufacturer of a new marine engine. Such engine modifications prevent you from using the provisions of this section.

(c) *Liability.* Engines for which you meet the requirements of this section are exempt from all the requirements and prohibitions of this part, except for those specified in this section. Engines exempted under this section must meet all the applicable requirements from 40 CFR part 89 or 1039. This paragraph (c) applies to engine manufacturers, boat builders who use such an engine, and all other persons as if the engine were used in its originally intended application. The prohibited acts of 40 CFR 1068.101(a)(1) apply to these new engines and vessels; however, we consider the certificate issued under 40 CFR part 89 or 1039 for each engine to also be a valid certificate of conformity under this part 1042 for its model year. If we make a determination that these engines do not conform to the regulations during their useful life, we may require you to recall them under 40 CFR part 89 or 1068.

(d) *Qualifying criteria.* If you are an engine manufacturer and meet all the following criteria and requirements regarding your new marine engine, the engine is eligible for an exemption under this section:

(1) The marine engine must be identical in all material respects to a land-based engine covered by a valid certificate of conformity for the appropriate model year showing that it meets emission standards for engines of that power rating under 40 CFR part 89 or 1039.

(2) The engines may not be used as propulsion marine engines.

(3) You must show that the number of auxiliary marine engines from the engine family must be smaller than the number of land-based engines from the engine family sold in the United States, as follows:

(i) If you are the original manufacturer of the engine, base this showing on your sales information.

(ii) In all other cases, you must get the original manufacturer of the engine to confirm this based on its sales information.

(e) *Specific requirements.* If you are an engine manufacturer or boat builder using this exemption, you must do all of the following:

(1) Make sure the original engine label will remain clearly visible after installation in the vessel. This label or a supplemental label must identify that the original certification is valid for marine auxiliary applications.

(2) Send a signed letter to the Designated Officer by the end of each calendar year (or less often if we tell you) with all the following information:

(i) Identify your full corporate name, address, and telephone number.

(ii) List the engine models you expect to produce under this exemption in the coming year and describe your basis for meeting the sales restrictions of paragraph (d)(3) of this section.

(iii) State: ''We produce each listed engine model for marine application without making any changes that could increase its certified emission levels, as described in 40 CFR 1042.610.''.

(3) If you are the certificate holder, you must describe in your application for certification how you plan to produce engines for both land-based and auxiliary marine applications, including projected sales of auxiliary marine engines to the extent this can be determined. If the projected marine sales are substantial, we may ask for the year-end report of production volumes to include actual auxiliary marine engine sales.

(f) *Failure to comply.* If your engines do not meet the criteria listed in paragraph (d) of this section, they will be subject to the standards, requirements, and prohibitions of this part 1042 and the certificate issued under 40 CFR part 89 or 1039 will not be deemed to also be a certificate issued under this part 1042. Introducing these engines into U.S. commerce as marine engines without a valid exemption or certificate of conformity under this part 1042 violates the prohibitions in 40 CFR 1068.101(a)(1).

(g) *Participation in averaging, banking and trading.* Engines using this exemption may not generate or use emission credits under this part 1042. These engines may generate credits under the ABT provisions in 40 CFR part 89 or 1039, as applicable. These engines must use emission credits under 40 CFR part 89 or 1039 as applicable if they are certified to an FEL that exceeds an emission standard.

(h) *Operator requirements.* The requirements specified for vessel manufacturers, owners, and operators in this subpart (including requirements in 40 CFR part 1068) apply to these engines whether they are certified under this part 1042 or another part as allowed by this section.

§ 1042.620 Engines used solely for competition.

The provisions of this section apply for new engines and vessels built on or after January 1, 2009.

(a) We may grant you an exemption from the standards and requirements of this part for a new engine on the grounds that it is to be used solely for competition. The requirements of this part, other than those in this section, do not apply to engines that we exempt for use solely for competition.

(b) We will exempt engines that we determine will be used solely for competition. The basis of our determination is described in paragraphs (c) and (d) of this section. Exemptions granted under this section are good for only one model year and you must request renewal for each subsequent model year. We will not approve your renewal request if we determine the engine will not be used solely for competition.

(c) Engines meeting all the following criteria are considered to be used solely for competition:

(1) Neither the engine nor any vessels containing the engine may be displayed for sale in any public dealership or otherwise offered for sale to the general public.

(2) Sale of the vessel in which the engine is installed must be limited to professional racing teams, professional racers, or other qualified racers. Keep records documenting this, such as a letter requesting an exempted engine.

(3) The engine and the vessel in which it is installed must have performance characteristics that are substantially superior to noncompetitive models.

(4) The engines are intended for use only as specified in paragraph (e) of this section.

(d) You may ask us to approve an exemption for engines not meeting the applicable criteria listed in paragraph (c) of this section as long as you have clear and convincing evidence that the engines will be used solely for competition.

(e) Engines will not be considered to be used solely for competition if they are ever used for any recreational or other noncompetitive purpose. This means that their use must be limited to competition events sanctioned by the U.S. Coast Guard or another public organization with authorizing permits for participating competitors. Operation for such engines may include only racing events or trials to qualify for racing events. Authorized attempts to set speed records (and the associated official trials) are also considered racing events. Any use of exempt engines in recreational events, such as poker runs and lobsterboat races, is a violation of 40 CFR 1068.101(b)(4).

(f) You must permanently label engines exempted under this section to clearly indicate that they are to be used only for competition. Failure to properly label an engine will void the exemption for that engine.

(g) If we request it, you must provide us any information we need to determine whether the engines or vessels are used solely for competition. This would include documentation regarding the number of engines and the ultimate purchaser of each engine. Keep these records for five years.

§ 1042.630 Personal-use exemption.

This section applies to individuals who manufacture vessels for personal use. If you and your vessel meet all the conditions of this section, the vessel and its engine are considered to be exempt from the standards and requirements of this part that apply to new engines and new vessels. For example, you may install an engine that was not certified as a marine engine.

(a) The vessel may not be manufactured from a previously certified vessel, nor may it be manufactured from a partially complete vessel that is equivalent to a certified vessel. The vessel must be manufactured primarily from unassembled components, but may incorporate some preassembled components. For example, fully preassembled steering assemblies may be used. You may also power the vessel with an engine that was previously used in a highway or land-based nonroad application.

(b) The vessel may not be sold within five years after the date of final assembly.

(c) No individual may manufacture more than one vessel in any ten-year period under this exemption.

(d) You may not use the vessel in any revenue-generating service or for any other commercial purpose, except that you may use a vessel exempt under this section for commercial fishing that you personally do.

(e) This exemption may not be used to circumvent the requirements of this part or the requirements of the Clean Air Act. For example, this exemption would not cover a case in which a person sells an almost completely assembled vessel to another person, who would then complete the assembly. This would be considered equivalent to the sale of the complete new vessel. This section also does not allow engine manufacturers to produce new engines that are exempt from emission standards and it does not provide an exemption from the prohibition against tampering with certified engines.

(f) The vessel must be a vessel that is not classed or subject to Coast Guard inspections or surveys.

§ 1042.640 Special provisions for branded engines.

The following provisions apply if you identify the name and trademark of another company instead of your own on your emission control information label, as provided by § 1042.135(c)(2):

(a) You must have a contractual agreement with the other company that obligates that company to take the following steps:

(1) Meet the emission warranty requirements that apply under § 1042.120. This may involve a separate agreement involving reimbursement of warranty-related expenses.

(2) Report all warranty-related information to the certificate holder.

(b) In your application for certification, identify the company whose trademark you will use and describe the arrangements you have made to meet your requirements under this section.

(c) You remain responsible for meeting all the requirements of this chapter, including warranty and defect-reporting provisions.

§ 1042.660 Requirements for vessel manufacturers, owners, and operators.

(a) The provisions of 40 CFR part 94, subpart K, apply to manufacturers, owners, and operators of marine vessels that contain Category 3 engines subject to the provisions of 40 CFR part 94, subpart A.

(b) For vessels equipped with emission controls requiring the use of specific fuels, lubricants, or other fluids, owners and operators must comply with the manufacturer/remanufacturer's specifications for such fluids when operating the vessels. For vessels equipped with SCR systems requiring the use of urea or other reductants, owners and operators must report to us within 30 days any operation of such vessels without the appropriate urea. Failure to comply with the requirements of this paragraph is a violation of 40 CFR 1068.101(a)(2).

Subpart H—Averaging, Banking, and Trading for Certification

§ 1042.701 General provisions.

(a) You may average, bank, and trade (ABT) emission credits for purposes of certification as described in this subpart to show compliance with the standards of this part. Participation in this program is voluntary.

(b) The definitions of subpart I of this part apply to this subpart. The following definitions also apply:

(1) *Actual emission credits* means emission credits you have generated that we have verified by reviewing your final report.

(2) *Averaging set* means a set of engines in which emission credits may be exchanged only with other engines in the same averaging set.

(3) *Broker* means any entity that facilitates a trade of emission credits between a buyer and seller.

(4) *Buyer* means the entity that receives emission credits as a result of a trade.

(5) *Reserved emission credits* means emission credits you have generated that we have not yet verified by reviewing your final report.

(6) *Seller* means the entity that provides emission credits during a trade.

(7) *Standard* means the emission standard that applies under subpart B of this part for engines not participating in the ABT program of this subpart.

(8) *Trade* means to exchange emission credits, either as a buyer or seller.

(c) Emission credits may be exchanged only within an averaging set. Except as specified in paragraph (d) of this section, the following criteria define the applicable averaging sets:

(1) Recreational engines.

(2) Commercial Category 1 engines.

(3) Category 2 engines.

(d) Emission credits generated by recreational or commercial Category 1 engine families may be used for compliance by Category 2 engine families. Such credits must be discounted by 25 percent.

(e) You may not use emission credits generated under this subpart to offset any emissions that exceed an FEL or standard. This applies for all testing, including certification testing, in-use testing, selective enforcement audits, and other production-line testing. However, if emissions from an engine exceed an FEL or standard (for example, during a selective enforcement audit), you may use emission credits to recertify the engine family with a higher FEL that applies only to future production.

(f) Engine families that use emission credits for one or more pollutants may not generate positive emission credits for another pollutant.

(g) Emission credits may be used in the model year they are generated or in future model years. Emission credits may not be used for past model years.

(h) You may increase or decrease an FEL during the model year by amending your application for certification under § 1042.225.

(i) You may use NO_X+HC credits to show compliance with a NO_X emission standard or use NO_X credits to show compliance with a NO_X+HC emission standard.

§ 1042.705 Generating and calculating emission credits.

The provisions of this section apply separately for calculating emission credits for NO_X, NO_X+HC, or PM.

(a) For each participating family, calculate positive or negative emission credits relative to the otherwise applicable emission standard. Calculate positive emission credits for a family that has an FEL below the standard. Calculate negative emission credits for a family that has an FEL above the standard. Sum your positive and negative credits for the model year before rounding. Round calculated emission credits to the nearest kilogram (kg), using consistent units throughout the following equation:

$$\text{Emission credits (kg)} = (\text{Std} - \text{FEL}) \times (\text{Volume}) \times (\text{Power}) \times (\text{LF}) \times (\text{UL}) \times (10^{-3})$$

Where:

Std = The emission standard, in g/kW-hr.

FEL = The family emission limit for the engine family, in g/kW-hr.

Volume = The number of engines eligible to participate in the averaging, banking, and trading program within the given engine family during the model year, as described in paragraph (c) of this section.

Power = The average value of maximum engine power of all the engine configurations within an engine family, calculated on a production-weighted basis, in kilowatts.

LF = Load factor. Use 0.69 for propulsion marine engines and 0.51 for auxiliary marine engines. We may specify a different load factor if we approve the use of special test procedures for an engine family under 40 CFR 1065.10(c)(2), consistent with good engineering judgment.

UL = The useful life for the given engine family, in hours.

(b) [Reserved]

(c) In your application for certification, base your showing of compliance on projected production volumes for engines whose point of first retail sale is in the United States. As described in § 1042.730, compliance with the requirements of this subpart is determined at the end of the model year based on actual production volumes for engines whose point of first retail sale is in the United States. Do not include any of the following engines to calculate emission credits:

(1) Engines exempted under subpart G of this part or under 40 CFR part 1068.

(2) Exported engines.

(3) Engines not subject to the requirements of this part, such as those excluded under § 1042.5.

(4) [Reserved]

(5) Any other engines, where we indicate elsewhere in this part 1042 that they are not to be included in the calculations of this subpart.

§ 1042.710 Averaging emission credits.

(a) Averaging is the exchange of emission credits among your engine families.

(b) You may certify one or more engine families to an FEL above the emission standard, subject to the FEL caps and other provisions in subpart B of this part, if you show in your application for certification that your projected balance of all emission-credit transactions in that model year is greater than or equal to zero.

(c) If you certify an engine family to an FEL that exceeds the otherwise applicable standard, you must obtain enough emission credits to offset the engine family's deficit by the due date for the final report required in § 1042.730. The emission credits used to address the deficit may come from your other engine families that generate emission credits in the same model year, from emission credits you have banked, or from emission credits you obtain through trading.

§ 1042.715 Banking emission credits.

(a) Banking is the retention of emission credits by the manufacturer generating the emission credits for use in averaging or trading in future model years.

(b) In your application for certification, designate any emission credits you intend to bank. These emission credits will be considered reserved credits. During the model year and before the due date for the final report, you may redesignate these emission credits for averaging or trading.

(c) You may use banked emission credits from the previous model year for averaging or trading before we verify them, but we may revoke these emission credits if we are unable to verify them after reviewing your reports or auditing your records.

(d) Reserved credits become actual emission credits only when we verify them in reviewing your final report.

§ 1042.720 Trading emission credits.

(a) Trading is the exchange of emission credits between manufacturers. You may use traded emission credits for averaging, banking, or further trading transactions.

(b) You may trade actual emission credits as described in this subpart. You may also trade reserved emission credits, but we may revoke these emission credits based on our review of your records or reports or those of the company with which you traded emission credits. You may trade banked credits to any certifying manufacturer.

(c) If a negative emission credit balance results from a transaction, both the buyer and seller are liable, except in cases we deem to involve fraud. See § 1042.255(e) for cases involving fraud. We may void the certificates of all engine families participating in a trade that results in a manufacturer having a negative balance of emission credits. See § 1042.745.

§ 1042.725 Information required for the application for certification.

(a) You must declare in your application for certification your intent to use the provisions of this subpart for each engine family that will be certified using the ABT program. You must also declare the FELs you select for the engine family for each pollutant for which you are using the ABT program. Your FELs must comply with the specifications of subpart B of this part, including the FEL caps. FELs must be expressed to the same number of decimal places as the emission standards.

(b) Include the following in your application for certification:

(1) A statement that, to the best of your belief, you will not have a negative balance of emission credits for any averaging set when all emission credits are calculated at the end of the year.

(2) Detailed calculations of projected emission credits (positive or negative) based on projected production volumes. If your engine family will generate positive emission credits, state specifically where the emission credits will be applied (for example, to which engine family they will be applied in averaging, whether they will be traded, or whether they will be reserved for banking). If you have projected negative emission credits for an engine family, state the source of positive emission credits to offset the negative emission credits. Describe whether the emission credits are actual or reserved and whether they will come from averaging, banking, trading, or a combination of these. Identify from which of your engine families or from which manufacturer the emission credits will come.

§ 1042.730 ABT reports.

(a) If any of your engine families are certified using the ABT provisions of this subpart, you must send an end-of-year report within 90 days after the end of the model year and a final report within 270 days after the end of the model year. We may waive the requirement to send the end-of year report, as long as you send the final report on time.

(b) Your end-of-year and final reports must include the following information for each engine family participating in the ABT program:

(1) Engine-family designation.

(2) The emission standards that would otherwise apply to the engine family.

(3) The FEL for each pollutant. If you changed an FEL during the model year, identify each FEL you used and calculate the positive or negative emission credits under each FEL. Also, describe how the FEL can be identified for each engine you produced. For example, you might keep a list of engine identification numbers that correspond with certain FEL values.

(4) The projected and actual production volumes for the model year with a point of first retail sale in the United States, as described in § 1042.705(c). If you changed an FEL during the model year, identify the actual production volume associated with each FEL.

(5) Maximum engine power for each engine configuration, and the production-weighted average engine power for the engine family.

(6) Useful life.

(7) Calculated positive or negative emission credits for the whole engine family. Identify any emission credits that you traded, as described in paragraph (d)(1) of this section.

(c) Your end-of-year and final reports must include the following additional information:

(1) Show that your net balance of emission credits from all your participating engine families in each averaging set in the applicable model year is not negative.

(2) State whether you will reserve any emission credits for banking.

(3) State that the report's contents are accurate.

(d) If you trade emission credits, you must send us a report within 90 days after the transaction, as follows:

(1) Sellers must include the following information in their report:

(i) The corporate names of the buyer and any brokers.

(ii) A copy of any contracts related to the trade.

(iii) The engine families that generated emission credits for the trade, including the number of emission credits from each family.

(2) Buyers must include the following information in their report:

(i) The corporate names of the seller and any brokers.

(ii) A copy of any contracts related to the trade.

(iii) How you intend to use the emission credits, including the number of emission credits you intend to apply to each engine family (if known).

(e) Send your reports electronically to the Designated Compliance Officer using an approved information format. If you want to use a different format, send us a written request with justification for a waiver.

(f) Correct errors in your end-of-year report or final report as follows:

(1) You may correct any errors in your end-of-year report when you prepare the final report, as long as you send us the final report by the time it is due.

(2) If you or we determine within 270 days after the end of the model year that errors mistakenly decrease your balance of emission credits, you may correct the errors and recalculate the balance of emission credits. You may not make these corrections for errors that are determined more than 270 days after the end of the model year. If you report a negative balance of emission credits, we may disallow corrections under this paragraph (f)(2).

(3) If you or we determine anytime that errors mistakenly increase your balance of emission credits, you must correct the errors and recalculate the balance of emission credits.

§ 1042.735 Recordkeeping.

(a) You must organize and maintain your records as described in this section. We may review your records at any time.

(b) Keep the records required by this section for eight years after the due date for the end-of-year report. You may not use emission credits on any engines if you do not keep all the records required under this section. You must therefore keep these records to continue to bank valid credits. Store these records in any format and on any media, as long as you can promptly send us organized, written records in English if we ask for them. You must keep these records readily available. We may review them at any time.

(c) Keep a copy of the reports we require in §§ 1042.725 and 1042.730.

(d) Keep the following additional records for each engine you produce that generates or uses emission credits under the ABT program:

(1) Engine family designation.

(2) Engine identification number.

(3) FEL and useful life.

(4) Maximum engine power.

(5) Build date and assembly plant.

(6) Purchaser and destination.

(e) We may require you to keep additional records or to send us relevant information not required by this section.

§ 1042.745 Noncompliance.

(a) For each engine family participating in the ABT program, the certificate of conformity is conditional upon full compliance with the provisions of this subpart during and after the model year. You are responsible to establish to our satisfaction that you fully comply with applicable requirements. We may void the certificate of conformity for an engine family if you fail to comply with any provisions of this subpart.

(b) You may certify your engine family to an FEL above an emission standard based on a projection that you will have enough emission credits to offset the deficit for the engine family. However, we may void the certificate of conformity if you cannot show in your final report that you have enough actual emission credits to offset a deficit for any pollutant in an engine family.

(c) We may void the certificate of conformity for an engine family if you fail to keep records, send reports, or give us information we request.

(d) You may ask for a hearing if we void your certificate under this section (see § 1042.820).

Subpart I—Definitions and Other Reference Information

§ 1042.801 Definitions.

The following definitions apply to this part. The definitions apply to all subparts unless we note otherwise. All undefined terms have the meaning the Clean Air Act gives to them. The definitions follow:

Act means the Clean Air Act, as amended, 42 U.S.C. 7401–7671q.

Adjustable parameter means any device, system, or element of design that someone can adjust (including those which are difficult to access) and that, if adjusted, may affect emissions or engine performance during emission testing or normal in-use operation. This includes, but is not limited to, parameters related to injection timing and fueling rate. You may ask us to exclude a parameter that is difficult to access if it cannot be adjusted to affect emissions without significantly degrading engine performance, or if you otherwise show us that it will not be adjusted in a way that affects emissions during in-use operation.

Aftertreatment means relating to a catalytic converter, particulate filter, or any other system, component, or technology mounted downstream of the exhaust valve (or exhaust port) whose design function is to decrease emissions in the engine exhaust before it is exhausted to the environment. Exhaust-gas recirculation (EGR) and turbochargers are not aftertreatment.

Amphibious vehicle means a vehicle with wheels or tracks that is designed primarily for operation on land and secondarily for operation in water.

Annex VI Technical Code means the ''Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines'', adopted by the International Maritime Organization (incorporated by reference in § 1042.810).

Applicable emission standard or *applicable standard* means an emission standard to which an engine is subject; or, where an engine has been or is being certified to another standard or FEL, applicable emission standards means the FEL and other standards to which the engine has been or is being certified. This definition does not apply to subpart H of this part.

Auxiliary emission control device means any element of design that senses temperature, motive speed, engine RPM, transmission gear, or any other parameter for the purpose of activating, modulating, delaying, or deactivating the operation of any part of the emission-control system.

Base engine means a land-based engine to be marinized, as configured prior to marinization.

Brake power means the usable power output of the engine, not including power required to fuel, lubricate, or heat the engine, circulate coolant to the engine, or to operate aftertreatment devices.

Calibration means the set of specifications and tolerances specific to a particular design, version, or application of a component or assembly capable of functionally describing its operation over its working range.

Category 1 means relating to a marine engine with specific engine displacement less than 7.0 liters per cylinder.

Category 2 means relating to a marine engine with a specific engine displacement greater than or equal to 7.0 liters per cylinder but less than 30.0 liters per cylinder.

Category 3 means relating to a marine engine with a specific engine displacement greater than or equal to 30.0 liters per cylinder.

Certification means relating to the process of obtaining a certificate of conformity for an engine family that complies with the emission standards and requirements in this part.

Certified emission level means the highest deteriorated emission level in an engine family for a given pollutant from either transient or steady-state testing.

Clean Air Act means the Clean Air Act, as amended, 42 U.S.C. 7401–7671q.

Commercial means relating to an engine or vessel that is not a recreational marine engine or a recreational vessel.

Compression-ignition means relating to a type of reciprocating, internal-combustion engine that is not a spark-ignition engine.

Constant-speed engine means an engine whose certification is limited to constant-speed operation. Engines whose constant-speed governor function is removed or disabled are no longer constant-speed engines.

Constant-speed operation has the meaning given in 40 CFR 1065.1001.

Crankcase emissions means airborne substances emitted to the atmosphere from any part of the engine crankcase's ventilation or lubrication systems. The crankcase is the housing for the crankshaft and other related internal parts.

Critical emission-related component means any of the following components:

(1) Electronic control units, aftertreatment devices, fuel-metering components, EGR-system components, crankcase-ventilation valves, all components related to charge-air compression and cooling, and all sensors and actuators associated with any of these components.

(2) Any other component whose primary purpose is to reduce emissions.

Designated Compliance Officer means the Manager, Heavy-Duty and Nonroad Engine Group (6403–J), U.S. Environmental Protection Agency, 1200 Pennsylvania Ave., NW., Washington, DC 20460.

Designated Enforcement Officer means the Director, Air Enforcement Division (2242A), U.S. Environmental Protection Agency, 1200 Pennsylvania Ave., NW., Washington, DC 20460.

Deteriorated emission level means the emission level that results from applying the appropriate deterioration factor to the official emission result of the emission-data engine.

Deterioration factor means the relationship between emissions at the end of useful life and emissions at the low-hour test point, expressed in one of the following ways:

(1) For multiplicative deterioration factors, the ratio of emissions at the end of useful life to emissions at the low-hour test point.

(2) For additive deterioration factors, the difference between emissions at the end of useful life and emissions at the low-hour test point.

Diesel fuel has the meaning given in 40 CFR 80.2. This generally includes No. 1 and No. 2 petroleum diesel fuels and biodiesel fuels.

Discrete-mode means relating to the discrete-mode type of steady-state test described in § 1042.505.

Dresser means any entity that modifies a land-based engine for use in a vessel, in compliance with the provisions of § 1042.605. This means that dressers may not modify the engine in a way that would affect emissions.

Emission-control system means any device, system, or element of design that controls or reduces the emissions of regulated pollutants from an engine.

Emission-data engine means an engine that is tested for certification. This includes engines tested to establish deterioration factors.

Emission-related maintenance means maintenance that substantially affects emissions or is likely to substantially affect emission deterioration.

Engine has the meaning given in 40 CFR 1068.30. This includes complete and partially complete engines.

Engine configuration means a unique combination of engine hardware and calibration within an engine family. Engines within a single engine configuration differ only with respect to normal production variability.

Engine family has the meaning given in § 1042.230.

Engine manufacturer means a manufacturer of an engine. See the definition of ''manufacturer'' in this section.

Engineering analysis means a summary of scientific and/or engineering principles and facts that support a conclusion made by a manufacturer, with respect to compliance with the provisions of this part.

Excluded means relating to an engine that either:

(1) Has been determined not to be a nonroad engine, as specified in 40 CFR 1068.30; or

(2) Is a nonroad engine that, according to § 1042.5, is not subject to this part 1042.

Exempted has the meaning given in 40 CFR 1068.30.

Exhaust-gas recirculation means a technology that reduces emissions by routing exhaust gases that had been exhausted from the combustion chamber(s) back into the engine to be mixed with incoming air before or during combustion. The use of valve timing to increase the amount of residual exhaust gas in the combustion chamber(s) that is mixed with incoming air before or during combustion is not considered exhaust-gas recirculation for the purposes of this part.

Family emission limit (FEL) means an emission level declared by the manufacturer to serve in place of an otherwise applicable emission standard under the ABT program in subpart H of this part. The family emission limit must be expressed to the same number of decimal places as the emission standard it replaces. The family emission limit serves as the emission standard for the engine family with respect to all required testing.

Foreign vessel means a vessel of foreign registry or a vessel operated under the authority of a country other than the United States.

Fuel system means all components involved in transporting, metering, and mixing the fuel from the fuel tank to the combustion chamber(s), including the fuel tank, fuel tank cap, fuel pump, fuel filters, fuel lines, carburetor or fuel-injection components, and all fuel-system vents.

Fuel type means a general category of fuels such as gasoline, diesel fuel, residual fuel, or natural gas. There can be multiple grades within a single fuel type, such as high-sulfur or low-sulfur diesel fuel.

Good engineering judgment has the meaning given in 40 CFR 1068.30. See 40 CFR 1068.5 for the administrative process we use to evaluate good engineering judgment.

Green Engine Factor means a factor that is applied to emission measurements from a Category 2 engine that has had little or no service accumulation. The Green Engine Factor adjusts emission measurements to be equivalent to emission measurements from an engine that has had approximately 300 hours of use.

High-sulfur diesel fuel means one of the following:

(1) For in-use fuels, *high-sulfur diesel fuel* means a diesel fuel with a maximum sulfur concentration greater than 500 parts per million.

(2) For testing, *high-sulfur diesel fuel* has the meaning given in 40 CFR part 1065.

Hydrocarbon (HC) means the hydrocarbon group on which the emission standards are based for each fuel type, as described in § 1042.101(d).

Identification number means a unique specification (for example, a model number/serial number combination) that allows someone to distinguish a particular engine from other similar engines.

Low-hour means relating to an engine that has stabilized emissions and represents the undeteriorated emission level. This would generally involve less than 300 hours of operation.

Low-sulfur diesel fuel means one of the following:

(1) For in-use fuels, *low-sulfur diesel fuel* means a diesel fuel market as low-sulfur diesel fuel having a maximum sulfur concentration of 500 parts per million.

(2) For testing, *low-sulfur diesel fuel* has the meaning given in 40 CFR part 1065.

Manufacture means the physical and engineering process of designing, constructing, and assembling an engine or a vessel.

Manufacturer has the meaning given in section 216(1) of the Clean Air Act. In general, this term includes any person who manufactures an engine or vessel for sale in the United States or otherwise introduces a new marine engine into U.S. commerce. This includes importers who import engines or vessels for resale. It also includes post-manufacture marinizers, but not dealers. All manufacturing entities under the control of the same person are considered to be a single manufacturer.

Marine engine means a nonroad engine that is installed or intended to be installed on a marine vessel. This includes a portable auxiliary marine engine only if its fueling, cooling, or exhaust system is an integral part of the vessel. A fueling system is considered integral to the vessel only if one or more essential elements are permanently affixed to the vessel. There are two kinds of marine engines:

(1) Propulsion marine engine means a marine engine that moves a vessel through the water or directs the vessel's movement.

(2) Auxiliary marine engine means a marine engine not used for propulsion.

Marine vessel has the meaning given in 1 U.S.C. 3, except that it does not include amphibious vehicles. The definition in 1 U.S.C. 3 very broadly includes every craft capable of being used as a means of transportation on water.

Maximum engine power has the meaning given in § 1042.140.

Maximum test power means:

(1) For Category 1 engines, the power output observed at the maximum test speed with the maximum fueling rate possible.

(2) For Category 2 engines, 90 percent of the power output observed at the maximum test speed with the maximum fueling rate possible.

Maximum test speed has the meaning given in 40 CFR 1065.1001.

Maximum test torque has the meaning given in 40 CFR 1065.1001.

Model year means one of the following things:

(1) For freshly manufactured engines (see definition of ''new marine engine,'' paragraph (1)), model year means one of the following:

(i) Calendar year.

(ii) Your annual new model production period if it is different than the calendar year. This must include January 1 of the calendar year for which the model year is named. It may not begin before January 2 of the previous calendar year and it must end by December 31 of the named calendar year.

(2) For an engine that is converted to a marine engine after originally being placed into service as a motor-vehicle engine, a nonroad engine that is not a marine engine, or a stationary engine, model year means the calendar year in which the engine was converted (see definition of ''new marine engine,'' paragraph (2)).

(3) For a marine engine excluded under § 1042.5 that is later converted to operate in an application that is not excluded, model year means the calendar year in which the engine was converted (see definition of ''new marine engine,'' paragraph (3)).

(4) For engines that are not freshly manufactured but are installed in new vessels, model year means the calendar year in which the engine is installed in the new vessel (see definition of ''new marine engine,''paragraph (4)).

(5) For imported engines:

(i) For imported engines described in paragraph (5)(i) of the definition of ''new marine engine,'' *model year* has the meaning given in paragraphs (1) through (4) of this definition.

(ii) For imported engines described in paragraph (5)(ii) of the definition of new marine engine,'' model year means the calendar year in which the engine is modified.

(iii) For imported engines described in paragraph (5)(iii) of the definition of ''new marine engine,'' *model year* means the calendar year in which the importation occurs.

(6) For freshly manufactured vessels, *model year* means the calendar year in which the keel is laid or the vessel is at a similar stage of construction. For vessels that become new as a result of substantial modifications, model year means the calendar year in which the modifications physically begin.

Motor vehicle has the meaning given in 40 CFR 85.1703(a).

New marine engine means any of the following things:

(1) A freshly manufactured marine engine for which the ultimate purchaser has never received the equitable or legal title. This kind of engine might commonly be thought of as ''brand new.'' In the case of this paragraph (1), the engine is new from the time it is produced until the ultimate purchaser receives the title or the product is placed into service, whichever comes first.

(2) An engine intended to be installed in a vessel that was originally manufactured as a motor-vehicle engine, a nonroad engine that is not a marine engine, or a stationary engine. In this case, the engine is no longer a motor-vehicle, nonmarine, or stationary engine and becomes a ''new marine engine''. The engine is no longer new when it is placed into marine service.

(3) A marine engine that has been previously placed into service in an application we exclude under § 1042.5, where that engine is installed in a vessel that is covered by this part 1042. The engine is no longer new when it is placed into marine service covered by this part 1042. For example, this would apply to a marine diesel engine that is no longer used in a foreign vessel.

(4) An engine not covered by paragraphs (1) through (3) of this definition that is intended to be installed in a new vessel. The engine is no longer new when the ultimate purchaser receives a title for the vessel or it is placed into service, whichever comes first. This generally includes installation of used engines in new vessels.

(5) An imported marine engine, subject to the following provisions:

(i) An imported marine engine covered by a certificate of conformity issued under this part that meets the criteria of one or more of paragraphs (1) through (4) of this definition, where the original engine manufacturer holds the certificate, is new as defined by those applicable paragraphs.

(ii) An imported marine engine covered by a certificate of conformity issued under this part, where someone other than the original engine manufacturer holds the certificate (such as when the engine is modified after its initial assembly), becomes new when it is imported. It is no longer new when the ultimate purchaser receives a title for the engine or it is placed into service, whichever comes first.

(iii) An imported marine engine that is not covered by a certificate of conformity issued under this part at the time of importation is new, but only if it was produced on or after the dates shown in the following table. This addresses uncertified engines and vessels initially placed into service that someone seeks to import into the United States. Importation of this kind of engine (or vessel containing such an engine) is generally prohibited by 40 CFR part 1068.

APPLICABILITY OF EMISSION STANDARDS FOR COMPRESSION-IGNITION MARINE ENGINES

Engine category and type	Power (kW)	Per-cylinder displacement (L/cyl)	Initial model year of emission standards
Category 1	P < 19	All	2000
Category 1	19 ≤ P < 37	All	1999
Category 1, Recreational	P ≥ 37	disp. < 0.9	2007
Category 1, Recreational	All	0.9 ≤ disp. < 2.5	2006
Category 1, Recreational	All	disp. ≥ 2.5	2004
Category 1, Commercial	P ≥ 37	disp. < 0.9	2005
Category 1, Commercial	All	disp. ≥ 0.9	2004
Category 2 and 3	All	disp. ≥ 5.0	2004

New vessel means any of the following:

(1) A vessel for which the ultimate purchaser has never received the equitable or legal title. The vessel is no longer new when the ultimate purchaser receives this title or it is placed into service, whichever comes first.

(2) For vessels with no Category 3 engines, a vessel that has been modified such that the value of the modifications exceeds 50 percent of the value of the modified vessel. The value of the modification is the difference in the assessed value of the vessel before the modification and the assessed value of the vessel after the modification. The vessel is no longer new when it is placed into service. Use the following equation to determine if the fractional value of the modification exceeds 50 percent:

Percent of value = [(Value after modification) − (Value before modification)÷100% (Value after modification)

(3) For vessels with Category 3 engines, a vessel that has undergone a modification that substantially alters the dimensions or carrying capacity of the vessel, changes the type of vessel, or substantially prolongs the vessel's life.

(4) An imported vessel that has already been placed into service, where it has an engine not covered by a certificate of conformity issued under this part at the time of importation that was manufactured after the requirements of this part start to apply (see § 1042.1).

Noncompliant engine means an engine that was originally covered by a certificate of conformity but is not in the certified configuration or otherwise does not comply with the conditions of the certificate.

Nonconforming engine means an engine not covered by a certificate of conformity that would otherwise be subject to emission standards.

Nonmethane hydrocarbon has the meaning given in 40 CFR 1065.1001. This generally means the difference between the emitted mass of total hydrocarbons and the emitted mass of methane.

Nonroad means relating to nonroad engines, or vessels, or equipment that include nonroad engines.

Nonroad engine has the meaning given in 40 CFR 1068.30. In general, this means all internal-combustion engines except motor vehicle engines, stationary engines, engines used solely for competition, or engines used in aircraft.

Official emission result means the measured emission rate for an emission-data engine on a given duty cycle before the application of any deterioration factor, but after the applicability of regeneration adjustment factors.

Operator demand has the meaning given in 40 CFR 1065.1001.

Owners manual means a document or collection of documents prepared by the engine manufacturer for the owner or operator to describe appropriate engine maintenance, applicable warranties, and any other information related to operating or keeping the engine. The owners manual is typically provided to the ultimate purchaser at the time of sale. The owners manual may be in paper or electronic format.

Oxides of nitrogen has the meaning given in 40 CFR 1065.1001.

Particulate trap means a filtering device that is designed to physically trap particulate matter above a certain size.

Passenger has the meaning given by 46 U.S.C. 2101 (21) and (21a). In the context of commercial vessels, this generally means that a passenger is a person that pays to be on the vessel.

Placed into service means put into initial use for its intended purpose.

Point of first retail sale means the location at which the initial retail sale occurs. This generally means a vessel dealership or manufacturing facility, but may also include an engine seller or distributor in cases where loose engines are sold to the general public for uses such as replacement engines.

Post-manufacture marinizer means an entity that produces a marine engine by modifying a non-marine engine, whether certified or uncertified, complete or partially complete, where the entity is not controlled by the manufacturer of the base engine or by an entity that also controls the manufacturer of the base engine. In addition, vessel manufacturers that substantially modify marine engines are post-manufacture marinizers. For the purpose of this definition, ''substantially modify'' means changing an engine in a way that could change engine emission characteristics.

Power density has the meaning given in § 1042.140.

Ramped-modal means relating to the ramped-modal type of steady-state test described in § 1042.505.

Rated speed means the maximum full-load governed speed for governed engines and the speed of maximum power for ungoverned engines.

Recreational marine engine means a Category 1 propulsion marine engine that is intended by the manufacturer to be installed on a recreational vessel.

Recreational vessel has the meaning given in 46 U.S.C. 2101 (25), but excludes ''passenger vessels'' and ''small passenger vessels'' as defined by 46 U.S.C. 2101 (22) and (35) and excludes vessels used solely for competition. For this part, ''recreational vessel'' generally 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, excluding 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.

Residual fuel has the meaning given in 40 CFR 80.2. This generally includes all RM grades of marine fuel without regard to whether they are known commercially as residual fuel. For example, fuel marketed as intermediate fuel may be residual fuel.

Revoke has the meaning given in 40 CFR 1068.30. In general this means to terminate the certificate or an exemption for an engine family.

Round has the meaning given in 40 CFR 1065.1001.

Scheduled maintenance means adjusting, repairing, removing, disassembling, cleaning, or replacing components or systems periodically to keep a part or system from failing, malfunctioning, or wearing prematurely. It also may mean actions you expect are necessary to correct an overt indication of failure or malfunction for which periodic maintenance is not appropriate.

Small-volume boat builder means a boat manufacturer with fewer than 500 employees and with annual worldwide production of fewer than 100 boats. For manufacturers owned by a parent company, these limits apply to the combined production and number of employees of the parent company and all its subsidiaries.

Small-volume engine manufacturer means a manufacturer with annual worldwide production of fewer than 1,000 internal combustion engines (marine and nonmarine). For manufacturers owned by a parent company, the limit applies to the production of the parent company and all its subsidiaries.

Spark-ignition means relating to a gasoline-fueled engine or any other type of engine with a spark plug (or other sparking device) and with operating characteristics significantly similar to the theoretical Otto combustion cycle. Spark-ignition engines usually use a throttle to regulate intake air flow to control power during normal operation.

Steady-state has the meaning given in 40 CFR 1065.1001.

Sulfur-sensitive technology means an emission-control technology that experiences a significant drop in emission-control performance or emission-system durability when an engine is operated on low-sulfur fuel (i.e., fuel with a sulfur concentration of 300 to 500 ppm) as compared to when it is operated on ultra low-sulfur fuel (i.e., fuel with a sulfur concentration less than 15 ppm). Exhaust-gas recirculation is not a sulfur-sensitive technology.

Suspend has the meaning given in 40 CFR 1068.30. In general this means to temporarily discontinue the certificate or an exemption for an engine family.

Test engine means an engine in a test sample.

Test sample means the collection of engines selected from the population of an engine family for emission testing. This may include testing for certification, production-line testing, or in-use testing.

Tier 1 means relating to the Tier 1 emission standards, as shown in Appendix I.

Tier 2 means relating to the Tier 2 emission standards, as shown in Appendix I.

Tier 3 means relating to the Tier 3 emission standards, as shown in § 1042.101.

Tier 4 means relating to the Tier 4 emission standards, as shown in § 1042.101.

Total hydrocarbon has the meaning given in 40 CFR 1065.1001. This generally means the combined mass of organic compounds measured by the specified procedure for measuring total hydrocarbon, expressed as a hydrocarbon with a hydrogen-to-carbon mass ratio of 1.85:1.

Total hydrocarbon equivalent has the meaning given in 40 CFR 1065.1001. This generally means the sum of the carbon mass contributions of non-oxygenated hydrocarbons, alcohols and aldehydes, or other organic compounds that are measured separately as contained in a gas sample, expressed as exhaust hydrocarbon from petroleum-fueled locomotives. The hydrogen-to-carbon ratio of the equivalent hydrocarbon is 1.85:1.

Ultimate purchaser means, with respect to any new vessel or new marine engine, the first person who in good faith purchases such new vessel or new marine engine for purposes other than resale.

Ultra low-sulfur diesel fuel means one of the following:

(1) For in-use fuels, *ultra low-sulfur diesel fuel* means a diesel fuel marketed as ultra low-sulfur diesel fuel having a maximum sulfur concentration of 15 parts per million.

(2) For testing, ultra low-sulfur diesel fuel has the meaning given in 40 CFR part 1065.

United States has the meaning given in 40 CFR 1068.30.

Upcoming model year means for an engine family the model year after the one currently in production.

U.S.-directed production volume means the number of engine units, subject to the requirements of this part, produced by a manufacturer for which the manufacturer has a reasonable assurance that sale was or will be made to ultimate purchasers in the United States.

Useful life means the period during which the engine is designed to properly function in terms of reliability and fuel consumption, without being remanufactured, specified as a number of hours of operation or calendar years, whichever comes first. It is the period during which a new engine is required to comply with all applicable emission standards. See § 1042.101(e).

Variable-speed engine means an engine that is not a constant-speed engine.

Vessel means a marine vessel.

Vessel operator means any individual that physically operates or maintains a vessel or exercises managerial control over the operation of the vessel.

Vessel owner means the individual or company that holds legal title to a vessel.

Void has the meaning given in 40 CFR 1068.30. In general this means to invalidate a certificate or an exemption both retroactively and prospectively.

Volatile liquid fuel means any fuel other than diesel or biodiesel that is a liquid at atmospheric pressure and has a Reid Vapor Pressure higher than 2.0 pounds per square inch.

We (us, our) means the Administrator of the Environmental Protection Agency and any authorized representatives.

§ 1042.805 Symbols, acronyms, and abbreviations.

The following symbols, acronyms, and abbreviations apply to this part:

ABT	Averaging, banking, and trading.
AECD	auxiliary-emission control device.
CFR	Code of Federal Regulations.
CO	carbon monoxide.
CO_2	carbon dioxide.

Cyl	cylinder.
disp.	displacement.
EPA	Environmental Protection Agency.
EGR	exhaust gas recirculation.
EPA	Environmental Protection Agency.
FEL	Family Emission Limit.
G	grams.
HC	hydrocarbon.
Hr	hours.
kPa	kilopascals.
kW	kilowatts.
L	liters.
LTR	Limited Testing Region.
NARA	National Archives and Records Administration.
NMHC	nonmethane hydrocarbons.
NO_X	oxides of nitrogen (NO and NO_2).
NTE	not-to-exceed.
PM	particulate matter.
RPM	revolutions per minute.
SAE	Society of Automotive Engineers.
SCR	selective catalytic reduction.
THC	total hydrocarbon.
THCE	total hydrocarbon equivalent.
ULSD	ultra low-sulfur diesel fuel.
U.S.C.	United States Code.

§ 1042.810 Reference materials.

Documents listed in this section have been incorporated by reference into this part. The Director of the Federal Register approved the incorporation by reference as prescribed in 5 U.S.C. 552(a) and 1 CFR part 51. Anyone may inspect copies at the U.S. EPA, Air and Radiation Docket and Information Center, 1301 Constitution Ave., NW., Room B102, EPA West Building, Washington, DC 20460 or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202–741–6030, or go to: *http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html.*

(a) *SAE material.* Table 1 of this section lists material from the Society of Automotive Engineers that we have incorporated by reference. The first column lists the number and name of the material. The second column lists the sections of this part where we reference it. Anyone may purchase copies of these materials from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096 or *http://www.sae.org.* Table 1 follows:

TABLE 1 OF § 1042.810—SAE MATERIALS

Document number and name	Part 1042 reference
SAE J1930, Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms, revised May 1998	1042.135

(b) *IMO material.* Table 2 of this section lists material from the International Maritime Organization that we have incorporated by reference. The first column lists the number and name of the material. The second column lists the section of this part where we reference it. Anyone may purchase copies of these materials from the International Maritime Organization, 4 Albert Embankment, London SE1 7SR, United Kingdom or *http://www.imo.org.* Table 3 follows:

TABLE 2 OF § 1042.810.—IMO MATERIALS

Document number and name	Part 1042 reference
Resolution 2—Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines, 1997.A	1042.801

§ 1042.815 Confidential information.

(a) Clearly show what you consider confidential by marking, circling, bracketing, stamping, or some other method.

(b) We will store your confidential information as described in 40 CFR part 2. Also, we will disclose it only as specified in 40 CFR part 2. This applies both to any information you send us and to any information we collect from inspections, audits, or other site visits.

(c) If you send us a second copy without the confidential information, we will assume it contains nothing confidential whenever we need to release information from it.

(d) If you send us information without claiming it is confidential, we may make it available to the public without further notice to you, as described in 40 CFR 2.204.

§ 1042.820 Hearings.

(a) You may request a hearing under certain circumstances, as described elsewhere in this part. To do this, you must file a written request, including a description of your objection and any supporting data, within 30 days after we make a decision.

(b) For a hearing you request under the provisions of this part, we will approve your request if we find that your request raises a substantial factual issue.

(c) If we agree to hold a hearing, we will use the procedures specified in 40 CFR part 1068, subpart G.

§ 1042.825 Reporting and recordkeeping requirements.

Under the Paperwork Reduction Act (44 U.S.C. 3501 *et seq.*), the Office of Management and Budget approves the reporting and recordkeeping specified in the applicable regulations. The following items illustrate the kind of reporting and recordkeeping we require for engines regulated under this part:

(a) We specify the following requirements related to engine certification in this part 1042:

(1) In § 1042.135 we require engine manufacturers to keep certain records related to duplicate labels sent to vessel manufacturers.

(2) In § 1042.145 we state the requirements for interim provisions.

(3) In subpart C of this part we identify a wide range of information required to certify engines.

(4) In §§ 1042.345 and 1042.350 we specify certain records related to production-line testing.

(5) In subpart G of this part we identify several reporting and recordkeeping items for making demonstrations and getting approval related to various special compliance provisions.

(6) In §§ 1042.725, 1042.730, and 1042.735 we specify certain records related to averaging, banking, and trading.

(b) We specify the following requirements related to testing in 40 CFR part 1065:

(1) In 40 CFR 1065.2 we give an overview of principles for reporting information.

(2) In 40 CFR 1065.10 and 1065.12 we specify information needs for establishing various changes to published test procedures.

(3) In 40 CFR 1065.25 we establish basic guidelines for storing test information.

(4) In 40 CFR 1065.695 we identify data that may be appropriate for collecting during testing of in-use engines using portable analyzers.

(c) We specify the following requirements related to the general compliance provisions in 40 CFR part 1068:

(1) In 40 CFR 1068.5 we establish a process for evaluating good engineering judgment related to testing and certification.

(2) In 40 CFR 1068.25 we describe general provisions related to sending and keeping information.

(3) In 40 CFR 1068.27 we require manufacturers to make engines available for our testing or inspection if we make such a request.

(4) In 40 CFR 1068.105 we require vessel manufacturers to keep certain records related to duplicate labels from engine manufacturers.

(5) In 40 CFR 1068.120 we specify recordkeeping related to rebuilding engines.

(6) In 40 CFR part 1068, subpart C, we identify several reporting and recordkeeping items for making demonstrations and getting approval related to various exemptions.

(7) In 40 CFR part 1068, subpart D, we identify several reporting and recordkeeping items for making demonstrations and getting approval related to importing engines.

(8) In 40 CFR 1068.450 and 1068.455 we specify certain records related to testing production-line engines in a selective enforcement audit.

(9) In 40 CFR 1068.501 we specify certain records related to investigating and reporting emission-related defects.

(10) In 40 CFR 1068.525 and 1068.530 we specify certain records related to recalling nonconforming engines.

Appendix I to Part 1042—Summary of Previous Emission Standards

The following standards apply to marine compression-ignition engines produced before the model years specified in § 1042.1:

(a) *Engines below 37 kW.* Tier 1 and Tier 2 standards for engines below 37 kW apply as specified in 40 CFR part 89 and summarized in the following table:

TABLE 1 OF APPENDIX I.—EMISSION STANDARDS FOR ENGINES BELOW 37 KW (G/KW-HR)

Rated power (kW)	Tier	Model year1	NMHC + NO_X	CO	PM
kW<8	Tier 1	2000	10.5	8.0	1.0
	Tier 2	2005	7.5	8.0	0.80
8=kW<19	Tier 1	2000	9.5	6.6	0.80
	Tier 2	2005	7.5	6.6	0.80
19=kW<37	Tier 1	1999	9.5	5.5	0.8
	Tier 2	2004	7.5	5.5	0.6

(b) *Engines at or above 37 kW.* Tier 1 and Tier 2 standards for engines at or above 37 kW apply as specified in 40 CFR part 94 and summarized as follows:

(1) *Tier 1 standards.* NO_X emissions from model year 2004 and later engines with displacement of 2.5 or more liters per cylinder may not exceed the following values:

(i) 17.0 g/kW-hr when maximum test speed is less than 130 rpm.

(ii) $45.0 \times N^{-0.20}$ when maximum test speed is at least 130 but less than 2000 rpm, where N is the maximum test speed of the engine in revolutions per minute. Round the calculated standard to the nearest 0.1 g/kW-hr.

(ii) 9.8 g/kW-hr when maximum test speed is 2000 rpm or more.

(2) *Tier 2 primary standards.* Exhaust emissions may not exceed the values shown in the following table:

TABLE 2 OF APPENDIX I.—PRIMARY TIER 2 EMISSION STANDARDS FOR COMMERCIAL AND RECREATIONAL MARINE ENGINES AT OR ABOVE 37 KW (G/KW-HR)

Engine Size liters/cylinder, rated power	Maximum engine power	Category	Model year	THC+NO_X g/kW-hr	CO g/kW-hr	PM g/kW-hr
disp. < 0.9	power ≡ 37 kW	Category 1	2005	7.5	5.0	0.40
0.9 = disp. < 1.2	All	Category 1	2004	7.2	5.0	0.30
1.2 = disp. < 2.5	All	Category 1	2004	7.2	5.0	0.20
2.5 = disp. < 5.0	All	Category 1	2007	7.2	5.0	0.20
5.0 = disp. < 15.0	All	Category 2	2007	7.8	5.0	0.27
15.0 = disp. < 20.0	power < 3300 kW	Category 2	2007	8.7	5.0	0.50
15.0 = disp. < 20.0	power ≡ 3300 kW	Category 2	2007	9.8	5.0	0.50
20.0 = disp. < 25.0	All	Category 2	2007	9.8	5.0	0.50
25.0 = disp. < 30.0	All	Category 2	2007	11	5	0.5

(3) *Tier 2 supplemental standards.* Not-to-exceed emission standards apply for Tier 2 engines as specified in 40 CFR 94.8(e).

Appendix II to Part 1042—Steady-State Duty Cycles

(a) Test commercial propulsion engines with maximum engine power at or above 19 kW that are used with (or intended to be used with) fixed-pitch propellers with one of the cycles specified in this paragraph (a). Use one of these duty cycles also for any other engines for which the other duty cycles of this appendix do not apply.

(1) The following duty cycle applies for discrete-mode testing:

E3 mode number	Engine speed [1]	Percent of maximum test power	Weighting factors
1	Maximum test	100	0.2
2	91%	75	0.5
3	80%	50	0.15
4	63%	25	0.15

[1] Speed terms are defined in 40 CFR part 1065. Percent speed values are relative to maximum test speed.

(2) The following duty cycle applies for ramped-modal testing:

RMC mode	Time in mode (seconds)	Engine speed [1 3]	Power (percent) [2 3]
1a Steady-state	229	Maximum test speed	100%.
1b Transition	20	Linear transition	Linear transition in torque.
2a Steady-state	166	63%	25%.
2b Transition	20	Linear transition	Linear transition in torque.
3a Steady-state	570	91%	75%.
3b Transition	20	Linear transition	Linear transition in torque.
4a Steady-state	175	80%	50%.

[1] Speed terms are defined in 40 CFR part 1065. Percent speed is relative to maximum test speed.
[2] The percent power is relative to the maximum test power.
[3] Advance from one mode to the next within a 20-second transition phase. During the transition phase, command a linear progression from the torquesetting of the current mode to the torque setting of the next mode, and simultaneously command a similar linear progression for engine speed if there is a change in speed setting.

(b) Test recreational engines that are used with (or intended to be used with) fixed-pitch propellers with maximum engine power at or above 19 kW with one of the following steady-state duty cycles:

(1) The following duty cycle applies for discrete-mode testing:

E5 mode number	Engine speed [1]	Percent of maximum test power	Weighting factors
1	Maximum test	100	0.08
2	91%	75	0.13
3	80%	50	0.17
4	63%	25	0.32
5	Idle	0	0.3

[1] Speed terms are defined in 40 CFR part 1065. Percent speed values are relative to maximum test speed.

(2) The following duty cycle applies for ramped-modal testing:

RMC mode	Time in mode (seconds)	Engine speed [1 3]	Power (percent) [2 3]
1a Steady-state	167	Warm Idle	0.
1b Transition	20	Linear transition	Linear transition in torque.
2a Steady-state	85	Maximum test speed	100%.
2b Transition	20	Linear transition	Linear transition in torque.
3a Steady-state	354	63%	25%.
3b Transition	20	Linear transition	Linear transition in torque.
4a Steady-state	141	91%	75%.
4b Transition	20	Linear transition	Linear transition in torque.
5a Steady-state	182	80%	50%.
5b Transition	20	Linear transition	Linear transition in torque.
6 Steady-state	171	Warm Idle	0.

[1] Speed terms are defined in 40 CFR part 1065. Percent speed is relative to maximum test speed.
[2] The percent power is relative to the maximum test power.

[3] Advance from one mode to the next within a 20-second transition phase. During the transition phase, command a linear progression from the torque setting of the current mode to the torque setting of the next mode, and simultaneously command a similar linear progression for engine speed if there is a change in speed setting.

(c) Test any constant-speed/propulsion engines that are used with (or intended to be used with) variable-pitch propellers or with electrically coupled propellers with one of the following steady-state duty cycles:

(1) The following duty cycle applies for discrete-mode testing:

E2 mode number	Engine speed [1]	Observed torque (percent) [2]	Weighting factors
1	Engine Governed	100	0.2
2	Engine Governed	75	0.5
3	Engine Governed	50	0.15
4	Engine Governed	25	0.15

[1] Speed terms are defined in 40 CFR part 1065.
[2] The percent torque is relative to the maximum test torque as defined in 40 CFR part 1065.

(2) The following duty cycle applies for ramped-modal testing:

RMC mode	Time in mode (seconds)	Engine speed	Torque (percent) [1 2]
1a Steady-state	234	Engine Governed	100%.
1b Transition	20	Engine Governed	Linear transition.
2a Steady-state	571	Engine Governed	25%.
2b Transition	20	Engine Governed	Linear transition.
3a Steady-state	165	Engine Governed	75%.
3b Transition	20	Engine Governed	Linear transition.
4a Steady-state	170	Engine Governed	50%.

[1] The percent torque is relative to the maximum test torque as defined in 40 CFR part 1065.
[2] Advance from one mode to the next within a 20-second transition phase. During the transition phase, command a linear progression from the torque setting of the current mode to the torque setting of the next mode.

Appendix III to Part 1042—Not-to-Exceed Zones

(a) The following Figure 1 illustrates the default NTE zone for commercial marine engines certified using the duty cycle specified in § 1042.505(b)(1):

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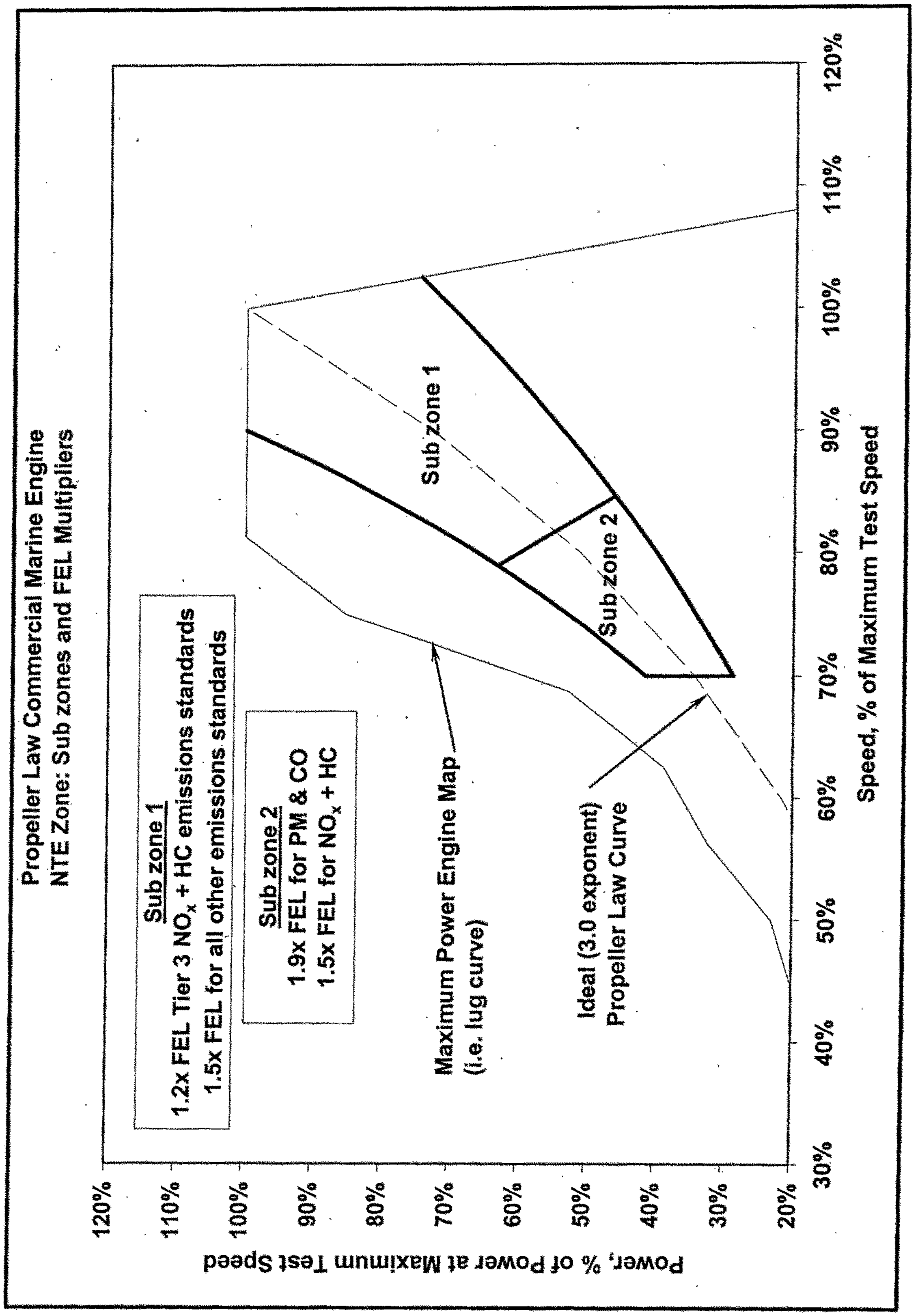

Figure 1 of Appendix III

(1) Subzone 1 is defined as follows, where percent power is equal to the percentage of the maximum power achieved at Maximum Test Speed and percent speed is the percentage of Maximum Test Speed:

(i) Percent power > 0.7 × (percent speed)^2.5, and

(ii) Percent power < (percent speed/0.9)^3.5, and

(iii) Percent power > 3.0. × (100% − percent speed).

(2) Sub zone 2 is defined as follows, where percent power is equal to the percentage of the maximum power achieved at Maximum Test Speed and percent speed is the percentage of Maximum Test Speed:

(i) Percent power > 0.7 × (percent speed)^2.5, and

(ii) Percent power < (percent speed/0.9)^3.5, and

(iii) Percent power > 3.0. × (100% − percent speed), and

(iv) Percent power > 70% of Maximum Test Speed.

(b) The following Figure 2 illustrates the defaut NTE zone for recreational marine propulsion engines that are used with (or intended to be used with) fixed-pitch propellers:

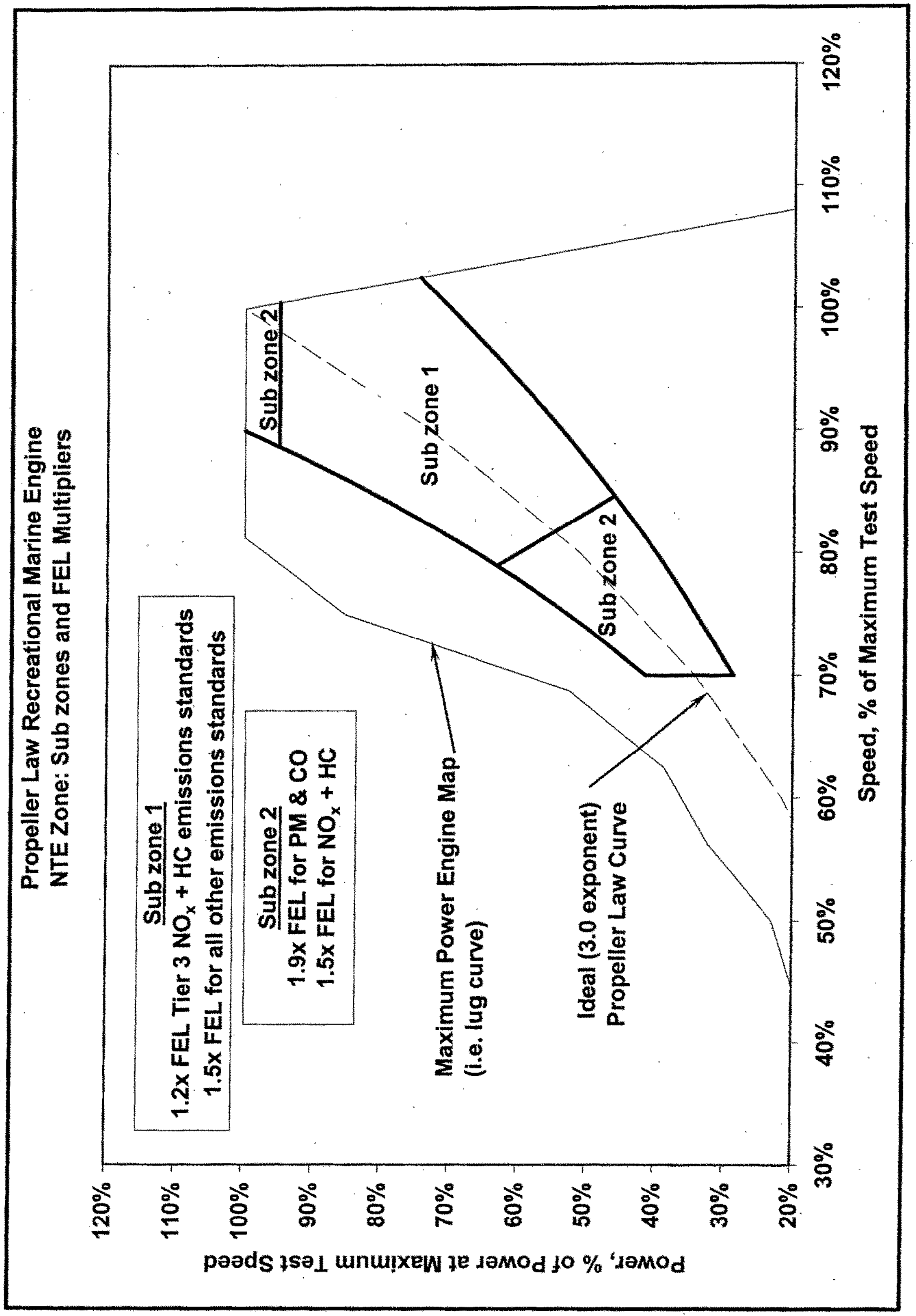

Figure 2 of Appendix III

(1) Sub zone 1 is defined as follows, where percent power is equal to the percentage of the maximum power achieved at Maximum Test Speed and percent speed is the percentage of Maximum Test Speed:

(i) Percent power > 0.7 × (percent speed)^2.5, and

(ii) Percent power < (percent speed/0.9)^3.5, and

(iii) Percent power > 3.0 × (100% − percent speed).

(iv) Percent power < 95% of the maximum power at Maximum Text Speed.

(2) Sub zone 2 is defined as follows, where percent power is equal to the percentage of the maximum power achieved at Maximum Test Speed and percent speed is the percentage of Maximum Test Speed:

(i) Percent power > 0.7 × (percent speed)^2.5, and

(ii) Percent power < (percent speed/0.9)^3.5, and

(iii) Percent power < 3.0 × (100% − percent speed), and

(iv) Percent speed > 70% of Maximum Test Speed.

(v) Any power > 95% of the maximum power at Maximum Test Speed

(c) The following Figure 3 illustrates the default NTE zone for constant speed engines certified using either the duty cycle specified in § 1042.505(b)(3)(I) or in § 1042.505(b)(4)(i):

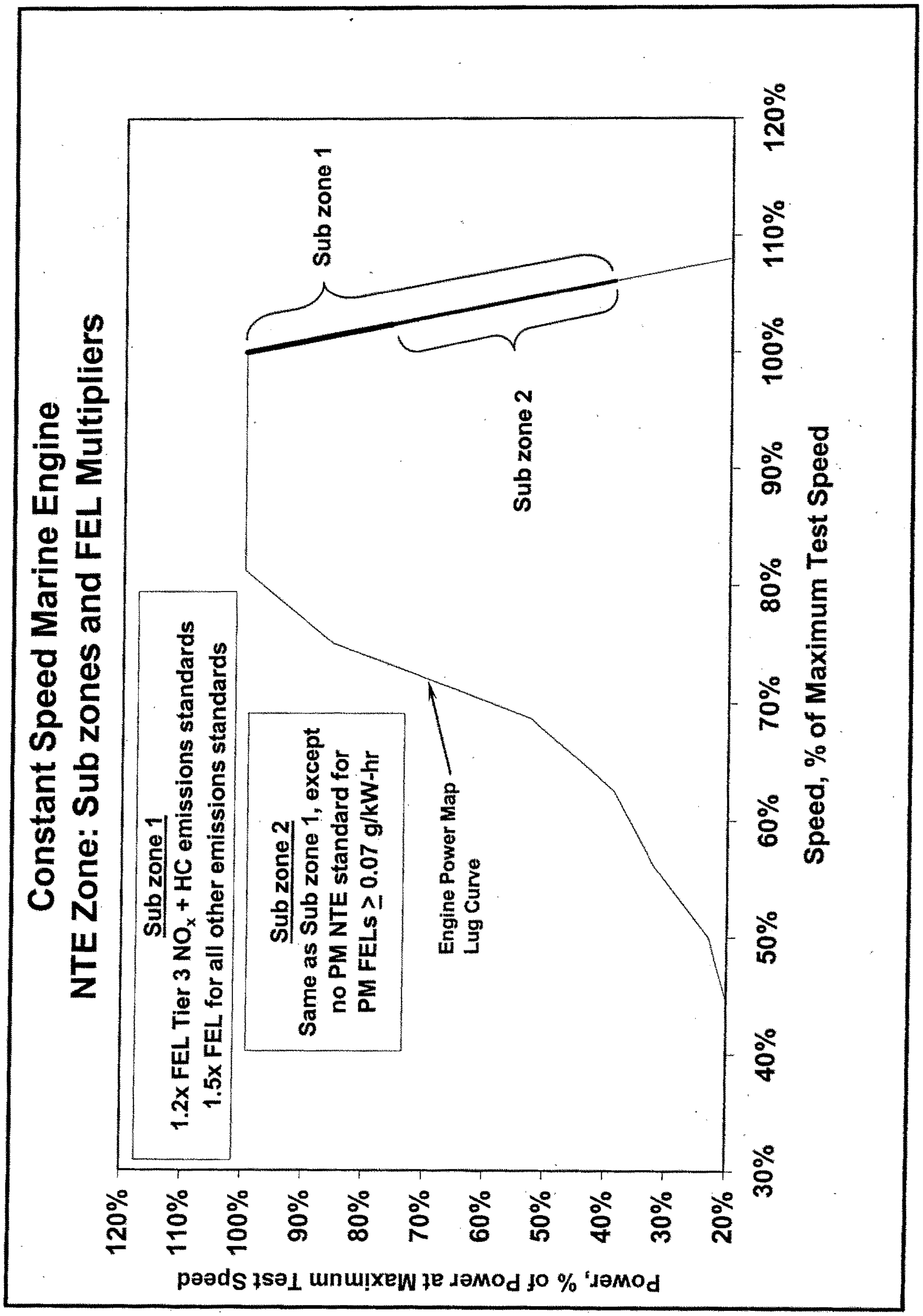

Figure 3 of Appendix III

(1) Subzone 1 is defined in § 1039.101(e).

(2) Subzone 2 is defined in § 1039.515(b).

(d) The following Figure 4 illustrates the default NTE zone for variable speed and load engines certified using either the duty cycle specified in § 1042.505(b)(3)(ii) or in § 1042.505(b)(4)(ii):

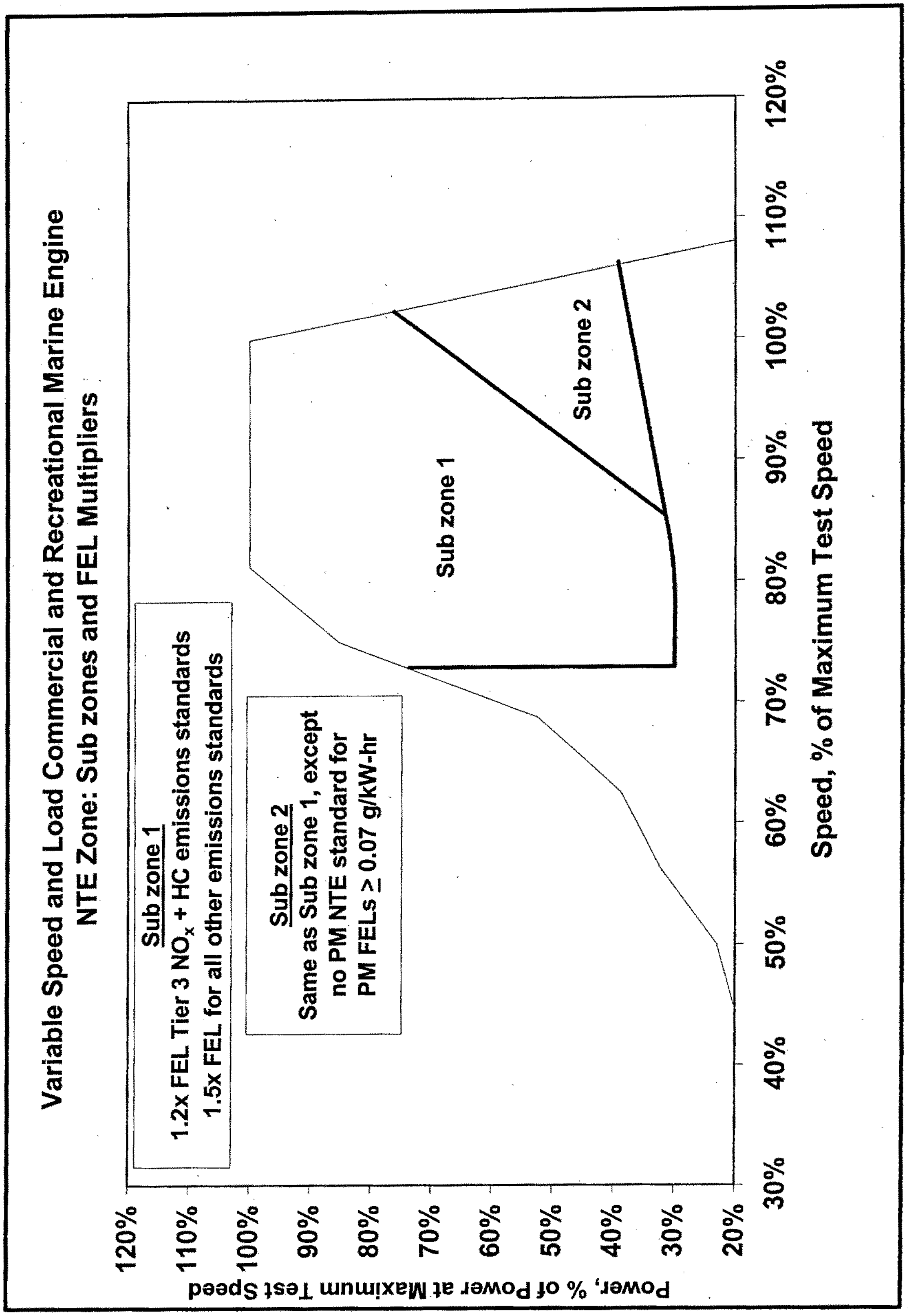

Figure 4 of Appendix III

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(1) Subzone 1 is defined in § 1039.101(e).
(2) Subzone 2 is defined in § 1039.515(b).

PART 1065—ENGINE-TESTING PROCEDURES

14. The authority citation for part 1065 continues to read as follows:

Authority: 42 U.S.C. 7401–7671q.

Subpart A—[Amended]

15. Section 1065.1 is revised to read as follows:

§ 1065.1 Applicability.

(a) This part describes the procedures that apply to testing we require for the following engines or for vehicles using the following engines:

(1) Locomotives we regulate under 40 CFR part 1033. For earlier model years, manufacturers may use the test procedures in this part or those specified in 40 CFR part 92 according to § 1065.10.

(2) Model year 2010 and later heavy-duty highway engines we regulate under 40 CFR part 86. For earlier model years, manufacturers may use the test procedures in this part or those specified in 40 CFR part 86, subpart N, according to § 1065.10.

(3) Nonroad diesel engines we regulate under 40 CFR part 1039 and stationary diesel engines that are certified to the standards in 40 CFR part 1039 as specified in 40 CFR part 60, subpart IIII. For earlier model years, manufacturers may use the test procedures in this part or those specified in 40 CFR part 89 according to § 1065.10.

(4) Marine diesel engines we regulate under 40 CFR part 1042. For earlier model years, manufacturers may use the test procedures in this part or those specified in 40 CFR part 94 according to § 1065.10.

(5) Marine spark-ignition engines we regulate under 40 CFR part 1045. For earlier model years, manufacturers may use the test procedures in this part or those specified in 40 CFR part 91 according to § 1065.10.

(6) Large nonroad spark-ignition engines we regulate under 40 CFR part 1048, and stationary engines that are certified to the standards in 40 CFR part 1048 as specified in 40 CFR part 60, subpart JJJJ.

(7) Vehicles we regulate under 40 CFR part 1051 (such as snowmobiles and off-highway motorcycles) based on engine testing. See 40 CFR part 1051, subpart F, for standards and procedures that are based on vehicle testing.

(8) Small nonroad spark-ignition engines we regulate under 40 CFR part 1054 and stationary engines that are certified to the standards in 40 CFR part 1054 as specified in 40 CFR part 60, subpart JJJJ. For earlier model years, manufacturers may use the test procedures in this part or those specified in 40 CFR part 90 according to § 1065.10.

(b) The procedures of this part may apply to other types of engines, as described in this part and in the standard-setting part.

(c) This part is addressed to you as a manufacturer of engines, vehicles, equipment, and vessels, but it applies equally to anyone who does testing for you. For example, if you manufacture engines that must be tested according to this part, this part applies to you. This part is also addressed to any manufacturer or supplier of test equipment, instruments, supplies, or any other goods or services related to the procedures, requirements, recommendations, or options in this part. For example, if you are an instrument manufacturer, this part applies to you.

(d) Paragraph (a) of this section identifies the parts of the CFR that define emission standards and other requirements for particular types of engines. In this part, we refer to each of these other parts generically as the ''standard-setting part.'' For example, 40 CFR part 1051 is always the standard-setting part for snowmobiles.

(e) Unless we specify otherwise, the terms ''procedures'' and ''test procedures'' in this part include all aspects of engine testing, including the equipment specifications, calibrations, calculations, and other protocols and procedural specifications needed to measure emissions.

(f) For vehicles, equipment, or vessels subject to this part and regulated under vehicle-based, equipment-based, or vessel-based standards, use good engineering judgment to interpret the term ''engine'' in this part to include vehicles, equipment, or vessels, where appropriate.

(g) For additional information regarding these test procedures, visit our Web site at *http://www.epa.gov,* and in particular *http://www.epa.gov/otaq/testingregs.htm.*

16. Section 1065.2 is amended by revising paragraph (c) to read as follows:

§ 1065.2 Submitting information to EPA under this part.

* * * * *

(c) We may void any certificates or approvals associated with a submission of information if we find that you intentionally submitted false, incomplete, or misleading information. For example, if we find that you intentionally submitted incomplete information to mislead EPA when requesting approval to use alternate test procedures, we may void the certificates for all engines families certified based on emission data collected using the alternate procedures. This would also apply if you ignore data from incomplete tests or from repeat tests with higher emission results.

* * * * *

17. Section 1065.5 is revised to read as follows:

§ 1065.5 Overview of this part 1065 and its relationship to the standard-setting part.

(a) This part specifies procedures that apply generally to testing various categories of engines. See the standard-setting part for directions in applying specific provisions in this part for a particular type of engine. Before using this part's procedures, read the standard-setting part to answer at least the following questions:

(1) What duty cycles must I use for laboratory testing?

(2) Should I warm up the test engine before measuring emissions, or do I need to measure cold-start emissions during a warm-up segment of the duty cycle?

(3) Which exhaust gases do I need to measure?

(4) Do any unique specifications apply for test fuels?

(5) What maintenance steps may I take before or between tests on an emission-data engine?

(6) Do any unique requirements apply to stabilizing emission levels on a new engine?

(7) Do any unique requirements apply to test limits, such as ambient temperatures or pressures?

(8) Is field testing required or allowed, and are there different emission standards or procedures that apply to field testing?

(9) Are there any emission standards specified at particular engine-operating conditions or ambient conditions?

(10) Do any unique requirements apply for durability testing?

(b) The testing specifications in the standard-setting part may differ from the specifications in this part. In cases where it is not possible to comply with both the standard-setting part and this part, you must comply with the specifications in the standard-setting part. The standard-setting part may also allow you to deviate from the procedures of this part for other reasons.

(c) The following table shows how this part divides testing specifications into subparts:

TABLE 1 OF § 1065.5—DESCRIPTION OF PART 1065 SUBPARTS

This subpart	Describes these specifications or procedures
Subpart A	Applicability and general provisions.
Subpart B	Equipment for testing.
Subpart C	Measurement instruments for testing.
Subpart D	Calibration and performance verifications for measurement systems.
Subpart E	How to prepare engines for testing, including service accumulation.
Subpart F	How to run an emission test over a predetermined duty cycle.
Subpart G	Test procedure calculations.
Subpart H	Fuels, engine fluids, analytical gases, and other calibration standards.
Subpart I	Special procedures related to oxygenated fuels.
Subpart J	How to test with portable emission measurement systems (PEMS).

18. Section 1065.10 is amended by revising paragraphs (c)(1) introductory text and (c)(7) introductory text to read as follows:

§ 1065.10 Other procedures.

* * * * *

(c) * * *

(1) The objective of the procedures in this part is to produce emission measurements equivalent to those that would result from measuring emissions during in-use operation using the same engine configuration as installed in a vehicle, equipment, or vessel. However, in unusual circumstances these procedures may result in measurements that do not represent in-use operation. You must notify us if good engineering judgment indicates that the specified procedures cause unrepresentative emission measurements for your engines. Note that you need not notify us of unrepresentative aspects of the test procedure if measured emissions are equivalent to in-use emissions. This provision does not obligate you to pursue new information regarding the different ways your engine might operate in use, nor does it obligate you to collect any other in-use information to verify whether or not these test procedures are representative of your engine's in-use operation. If you notify us of unrepresentative procedures under this paragraph (c)(1), we will cooperate with you to establish whether and how the procedures should be appropriately changed to result in more representative measurements. While the provisions of this paragraph (c)(1) allow us to be responsive to issues as they arise, we would generally work toward making these testing changes generally applicable through rulemaking. We will allow reasonable lead time for compliance with any resulting change in procedures. We will consider the following factors in determining the importance of pursuing changes to the procedures:

* * * * *

(7) You may request to use alternate procedures, or procedures that are more accurate or more precise than the allowed procedures. The following provisions apply to requests for alternate procedures:

* * * * *

19. Section 1065.12 is amended by revising paragraphs (a) and (d)(1) to read as follows:

§ 1065.12 Approval of alternate procedures.

(a) To get approval for an alternate procedure under § 1065.10(c), send the Designated Compliance Officer an initial written request describing the alternate procedure and why you believe it is equivalent to the specified procedure. Anyone may request alternate procedure approval. This means that an individual engine manufacturer may request to use an alternate procedure. This also means that an instrument manufacturer may request to have an instrument, equipment, or procedure approved as an alternate procedure to those specified in this part. We may approve your request based on this information alone, or, as described in this section, we may ask you to submit to us in writing supplemental information showing that your alternate procedure is consistently and reliably at least as accurate and repeatable as the specified procedure.

* * * * *

(d) * * *

(1) Theoretical basis. Give a brief technical description explaining why you believe the proposed alternate procedure should result in emission measurements equivalent to those using the specified procedure. You may include equations, figures, and references. You should consider the full range of parameters that may affect equivalence. For example, for a request to use a different NO_X measurement procedure, you should theoretically relate the alternate detection principle to the specified detection principle over the expected concentration ranges for NO, NO_2, and interference gases. For a request to use a different PM measurement procedure, you should explain the principles by which the alternate procedure quantifies particulate mass similarly to the specified procedures.

* * * * *

20. Section 1065.15 is amended by revising paragraphs (c)(1) and (e) to read as follows:

§ 1065.15 Overview of procedures for laboratory and field testing.

* * * * *

(c) * * *

(1) Engine operation. Engine operation is specified over a test interval. A test interval is the time over which an engine's total mass of emissions and its total work are determined. Refer to the standard-setting part for the specific test intervals that apply to each engine. Testing may involve measuring emissions and work during the following types of engine operation:

(i) Laboratory testing. Under this type of testing, you determine brake-specific emissions for duty-cycle testing by using an engine dynamometer in a laboratory or other environment. This typically consists of one or more test intervals, each defined by a duty cycle, which is a sequence of modes, speeds, and/or torques that an engine must follow. If the standard-setting part allows it, you may also simulate field testing by running on an engine dynamometer in a laboratory or other environment.

(ii) Field testing. This type of testing consists of normal in-use engine operation while an engine is installed in a vehicle, equipment, or vessel. The standard-setting part specifies how test intervals are defined for field testing.

* * * * *

(e) The following figure illustrates the allowed measurement configurations described in this part 1065:

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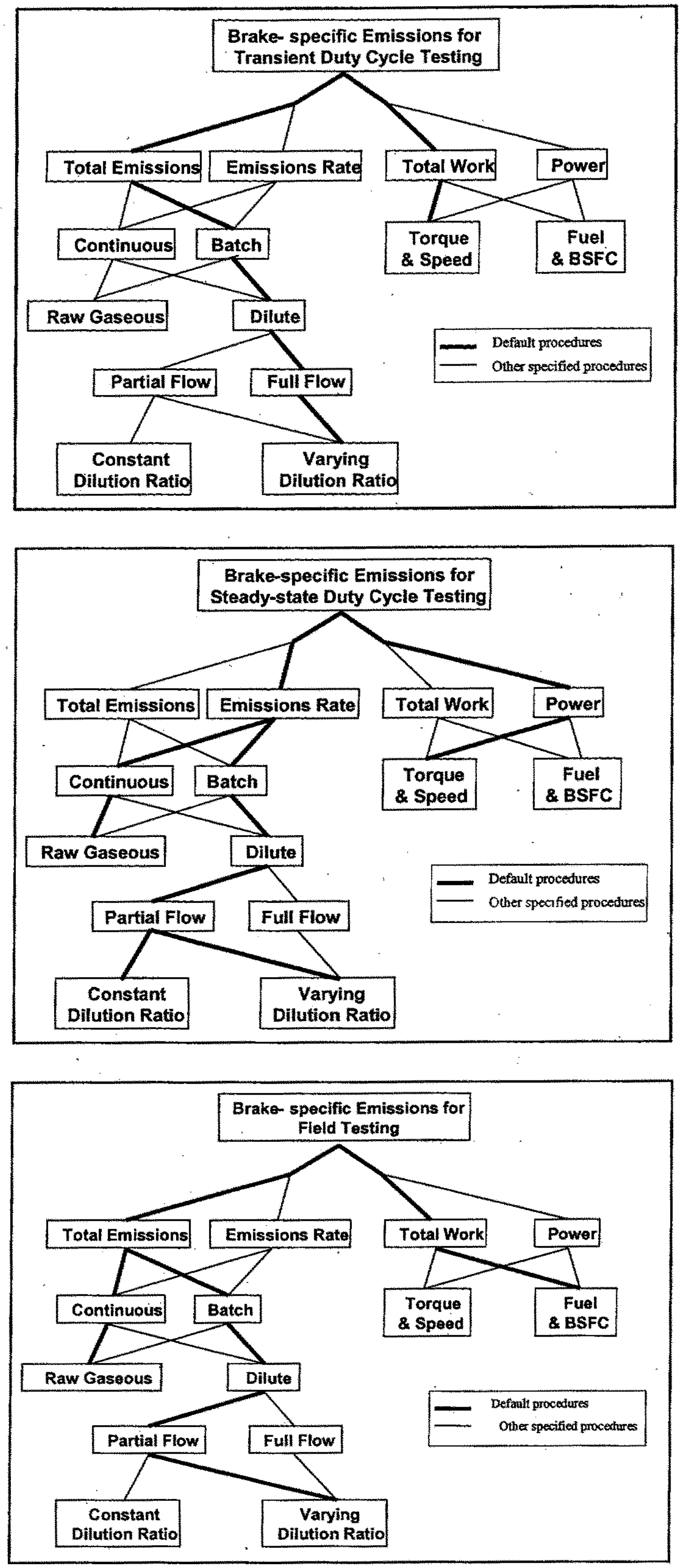
Figure 1 of §1065.15—Default test procedures and other specified procedures.



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21. Section 1065.20 is amended by revising paragraphs (f) and (g) to read as follows:

§ 1065.20 Units of measure and overview of calculations.

* * * * *

(f) Interpretation of ranges. Interpret a range as a tolerance unless we explicitly identify it as an accuracy, repeatability, linearity, or noise specification. See § 1065.1001 for the definition of tolerance. In this part, we specify two types of ranges:

(1) Whenever we specify a range by a single value and corresponding limit values above and below that value, target any associated control point to that single value. Examples of this type of range include ''±10% of maximum pressure'', or ''(30 ± 10) kPa''.

(2) Whenever we specify a range by the interval between two values, you may target any associated control point to any value within that range. An example of this type of range is ''(40 to 50) kPa''.

(g) Scaling of specifications with respect to an applicable standard. Because this part 1065 is applicable to a wide range of engines and emission standards, some of the specifications in this part are scaled with respect to an engine's applicable standard or maximum power. This ensures that the specification will be adequate to determine compliance, but not overly burdensome by requiring unnecessarily high-precision equipment. Many of these specifications are given with respect to a ''flow-weighted mean'' that is expected at the standard or during testing. Flow-weighted mean is the mean of a quantity after it is weighted proportional to a corresponding flow rate. For example, if a gas concentration is measured continuously from the raw exhaust of an engine, its flow-weighted mean concentration is the sum of the products of each recorded concentration times its respective exhaust flow rate, divided by the sum of the recorded flow rates. As another example, the bag concentration from a CVS system is the same as the flow-weighted mean concentration, because the CVS system itself flow-weights the bag concentration. Refer to § 1065.602 for information needed to estimate and calculate flow-weighted means. Wherever a specification is scaled to a value based upon an applicable standard, interpret the standard to be the family emission limit if the engine is certified under an emission credit program in the standard-setting part.

Subpart B—[Amended]

22. Section 1065.101 is amended by revising paragraph (a) to read as follows:

§ 1065.101 Overview.

(a) This subpart specifies equipment, other than measurement instruments, related to emission testing. The provisions of this subpart apply for all testing in laboratories or other environments where engine speeds and loads are controlled to follow a prescribed duty cycle. See subpart J of this part to determine which of the provisions of this subpart apply for field testing. This equipment includes three broad categories—dynamometers, engine fluid systems (such as fuel and intake-air systems), and emission-sampling hardware.

* * * * *

23. Section 1065.110 is amended by revising paragraphs (a) and (e) to read as follows:

§ 1065.110 Work inputs and outputs, accessory work, and operator demand.

(a) *Work.* Use good engineering judgment to simulate all engine work inputs and outputs as they typically would operate in use. Account for work inputs and outputs during an emission test by measuring them; or, if they are small, you may show by engineering analysis that disregarding them does not affect your ability to determine the net work output by more than ±0.5% of the net expected work output over the test interval. Use equipment to simulate the specific types of work, as follows:

(1) Shaft work. Use an engine dynamometer that is able to meet the cycle-validation criteria in § 1065.514 over each applicable duty cycle.

(i) You may use eddy-current and water-brake dynamometers for any testing that does not involve engine motoring, which is identified by negative torque commands in a reference duty cycle. See the standard setting part for reference duty cycles that are applicable to your engine.

(ii) You may use alternating-current or direct-current motoring dynamometers for any type of testing.

(iii) You may use one or more dynamometers.

(iv) You may use any device that is already installed on a vehicle, equipment, or vessel to absorb work from the engine's output shaft(s). Examples of these types of devices include a vessel's propeller and a locomotive's generator.

(2) Electrical work. Use one or more of the following to simulate electrical work:

(i) Use storage batteries or capacitors that are of the type and capacity installed in use.

(ii) Use motors, generators, and alternators that are of the type and capacity installed in use.

(iii) Use a resistor load bank to simulate electrical loads.

(3) Pump, compressor, and turbine work. Use pumps, compressors, and turbines that are of the type and capacity installed in use. Use working fluids that are of the same type and thermodynamic state as normal in-use operation.

* * * * *

(e) *Operator demand for shaft work.* Operator demand is defined in § 1065.1001. Command the operator demand and the dynamometer(s) to follow a prescribed duty cycle with set points for engine speed and torque at 5 Hz (or more frequently) for transient testing or 1 Hz (or more frequently) for steady-state testing. Refer to the standard-setting part to determine the specifications for your duty cycle(s). Use a mechanical or electronic input to control operator demand such that the engine is able to meet the validation criteria in § 1065.514 over each applicable duty cycle. Record feedback values for engine speed and torque at 5 Hz or more frequently for evaluating performance relative to the cycle validation criteria. Using good engineering judgment, you may improve control of operator demand by altering on-engine speed and torque controls. However, if these changes result in unrepresentative testing, you must notify us and recommend other test procedures under § 1065.10(c)(1).

24. Section 1065.120 is amended by revising paragraph (a) to read as follows:

§ 1065.120 Fuel properties and fuel temperature and pressure.

(a) Use fuels as specified in the standard-setting part, or as specified in subpart H of this part if fuels are not specified in the standard-setting part.

* * * * *

25. Section 1065.122 is amended by revising paragraphs (a) introductory text and (a)(1) to read as follows:

§ 1065.122 Engine cooling and lubrication.

(a) *Engine cooling.* Cool the engine during testing so its intake-air, oil, coolant, block, and head temperatures are within their expected ranges for normal operation. You may use auxiliary coolers and fans.

(1) For air-cooled engines only, if you use auxiliary fans you must account for work input to the fan(s) according to § 1065.110.

* * * * *

26. Section 1065.125 is revised to read as follows:

§ 1065.125 Engine intake air.

(a) Use the intake-air system installed on the engine or one that represents a typical in-use configuration. This includes the charge-air cooling and exhaust gas recirculation systems.

(b) Measure temperature, humidity, and atmospheric pressure near the entrance to the engine's air filter, or at the inlet to the air intake system for engines that have no air filter. You may use a shared atmospheric pressure meter as long as your equipment for handling intake air maintains ambient pressure where you test the engine within ±1 kPa of the shared atmospheric pressure. You may use a shared humidity measurement for intake air as long as your equipment for handling intake air maintains dewpoint where you test the engine to within ±0.5 °C of the shared humidity measurement.

(c) Unless stated otherwise in the standard-setting part, maintain the temperature of intake air to (25 ± 5) °C, as measured upstream of any engine component.

(d) Use an intake-air restriction that represents production engines. Make sure the intake-air restriction is between the manufacturer's specified maximum for a clean filter and the manufacturer's specified maximum allowed. Measure the static differential pressure of the restriction at the location and at the speed and torque set points specified by the manufacturer. If the manufacturer does not specify a location, measure this pressure upstream of any turbocharger or exhaust gas recirculation system connection to the intake air system. If the manufacturer does not specify speed and torque points, measure this pressure while the engine outputs maximum power. As the manufacturer, you are liable for emission compliance for all values up to the maximum restriction you specify for a particular engine. (e) This paragraph (e) includes provisions for simulating charge-air cooling in the laboratory. This approach is described in paragraph (e)(1) of this section. Limits on using this approach are described in paragraphs (e)(2) and (3) of this section.

(1) Use a charge-air cooling system with a total intake-air capacity that represents production engines' in-use installation. Design any laboratory charge-air cooling system to minimize accumulation of condensate. Drain any accumulated condensate before emission testing. Modulate any condensate drain during an emission test as it would normally operate in use. Maintain coolant conditions as follows:

(i) Maintain a coolant temperature of at least 20 °C at the inlet to the charge-air cooler throughout testing.

(ii) At the engine conditions specified by the manufacturer, set the coolant flow rate to achieve an air temperature within ±5 °C of the value specified by the manufacturer at the charge-air cooler's outlet. Measure the air-outlet temperature at the location specified by the manufacturer. Use this coolant flow rate set point throughout testing. If the engine manufacturer does not specify engine conditions or the corresponding charge-air cooler air outlet temperature, set the coolant flow rate at maximum engine power to achieve a charge-air cooler air outlet temperature that represents in-use operation.

(iii) If the engine manufacturer specifies pressure-drop limits across the charge-air cooling system, ensure that the pressure drop across the charge-air cooling system at engine conditions specified by the manufacturer is within the manufacturer's specified limit(s). Measure the pressure drop at the manufacturer's specified locations.

(2) The objective of this section is to produce emission results that are representative of in-use operation. If good engineering judgment indicates that the specifications in this section would result in unrepresentative testing (such as overcooling of the intake air), you may use more sophisticated setpoints and controls of charge-air pressure drop, coolant temperature, and flowrate to achieve more representative results.

(3) This approach does not apply for field testing. You may not correct measured emission levels from field testing to account for any differences caused by the simulated cooling in the laboratory.

27. Section 1065.130 is revised to read as follows:

§ 1065.130 Engine exhaust.

(a) *General.* Use the exhaust system installed with the engine or one that represents a typical in-use configuration. This includes any applicable aftertreatment devices.

(b) *Aftertreatment configuration.* If you do not use the exhaust system installed with the engine, configure any aftertreatment devices as follows:

(1) Position any aftertreatment device so its distance from the nearest exhaust manifold flange or turbocharger outlet is within the range specified by the engine manufacturer in the application for certification. If this distance is not specified, position aftertreatment devices to represent typical in-use vehicle configurations.

(2) You may use laboratory exhaust tubing upstream of any aftertreatment device that is of diameter(s) typical of in-use configurations. If you use laboratory exhaust tubing upstream of any aftertreatment device, position each aftertreatment device according to paragraph (b)(1) of this section.

(c) *Sampling system connections.* Connect an engine's exhaust system to any raw sampling location or dilution stage, as follows:

(1) Minimize laboratory exhaust tubing lengths and use a total length of laboratory tubing of no more than 10 m or 50 outside diameters, whichever is greater. If laboratory exhaust tubing consists of several different outside tubing diameters, count the number of diameters of length of each individual diameter, then sum all the diameters to determine the total length of exhaust tubing in diameters. Use the mean outside diameter of any converging or diverging sections of tubing. Use outside hydraulic diameters of any noncircular sections.

(2) You may install short sections of flexible laboratory exhaust tubing at any location in the engine or laboratory exhaust systems. You may use up to a combined total of 2 m or 10 outside diameters of flexible exhaust tubing.

(3) Insulate any laboratory exhaust tubing downstream of the first 25 outside diameters of length.

(4) Use laboratory exhaust tubing materials that are smooth-walled, electrically conductive, and not reactive with exhaust constituents. Stainless steel is an acceptable material.

(5) We recommend that you use laboratory exhaust tubing that has either a wall thickness of less than 2 mm or is air gap-insulated to minimize temperature differences between the wall and the exhaust.

(6) We recommend that you connect multiple exhaust stacks from a single engine into one stack upstream of any emission sampling. To ensure mixing of the multiple exhaust streams before emission sampling, you may configure the exhaust system with turbulence generators, such as orifice plates or fins, to achieve good mixing. We recommend a minimum Reynolds number, Re#, of 4000 for the combined exhaust stream, where Re# is based on the inside diameter of the single stack. Re# is defined in § 1065.640.

(d) *In-line instruments.* You may insert instruments into the laboratory exhaust tubing, such as an in-line smoke meter. If you do this, you may leave a length of up to 5 outside diameters of laboratory exhaust tubing uninsulated on each side of each instrument, but you must leave a length of no more than 25 outside diameters of laboratory exhaust tubing uninsulated in total, including any lengths adjacent to in-line instruments.

(e) *Leaks.* Minimize leaks sufficiently to ensure your ability to demonstrate compliance with the applicable standards. We recommend performing a chemical balance of fuel, intake air, and exhaust according to § 1065.655 to verify exhaust system integrity.

(f) *Grounding.* Electrically ground the entire exhaust system.

(g) *Forced cooldown.* You may install a forced cooldown system for an exhaust aftertreatment device according to § 1065.530(a)(1)(i).

(h) *Exhaust restriction.* As the manufacturer, you are liable for emission compliance for all values up to the maximum restriction(s) you specify for a particular engine. Measure and set exhaust restriction(s) at the location(s) and at the speed, torque and aftertreatment set points specified by the manufacturer. If the manufacturer does not specify any location, measure this pressure downstream of any turbocharger or exhaust gas recirculation system connection to the exhaust system. If the manufacturer does not specify speed and torque points, measure this pressure while the engine produces maximum power. Use an exhaust restriction setpoint that represents a typical in-use value, if available.

(1) If a typical in-use value for exhaust restriction is not available for exhaust systems with a fixed restriction, set the exhaust restriction at (80 to 100)% of the maximum exhaust restriction specified by the manufacturer, or if the maximum is 5 kPa or less, the set point must be no less than 1.0 kPa from the maximum. For example, if the maximum back pressure is 4.5 kPa, do not use an exhaust restriction set point that is less than 3.5 kPa.

(2) If a typical value for exhaust restriction is not available for exhaust systems with variable restriction, set the exhaust restriction between the maximum clean and dirty values specified by the manufacturer.

(i) *Open crankcase emissions.* If the standard-setting part requires measuring open crankcase emissions, you may either measure open crankcase emissions separately using a method that we approve in advance, or route open crankcase emissions directly into the exhaust system for emission measurement. If the engine is not already configured to route open crankcase emissions for emission measurement, route open crankcase emissions as follows:

(1) Use laboratory tubing materials that are smooth-walled, electrically conductive, and not reactive with crankcase emissions. Stainless steel is an acceptable material. Minimize tube lengths. We also recommend using heated or thin-walled or air gap-insulated tubing to minimize temperature differences between the wall and the crankcase emission constituents.

(2) Minimize the number of bends in the laboratory crankcase tubing and maximize the radius of any unavoidable bend.

(3) Use laboratory crankcase exhaust tubing that meets the engine manufacturer's specifications for crankcase back pressure.

(4) Connect the crankcase exhaust tubing into the raw exhaust downstream of any aftertreatment system, downstream of any installed exhaust restriction, and sufficiently upstream of any sample probes to ensure complete mixing with the engine's exhaust before sampling. Extend the crankcase exhaust tube into the free stream of exhaust to avoid boundary-layer effects and to promote mixing. You may orient the crankcase exhaust tube's outlet in any direction relative to the raw exhaust flow.

28. Section 1065.140 is revised to read as follows:

§ 1065.140 Dilution for gaseous and PM constituents.

(a) *General.* You may dilute exhaust with ambient air, synthetic air, or nitrogen. Note that the composition of the diluent affects some gaseous emission measurement instruments' response to emissions. We recommend diluting exhaust at a location as close as possible to the location where ambient air dilution would occur in use.

(b) *Dilution-air conditions and background concentrations.* Before a diluent is mixed with exhaust, you may precondition it by increasing or decreasing its temperature or humidity. You may also remove constituents to reduce their background concentrations. The following provisions apply to removing constituents or accounting for background concentrations:

(1) You may measure constituent concentrations in the diluent and compensate for background effects on test results. See § 1065.650 for calculations that compensate for background concentrations.

(2) Either measure these background concentrations the same way you measure diluted exhaust constituents, or measure them in a way that does not affect your ability to demonstrate compliance with the applicable standards. For example, you may use the following simplifications for background sampling:

(i) You may disregard any proportional sampling requirements.

(ii) You may use unheated gaseous sampling systems.

(iii) You may use unheated PM sampling systems.

(iv) You may use continuous sampling if you use batch sampling for diluted emissions.

(v) You may use batch sampling if you use continuous sampling for diluted emissions.

(3) For removing background PM, we recommend that you filter all dilution air, including primary full-flow dilution air, with high-efficiency particulate air (HEPA) filters that have an initial minimum collection efficiency specification of 99.97% (see § 1065.1001 for procedures related to HEPA-filtration efficiencies). Ensure that HEPA filters are installed properly so that background PM does not leak past the HEPA filters. If you choose to correct for background PM without using HEPA filtration, demonstrate that the background PM in the dilution air contributes less than 50% to the net PM collected on the sample filter. You may correct net PM without restriction if you use HEPA filtration.

(c) *Full-flow dilution; constant-volume sampling (CVS).* You may dilute the full flow of raw exhaust in a dilution tunnel that maintains a nominally constant volume flow rate, molar flow rate or mass flow rate of diluted exhaust, as follows:

(1) Construction. Use a tunnel with inside surfaces of 300 series stainless steel. Electrically ground the entire dilution tunnel. We recommend a thin-walled and insulated dilution tunnel to minimize temperature differences between the wall and the exhaust gases.

(2) Pressure control. Maintain static pressure at the location where raw exhaust is introduced into the tunnel within ±1.2 kPa of atmospheric pressure. You may use a booster blower to control this pressure. If you test an engine using more careful pressure control and you show by engineering analysis or by test data that you require this level of control to demonstrate compliance at the applicable standards, we will maintain the same level of static pressure control when we test that engine.

(3) Mixing. Introduce raw exhaust into the tunnel by directing it downstream along the centerline of the tunnel. You may introduce a fraction of dilution air radially from the tunnel's inner surface to minimize exhaust interaction with the tunnel walls. You

may configure the system with turbulence generators such as orifice plates or fins to achieve good mixing. We recommend a minimum Reynolds number, Re#, of 4000 for the diluted exhaust stream, where Re# is based on the inside diameter of the dilution tunnel. Re# is defined in § 1065.640.

(4) Flow measurement preconditioning. You may condition the diluted exhaust before measuring its flow rate, as long as this conditioning takes place downstream of any sample probes, as follows:

(i) You may use flow straighteners, pulsation dampeners, or both of these.

(ii) You may use a filter.

(iii) You may use a heat exchanger to control the temperature upstream of any flow meter. Note paragraph (c)(6) of this section regarding aqueous condensation.

(5) Flow measurement. Section 1065.240 describes measurement instruments for diluted exhaust flow.

(6) Aqueous condensation. To ensure that you measure a flow that corresponds to a measured concentration, you may either prevent aqueous condensation between the sample probe location and the flow meter inlet in the dilution tunnel or you may allow aqueous condensation to occur and then measure humidity at the flow meter inlet. Calculations in § 1065.645 and § 1065.650 account for either method of addressing humidity in the diluted exhaust. Note that preventing aqueous condensation involves more than keeping pure water in a vapor phase (see § 1065.1001).

(7) Flow compensation. Maintain nominally constant molar, volumetric or mass flow of diluted exhaust. You may maintain nominally constant flow by either maintaining the temperature and pressure at the flow meter or by directly controlling the flow of diluted exhaust. You may also directly control the flow of proportional samplers to maintain proportional sampling. For an individual test, validate proportional sampling as described in § 1065.545.

(d) *Partial-flow dilution (PFD).* You may dilute a partial flow of raw or previously diluted exhaust before measuring emissions. Section 1065.240 describes PFD-related flow measurement instruments. PFD may consist of constant or varying dilution ratios as described in paragraphs (d)(2) and (3) of this section. An example of a constant dilution ratio PFD is a ‘‘secondary dilution PM’’ measurement system. An example of a varying dilution ratio PFD is a ‘‘bag mini-diluter’’ or BMD.

(1) *Applicability.* (i) You may use PFD to extract a proportional raw exhaust sample for any batch or continuous PM emission sampling over any transient duty cycle, any steady-state duty cycle or any ramped-modal cycle (RMC).

(ii) You may use PFD to extract a proportional raw exhaust sample for any batch or continuous gaseous emission sampling over any transient duty cycle, any steady-state duty cycle or any ramped-modal cycle (RMC).

(iii)You may use PFD to extract a proportional raw exhaust sample for any batch or continuous field-testing.

(iv) You may use PFD to extract a proportional diluted exhaust sample from a CVS for any batch or continuous emission sampling.

(v) You may use PFD to extract a constant raw or diluted exhaust sample for any continuous emission sampling.

(vi) You may use PFD to extract a constant raw or diluted exhaust sample for any steady-state emission sampling.

(2) Constant dilution-ratio PFD. Do one of the following for constant dilution-ratio PFD:

(i) Dilute an already proportional flow. For example, you may do this as a way of performing secondary dilution from a CVS tunnel to achieve temperature control for PM sampling.

(ii) Continuously measure constituent concentrations. For example, you might dilute to precondition a sample of raw exhaust to control its temperature, humidity, or constituent concentrations upstream of continuous analyzers. In this case, you must take into account the dilution ratio before multiplying the continuous concentration by the sampled exhaust flow rate.

(iii) Extract a proportional sample from a separate constant dilution ratio PFD system. For example, you might use a variable-flow pump to proportionally fill a gaseous storage medium such as a bag from a PFD system. In this case, the proportional sampling must meet the same specifications as varying dilution ratio PFD in paragraph (d)(3) of this section.

(iv) For each mode of a discrete-mode test (such as a locomotive notch setting or a specific setting for speed and torque), use a constant dilution ratio for any batch or continuous sampling. You may change the dilution ratio between modes, but you must account for this change in dilution ratio in your emission calculations. Also, you may not sample emissions at the same time you are changing the dilution ratio from one constant dilution ratio to another.

(3) Varying dilution-ratio PFD. All the following provisions apply for varying dilution-ratio PFD:

(i) Use a control system with sensors and actuators that can maintain proportional sampling over intervals as short as 200 ms (i.e., 5 Hz control).

(ii) For control input, you may use any sensor output from one or more measurements; for example, intake-air flow, fuel flow, exhaust flow, engine speed, and intake manifold temperature and pressure.

(iii) Account for any emission transit time in the PFD system, as necessary.

(iv) You may use preprogrammed data if they have been determined for the specific test site, duty cycle, and test engine from which you dilute emissions.

(v) We recommend that you run practice cycles to meet the validation criteria in § 1065.545. Note that you must validate every emission test by meeting the validation criteria with the data from that specific test. Data from previously validated practice cycles or other tests may not be used to validate a different emission test.

(vi) You may not use a PFD system that requires preparatory tuning or calibration with a CVS or with the emission results from a CVS. Rather, you must be able to independently calibrate the PFD.

(e) *Dilution air temperature, dilution ratio, residence time, and temperature control.* Dilute PM samples at least once upstream of transfer lines. You may dilute PM samples upstream of a transfer line using full-flow dilution, or partial-flow dilution immediately downstream of a PM probe. Configure dilution systems as follows:

(1) Control dilution air temperature just upstream of the mixing zones to (25 ± 5) °C. We recommend controlling dilution air temperature to within a narrower tolerance of (25 ± 1) °C.

(2) Adjust the dilution system s dilution ratio for your particular engine and duty cycle to achieve a maximum dewpoint of the diluted exhaust of (20 ±3) °C.

(3) Configure your dilution system to achieve a sample residence time of (1 to 5) seconds from the initial point at which dilution air was first introduced into the exhaust to the sample media. When calculating residence time, use an assumed flow temperature of 25 °C.

(4) Control inside wall temperature to a (42 to 52) °C tolerance, as measured anywhere within 20 cm upstream or downstream of the PM storage media (such as a filter). Measure this temperature with a bare-wire junction thermocouple with wires that are (0.500 ±0.025) mm diameter, or with another suitable instrument that has equivalent performance. If heat must be rejected from the sample to meet this requirement, reject the heat after the point at which the last dilution air was introduced into the diluted exhaust and

reject as little heat as practical to meet this specification.

29. Section 1065.145 is revised to read as follows:

§ 1065.145 Gaseous and PM probes, transfer lines, and sampling system components.

(a) *Continuous and batch sampling.* Determine the total mass of each constituent with continuous or batch sampling, as described in § 1065.15(c)(2). Both types of sampling systems have probes, transfer lines, and other sampling system components that are described in this section.

(b) *Gaseous and PM sample probes.* A probe is the first fitting in a sampling system. It protrudes into a raw or diluted exhaust stream to extract a sample, such that its inside and outside surfaces are in contact with the exhaust. A sample is transported out of a probe into a transfer line, as described in paragraph (c) of this section. The following provisions apply to sample probes:

(1) *Probe design and construction.* Use sample probes with inside surfaces of 300 series stainless steel or, for raw exhaust sampling, use any nonreactive material capable of withstanding raw exhaust temperatures. Locate sample probes where constituents are mixed to their mean sample concentration. Take into account the mixing of any crankcase emissions that may be routed into the raw exhaust. Locate each probe to minimize interference with the flow to other probes. We recommend that all probes remain free from influences of boundary layers, wakes, and eddies—especially near the outlet of a raw-exhaust tailpipe where unintended dilution might occur. Make sure that purging or back-flushing of a probe does not influence another probe during testing. You may use a single probe to extract a sample of more than one constituent as long as the probe meets all the specifications for each constituent.

(2) *Probe installation on multi-stack engines.* We recommend combining multiple exhaust streams from multi-stack engines before emission sampling as described in § 1065.130(c)(6). If this is impractical, you may install symmetrical probes and transfer lines in each stack. In this case, each stack must be installed such that similar exhaust velocities are expected at each probe location. Use identical probe and transfer line diameters, lengths, and bends for each stack. Minimize the individual transfer line lengths, and manifold the individual transfer lines into a single transfer line to route the combined exhaust sample to analyzers and/or batch samplers. For PM sampling the manifold design must merge the individual sample streams within 12.5° of the single sample stream's flow. Note that the manifold must meet the same specifications as the transfer line according to paragraph (c) of this section. If you use this probe configuration and you determine your exhaust flow rates with a chemical balance of exhaust gas concentrations and either intake air flow or fuel flow, then show by prior testing that the concentration of O_2 in each stack remains within 5% of the mean O_2 concentration throughout the entire duty cycle.

(3) *Gaseous sample probes.* Use either single-port or multi-port probes for sampling gaseous emissions. You may orient these probes in any direction relative to the raw or diluted exhaust flow. For some probes, you must control sample temperatures, as follows:

(i) For probes that extract NO_X from diluted exhaust, control the probe's wall temperature to prevent aqueous condensation.

(ii) For probes that extract hydrocarbons for NMHC or NMHCE analysis from the diluted exhaust of compression-ignition engines, 2-stroke spark-ignition engines, or 4-stroke spark-ignition engines below 19 kW, maintain a probe wall temperature tolerance of (191 ± 11) °C.

(4) *PM sample probes.* Use PM probes with a single opening at the end. Orient PM probes to face directly upstream. If you shield a PM probe's opening with a PM pre-classifier such as a hat, you may not use the preclassifier we specify in paragraph (e)(1) of this section. We recommend sizing the inside diameter of PM probes to approximate isokinetic sampling at the expected mean flow rate.

(c) *Transfer lines.* You may use transfer lines to transport an extracted sample from a probe to an analyzer, storage medium, or dilution system. Minimize the length of all transfer lines by locating analyzers, storage media, and dilution systems as close to probes as practical. We recommend that you minimize the number of bends in transfer lines and that you maximize the radius of any unavoidable bend. Avoid using 90° elbows, tees, and cross-fittings in transfer lines. Where such connections and fittings are necessary, take steps, using good engineering judgment, to ensure that you meet the temperature tolerances in this paragraph (c). This may involve measuring temperature at various locations within transfer lines and fittings. You may use a single transfer line to transport a sample of more than one constituent, as long as the transfer line meets all the specifications for each constituent. The following construction and temperature tolerances apply to transfer lines:

(1) *Gaseous samples.* Use transfer lines with inside surfaces of 300 series stainless steel, PTFE, Viton™, or any other material that you demonstrate has better properties for emission sampling. For raw exhaust sampling, use a non-reactive material capable of withstanding raw exhaust temperatures. You may use in-line filters if they do not react with exhaust constituents and if the filter and its housing meet the same temperature requirements as the transfer lines, as follows:

(i) For NO_X transfer lines upstream of either an NO_2-to-NO converter that meets the specifications of § 1065.378 or a chiller that meets the specifications of § 1065.376, maintain a sample temperature that prevents aqueous condensation.

(ii) For THC transfer lines for testing compression-ignition engines, 2-stroke spark-ignition engines, or 4-stroke spark-ignition engines below 19 kW, maintain a wall temperature tolerance throughout the entire line of (191 ± 11) °C. If you sample from raw exhaust, you may connect an unheated, insulated transfer line directly to a probe. Design the length and insulation of the transfer line to cool the highest expected raw exhaust temperature to no lower than 191 °C, as measured at the transfer line's outlet.

(2) *PM samples.* We recommend heated transfer lines or a heated enclosure to minimize temperature differences between transfer lines and exhaust constituents. Use transfer lines that are inert with respect to PM and are electrically conductive on the inside surfaces. We recommend using PM transfer lines made of 300 series stainless steel. Electrically ground the inside surface of PM transfer lines.

(d) *Optional sample-conditioning components for gaseous sampling.* You may use the following sample-conditioning components to prepare gaseous samples for analysis, as long as you do not install or use them in a way that adversely affects your ability to show that your engines comply with all applicable gaseous emission standards.

(1) *NO_2-to-NO converter.* You may use an NO_2-to-NO converter that meets the efficiency-performance check specified in § 1065.378 at any point upstream of a NO_X analyzer, sample bag, or other storage medium.

(2) *Sample dryer.* You may use either type of sample dryer described in this paragraph (d)(2) to decrease the effects of water on gaseous emission measurements. You may not use a

chemical dryer, or use dryers upstream of PM sample filters.

(i) *Osmotic-membrane.* You may use an osmotic-membrane dryer upstream of any gaseous analyzer or storage medium, as long as it meets the temperature specifications in paragraph (c)(1) of this section. Because osmotic-membrane dryers may deteriorate after prolonged exposure to certain exhaust constituents, consult with the membrane manufacturer regarding your application before incorporating an osmotic-membrane dryer. Monitor the dewpoint, T_{dew}, and absolute pressure, p_{total}, downstream of an osmotic-membrane dryer. You may use continuously recorded values of T_{dew} and p_{total} in the amount of water calculations specified in § 1065.645. If you do not continuously record these values, you may use their peak values observed during a test or their alarm setpoints as constant values in the calculations specified in § 1065.645. You may also use a nominal p_{total}, which you may estimate as the dryer's lowest absolute pressure expected during testing.

(ii) *Thermal chiller.* You may use a thermal chiller upstream of some gas analyzers and storage media. You may not use a thermal chiller upstream of a THC measurement system for compression-ignition engines, 2-stroke spark-ignition engines, or 4-stroke spark-ignition engines below 19 kW. If you use a thermal chiller upstream of an NO_2-to-NO converter or in a sampling system without an NO_2-to-NO converter, the chiller must meet the NO_2 loss-performance check specified in § 1065.376. Monitor the dewpoint, T_{dew}, and absolute pressure, p_{total}, downstream of a thermal chiller. You may use continuously recorded values of T_{dew} and p_{total} in the emission calculations specified in § 1065.650. If you do not continuously record these values, you may use the maximum temperature and minimum pressure values observed during a test or the high alarm temperature setpoint and the low alarm pressure setpoint as constant values in the amount of water calculations specified in § 1065.645. You may also use a nominal p_{total}, which you may estimate as the dryer's lowest absolute pressure expected during testing. If it is valid to assume the degree of saturation in the thermal chiller, you may calculate T_{dew} based on the known chiller efficiency and continuous monitoring of chiller temperature, $T_{chiller}$. If you do not continuously record values of $T_{chiller}$, you may use its peak value observed during a test, or its alarm setpoint, as a constant value to determine a constant amount of water according to § 1065.645. If it is valid to assume that $T_{chiller}$ is equal to T_{dew}, you may use $T_{chiller}$ in lieu of T_{dew} according to § 1065.645. If it is valid to assume a constant temperature offset between $T_{chiller}$ and T_{dew}, due to a known and fixed amount of sample reheat between the chiller outlet and the temperature measurement location, you may factor in this assumed temperature offset value into emission calculations. If we ask for it, you must show by engineering analysis or by data the validity of any assumptions allowed by this paragraph (d)(2)(ii).

(3) *Sample pumps.* You may use sample pumps upstream of an analyzer or storage medium for any gas. Use sample pumps with inside surfaces of 300 series stainless steel, PTFE, or any other material that you demonstrate has better properties for emission sampling. For some sample pumps, you must control temperatures, as follows:

(i) If you use a NO_X sample pump upstream of either an NO_2-to-NO converter that meets § 1065.378 or a chiller that meets § 1065.376, it must be heated to prevent aqueous condensation.

(ii) For testing compression-ignition engines, 2-stroke spark-ignition engines, or 4-stroke compression ignition engines below 19 kW, if you use a THC sample pump upstream of a THC analyzer or storage medium, its inner surfaces must be heated to a tolerance of (191 ± 11) °C

(e) *Optional sample-conditioning components for PM sampling.* You may use the following sample-conditioning components to prepare PM samples for analysis, as long as you do not install or use them in a way that adversely affects your ability to show that your engines comply with the applicable PM emission standards. You may condition PM samples to minimize positive and negative biases to PM results, as follows:

(1) *PM preclassifier.* You may use a PM preclassifier to remove large-diameter particles. The PM preclassifier may be either an inertial impactor or a cyclonic separator. It must be constructed of 300 series stainless steel. The preclassifier must be rated to remove at least 50% of PM at an aerodynamic diameter of 10 µm and no more than 1% of PM at an aerodynamic diameter of 1 µm over the range of flow rates for which you use it. Follow the preclassifier manufacturer s instructions for any periodic servicing that may be necessary to prevent a buildup of PM. Install the preclassifier in the dilution system downstream of the last dilution stage. Configure the preclassifier outlet with a means of bypassing any PM sample media so the preclassifier flow may be stabilized before starting a test. Locate PM sample media within 75 cm downstream of the preclassifier's exit. You may not use this preclassifier if you use a PM probe that already has a preclassifier. For example, if you use a hat-shaped preclassifier that is located immediately upstream of the probe in such a way that it forces the sample flow to change direction before entering the probe, you may not use any other preclassifier in your PM sampling system.

(2) *Other components.* You may request to use other PM conditioning components upstream of a PM preclassifier, such as components that condition humidity or remove gaseous-phase hydrocarbons from the diluted exhaust stream. You may use such components only if we approve them under § 1065.10.

30. Section 1065.170 is amended by revising the introductory text and paragraphs (a) and (c)(1) to read as follows:

§ 1065.170 Batch sampling for gaseous and PM constituents.

Batch sampling involves collecting and storing emissions for later analysis. Examples of batch sampling include collecting and storing gaseous emissions in a bag or collecting and storing PM on a filter. You may use batch sampling to store emissions that have been diluted at least once in some way, such as with CVS, PFD, or BMD. You may use batch-sampling to store undiluted emissions.

(a) *Sampling methods.* If you extract from a constant-volume flow rate, sample at a constant-volume flow rate. If you extract from a varying flow rate, vary the sample rate in proportion to the varying flow rate. Validate proportional sampling after an emission test as described in § 1065.545. Use storage media that do not significantly change measured emission levels (either up or down). For example, do not use sample bags for storing emissions if the bags are permeable with respect to emissions or if they offgas emissions to the extent that it affects your ability to demonstrate compliance with the applicable gaseous emission standards. As another example, do not use PM filters that irreversibly absorb or adsorb gases to the extent that it affects your ability to demonstrate compliance with the applicable PM emission standard.

* * * * *

(c) * * *

(1) If you use filter-based sampling media to extract and store PM for measurement, your procedure must meet the following specifications:

(i) If you expect that a filter's total surface concentration of PM will exceed

0.473 μg/mm² for a given test interval, you may use filter media with a minimum initial collection efficiency of 98%; otherwise you must use a filter media with a minimum initial collection efficiency of 99.7%. Collection efficiency must be measured as described in ASTM D 2986–95a (incorporated by reference in § 1065.1010), though you may rely on the sample-media manufacturer's measurements reflected in their product ratings to show that you meet this requirement.

(ii) The filter must be circular, with an overall diameter of 46.50 ± 0.6 mm and an exposed diameter of at least 38 mm. See the cassette specifications in paragraph (c)(1)(vii) of this section.

(iii) We highly recommend that you use a pure PTFE filter material that does not have any flow-through support bonded to the back and has an overall thickness of 40 ± 20 μm. An inert polymer ring may be bonded to the periphery of the filter material for support and for sealing between the filter cassette parts. We consider Polymethylpentene (PMP) and PTFE inert materials for a support ring, but other inert materials may be used. See the cassette specifications in paragraph (c)(1)(vii) of this section. We allow the use of PTFE-coated glass fiber filter material, as long as this filter media selection does not affect your ability to demonstrate compliance with the applicable standards, which we base on a pure PTFE filter material. Note that we will use pure PTFE filter material for compliance testing, and we may require you to use pure PTFE filter material for any compliance testing we require, such as for selective enforcement audits.

(iv) You may request to use other filter materials or sizes under the provisions of § 1065.10.

(v) To minimize turbulent deposition and to deposit PM evenly on a filter, use a 12.5° (from center) divergent cone angle to transition from the transfer-line inside diameter to the exposed diameter of the filter face. Use 300 series stainless steel for this transition.

(vi) Maintain sample velocity at the filter face at or below 100 cm/s, where filter face velocity is the measured volumetric flow rate of the sample at the pressure and temperature upstream of the filter face, divided by the filter's exposed area.

(vii) Use a clean cassette designed to the specifications of Figure 1 of § 1065.170 and made of any of the following materials: Delrin™, 300 series stainless steel, polycarbonate, acrylonitrile-butadiene-styrene (ABS) resin, or conductive polypropylene. We recommend that you keep filter cassettes clean by periodically washing or wiping them with a compatible solvent applied using a lint-free cloth. Depending upon your cassette material, ethanol (C_2H_5OH) might be an acceptable solvent. Your cleaning frequency will depend on your engine's PM and HC emissions.

(viii) If you store filters in cassettes in an automatic PM sampler, cover or seal individual filter cassettes after sampling to prevent communication of semi-volatile matter from one filter to another.

* * * * *

31. Section 1065.190 is amended by revising paragraphs (e) and (g)(6) to read as follows:

§ 1065.190 PM-stabilization and weighing environments for gravimetric analysis.

* * * * *

(e) Verify the following ambient conditions using measurement instruments that meet the specifications in subpart C of this part:

(1) Continuously measure dewpoint and ambient temperature. Use these values to determine if the stabilization and weighing environments have remained within the tolerances specified in paragraph (d) of this section for at least 60 min before weighing filters. We recommend that you provide an interlock that automatically prevents the balance from reporting values if either of the environments have not been within the applicable tolerances for the past 60 min.

(2) Continuously measure atmospheric pressure within the weighing environment. You may use a shared atmospheric pressure meter as long as you can show that your ventilation system for the weighing environment maintains ambient pressure at the balance within ±100 Pa of the shared atmospheric pressure meter. Provide a means to record the most recent atmospheric pressure when you weigh each PM sample. Use this value to calculate the PM buoyancy correction in § 1065.690.

* * * * *

(g) * * *

(6) We recommend that you neutralize PM sample media to within ±2.0 V of neutral. Measure static voltages as follows:

(i) Measure static voltage of PM sample media according to the electrostatic voltmeter manufacturer's instructions.

(ii) Measure static voltage of PM sample media while the media is at least 15 cm away from any grounded surfaces to avoid mirror image charge interference.

32. Section 1065.195 is amended by revising paragraph (c)(4) to read as follows:

§ 1065.195 PM-stabilization environment for in-situ analyzers.

* * * * *

(c) * * *

(4) *Absolute pressure.* Use good engineering judgment to maintain a tolerance of absolute pressure if your PM measurement instrument requires it.

* * * * *

Subpart C—[Amended]

33. Section 1065.201 is amended by revising paragraphs (a), (b), and (d) and adding paragraph (h) to read as follows:

§ 1065.201 Overview and general provisions.

(a) *Scope.* This subpart specifies measurement instruments and associated system requirements related to emission testing in a laboratory or similar environment and in the field. This includes laboratory instruments and portable emission measurement systems (PEMS) for measuring engine parameters, ambient conditions, flow-related parameters, and emission concentrations.

(b) *Instrument types.* You may use any of the specified instruments as described in this subpart to perform emission tests. If you want to use one of these instruments in a way that is not specified in this subpart, or if you want to use a different instrument, you must first get us to approve your alternate procedure under § 1065.10. Where we specify more than one instrument for a particular measurement, we may identify which instrument serves as the reference for comparing with an alternate procedure.

* * * * *

(d) *Redundant systems.* For all measurement instruments described in this subpart, you may use data from multiple instruments to calculate test results for a single test. If you use redundant systems, use good engineering judgment to use multiple measured values in calculations or to disregard individual measurements. Note that you must keep your results from all measurements, as described in § 1065.25. This requirement applies whether or not you actually use the measurements in your calculations.

* * * * *

(h) *Recommended practices.* This subpart identifies a variety of recommended but not required practices for proper measurements. We believe in most cases it is necessary to follow these recommended practices for accurate and repeatable measurements and we intend to follow them as much as possible for our testing. However, we do not specifically require you to follow these recommended practices to perform a valid test, as long as you meet the required calibrations and verifications of measurement systems specified in subpart D of this part.

34. Section 1065.210 is amended by revising paragraph (a) before the figure to read as follows:

§ 1065.210 Work input and output sensors.

(a) *Application.* Use instruments as specified in this section to measure work inputs and outputs during engine operation. We recommend that you use sensors, transducers, and meters that meet the specifications in Table 1 of § 1065.205. Note that your overall systems for measuring work inputs and outputs must meet the linearity verifications in § 1065.307. We recommend that you measure work inputs and outputs where they cross the system boundary as shown in Figure 1 of § 1065.210. The system boundary is different for air-cooled engines than for liquid-cooled engines. If you choose to measure work before or after a work conversion, relative to the system boundary, use good engineering judgment to estimate any work-conversion losses in a way that avoids overestimation of total work. For example, if it is impractical to instrument the shaft of an exhaust turbine generating electrical work, you may decide to measure its converted electrical work. As another example, you may decide to measure the tractive (*i.e.*, electrical output) power of a locomotive, rather than the brake power of the locomotive engine. In these cases, divide the electrical work by accurate values of electrical generator efficiency ($\eta<1$), or assume an efficiency of 1 ($\eta=1$), which would overestimate brake-specific emissions. For the example of using locomotive tractive power with a generator efficiency of 1 ($\eta=1$), this means using the tractive power as the brake power in emission calculations. Do not underestimate any work conversion efficiencies for any components outside the system boundary that do not return work into the system boundary. And do not overestimate any work conversion efficiencies for components outside the system boundary that do return work into the system boundary. In all cases, ensure that you are able to accurately demonstrate compliance with the applicable standards.

* * * * *

35. Section 1065.215 is amended by revising paragraph (e) to read as follows:

§ 1065.215 Pressure transducers, temperature sensors, and dewpoint sensors.

* * * * *

(e) *Dewpoint.* For PM-stabilization environments, we recommend chilled-surface hygrometers, which include chilled mirror detectors and chilled surface acoustic wave (SAW) detectors. For other applications, we recommend thin-film capacitance sensors. You may use other dewpoint sensors, such as a wet-bulb/dry-bulb psychrometer, where appropriate.

36. Section 1065.220 is amended by revising paragraph (d) to read as follows:

§ 1065.220 Fuel flow meter.

* * * * *

(d) *Flow conditioning.* For any type of fuel flow meter, condition the flow as needed to prevent wakes, eddies, circulating flows, or flow pulsations from affecting the accuracy or repeatability of the meter. You may accomplish this by using a sufficient length of straight tubing (such as a length equal to at least 10 pipe diameters) or by using specially designed tubing bends, straightening fins, or pneumatic pulsation dampeners to establish a steady and predictable velocity profile upstream of the meter. Condition the flow as needed to prevent any gas bubbles in the fuel from affecting the fuel meter.

37. Section 1065.265 is amended by revising paragraph (c) to read as follows:

§ 1065.265 Nonmethane cutter.

* * * * *

(c) *Configuration.* Configure the nonmethane cutter with a bypass line if it is needed for the verification described in § 1065.365.

* * * * *

38. Section 1065.270 is amended by revising paragraph (c) to read as follows:

§ 1065.270 Chemiluminescent detector.

* * * * *

(c) *NO_2-to-NO converter.* Place upstream of the CLD an internal or external NO_2-to-NO converter that meets the verification in § 1065.378. Configure the converter with a bypass line if it is needed to facilitate this verification.

* * * * *

39. Section 1065.280 is revised to read as follows:

§ 1065.280 Paramagnetic and magnetopneumatic O_2 detection analyzers.

(a) *Application.* You may use a paramagnetic detection (PMD) or magnetopneumatic detection (MPD) analyzer to measure O_2 concentration in raw or diluted exhaust for batch or continuous sampling. You may use O_2 measurements with intake air or fuel flow measurements to calculate exhaust flow rate according to § 1065.650.

(b) *Component requirements.* We recommend that you use a PMD or MPD analyzer that meets the specifications in Table 1 of § 1065.205. Note that it must meet the linearity verification in § 1065.307. You may use a PMD or MPD that has compensation algorithms that are functions of other gaseous measurements and the engine's known or assumed fuel properties. The target value for any compensation algorithm is 0.0% (that is, no bias high and no bias low), regardless of the uncompensated signal's bias.

40. Section 1065.290 is amended by revising paragraph (c)(1) to read as follows:

§ 1065.290 PM gravimetric balance.

* * * * *

(c) * * *

(1) Use a pan that centers the PM sample media (such as a filter) on the weighing pan. For example, use a pan in the shape of a cross that has upswept tips that center the PM sample media on the pan.

* * * * *

Subpart D—[Amended]

41. Section 1065.303 is revised to read as follows:

§ 1065.303 Summary of required calibration and verifications

The following table summarizes the required and recommended calibrations and verifications described in this subpart and indicates when these have to be performed:

TABLE 1 OF § 1065.303.—SUMMARY OF REQUIRED CALIBRATION AND VERIFICATIONS

Type of calibration or verification	Minimum frequency [a]
§ 1065.305: Accuracy, repeatability and noise	Accuracy: Not required, but recommended for initial installation. Repeatability: Not required, but recommended for initial installation. Noise: Not required, but recommended for initial installation.
§ 1065.307: Linearity	Speed: Upon initial installation, within 370 days before testing and after major maintenance. Torque: Upon initial installation, within 370 days before testing and after major maintenance. Electrical power: Upon initial installation, within 370 days before testing and after major maintenance. Clean gas and diluted exhaust flows: Upon initial installation, within 370 days before testing and after major maintenance, unless flow is verified by propane check or by carbon or oxygen balance. Raw exhaust flow: Upon initial installation, within 185 days before testing and after major maintenance, unless flow is verified by propane check or by carbon or oxygen balance. Gas analyzers: Upon initial installation, within 35 days before testing and after major maintenance. PM balance: Upon initial installation, within 370 days before testing and after major maintenance. Stand-alone pressure and temperature: Upon initial installation, within 370 days before testing and after major maintenance.
§ 1065.308: Continuous analyzer system response and recording.	Upon initial installation, after system reconfiguration, and after major maintenance.
§ 1065.309: Continuous analyzer uniform response.	Upon initial installation, after system reconfiguration, and after major maintenance.
§ 1065.310: Torque	Upon initial installation and after major maintenance.
§ 1065.315: Pressure, temperature, dewpoint	Upon initial installation and after major maintenance.
§ 1065.320: Fuel flow	Upon initial installation and after major maintenance.
§ 1065.325: Intake flow	Upon initial installation and after major maintenance.
§ 1065.330: Exhaust flow	Upon initial installation and after major maintenance.
§ 1065.340: Diluted exhaust flow (CVS)	Upon initial installation and after major maintenance.
§ 1065.341: CVS sampler and batch verification	Upon initial installation, within 35 days before testing, and after major maintenance.
§ 1065.345: Vacuum leak	Before each laboratory test according to subpart F of this part and before each field test according to subpart J of this part.
§ 1065.350: CO_2 NDIR H_2O interference	Upon initial installation and after major maintenance.
§ 1065.355: CO NDIR CO_2 and H_2O interference.	Upon initial installation and after major maintenance.
§ 1065.360: FID calibration THC FID optimization, and THC FID verification.	Calibrate all FID analyzers: Upon initial installation and after major maintenance. Optimize and determine CH_4 response for THC FID analyzers: Upon initial installation and after major maintenance. Verify CH_4 response for THC FID analyzers: Upon initial installation, within 185 days before testing, and after major maintenance.
§ 1065.362: Raw exhaust FID O_2 interference	For all FID analyzers: Upon initial installation, after major maintenance. For THC FID analyzers: Upon initial installation, after major maintenance, and after FID optimization according to § 1065.360.
§ 1065.365: Nonmethane cutter penetration	Upon initial installation, within 185 days before testing, and after major maintenance.
§ 1065.370: CLD CO_2 and H_2O quench	Upon initial installation and after major maintenance.
§ 1065.372: NDUV HC and H_2O interference	Upon initial installation and after major maintenance.
§ 1065.376: Chiller NO_2 penetration	Upon initial installation and after major maintenance.
§ 1065.378: NO_2-to-NO converter conversion	Upon initial installation, within 35 days before testing, and after major maintenance.
§ 1065.390: PM balance and weighing	Independent verification: Upon initial installation, within 370 days before testing, and after major maintenance. Zero, span, and reference sample verifications: Within 12 hours of weighing, and after major maintenance.
§ 1065.395: Inertial PM balance and weighing	Independent verification: Upon initial installation, within 370 days before testing, and after major maintenance. Other verifications: Upon initial installation and after major maintenance.

[a] Perform calibrations and verifications more frequently, according to measurement system manufacturer instructions and good engineering judgment.

42.Section 1065.305 is amended by revising paragraphs (d)(4) and (d)(8) to read as follows:

§ 1065.305 Verifications for accuracy, repeatability, and noise.

* * * * *

(d) * * *

(4) Use the instrument to quantify a NIST-traceable reference quantity, $\gamma_{ref.}$ For gas analyzers the reference gas must meet the specifications of § 1065.750. Select a reference quantity near the mean value expected during testing. For all gas analyzers, use a quantity near the flow-weighted mean concentration expected at the standard or expected during testing, whichever is greater. For a noise verification, use the same zero gas from paragraph (e) of this section as the reference quantity. In all cases, allow time for the instrument to stabilize while it measures the reference quantity. Stabilization time may include time to purge an instrument and time to account for its response.

* * * * *

(8) Repeat the steps specified in paragraphs (d)(2) through (7) of this section until you have ten arithmetic means ($\bar{y}_1, \bar{y}_2, \bar{y}_i$,* * * $\bar{y}_{10}$), ten standard deviations, ($\sigma_1, \sigma_2, \sigma_i$, * * * σ_{10}), and ten errors ($\varepsilon_1, \varepsilon_2, \varepsilon_i$, * * * ε_{10}).

* * * * *

43. Section 1065.307 is amended by revising paragraphs (b) and (c)(6), adding paragraph (d)(8) and revising Table 1 to read as follows:

§ 1065.307 Linearity verification.

* * * * *

(b) *Performance requirements.* If a measurement system does not meet the applicable linearity criteria in Table 1 of this section, correct the deficiency by re-calibrating, servicing, or replacing components as needed. Repeat the linearity verification after correcting the deficiency to ensure that the measurement system meets the linearity criteria. Before you may use a measurement system that does not meet linearity criteria, you must demonstrate to us that the deficiency does not adversely affect your ability to demonstrate compliance with the applicable standards.

(c) * * *

(6) For all measured quantities except temperature, use instrument manufacturer recommendations and good engineering judgment to select at least 10 reference values, y_{refi}, that are within the range from zero to the highest values expected during emission testing. We recommend selecting a zero reference signal as one of the reference values of the linearity verification. For temperature linearity verifications, we recommend three to five reference values.

* * * * *

(13) Use the arithmetic means, $\bar{y}_i$, and reference values, y_{refi}, to calculate least-squares linear regression parameters and statistical values to compare to the minimum performance criteria specified in Table 1 of this section. Use the calculations described in § 1065.602. Using good engineering judgment, you may weight the results of individual data pairs (i.e., (y_{refi}, $\bar{y}_i$)), in the linear regression calculations.

(d) * * *

(8) *Analog-to-digital conversion of stand-alone temperature signals.* For reference values, select a temperature signal calibrator to simultaneously simulate and measure an analog signal similar to your temperature sensor(s). Analog signals may include voltage, current, resistance, frequency, and pulse signals. Use a calibrator that is independently linearized and cold-junction compensated, as necessary, and is NIST-traceable within ±0.5% uncertainty.

TABLE 1 OF § 1065.307.—MEASUREMENT SYSTEMS THAT REQUIRE LINEARITY VERIFICATIONS

Measurement system	Quantity	Minimum verification frequency [a]	Linearity criteria			
			$\lvert a_0 \rvert$ [b]	a_1 [c]	SEE [b]	r^2
Engine speed	f_n	Within 370 days before testing	≤0.05% f_{nmax}.	0.98–1.02	≤2% f_{nmax}	≥0.990
Engine torque	T	Within 370 days before testing	≤1% ·T_{max}	0.98–1.02	≤2% T_{max}	≥0.990
Electrical work	W	Within 370 days before testing	≤1% ·T_{max}	0.98–1.02	≤2% T_{max}	≥0.990
Fuel flow rate	$\dot{m}$	Within 370 days before testing [d]	≤1% ·$\dot{m}_{max}$	0.98–1.02 [e]	≤2% ·$\dot{m}_{max}$	≥0.990
Intake-air flow rate	$\dot{n}$	Within 370 days before testing [d]	≤1% ·$\dot{n}_{max}$	0.98–1.02 [e]	≤2% ·n_{max}	≥0.990
Dilution air flow rate	$\dot{n}$	Within 370 days before testing [d]	≤1% ·$\dot{n}_{max}$	0.98–1.02	≤2% ·$\dot{n}_{max}$	≥0.990
Diluted exhaust flow rate	$\dot{n}$	Within 370 days before testing [d]	≤1% ·$\dot{n}_{max}$	0.98–1.02	≤2% ·$\dot{n}_{max}$	≥0.990
Raw exhaust flow rate	$\dot{n}$	Within 185 days before testing [d]	≤1% ·$\dot{n}_{max}$	0.98–1.02 [e]	≤2% ·$\dot{n}_{max}$	≥0.990
Batch sampler flow rates	$\dot{n}$	Within 370 days before testing [d]	≤1% ·$\dot{n}_{max}$	0.98–1.02	≤2% ·$\dot{n}_{max}$	≥0.990
Gas dividers	x	Within 370 days before testing	≤0.5% ··x_{max}.	0.98–1.02	≤2% ·x_{max}	≥0.990
All gas analyzers	x	Within 35 days before testing	≤1% ·x_{max}	0.99–1.01	≤1% ·x_{max}	≥0.998
PM balance	m	Within 370 days before testing	≤1% ·m_{max}	0.99–1.01	≤1% ·m_{max}	≥0.998
Stand-alone pressures	p	Within 370 days before testing	≤1% ·p_{max}	0.99–1.01	≤1% ·p_{max}	≥0.998
Analog-to-digital conversion of stand-alone temperature signals.	·T	Within 370 days before testing	≤1% ·T_{max}	0.99–1.01	≤1% ·T_{max}	≥0.998

[a] Perform a linearity verification more frequently if the instrument manufacturer recommends it or based on good engineering judgment.
[b] "max." refers to the peak value expected during testing or at the applicable standard over any test interval, whichever is greater.
[c] The specified ranges are inclusive. For example, a specified range of 0.98–1.02 for a_1 means $0.98 \le a_1 \le 1.02$.
[d] These linearity verifications are not required for systems that pass the flow-rate verification for diluted exhaust as described in § 1065.341 (the propane check) or for systems that agree within ±2% based on a chemical balance of carbon or oxygen of the intake air, fuel, and exhaust.
[e] a_1 criteria for these quantities must be met only if the absolute value of the quantity is required, as opposed to a signal that is only linearly proportional to the actual value.

44. Section 1065.308 is revised to read as follows:

§ 1065.308 Continuous gas analyzer system-response and updating-recording verification.

(a) *Scope and frequency.* Perform this verification after installing or replacing a gas analyzer that you use for continuous sampling. Also perform this verification if you reconfigure your system in a way that would change system response. For example, perform this verification if you add a significant volume to the transfer lines by increasing their length or adding a filter; or if you change the frequency at which you sample and record gas-analyzer concentrations. You do not have to perform this verification for gas analyzer systems used only for discrete-mode testing.

(b) *Measurement principles.* This test verifies that the updating and recording frequencies match the overall system response to a rapid change in the value of concentrations at the sample probe. Gas analyzer systems must be optimized such that their overall response to a rapid change in concentration is updated and recorded at an appropriate frequency to prevent loss of information. This test also verifies that continuous gas analyzer systems meet a minimum response time.

(c) *System requirements.* To demonstrate acceptable updating and recording with respect to the system's overall response, use good engineering judgment to select one of the following criteria that your system must meet:

(1) The product of the mean rise time and the frequency at which the system records an updated concentration must be at least 5, and the product of the mean fall time and the frequency at which the system records an updated concentration must be at least 5. These criteria make no assumption regarding the frequency content of changes in emission concentrations during emission testing; therefore, it is valid for

any testing. In any case the mean rise time and the mean fall time must be no more than 10 seconds.

(2) The frequency at which the system records an updated concentration must be at least 5 Hz. This criteria assumes that the frequency content of significant changes in emission concentrations during emission testing do not exceed 1 Hz. In any case the mean rise time and the mean fall time must be no more than 10 seconds.

(3) You may use other criteria if we approve the criteria in advance.

(4) For PEMS, you do not have to meet this criteria if your PEMS meets the overall PEMS check in § 1065.920.

(d) *Procedure.* Use the following procedure to verify the response of a continuous gas analyzer system:

(1) *Instrument setup.* Follow the analyzer system manufacturer's start-up and operating instructions. Adjust the system as needed to optimize performance.

(2) *Equipment setup.* Using minimal gas transfer line lengths between all connections, connect a zero-air source to one inlet of a fast-acting 3-way valve (2 inlets, 1 outlet). Using a gas divider, equally blend an NO-CO-CO_2-C_3H_8-CH_4, balance N_2 span gas with a span gas of NO_2, balance N_2. Connect the gas divider outlet to the other inlet of the 3-way valve. Connect the valve outlet to an overflow at the gas analyzer system's probe or to an overflow fitting between the probe and transfer line to all the analyzers being verified. Note that you may omit any of these gas constituents if they are not relevant to your analyzers for this verification.

(3) *Data collection.* (i) Switch the valve to flow zero gas.

(ii) Allow for stabilization, accounting for transport delays and the slowest instrument's full response.

(iii) Start recording data at the frequency used during emission testing. Each recorded value must be a unique updated concentration measured by the analyzer; you may not use interpolation to increase the number of recorded values.

(iv) Switch the valve to flow the blended span gases.

(v) Allow for transport delays and the slowest instrument's full response.

(vi) Repeat the steps in paragraphs (d)(3)(i) through (v) of this section to record seven full cycles, ending with zero gas flowing to the analyzers.

(vii) Stop recording.

(e) *Performance evaluation.* (1) If you chose to demonstrate compliance with paragraph (c)(1) of this section, use the data from paragraph (d)(3) of this section to calculate the mean rise time, t_{10-90}, and mean fall time, t_{90-10}, for each of the analyzers. Multiply these times (in seconds) by their respective recording frequencies in Hertz (1/second). The value for each result must be at least 5. If the value is less than 5, increase the recording frequency or adjust the flows or design of the sampling system to increase the rise time and fall time as needed. You may also configure digital filters to increase rise and fall times. The mean rise time and mean fall time must be no greater than 10 seconds.

(2) If a measurement system fails the criterion in paragraph (e)(1) of this section, ensure that signals from the system are updated and recorded at a frequency of at least 5 Hz. In any case, the mean rise time and mean fall time must be no greater than 10 seconds.

(3) If a measurement system fails the criteria in paragraphs (e)(1) and (2) of this section, you may use the continuous analyzer system only if the deficiency does not adversely affect your ability to show compliance with the applicable standards.

45. Section 1065.309 is revised to read as follows:

§ 1065.309 Continuous gas analyzer uniform response verification.

(a) *Scope and frequency.* Perform this verification if you multiply or divide one continuous gas analyzer's response by another's to quantify a gaseous emission. Note that we consider water vapor a gaseous constituent. You do not have to perform this verification if you multiply one gas analyzer's response to another's to compensate for an interference that never requires a compensation more than 2% of the flow-weighted mean concentration at the applicable standard or during testing, whichever is greatest. You also do not have to perform this verification for batch gas analyzer systems or for continuous analyzer systems that are only used for discrete-mode testing. Perform this verification after initial installation or major maintenance. Also perform this verification if you reconfigure your system in a way that would change system response. For example, perform this verification if you add a significant volume to the transfer lines by increasing their length or by adding a filter; or if you change the frequency at which you sample and record gas-analyzer concentrations.

(b) *Measurement principles.* This procedure verifies the time-alignment and uniform response of continuously combined gas measurements.

(c) *System requirements.* Demonstrate that continuously combined concentration measurements have a uniform rise and fall during a simultaneous step change in both concentrations. During a system response to a rapid change in multiple gas concentrations, demonstrate that the t_{50} times of all combined analyzers all occur at the same recorded second of data or between the same two recorded seconds of data.

(d) *Procedure.* Use the following procedure to verify the response of a continuous gas analyzer system:

(1) *Instrument setup.* Follow the analyzer system manufacturer's start-up and operating instructions. Adjust the system as needed to optimize performance.

(2) *Equipment setup.* Using a gas divider, equally blend a span gas of NO-CO-CO_2-C_3H_8-CH_4, balance N_2, with a span gas of NO_2, balance N_2. Connect the gas divider outlet to a 100 °C heated line. Connect the other end of this line to a 100 °C heated three-way tee. Next connect a dewpoint generator, set at a dewpoint of 50 °C, to one end of a heated line at 100 °C. Connect the other end of this line to the heated tee and connect a third 100 °C heated line from the tee to an overflow at the inlet of a 100 °C heated fast-acting three-way valve (two inlets, one outlet). Connect a zero-air source, heated to 100 °C, to a separate overflow at the other inlet of the three-way valve. Connect the three-way valve outlet to the gas analyzer system's probe or to an overflow fitting between the probe and transfer line to all the analyzers being verified. Note that you may omit any of these gas constituents if they are not relevant to your analyzers for this verification.

(3) *Data collection.* (i) Switch the valve to flow zero gas.

(ii) Allow for stabilization, accounting for transport delays and the slowest instrument's full response.

(iii) Start recording data at the frequency used during emission testing.

(iv) Switch the valve to flow span gas.

(v) Allow for transport delays and the slowest instrument's full response.

(vi) Repeat the steps in paragraphs (d)(3)(i) through (v) of this section to record seven full cycles, ending with zero gas flowing to the analyzers.

(vii) Stop recording.

(e) *Performance evaluations.* Perform the following evaluations:

(1) Uniform response evaluation. (i) Calculate the mean rise time, t_{10-90}, mean fall time, t_{90-10} for each analyzer.

(ii) Determine the maximum mean rise and fall times for the slowest responding analyzer in each combination of continuous analyzer signals that you use to determine a single emission concentration.

(iii) If the maximum rise time or fall time is greater than one second, verify that all other gas analyzers combined with it have mean rise and fall times of at least 75% of that analyzer's response. If the slowest analyzer has t_{10-90} and t_{90-10} values less than 1 sec, no dispersion is necessary for any of the analyzers.

(iv) If any analyzer has shorter rise or fall times, disperse that signal so that it better matches the rise and fall times of the slowest signal with which it is combined. We recommend that you perform dispersion using SAE 2001–01–3536 (incorporated by reference in § 1065.1010) as a guide.

(v) Repeat this verification after optimizing your systems to ensure that you dispersed signals correctly. If after repeated attempts at dispersing signals your system still fails this verification, you may use the continuous analyzer system if the deficiency does not adversely affect your ability to show compliance with the applicable standards.

(2) *Time alignment evaluation.* (i) After all signals are adjusted to meet the uniform response evaluation, determine the second at which—or the two seconds between which—each analyzer crossed the midpoint of its response, t_{50}.

(ii) Verify that all combined gas analyzer signals are time-aligned such that all of their t_{50} times occurred at the same second or between the same two seconds in the recorded data.

(iii) If your system fails to meet this criterion, you may change the time alignment of your system and retest the system completely. If after changing the time alignment of your system, some of the t_{50} times still are not aligned, take corrective action by dispersing analyzer signals that have the shortest rise and fall times.

(iv) If some t_{50} times are still not aligned after repeated attempts at dispersion and time alignment, you may use the continuous analyzer system if the deficiency does not adversely affect your ability to show compliance with the applicable standards.

46. Section 1065.310 is amended by revising paragraph (d) to read as follows:

§ 1065.310 Torque calibration.

* * * * *

(d) *Strain gage or proving ring calibration.* This technique applies force either by hanging weights on a lever arm (these weights and their lever arm length are not used as part of the reference torque determination) or by operating the dynamometer at different torques. Apply at least six force combinations for each applicable torque-measuring range, spacing the force quantities about equally over the range. Oscillate or rotate the dynamometer during calibration to reduce frictional static hysteresis. In this case, the reference torque is determined by multiplying the force output from the reference meter (such as a strain gage or proving ring) by its effective lever-arm length, which you measure from the point where the force measurement is made to the dynamometer's rotational axis. Make sure you measure this length perpendicular to the reference meter's measurement axis and perpendicular to the dynamometer's rotational axis.

47. Section 1065.340 is amended by revising paragraphs (f)(6)(ii), (f)(9), and (g)(6)(i) and Figure 1 to read as follows:

§ 1065.340 Diluted exhaust flow (CVS) calibration.

* * * * *

(f) * * *

(6) * * *

(ii) The mean dewpoint of the calibration air, $\bar{T}_{dew}$. See § 1065.640 for permissible assumptions during emission measurements.

* * * * *

(9) Determine C_d and the lowest allowable $\Delta\bar{p}_{CFV}$ according to § 1065.640.

* * * * *

(g) * * *

(6) * * *

(i) The mean flow rate of the reference flow meter, n_{ref}. This may include several measurements of different quantities, such as reference meter pressures and temperatures, for calculating n_{ref}.

* * * * *

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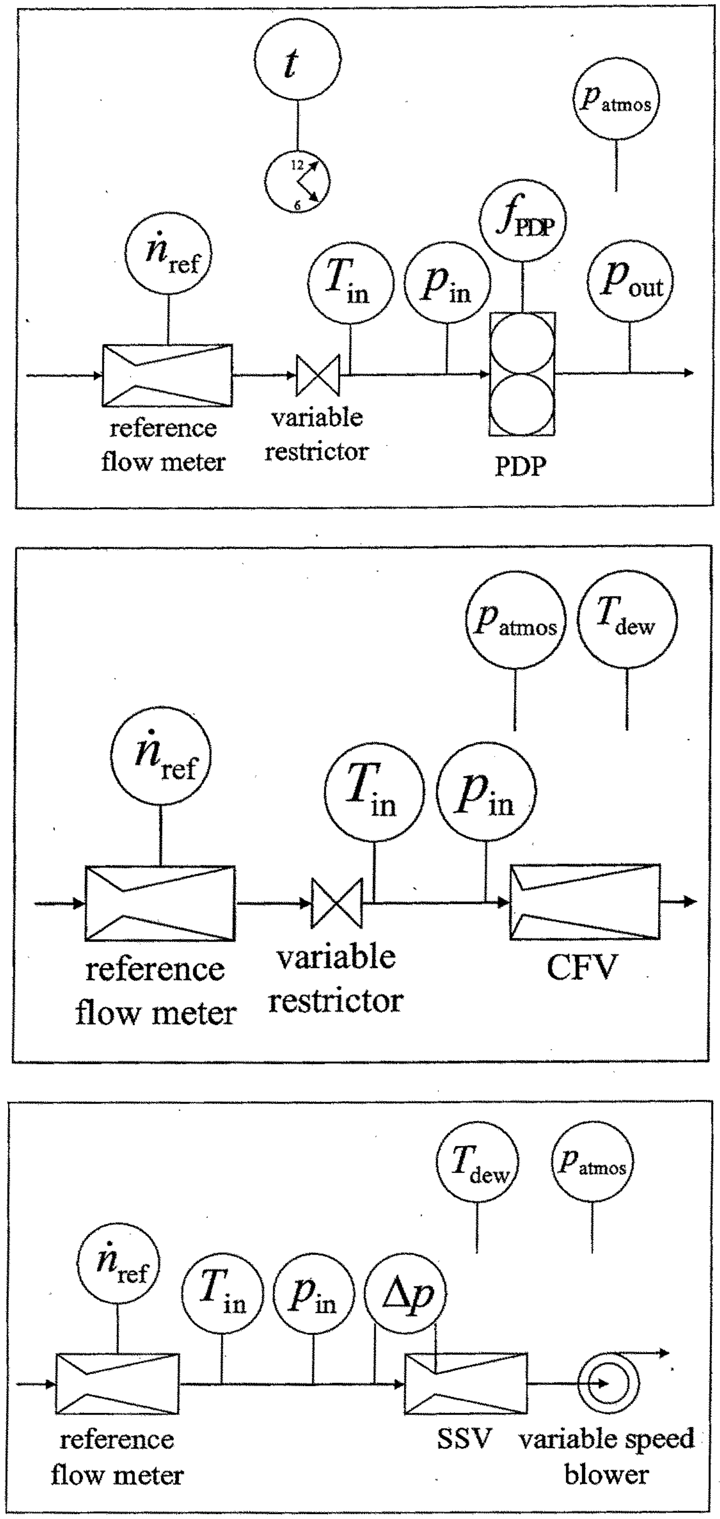
Figure 1 of 1065.340 CVS calibration configurations.



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48. Section 1065.341 is amended by revising paragraph (g) introductory text to read as follows:

§ 1065.341 CVS and batch sampler verification (propane check).

* * * * *

(g) You may repeat the propane check to verify a batch sampler, such as a PM secondary dilution system.

* * * * *

49. Section 1065.345 is revised to read as follows:

§ 1065.345 Vacuum-side leak verification.

(a) *Scope and frequency.* Upon initial sampling system installation, after major maintenance, and before each test according to subpart F of this part for laboratory tests and according to subpart J of this part for field tests, verify that there are no significant vacuum-side leaks using one of the leak tests described in this section. This verification does not apply to any full-flow portion of a CVS dilution system.

(b) *Measurement principles.* A leak may be detected either by measuring a small amount of flow when there should be zero flow, or by detecting the dilution of a known concentration of span gas when it flows through the vacuum side of a sampling system.

(c) *Low-flow leak test.* Test a sampling system for low-flow leaks as follows:

(1) Seal the probe end of the system by taking one of the following steps:

(i) Cap or plug the end of the sample probe.

(ii) Disconnect the transfer line at the probe and cap or plug the transfer line.

(iii) Close a leak-tight valve in-line between a probe and transfer line.

(2) Operate all vacuum pumps. After stabilizing, verify that the flow through the vacuum-side of the sampling system is less than 0.5% of the system's normal in-use flow rate. You may estimate typical analyzer and bypass flows as an approximation of the system's normal in-use flow rate.

(d) *Dilution-of-span-gas leak test.* You may use any gas analyzer for this test. If you use a FID for this test, correct for any HC contamination in the sampling system according to § 1065.660. To avoid misleading results from this test, we recommend using only analyzers that have a repeatability of 0.5% or better at the span gas concentration used for this test. Perform a vacuum-side leak test as follows:

(1) Prepare a gas analyzer as you would for emission testing.

(2) Supply span gas to the analyzer port and verify that it measures the span gas concentration within its expected measurement accuracy and repeatability.

(3) Route overflow span gas to one of the following locations in the sampling system:

(i) The end of the sample probe.

(ii) Disconnect the transfer line at the probe connection, and overflow the span gas at the open end of the transfer line.

(iii) A three-way valve installed in-line between a probe and its transfer line, such as a system overflow zero and span port.

(4) Verify that the measured overflow span gas concentration is within ±0.5% of the span gas concentration. A measured value lower than expected indicates a leak, but a value higher than expected may indicate a problem with the span gas or the analyzer itself. A measured value higher than expected does not indicate a leak.

(e) *Vacuum-decay leak test.* To perform this test you must apply a vacuum to the vacuum-side volume of your sampling system and then observe the leak rate of your system as a decay in the applied vacuum. To perform this test you must know the vacuum-side volume of your sampling system to within ±10% of its true volume. For this test you must also use measurement instruments that meet the specifications of subpart C of this part and of this subpart D. Perform a vacuum-decay leak test as follows:

(1) Seal the probe end of the system as close to the probe opening as possible by taking one of the following steps:

(i) Cap or plug the end of the sample probe.

(ii) Disconnect the transfer line at the probe and cap or plug the transfer line.

(iii) Close a leak-tight valve in-line between a probe and transfer line.

(2) Operate all vacuum pumps. Draw a vacuum that is representative of normal operating conditions. In the case of sample bags, we recommend that you repeat your normal sample bag pump-down procedure twice to minimize any trapped volumes.

(3) Turn off the sample pumps and seal the system. Measure and record the absolute pressure of the trapped gas, the time, and optionally the system absolute temperature. Wait at least 60 sec and again record the pressure, time, and optionally temperature. You may have to adjust your wait time by trial and error to accurately quantify a change in pressure over a time interval.

(4) Calculate the leak flow rate based on an assumed value of zero for pumped-down bag volumes and based on known values for the sample system volume, the initial and final pressures, optional temperatures, and elapsed time. Verify that the vacuum-decay leak flow rate is less than 0.5% of the system's normal in-use flow rate.

50. Section 1065.350 is amended by revising paragraphs (c) and (d) to read as follows:

§ 1065.350 H_2O interference verification for CO_2 NDIR analyzers.

* * * * *

(c) *System requirements.* A CO_2 NDIR analyzer must have an H_2O interference that is within (0 ±400) µmol/mol., though we strongly recommend a lower interference that is within (0 ±200) µmol/mol.

(d) *Procedure.* Perform the interference verification as follows:

(1) Start, operate, zero, and span the CO_2 NDIR analyzer as you would before an emission test.

(2) Create a humidified test gas by bubbling zero air that meets the specifications in § 1065.750 through distilled water in a sealed vessel at (25 ±10) °C.

(3) Downstream of the vessel, maintain the humidified test gas temperature at least 5 °C above its dewpoint. We recommend using a heated transfer line.

(4) Introduce the humidified test gas upstream of any sample dryer, if one is used during testing.

(5) Allow time for the analyzer response to stabilize. Stabilization time may include time to purge the transfer line and to account for analyzer response.

(6) While the analyzer measures the sample's concentration, record 30 seconds of sampled data. Calculate the arithmetic mean of this data. The analyzer meets the interference verification if this value is within (0 ±400) µmol/mol.

* * * * *

51. Section 1065.355 is amended by revising paragraphs (d) and (e)(1) to read as follows:

§ 1065.355 H_2O and CO_2 interference verification for CO NDIR analyzers.

* * * * *

(d) *Procedure.* Perform the interference verification as follows:

(1) Start, operate, zero, and span the CO NDIR analyzer as you would before an emission test.

(2) Create a humidified CO_2 test gas by bubbling a CO_2 span gas through distilled water in a sealed vessel at (25 ±10) °C.

(3) Downstream of the vessel, maintain the humidified gas temperature at least 5 °C above its dewpoint. We recommend using a heated transfer line.

(4) Introduce the humidified CO_2 test gas upstream of any sample dryer, if one is used during testing.

(5) Measure the humidified CO_2 test gas dewpoint and pressure as close as possible to the inlet of the analyzer, or to the inlet of the sample dryer, if one is used.

(6) Allow time for the analyzer response to stabilize. Stabilization time may include time to purge the transfer line and to account for analyzer response.

(7) While the analyzer measures the sample's concentration, record its output for 30 seconds. Calculate the arithmetic mean of this data.

(8) Scale the CO_2 interference by multiplying this mean value (from paragraph (d)(7) of this section) by the ratio of expected CO_2 to span gas CO_2 concentration. In other words, estimate the flow-weighted mean dry concentration of CO_2 expected during testing, and then divide this value by the concentration of CO_2 in the span gas used for this verification. Then multiply this ratio by the mean value recorded during this verification (from paragraph (d)(7) of this section).

(9) Scale the H_2O interference by estimating the flow-weighted mean concentration of H_2O expected during testing, then divide this value by the concentration of H_2O in the span gas used for this verification. Then multiply this ratio by the CO_2-scaled result of paragraph (d)(8) of this section.

(10) The analyzer meets the interference verification if the result of paragraph (d)(9) of this section is within ±2% of the flow-weighted mean concentration of CO expected at the standard.

(e) * * *

(1) You may omit this verification if you can show by engineering analysis that for your CO sampling system and your emission calculations procedures, the combined CO_2 and H_2O interference for your CO NDIR analyzer always affects your brake-specific CO emission results within ±0.5% of the applicable CO standard.

* * * * *

52. Section 1065.360 is revised to read as follows:

§ 1065.360 FID optimization and verification.

(a) *Scope and frequency.* For all FID analyzers, calibrate the FID upon initial installation. Repeat the calibration as needed using good engineering judgment. For a FID that measures THC, perform the following steps:

(1) Optimize the response to various hydrocarbons after initial analyzer installation and after major maintenance as described in paragraph (c) of this section.

(2) Determine the methane (CH_4) response factor after initial analyzer installation and after major maintenance as described in paragraph (d) of this section.

(3) Verify the methane (CH_4) response within 185 days before testing as described in paragraph (e) of this section.

(b) *Calibration.* Use good engineering judgment to develop a calibration procedure, such as one based on the FID-analyzer manufacturer's instructions and recommended frequency for calibrating the FID. Alternately, you may remove system components for off-site calibration. For a FID that measures THC, calibrate using C_3H_8 calibration gases that meet the specifications of § 1065.750. For a FID that measures CH_4, calibrate using CH_4 calibration gases that meet the specifications of § 1065.750. We recommend FID analyzer zero and span gases that contain approximately the flow-weighted mean concentration of O_2 expected during testing. If you use a FID to measure methane (CH_4) downstream of a nonmethane cutter, you may calibrate that FID using CH_4 calibration gases with the cutter. Regardless of the calibration gas composition, calibrate on a carbon number basis of one (C_1). For example, if you use a C_3H_8 span gas of concentration 200 μmol/mol, span the FID to respond with a value of 600 μmol/mol. As another example, if you use a CH_4 span gas with a concentration of 200 μmol/mol, span the FID to respond with a value of 200 μmol/mol.

(c) *THC FID response optimization.* This procedure is only for FID analyzers that measure THC. Use good engineering judgment for initial instrument start-up and basic operating adjustment using FID fuel and zero air. Heated FIDs must be within their required operating temperature ranges. Optimize FID response at the most common analyzer range expected during emission testing. Optimization involves adjusting flows and pressures of FID fuel, burner air, and sample to minimize response variations to various hydrocarbon species in the exhaust. Use good engineering judgment to trade off peak FID response to propane calibration gases to achieve minimal response variations to different hydrocarbon species. For an example of trading off response to propane for relative responses to other hydrocarbon species, see SAE 770141 (incorporated by reference in § 1065.1010). Determine the optimum flow rates for FID fuel, burner air, and sample and record them for future reference.

(d) *THC FID CH_4 response factor determination.* This procedure is only for FID analyzers that measure THC. Since FID analyzers generally have a different response to CH_4 versus C_3H_8, determine each THC FID analyzer's CH_4 response factor, RF_{CH4}, after FID optimization. Use the most recent $RFCH_4$ measured according to this section in the calculations for HC determination described in § 1065.660 to compensate for CH_4 response. Determine RF_{CH4} as follows, noting that you do not determine $RFCH_4$ for FIDs that are calibrated and spanned using CH_4 with a nonmethane cutter:

(1) Select a C_3H_8 span gas concentration that you use to span your analyzers before emission testing. Use only span gases that meet the specifications of § 1065.750. Record the C_3H_8 concentration of the gas.

(2) Select a CH_4 span gas concentration that you use to span your analyzers before emission testing. Use only span gases that meet the specifications of § 1065.750. Record the CH_4 concentration of the gas.

(3) Start and operate the FID analyzer according to the manufacturer's instructions.

(4) Confirm that the FID analyzer has been calibrated using C_3H_8. Calibrate on a carbon number basis of one (C_1). For example, if you use a C_3H_8 span gas of concentration 200 μmol/mol, span the FID to respond with a value of 600 μmol/mol.

(5) Zero the FID with a zero gas that you use for emission testing.

(6) Span the FID with the C_3H_8 span gas that you selected under paragraph (d)(1) of this section.

(7) Introduce at the sample port of the FID analyzer, the CH_4 span gas that you selected under paragraph (d)(2) of this section.

(8) Allow time for the analyzer response to stabilize. Stabilization time may include time to purge the analyzer and to account for its response.

(9) While the analyzer measures the CH_4 concentration, record 30 seconds of sampled data. Calculate the arithmetic mean of these values.

(10) Divide the mean measured concentration by the recorded span concentration of the CH_4 calibration gas. The result is the FID analyzer's response factor for CH_4, RF_{CH4}.

(e) *THC FID methane (CH_4) response verification.* This procedure is only for FID analyzers that measure THC. If the value of RF_{CH4} from paragraph (d) of this section is within ±5.0% of its most recent previously determined value, the THC FID passes the methane response verification. For example, if the most recent previous value for RF_{CH4} was 1.05 and it changed by ±0.05 to become 1.10 or it changed by −0.05 to become

1.00, either case would be acceptable because ±4.8% is less than ±5.0%. Verify RF_{CH4} as follows:

(1) First verify that the pressures and flow rates of FID fuel, burner air, and sample are each within ±0.5% of their most recent previously recorded values, as described in paragraph (c) of this section. You may adjust these flow rates as necessary. Then determine the RF_{CH4} as described in paragraph (d) of this section and verify that it is within the tolerance specified in this paragraph (e).

(2) If RF_{CH4} is not within the tolerance specified in this paragraph (e), re-optimize the FID response as described in paragraph (c) of this section.

(3) Determine a new RF_{CH4} as described in paragraph (d) of this section. Use this new value of RF_{CH4} in the calculations for HC determination, as described in § 1065.660.

53. Section 1065.362 is amended by revising paragraph (d) to read as follows:

§ 1065.362 Non-stoichiometric raw exhaust FID O_2 interference verification.

* * * * *

(d) *Procedure*. Determine FID O_2 interference as follows, noting that you may use one or more gas dividers to create the reference gas concentrations that are required to perform this verification:

(1) Select two span reference gases that contain a C_3H_8 concentration that you use to span your analyzers before emission testing. Use only span gases that meet the specifications of § 1065.750. You may use CH_4 span reference gases for FIDs calibrated on CH_4 with a nonmethane cutter. Select the two balance gas concentrations such that the concentrations of O_2 and N_2 represent the minimum and maximum O_2 concentrations expected during testing.

(2) Confirm that the FID analyzer meets all the specifications of § 1065.360.

(3) Start and operate the FID analyzer as you would before an emission test. Regardless of the FID burner's air source during testing, use zero air as the FID burner's air source for this verification.

(4) Zero the FID analyzer using the zero gas used during emission testing.

(5) Span the FID analyzer using a span gas that you use during emission testing.

(6) Check the zero response of the FID analyzer using the zero gas used during emission testing. If the mean zero response of 30 seconds of sampled data is within ±0.5% of the span reference value used in paragraph (d)(5) of this section, then proceed to the next step; otherwise restart the procedure at paragraph (d)(4) of this section.

(7) Check the analyzer response using the span gas that has the minimum concentration of O_2 expected during testing. Record the mean response of 30 seconds of stabilized sample data as $x_{O2minHC}$.

(8) Check the zero response of the FID analyzer using the zero gas used during emission testing. If the mean zero response of 30 seconds of stabilized sample data is within ±0.5% of the span reference value used in paragraph (d)(5) of this section, then proceed to the next step; otherwise restart the procedure at paragraph (d)(4) of this section.

(9) Check the analyzer response using the span gas that has the maximum concentration of O_2 expected during testing. Record the mean response of 30 seconds of stabilized sample data as $x_{O2maxHC}$.

(10) Check the zero response of the FID analyzer using the zero gas used during emission testing. If the mean zero response of 30 seconds of stabilized sample data is within ±0.5% of the span reference value used in paragraph (d)(5) of this section, then proceed to the next step; otherwise restart the procedure at paragraph (d)(4) of this section.

(11) Calculate the percent difference between $x_{O2maxHC}$ and its reference gas concentration. Calculate the percent difference between $x_{O2minHC}$ and its reference gas concentration. Determine the maximum percent difference of the two. This is the O_2 interference.

(12) If the O_2 interference is within ±1.5%, the FID passes the O_2 interference verification; otherwise perform one or more of the following to address the deficiency:

(i) Repeat the verification to determine if a mistake was made during the procedure.

(ii) Select zero and span gases for emission testing that contain higher or lower O_2 concentrations and repeat the verification.

(iii) Adjust FID burner air, fuel, and sample flow rates. Note that if you adjust these flow rates on a THC FID to meet the O_2 interference verification, you must re-verify RF_{CH4} according to § 1065.360. Repeat the O_2 interference verification after adjustment and RF_{CH4} verification.

(iv) Repair or replace the FID and repeat the O_2 interference verification.

(v) Demonstrate that the deficiency does not adversely affect your ability to demonstrate compliance with the applicable emission standards.

54. Section 1065.365 is revised to read as follows:

§ 1065.365 Nonmethane cutter penetration fractions.

(a) *Scope and frequency.* If you use a FID analyzer and a nonmethane cutter (NMC) to measure methane (CH_4), determine the nonmethane cutter's penetration fractions of methane, PF_{CH4}, and ethane, PF_{C2H6}. As detailed in this section, these penetration fractions may be determined as a combination of NMC penetration fractions and FID analyzer response factors, depending on your particular NMC and FID analyzer configuration. Perform this verification after installing the nonmethane cutter. Repeat this verification within 185 days of testing to verify that the catalytic activity of the cutter has not deteriorated. Note that because nonmethane cutters can deteriorate rapidly and without warning if they are operated outside of certain ranges of gas concentrations and outside of certain temperature ranges, good engineering judgment may dictate that you determine a nonmethane cutter's penetration fractions more frequently.

(b) *Measurement principles.* A nonmethane cutter is a heated catalyst that removes nonmethane hydrocarbons from an exhaust sample stream before the FID analyzer measures the remaining hydrocarbon concentration. An ideal nonmethane cutter would have a methane penetration fraction, PF_{CH4}, of 1.000, and the penetration fraction for all other nonmethane hydrocarbons would be 0.000, as represented by PF_{C2H6}. The emission calculations in § 1065.660 use the measured values from this verification to account for less than ideal NMC performance.

(c) *System requirements.* We do not limit NMC penetration fractions to a certain range. However, we recommend that you optimize a nonmethane cutter by adjusting its temperature to achieve a $PF_{CH4} > 0.85$ and a $PF_{C2H6} < 0.02$, as determined by paragraphs (d), (e), or (f) of this section, as applicable. If we use a nonmethane cutter for testing, it will meet this recommendation. If adjusting NMC temperature does not result in achieving both of these specifications simultaneously, we recommend that you replace the catalyst material. Use the most recently determined penetration values from this section to calculate HC emissions according to § 1065.660 and § 1065.665 as applicable.

(d) *Procedure for a FID calibrated with the NMC.* If your FID arrangement is such that a FID is always calibrated to measure CH_4 with the NMC, then span that FID with the NMC cutter using a CH_4 span gas, set the product of that FID's CH_4 response factor and CH_4 penetration fraction, $RF_{CH4} \cdot PF_{CH4}$, equal to 1.0 for all emission calculations, and determine its ethane (C_2H_6) penetration fraction, PF_{C2H6} as follows:

(1) Select a CH_4 gas mixture and a C_2H_6 analytical gas mixture and ensure that both mixtures meet the specifications of § 1065.750. Select a CH_4 concentration that you would use for spanning the FID during emission testing and select a C_2H_6 concentration that is typical of the peak NMHC concentration expected at the hydrocarbon standard or equal to THC analyzer's span value.

(2) Start, operate, and optimize the nonmethane cutter according to the manufacturer's instructions, including any temperature optimization.

(3) Confirm that the FID analyzer meets all the specifications of § 1065.360.

(4) Start and operate the FID analyzer according to the manufacturer's instructions.

(5) Zero and span the FID with the cutter and use CH_4 span gas to span the FID with the cutter. Note that you must span the FID on a C_1 basis. For example, if your span gas has a CH_4 reference value of 100 µmol/mol, the correct FID response to that span gas is 100 µmol/mol because there is one carbon atom per CH_4 molecule.

(6) Introduce the C_2H_6 analytical gas mixture upstream of the nonmethane cutter.

(7) Allow time for the analyzer response to stabilize. Stabilization time may include time to purge the nonmethane cutter and to account for the analyzer's response.

(8) While the analyzer measures a stable concentration, record 30 seconds of sampled data. Calculate the arithmetic mean of these data points.

(9) Divide the mean by the reference value of C_2H_6, converted to a C_1 basis. The result is the C_2H_6 penetration fraction, PF_{C2H6}. Use this penetration fraction and the product of the CH_4 response factor and CH_4 penetration fraction, $RF_{CH4} \cdot PF_{CH4}$, set to 1.0 in emission calculations according to § 1065.660 or § 1065.665, as applicable.

(e) *Procedure for a FID calibrated with propane, bypassing the NMC.* If you use a FID with an NMC that is calibrated with propane, C_3H_8, by bypassing the NMC, determine penetration fractions as follows:

(1) Select CH_4 and C_2H_6 analytical gas mixtures that meet the specifications of § 1065.750 with the CH_4 concentration typical of its peak concentration expected at the hydrocarbon standard and the C_2H_6 concentration typical of the peak total hydrocarbon (THC) concentration expected at the hydrocarbon standard or the THC analyzer span value.

(2) Start and operate the nonmethane cutter according to the manufacturer's instructions, including any temperature optimization.

(3) Confirm that the FID analyzer meets all the specifications of § 1065.360.

(4) Start and operate the FID analyzer according to the manufacturer's instructions.

(5) Zero and span the FID as you would during emission testing. Span the FID by bypassing the cutter and by using C_3H_8 span gas to span the FID. Note that you must span the FID on a C_1 basis. For example, if your span gas has a propane reference value of 100 µmol/mol, the correct FID response to that span gas is 300 µmol/mol because there are three carbon atoms per C_3H_8 molecule.

(6) Introduce the C_2H_6 analytical gas mixture upstream of the nonmethane cutter.

(7) Allow time for the analyzer response to stabilize. Stabilization time may include time to purge the nonmethane cutter and to account for the analyzer's response.

(8) While the analyzer measures a stable concentration, record 30 seconds of sampled data. Calculate the arithmetic mean of these data points.

(9) Reroute the flow path to bypass the nonmethane cutter, introduce the C_2H_6 analytical gas mixture to the bypass, and repeat the steps in paragraphs (e)(7) through (8) of this section.

(10) Divide the mean C_2H_6 concentration measured through the nonmethane cutter by the mean concentration measured after bypassing the nonmethane cutter. The result is the C_2H_6 penetration fraction, PF_{C2H6}. Use this penetration fraction according to § 1065.660 or § 1065.665, as applicable.

(11) Repeat the steps in paragraphs (e)(6) through (10) of this section, but with the CH_4 analytical gas mixture instead of C_2H_6. The result will be the CH_4 penetration fraction, PF_{CH4}. Use this penetration fraction according to § 1065.660 or § 1065.665, as applicable.

(f) *Procedure for a FID calibrated with methane, bypassing the NMC.* If you use a FID with an NMC that is calibrated with methane, CH_4, by bypassing the NMC, determine penetration fractions as follows:

(1) Select CH_4 and C_2H_6 analytical gas mixtures that meet the specifications of § 1065.750, with the CH_4 concentration typical of its peak concentration expected at the hydrocarbon standard and the C_2H_6 concentration typical of the peak total hydrocarbon (THC) concentration expected at the hydrocarbon standard or the THC analyzer span value.

(2) Start and operate the nonmethane cutter according to the manufacturer's instructions, including any temperature optimization.

(3) Confirm that the FID analyzer meets all the specifications of § 1065.360.

(4) Start and operate the FID analyzer according to the manufacturer's instructions.

(5) Zero and span the FID as you would during emission testing. Span the FID with CH_4 span gas by bypassing the cutter. Note that you must span the FID on a C_1 basis. For example, if your span gas has a methane reference value of 100 µmol/mol, the correct FID response to that span gas is 100 µmol/mol because there is one carbon atom per CH_4 molecule.

(6) Introduce the C_2H_6 analytical gas mixture upstream of the nonmethane cutter.

(7) Allow time for the analyzer response to stabilize. Stabilization time may include time to purge the nonmethane cutter and to account for the analyzer's response.

(8) While the analyzer measures a stable concentration, record 30 seconds of sampled data. Calculate the arithmetic mean of these data points.

(9) Reroute the flow path to bypass the nonmethane cutter, introduce the C_2H_6 analytical gas mixture to the bypass, and repeat the steps in paragraphs (e)(7) and (8) of this section.

(10) Divide the mean C_2H_6 concentration measured through the nonmethane cutter by the mean concentration measured after bypassing the nonmethane cutter. The result is the C_2H_6 penetration fraction, PF_{C2H6}. Use this penetration fraction according to § 1065.660 or § 1065.665, as applicable.

(11) Repeat the steps in paragraphs (e)(6) through (10) of this section, but with the CH_4 analytical gas mixture instead of C_2H_6. The result will be the CH_4 penetration fraction, PF_{CH4}. Use this penetration fraction according to § 1065.660 or § 1065.665, as applicable.

55. Section 1065.370 is amended by revising paragraphs (e) and (g)(1) to read as follows:

§ 1065.370 CLD CO_2 and H_2O quench verification.

* * * * *

(e) *H_2O quench verification procedure.* Use the following method to determine H_2O quench, or use good engineering judgment to develop a different protocol:

(1) Use PTFE tubing to make necessary connections.

(2) If the CLD has an operating mode in which it detects NO-only, as opposed to total NO_X, operate the CLD in the NO-only operating mode.

(3) Measure an NO calibration span gas that meets the specifications of § 1065.750 and is near the maximum concentration expected during testing. Record this concentration, x_{NOdry}.

(4) Humidify the NO span gas by bubbling it through distilled water in a sealed vessel. We recommend that you humidify the gas to the highest sample dewpoint that you estimate during emission sampling.

(5) Downstream of the vessel, maintain the humidified gas temperature at least 5 °C above its dewpoint.

(6) Introduce the humidified gas upstream of any sample dryer, if one is used during testing.

(7) Measure the humidified gas dewpoint, T_{dew}, and pressure, p_{total}, as close as possible to the inlet of the analyzer, or to the inlet of the sample dryer, if one is used.

(8) Allow time for the analyzer response to stabilize. Stabilization time may include time to purge the transfer line and to account for analyzer response.

(9) While the analyzer measures the sample's concentration, record the analyzer's output for 30 seconds. Calculate the arithmetic mean of these data. This mean is x_{NOmeas}.

(10) If your CLD is not equipped with a sample dryer, set x_{NOwet} equal to x_{NOmeas} from paragraph (e)(9) of this section.

(11) If your CLD is equipped with a sample dryer, determine x_{NOwet} from x_{NOmeas} by correcting for the removed water according to § 1065.645. Use the amount of water at the sample dryer outlet as $x_{H2Omeas}$ for this calculation. Refer to § 1065.145(d)(2) and use the humidified gas dewpoint, T_{dew}, and pressure, p_{total}, to determine x_{H2O}.

(12) Use x_{NOwet} to calculate the quench according to § 1065.675.

* * * * *

(g) * * *

(1) You may omit this verification if you can show by engineering analysis that for your NO_X sampling system and your emission calculations procedures, the combined CO_2 and H_2O interference for your NO_X CLD analyzer always affects your brake-specific NO_X emission results within no more than ±1.0% of the applicable NO_X standard.

* * * * *

56. Section 1065.372 is amended by revising paragraph (e)(1) to read as follows:

§ 1065.372 NDUV analyzer HC and H_2O interference verification.

* * * * *

(e) * * *

(1) You may omit this verification if you can show by engineering analysis that for your NO_X sampling system and your emission calculations procedures, the combined HC and H_2O interference for your NO_X NDUV analyzer always affects your brake-specific NO_X emission results by less than 0.5% of the applicable NO_X standard.

* * * * *

57. Section 1065.376 is revised to read as follows:

§ 1065.376 Chiller NO_2 penetration.

(a) *Scope and frequency.* If you use a chiller to dry a sample upstream of a NO_X measurement instrument, but you don't use an NO_2-to-NO converter upstream of the chiller, you must perform this verification for chiller NO_2 penetration. Perform this verification after initial installation and after major maintenance.

(b) *Measurement principles.* A chiller removes water, which can otherwise interfere with a NO_X measurement. However, liquid water remaining in an improperly designed chiller can remove NO_2 from the sample. If a chiller is used without an NO_2-to-NO converter upstream, it could remove NO_2 from the sample prior NO_X measurement.

(c) *System requirements.* A chiller must allow for measuring at least 95% of the total NO_2 at the maximum expected concentration of NO_2.

(d) *Procedure.* Use the following procedure to verify chiller performance:

(1) *Instrument setup.* Follow the analyzer and chiller manufacturers' start-up and operating instructions. Adjust the analyzer and chiller as needed to optimize performance.

(2) *Equipment setup and data collection.* (i) Zero and span the total NO_X gas analyzer(s) as you would before emission testing.

(ii) Select an NO_2 calibration gas, balance gas of dry air, that has an NO_2 concentration within ±5% of the maximum NO_2 concentration expected during testing.

(iii) Overflow this calibration gas at the gas sampling system's probe or overflow fitting. Allow for stabilization of the total NO_X response, accounting only for transport delays and instrument response.

(iv) Calculate the mean of 30 seconds of recorded total NO_X data and record this value as x_{NOxref}.

(v) Stop flowing the NO_2 calibration gas.

(vi) Next saturate the sampling system by overflowing a dewpoint generator's output, set at a dewpoint of 50 °C, to the gas sampling system's probe or overflow fitting. Sample the dewpoint generator's output through the sampling system and chiller for at least 10 minutes until the chiller is expected to be removing a constant rate of water.

(vii) Immediately switch back to overflowing the NO_2 calibration gas used to establish x_{NOxref}. Allow for stabilization of the total NO_X response, accounting only for transport delays and instrument response. Calculate the mean of 30 seconds of recorded total NO_X data and record this value as $x_{NOxmeas}$.

(viii) Correct $x_{NOxmeas}$ to x_{NOxdry} based upon the residual water vapor that passed through the chiller at the chiller's outlet temperature and pressure.

(3) *Performance evaluation.* If x_{NOxdry} is less than 95% of x_{NOxref}, repair or replace the chiller.

(e) *Exceptions.* The following exceptions apply:

(1) You may omit this verification if you can show by engineering analysis that for your NO_X sampling system and your emission calculations procedures, the chiller always affects your brake-specific NO_X emission results by less than 0.5% of the applicable NO_X standard.

(2) You may use a chiller that you determine does not meet this verification, as long as you try to correct the problem and the measurement deficiency does not adversely affect your ability to show that engines comply with all applicable emission standards.

58. Section 1065.378 is amended by revising paragraphs (d) and (e)(1) to read as follows:

§ 1065.378 NO_2-to-NO converter conversion verification.

* * * * *

(d) *Procedure.* Use the following procedure to verify the performance of a NO_2-to-NO converter:

(1) *Instrument setup.* Follow the analyzer and NO_2-to-NO converter manufacturers' start-up and operating instructions. Adjust the analyzer and converter as needed to optimize performance.

(2) *Equipment setup.* Connect an ozonator's inlet to a zero-air or oxygen source and connect its outlet to one port of a three-way tee fitting. Connect an NO span gas to another port, and connect the NO_2-to-NO converter inlet to the last port.

(3) *Adjustments.* Take the following steps to make adjustments:

(i) With the NO_2-to-NO converter in the bypass mode (i.e., NO mode) and the ozonator off, adjust the NO and zero-gas flows so the NO concentration at the analyzer is at the peak total NO_X concentration expected during testing.

(ii) With the NO_2-to-NO converter still in the bypass mode, turn on the ozonator and adjust the ozonator so the NO concentration measured by the analyzer decreases by the same amount as maximum concentration of NO_2 expected during testing. This ensures that the ozonator is generating NO_2 at the maximum concentration expected during testing.

(4) *Data collection.* Maintain the ozonator adjustment in paragraph (d)(3) of this section, and keep the NO_X analyzer in the NO only mode (i.e., bypass the NO_2-to-NO converter).

(i) Allow for stabilization, accounting only for transport delays and instrument response.

(ii) Calculate the mean of 30 seconds of sampled data from the analyzer and record this value as x_{NOxref}.

(iii) Switch the analyzer to the total NO_X mode (that is, sample with the NO_2-to-NO converter) and allow for stabilization, accounting only for transport delays and instrument response.

(iv) Calculate the mean of 30 seconds of sampled data from the analyzer and record this value as $x_{NOxmeas}$.

(v) Turn off the ozonator and allow for stabilization, accounting only for transport delays and instrument response.

(vi) Calculate the mean of 30 seconds of sampled data from the analyzer and record this value as x_{NOxref}.

(5) *Performance evaluation.* Divide the quantity of ($x_{NOxmeas} - x_{NOref}$) by the quantity of ($x_{NOref} - x_{NOref}$). If the result is less than 95%, repair or replace the NO_2-to-NO converter.

(e) * * *

(1) You may omit this verification if you can show by engineering analysis that for your NO_X sampling system and your emission calculations procedures, the converter always affects your brake-specific NO_X emission results by less than 0.5% of the applicable NO_X standard.

* * * * *

59. Section 1065.390 is amended by revising paragraphs (d)(8) and (d)(9) and adding paragraph (d)(10) to read as follows:

§ 1065.390 PM balance verifications and weighing process verification.

* * * * *

(d) * * *

(8) Subtract each buoyancy-corrected reference mass from its most recent previously recorded buoyancy-corrected mass.

(9) You may discard reference PM sample media if you positively identify a cause for the media's contamination, such as the media falling onto the floor. In this case, you do not have to include the contaminated reference media when determining compliance with paragraph (d)(10) of this section.

(10) If any of the reference masses change by more than that allowed under this paragraph (d), invalidate all PM results that were determined between the two times that the reference masses were determined. If you discarded reference PM sample media according to paragraph (d)(9) of this section, you must still have at least one reference mass difference that meets the criteria in this paragraph (d). Otherwise, you must invalidate all PM results that were determined between the two times that the reference masses were determined.

Subpart E—[Amended]

60. Section 1065.405 is amended by revising paragraphs (b) and (e) introductory text to read as follows:

§ 1065.405 Test engine preparation and maintenance.

* * * * *

(b) Run the test engine, with all emission control systems operating, long enough to stabilize emission levels to appropriately apply deterioration factors. You must use the same stabilization procedures for all emission-data engines for which you apply the same deterioration factors so that all low-hour emission-data engines are consistent with the low-hour engine used to develop the deterioration factor.

(1) Unless otherwise specified in the standard-setting part, you may consider emission levels stable without measurement if you accumulate 12 h of operation for a spark-ignition engine or 125 h for a compression-ignition engine.

(2) If the engine needs more or less operation to stabilize emission levels, record your reasons and the methods for doing this, and give us these records if we ask for them.

(3) You may stabilize emissions from a catalytic exhaust aftertreatment device by operating it on an engine that is different from the test engine, but only where it is consistent with good engineering judgment. You may alternatively stabilize emissions from a catalytic exhaust aftertreatment device by operating it on an engine-exhaust simulator if it is allowed in the standard-setting part, or if we have issued prior guidance, or if we otherwise approve of the use of an engine-exhaust simulator in advance. This process of stabilizing emissions from a catalytic exhaust aftertreatment device is often called ''degreening''. Be sure to consider whether degreening under this paragraph (b)(3) will adversely affect your ability to develop and apply appropriate deterioration factors.

* * * * *

(e) If your engine will be used in a vehicle equipped with a canister for storing evaporative hydrocarbons for eventual combustion in the engine and the test sequence involves a cold-start or hot-start duty cycle, attach a canister to the engine before running an emission test. You may omit using an evaporative canister for any hot-stabilized duty cycles. You may request to omit using an evaporative canister during testing if you can show that it would not affect your ability to show compliance with the applicable emission standards. You do not have to accumulate engine operation before emission testing with an installed canister. Prior to an emission test, use the following steps to attach a canister to your engine:

* * * * *

61. The heading of subpart F is revised to read as follows:

Subpart F—Performing an Emission Test Over Specified Duty Cycles

62. Section 1065.501 is revised to read as follows:

§ 1065.501 Overview.

(a) Use the procedures detailed in this subpart to measure engine emissions over a specified duty cycle. Refer to subpart J of this part for field test procedures that describe how to measure emissions during in-use engine operation. This section describes how to:

(1) Map your engine, if applicable, by recording specified speed and torque data, as measured from the engine's primary output shaft.

(2) Transform normalized duty cycles into reference duty cycles for your engine by using an engine map.

(3) Prepare your engine, equipment, and measurement instruments for an emission test.

(4) Perform pre-test procedures to verify proper operation of certain equipment and analyzers.

(5) Record pre-test data.

(6) Start or restart the engine and sampling systems.

(7) Sample emissions throughout the duty cycle.

(8) Record post-test data.

(9) Perform post-test procedures to verify proper operation of certain equipment and analyzers.

(10) Weigh PM samples.

(b) An emission test generally consists of measuring emissions and other parameters while an engine follows one or more duty cycles that are specified in the standard-setting part. There are two general types of duty cycles:

(1) *Transient cycles.* Transient duty cycles are typically specified in the standard-setting part as a second-by-second sequence of speed commands and torque (or power) commands. Operate an engine over a transient cycle such that the speed and torque of the engine's primary output shaft follows the target values. Proportionally sample emissions and other parameters and use the calculations in subpart G of this part to calculate emissions. Start a transient test according to the standard-setting part, as follows:

(i) A cold-start transient cycle where you start to measure emissions just before starting an engine that has not been warmed up.

(ii) A hot-start transient cycle where you start to measure emissions just before starting a warmed-up engine.

(iii) A hot running transient cycle where you start to measure emissions after an engine is started, warmed up, and running.

(2) *Steady-state cycles.* Steady-state duty cycles are typically specified in the standard-setting part as a list of discrete operating points (modes or notches), where each operating point and has one value of a speed command and one value of a torque (or power) command. Ramped-modal cycles for steady-state testing also list test times for each mode and ramps of speed and torque to follow between modes. Start a steady-state cycle as a hot running test, where you start to measure emissions after an engine is started, warmed up and running. You may run a steady-state duty cycle as a discrete-mode cycle or a ramped-modal cycle, as follows:

(i) *Discrete-mode cycles.* Before emission sampling, stabilize an engine at the first discrete mode. Sample emissions and other parameters for that mode and then stop emission sampling. Record mean values for that mode, and then stabilize the engine at the next mode. Continue to sample each mode discretely and calculate weighted emission results according to the standard-setting part.

(ii) *Ramped-modal cycles.* Perform ramped-modal cycles similar to the way you would perform transient cycles, except that ramped-modal cycles involve mostly steady-state engine operation. Perform a ramped-modal cycle as a sequence of second-by-second speed commands and torque (or power) commands. Proportionally sample emissions and other parameters during the cycle and use the calculations in subpart G of this part to calculate emissions.

(c) Other subparts in this part identify how to select and prepare an engine for testing (subpart E), how to perform the required engine service accumulation (subpart E), and how to calculate emission results (subpart G).

(d) Subpart J of this part describes how to perform field testing.

63. Section 1065.510 is revised to read as follows:

§ 1065.510 Engine mapping.

(a) *Applicability, scope, and frequency.* An engine map is a data set that consists of a series of paired data points that represent the maximum brake torque versus engine speed, measured at the engine's primary output shaft. Map your engine if the standard-setting part requires engine mapping to generate a duty cycle for your engine configuration. Map your engine while it is connected to a dynamometer or other device that can absorb work output from the engine's primary output shaft according to § 1065.110. Configure any auxiliary work inputs and outputs such as hybrid, turbo-compounding, or thermoelectric systems to represent their in-use configurations, and use the same configuration for emission testing. See Figure 1 of § 1065.210. This may involve configuring initial states of charge and rates and times of auxiliary-work inputs and outputs. We recommend that you contact the Designated Compliance Officer before testing to determine how you should configure any auxiliary-work inputs and outputs. Use the most recent engine map to transform a normalized duty cycle from the standard-setting part to a reference duty cycle specific to your engine. Normalized duty cycles are specified in the standard-setting part. You may update an engine map at any time by repeating the engine-mapping procedure. You must map or re-map an engine before a test if any of the following apply:

(1) If you have not performed an initial engine map.

(2) If the atmospheric pressure near the engine's air inlet is not within ±5 kPa of the atmospheric pressure recorded at the time of the last engine map.

(3) If the engine or emission-control system has undergone changes that might affect maximum torque performance. This includes changing the configuration of auxiliary work inputs and outputs.

(4) If you capture an incomplete map on your first attempt or you do not complete a map within the specified time tolerance. You may repeat mapping as often as necessary to capture a complete map within the specified time.

(b) *Mapping variable-speed engines.* Map variable-speed engines as follows:

(1) Record the atmospheric pressure.

(2) Warm up the engine by operating it. We recommend operating the engine at any speed and at approximately 75% of its expected maximum power. Continue the warm-up until the engine coolant, block, or head absolute temperature is within ±2% of its mean value for at least 2 min or until the engine thermostat controls engine temperature.

(3) Operate the engine at its warm idle speed, within manufacturer tolerances, if specified. Apply a representative amount of torque to the engine's primary output shaft if nonzero torque at idle speed is representative of its in-use operation. For example output torque at idle speed might normally occur if the engine is always coupled to a device such as a pump or hydrostatic drive that always applies some amount of nonzero torque at idle. Record at least 30 values of speed and use the mean of those values as measured idle speed for cycle generation.

(4) Set operator demand to maximum and control engine speed at (95 ±1)% of its warm idle speed for at least 15 seconds. For engines with reference duty cycles whose lowest speed is greater than warm idle speed, you may start the map at (95 ±1)% of the lowest reference speed.

(5) Perform one of the following:

(i) For any engine subject only to steady-state duty cycles (i.e., discrete-mode or ramped-modal), you may perform an engine map by using discrete speeds. Select at least 20 evenly spaced setpoints between warm idle and the highest speed above maximum mapped power at which (50 to 75)% of maximum power occurs. If this highest speed is unsafe or unrepresentative (e.g., for ungoverned engines), use good engineering judgment to map up to the maximum safe speed or the maximum representative speed. At each setpoint, stabilize speed and allow torque to stabilize. Record the mean speed and torque at each setpoint. We recommend that you stabilize an engine for at least 15 seconds at each setpoint and record the mean feedback speed and torque of the last (4 to 6) seconds. Use linear interpolation to determine intermediate speeds and torques. Use this series of speeds and torques to generate the power map as described in paragraph (e) of this section.

(ii) For any variable-speed engine, you may perform an engine map by using a continuous sweep of speed by continuing to record the mean feedback speed and torque at 1 Hz or more frequently and increasing speed at a constant rate such that it takes (4 to 6) min to sweep from 95% of warm idle to the highest speed above maximum power at which (50 to 75)% of maximum power occurs. If this highest speed is unsafe or unrepresentative (e.g., for ungoverned engines), use good engineering judgment to map up to the maximum safe speed or the maximum representative speed. Stop recording after you complete the sweep. From the series of mean speed and maximum torque values, use linear interpolation to determine intermediate values. Use this series of speeds and torques to generate the power map as described in paragraph (e) of this section.

(c) *Negative torque mapping.* If your engine is subject to a reference duty cycle that specifies negative torque values (i.e., engine motoring), generate a motoring map by any of the following procedures:

(1) Multiply the positive torques from your map by −40%. Use linear interpolation to determine intermediate values.

(2) Map the amount of negative torque required to motor the engine by repeating paragraph (b) of this section with minimum operator demand.

(3) Determine the amount of negative torque required to motor the engine at the following two points: at warm idle and at the highest speed above maximum power at which (50 to 75)% of maximum power occurs. If this highest speed is unsafe or unrepresentative (e.g., for ungoverned engines), use good engineering judgment to map up to the maximum safe speed or the maximum representative speed. Operate the engine at these two points at minimum operator demand. Use linear interpolation to determine intermediate values.

(d) *Mapping constant-speed engines.* For constant-speed engines, generate a map as follows:

(1) Record the atmospheric pressure.

(2) Warm up the engine by operating it. We recommend operating the engine at approximately 75% of the engine's expected maximum power. Continue the warm-up until the engine coolant, block, or head absolute temperature is within ±2% of its mean value for at least 2 min or until the engine thermostat controls engine temperature.

(3) You may operate the engine with a production constant-speed governor or simulate a constant-speed governor by controlling engine speed with an operator demand control system described in § 1065.110. Use either isochronous or speed-droop governor operation, as appropriate.

(4) With the governor or simulated governor controlling speed using operator demand, operate the engine at no-load governed speed (at high speed, not low idle) for at least 15 seconds.

(5) Record at 1 Hz the mean of feedback speed and torque. Use the dynamometer to increase torque at a constant rate. Unless the standard-setting part specifies otherwise, complete the map such that it takes (2 to 4) min to sweep from no-load governed speed to the lowest speed below maximum mapped power at which the engine develops (85–95)% of maximum mapped power. You may map your engine to lower speeds. Stop recording after you complete the sweep. Use this series of speeds and torques to generate the power map as described in paragraph (e) of this section.

(e) *Power mapping.* For all engines, create a power-versus-speed map by transforming torque and speed values to corresponding power values. Use the mean values from the recorded map data. Do not use any interpolated values. Multiply each torque by its corresponding speed and apply the appropriate conversion factors to arrive at units of power (kW). Interpolate intermediate power values between these power values, which were calculated from the recorded map data.

(f) *Measured and declared test speeds and torques.* You may use test speeds and torques that you declare instead of measured speeds and torques if they meet the criteria in this paragraph (f). Otherwise, you must use speeds and torques derived from the engine map.

(1) Measured speeds and torques. Determine the applicable speeds and torques according to § 1065.610:

(i) Measured maximum test speed for variable-speed engines.

(ii) Measured maximum test torque for constant-speed engines.

(iii) Measured ''A'', ''B'', and ''C'' speeds for steady-state tests.

(iv) Measured intermediate speed for steady-state tests.

(2) *Required declared speeds.* You must declare the following speeds:

(i) Warmed-up, low-idle speed for variable-speed engines. Declare this speed in a way that is representative of in-use operation. For example, if your engine is typically connected to an automatic transmission or a hydrostatic transmission, declare this speed at the idle speed at which your engine operates when the transmission is engaged.

(ii) Warmed-up, no-load, high-idle speed for constant-speed engines.

(3) *Optional declared speeds.* You may declare an enhanced idle speed according to § 1065.610. You may use a declared value for any of the following as long as the declared value is within (97.5 to 102.5)% of its corresponding measured value:

(i) Measured maximum test speed for variable-speed engines.

(ii) Measured intermediate speed for steady-state tests.

(iii) Measured ''A'', ''B'', and ''C'' speeds for steady-state tests.

(4) *Declared torques.* You may declare an enhanced idle torque according to § 1065.610. You may declare maximum test torque as long as it is within (95 to 100)% of the measured value.

(g) *Other mapping procedures.* You may use other mapping procedures if you believe the procedures specified in this section are unsafe or unrepresentative for your engine. Any alternate techniques you use must satisfy the intent of the specified mapping procedures, which is to determine the maximum available torque at all engine speeds that occur during a duty cycle. Identify any deviations from this section's mapping procedures when you submit data to us.

64. Section 1065.512 is revised to read as follows:

§ 1065.512 Duty cycle generation.

(a) Generate duty cycles according to this section if the standard-setting part requires engine mapping to generate a duty cycle for your engine configuration. The standard-setting part generally defines applicable duty cycles in a normalized format. A normalized duty cycle consists of a sequence of paired values for speed and torque or for speed and power.

(b) Transform normalized values of speed, torque, and power using the following conventions:

(1) Engine speed for variable-speed engines. For variable-speed engines, normalized speed may be expressed as a percentage between idle speed and maximum test speed, f_{ntest}, or speed may be expressed by referring to a defined speed by name, such as ''warm idle,'' ''intermediate speed,'' or ''A,'' ''B,'' or ''C'' speed. Section 1065.610 describes how to transform these normalized values into a sequence of reference speeds, f_{nref}. Note that the cycle-validation criteria in § 1065.514 allow an engine to govern itself at its in-use idle speed. This allowance permits you to test engines with enhanced-idle devices and to simulate the effects of transmissions such as automatic transmissions. For example, an enhanced-idle device might be an idle speed value that is normally commanded only under cold-start conditions to quickly warm up the engine and aftertreatment devices.

(2) Engine torque for variable-speed engines. For variable-speed engines,

normalized torque is expressed as a percentage of the mapped torque at the corresponding reference speed. Section 1065.610 describes how to transform normalized torques into a sequence of reference torques, T_{ref}. Section 1065.610 also describes under what conditions you may command T_{ref} greater than the reference torque you calculated from a normalized duty cycle. This provision permits you to command T_{ref} values representing curb-idle transmission torque (CITT). For any negative torque commands, command minimum operator demand and use the dynamometer to control engine speed to the reference speed. Note that the cycle-validation criteria in § 1065.514 allow an engine to pass cycle statistics for torque for any data points recorded during negative torque commands. Also, use the maximum recorded torque at the minimum mapped speed as the maximum torque for any reference speed at or below the minimum mapped speed.

(3) Engine torque for constant-speed engines. For constant-speed engines, normalized torque is expressed as a percentage of maximum test torque, T_{test}. Section 1065.610 describes how to transform normalized torques into a sequence of reference torques, T_{ref}. Section 1065.610 also describes under what conditions you may command T_{ref} greater than 0 Nm when a normalized duty cycle specifies a 0% torque command.

(4) Engine power. For all engines, normalized power is expressed as a percentage of mapped power at maximum test speed, f_{ntest}. Section 1065.610 describes how to transform these normalized values into a sequence of reference powers, P_{ref}. Convert these reference powers to reference speeds and torques for operator demand and dynamometer control.

(c) For variable-speed engines, command reference speeds and torques sequentially to perform a duty cycle. Issue speed and torque commands at a frequency of at least 5 Hz for transient cycles and at least 1 Hz for steady-state cycles (i.e., discrete-mode and ramped-modal). Linearly interpolate between the 1 Hz reference values specified in the standard-setting part to determine more frequently issued reference speeds and torques. During an emission test, record the reference speeds and torques and the feedback speeds and torques at the same frequency. Use these recorded values to calculate cycle-validation statistics and total work.

(d) For constant-speed engines, operate the engine with the same production governor you used to map the engine in § 1065.510 or simulate the in-use operation of a governor the same way you simulated it to map the engine in § 1065.510. Command reference torque values sequentially to perform a duty cycle. Issue torque commands at a frequency of at least 5 Hz for transient cycles and at least 1 Hz for steady-state cycles (i.e., discrete-mode, ramped-modal). Linearly interpolate between the 1 Hz reference values specified in the standard-setting part to determine more frequently issued reference torque values. During an emission test, record the reference torques and the feedback speeds and torques at the same frequency. Use these recorded values to calculate cycle-validation statistics and total work.

(e) You may perform practice duty cycles with the test engine to optimize operator demand and dynamometer controls to meet the cycle-validation criteria specified in § 1065.514.

65. Section 1065.514 is revised to read as follows:

§ 1065.514 Cycle-validation criteria for operation over specified duty cycles.

Validate the execution of your duty cycle according to this section unless the standard-setting part specifies otherwise. This section describes how to determine if the engine's operation during the test adequately matched the reference duty cycle. This section applies only to speed, torque, and power from the engine's primary output shaft. Other work inputs and outputs are not subject to cycle-validation criteria. For any data required in this section, use the duty cycle reference and feedback values that you recorded during a test interval.

(a) *Testing performed by EPA.* Our tests must meet the specifications of paragraph (g) of this section, unless we determine that failing to meet the specifications is related to engine performance rather than to shortcomings of the dynamometer or other laboratory equipment.

(b) *Testing performed by manufacturers.* Emission tests that meet the specifications of paragraph (g) of this section satisfy the standard-setting part's requirements for duty cycles. You may ask to use a dynamometer or other laboratory equipment that cannot meet those specifications. We will approve your request as long as using the alternate equipment does not adversely affect your ability to show compliance with the applicable emission standards.

(c) *Time-alignment.* Because time lag between feedback values and the reference values may bias cycle-validation results, you may advance or delay the entire sequence of feedback engine speed and/or torque pairs to synchronize them with the reference sequence.

(d) *Omitting additional points.* Besides engine cranking, you may omit additional points from cycle-validation statistics as described in the following table:

TABLE 1 OF § 1065.514.—PERMISSIBLE CRITERIA FOR OMITTING POINTS FROM DUTY-CYCLE REGRESSION STATISTICS

When operator demand is at its . . .	you may omit . . .	if . . .
For reference duty cycles that are specified in terms of speed and torque (f_{nref}, T_{ref})		
minimum	power and torque	T_{ref} < 0% (motoring).
minimum	power and speed	f_{nref} = 0% (idle speed) and T_{ref} = 0% (idle torque) and $T_{ref} - (2\% \cdot T_{max\ mapped}) < T < T_{ref} + (2\% \cdot T_{max\ mapped})$.
minimum	power and either torque or speed	$f_n > f_{nref}$ or $T > T_{ref}$ but not if $f_n > f_{nref}$ and $T > T_{ref}$.
maximum	power and either torque or speed	$f_n < f_{nref}$ or $T < T_{ref}$ but not if $f_n < f_{nref}$ and $T < T_{ref}$.
For reference duty cycles that are specified in terms of speed and power (f_{nref}, P_{ref})		
minimum	power and torque	P_{ref} < 0% (motoring).
minimum	power and speed	f_{nref} = 0% (idle speed) and P_{ref} = 0% (idle power) and $P_{ref} - (2\% \cdot P_{max\ mapped}) < P < P_{ref} + (2\ \% \cdot P_{max\ mapped})$.
minimum	power and either torque or speed	$f_n > f_{nref}$ or $P > P_{ref}$ but not if $f_n > f_{nref}$ and $P > P_{ref}$.

TABLE 1 OF § 1065.514.—PERMISSIBLE CRITERIA FOR OMITTING POINTS FROM DUTY-CYCLE REGRESSION STATISTICS—Continued

When operator demand is at its . . .	you may omit . . .	if . . .
maximum	power and either torque or speed	$f_n < f_{nref}$ or $P < P_{ref}$ but not if $f_n < f_{ref}$ and $P < P_{ref}$.

(e) *Statistical parameters*. Use the remaining points to calculate regression statistics described in § 1065.602. Round calculated regression statistics to the same number of significant digits as the criteria to which they are compared. Refer to Table 2 of § 1065.514 for the default criteria and refer to the standard-setting part to determine if there are other criteria for your engine. Calculate the following regression statistics:

(1) Slopes for feedback speed, a_{1fn}, feedback torque, a_{1T}, and feedback power a_{1P}.

(2) Intercepts for feedback speed, a_{0fn}, feedback torque, a_{0T}, and feedback power a_{0P}.

(3) Standard estimates of error for feedback speed, SEE_{fn}, feedback torque, SEE_T, and feedback power SEE_P.

(4) Coefficients of determination for feedback speed, r^2_{fn}, feedback torque, r^2_T, and feedback power r^2_P.

(f) *Cycle-validation criteria*. Unless the standard-setting part specifies otherwise, use the following criteria to validate a duty cycle:

(1) For variable-speed engines, apply all the statistical criteria in Table 2 of this section.

(2) For constant-speed engines, apply only the statistical criteria for torque in Table 2 of this section.

TABLE 2 OF § 1065.514.—DEFAULT STATISTICAL CRITERIA FOR VALIDATING DUTY CYCLES

Parameter	Speed	Torque	Power
Slope, a_1	$0.950 \leq a_1 \leq 1.030$	$0.830 \leq a_1 \leq 1.030$	$0.830 \leq a_1 \leq 1.030$.
Absolute value of intercept, $\|a_0\|$	≤ 10% of warm idle	≤ 2.0% of maximum mapped torque.	≤ 2.0% of maximum mapped power.
Standard error of estimate, SEE	≤ 5.0% of maximum test speed	≤ 10% of maximum mapped torque.	≤ 10% of maximum mapped power.
Coefficient of determination, r^2	≥ 0.970	≥ 0.850	≥ 0.910.

66. Section 1065.520 is amended by revising paragraphs (b), (f)(1), (g) introductory text, and (g)(7)(iii) to read as follows:

§ 1065.520 Pre-test verification procedures and pre-test data collection.

* * * * *

(b) Unless the standard-setting part specifies different tolerances, verify that ambient conditions are within the following tolerances before the test:

(1) Ambient temperature of (20 to 30) °C.

(2) Intake air temperature of (20 to 30) °C upstream of all engine components.

(3) Atmospheric pressure of (80.000 to 103.325) kPa and within ±5% of the value recorded at the time of the last engine map.

(4) Dilution air conditions as specified in § 1065.140.

* * * * *

(f) * * *

(1) Start the engine and use good engineering judgment to bring it to one of the following:

(i) 100% torque at any speed above its peak-torque speed.

(ii) 100% operator demand.

* * * * *

(g) After the last practice or preconditioning cycle before an emission test, verify the amount of nonmethane contamination in the exhaust and background HC sampling systems. You may omit verifying the contamination of a background HC sampling system if its contamination was verified within ten days before testing. For any NMHC measurement system that involves separately measuring methane and subtracting it from a THC measurement, verify the amount of HC contamination using only the THC analyzer response. There is no need to operate any separate methane analyzer for this verification. Perform this verification as follows:

* * * * *

(7) * * *

(iii) 2 µmol/mol.

* * * * *

67. Section 1065.525 is revised to read as follows:

§ 1065.525 Engine starting, restarting, optional repeating of void discrete modes and shutdown.

(a) Start the engine using one of the following methods:

(1) Start the engine as recommended in the owners manual using a production starter motor or air-start system and either an adequately charged battery, a suitable power supply, or a suitable compressed air source.

(2) Use the dynamometer to start the engine. To do this, motor the engine within ±25% of its typical in-use cranking speed. Stop cranking within 1 second of starting the engine.

(b) If the engine does not start after 15 seconds of cranking, stop cranking and determine why the engine failed to start, unless the owners manual or the service-repair manual describes the longer cranking time as normal.

(c) Respond to engine stalling with the following steps:

(1) If the engine stalls during warm-up before emission sampling begins, restart the engine and continue warm-up.

(2) If the engine stalls during preconditioning before emission sampling begins, restart the engine and restart the preconditioning sequence.

(3) If the engine stalls at any time after emission sampling begins for a transient test or ramped-modal cycle test, the test is void.

(4) Except as described in paragraph (d) of this section, void the test if the engine stalls at any time after emission sampling begins.

(d) If emission sampling is interrupted during one of the modes of a discrete-mode test, you may void the results only for that individual mode and perform the following steps to continue the test:

(i) If the engine has stalled, restart the engine.

(ii) Use good engineering judgment to restart the test sequence using the appropriate steps in § 1065.530(b).

(iii) Precondition the engine by operating at the previous mode for approximately the same amount of time it operated at that mode for the last emission measurement.

(iv) Advance to the mode at which the engine stalled and continue with the duty cycle as specified in the standard-setting part.

(v) Complete the remainder of the test according to the requirements in this subpart.

(e) Shut down the engine according to the manufacturer's specifications.

68. Section 1065.530 is revised to read as follows:

§ 1065.530 Emission test sequence.

(a) Time the start of testing as follows:

(1) Perform one of the following if you precondition sampling systems as described in § 1065.520(f):

(i) For cold-start duty cycles, shut down the engine. Unless the standard-setting part specifies that you may only perform a natural engine cooldown, you may perform a forced engine cooldown. Use good engineering judgment to set up systems to send cooling air across the engine, to send cool oil through the engine lubrication system, to remove heat from coolant through the engine cooling system, and to remove heat from any exhaust aftertreatment systems. In the case of a forced aftertreatment cooldown, good engineering judgment would indicate that you not start flowing cooling air until the aftertreatment system has cooled below its catalytic activation temperature. For platinum-group metal catalysts, this temperature is about 200 °C. Once the aftertreatment system has naturally cooled below its catalytic activation temperature, good engineering judgment would indicate that you use clean air with a temperature of at least 15 °C, and direct the air through the aftertreatment system in the normal direction of exhaust flow. Do not use any cooling procedure that results in unrepresentative emissions (see § 1065.10(c)(1)). You may start a cold-start duty cycle when the temperatures of an engine's lubricant, coolant, and aftertreatment systems are all between (20 and 30) °C.

(ii) For hot-start emission measurements, shut down the engine. Start the hot-start duty cycle as specified in the standard-setting part.

(iii) For testing that involves hot-stabilized emission measurements, such as any steady-state testing, you may continue to operate the engine at maximum test speed and 100% torque if that is the first operating point. Otherwise, operate the engine at warm idle or the first operating point of the duty cycle. In any case, start the emission test within 10 min after you complete the preconditioning procedure.

(2) If you do not precondition sampling systems, perform one of the following:

(i) For cold-start duty cycles, prepare the engine according to paragraph (a)(1)(i) of this section.

(ii) For hot-start emission measurements, first operate the engine at any speed above peak-torque speed and at (65 to 85)% of maximum mapped power until either the engine coolant, block, or head absolute temperature is within ±2% of its mean value for at least 2 min or until the engine thermostat controls engine temperature. Shut down the engine. Start the duty cycle within 20 min of engine shutdown.

(iii) For testing that involves hot-stabilized emission measurements, bring the engine either to warm idle or the first operating point of the duty cycle. Start the test within 10 min of achieving temperature stability. Determine temperature stability either as the point at which the engine coolant, block, or head absolute temperature is within ±2% of its mean value for at least 2 min, or as the point at which the engine thermostat controls engine temperature.

(b) Take the following steps before emission sampling begins:

(1) For batch sampling, connect clean storage media, such as evacuated bags or tare-weighed filters.

(2) Start all measurement instruments according to the instrument manufacturer's instructions and using good engineering judgment.

(3) Start dilution systems, sample pumps, cooling fans, and the data-collection system.

(4) Pre-heat or pre-cool heat exchangers in the sampling system to within their operating temperature tolerances for a test.

(5) Allow heated or cooled components such as sample lines, filters, chillers, and pumps to stabilize at their operating temperatures.

(6) Verify that there are no significant vacuum-side leaks according to § 1065.345.

(7) Adjust the sample flow rates to desired levels, using bypass flow, if desired.

(8) Zero or re-zero any electronic integrating devices, before the start of any test interval.

(9) Select gas analyzer ranges. You may automatically or manually switch gas analyzer ranges during a test only if switching is performed by changing the span over which the digital resolution of the instrument is applied. During a test you may not switch the gains of an analyzer's analog operational amplifier(s).

(10) Zero and span all continuous analyzers using NIST-traceable gases that meet the specifications of § 1065.750. Span FID analyzers on a carbon number basis of one (1), C_1. For example, if you use a C_3H_8 span gas of concentration 200 μmol/mol, span the FID to respond with a value of 600 μmol/mol. Span FID analyzers consistently with the determination of their respective response factors, *RF*, and penetration fractions, *PF*, according to § 1065.365.

(11) We recommend that you verify gas analyzer responses after zeroing and spanning by sampling a calibration gas that has a concentration near one-half of the span gas concentration. Based on the results and good engineering judgment, you may decide whether or not to re-zero, re-span, or re-calibrate a gas analyzer before starting a test.

(12) If you correct for dilution air background concentrations of engine exhaust constituents, start measuring and recording background concentrations.

(13) Drain any condensate from the intake air system and close any intake air condensate drains that are not normally open during in-use operation.

(c) Start testing as follows:

(1) If an engine is already running and warmed up, and starting is not part of the duty cycle, perform the following for the various duty cycles:

(i) Transient and steady-state ramped-modal cycles. Simultaneously start running the duty cycle, sampling exhaust gases, recording data, and integrating measured values.

(ii) Steady-state discrete-mode cycles. Control the engine operation to match the first mode in the test cycle. This will require controlling engine speed and load, engine load, or other operator demand settings, as specified in the standard-setting part. Follow the instructions in the standard-setting part to determine how long to stabilize engine operation at each mode, how long to sample emissions at each mode, and how to transition between modes.

(2) If engine starting is part of the duty cycle, initiate data logging, sampling of exhaust gases, and integrating measured values before attempting to start the engine. Initiate the duty cycle when the engine starts.

(d) At the end of each test interval, continue to operate all sampling and dilution systems to allow the sampling system's response time to elapse. Then stop all sampling and recording, including the recording of background samples. Finally, stop any integrating devices and indicate the end of the duty cycle in the recorded data.

(e) Shut down the engine if you have completed testing or if it is part of the duty cycle.

(f) If testing involves another duty cycle after a soak period with the engine off, start a timer when the engine shuts down, and repeat the steps in paragraphs (b) through (e) of this section as needed.

(g) Take the following steps after emission sampling is complete:

(1) For any proportional batch sample, such as a bag sample or PM sample, verify that proportional sampling was maintained according to § 1065.545. Void any samples that did not maintain proportional sampling according to § 1065.545.

(2) Place any used PM samples into covered or sealed containers and return them to the PM-stabilization environment. Follow the PM sample post-conditioning and total weighing procedures in § 1065.595.

(3) As soon as practical after the duty cycle is complete but no later than 30 minutes after the duty cycle is complete, perform the following:

(i) Zero and span all batch gas analyzers.

(ii) Analyze any gaseous batch samples, including background samples.

(4) After quantifying exhaust gases, verify drift as follows:

(i) For batch and continuous gas anlyzers, record the mean analyzer value after stabilizing a zero gas to the analyzer. Stabilization may include time to purge the analyzer of any sample gas, plus any additional time to account for analyzer response.

(ii) Record the mean analyzer value after stabilizing the span gas to the analyzer. Stabilization may include time to purge the analyzer of any sample gas, plus any additional time to account for analyzer response.

(iii) Use these data to validate and correct for drift as described in § 1065.550.

(h) Unless the standard-setting part specifies otherwise, determine whether or not the test meets the cycle-validation criteria in § 1065.514.

(1) If the criteria void the test, you may retest using the same denormalized duty cycle, or you may re-map the engine, denormalize the reference duty cycle based on the new map and retest the engine using the new denormalized duty cycle.

(2) If the criteria void the test for a constant-speed engine only during commands of maximum test torque, you may do the following:

(i) Determine the first and last feedback speeds at which maximum test torque was commanded.

(ii) If the last speed is greater than or equal to 90% of the first speed, the test is void. You may retest using the same denormalized duty cycle, or you may re-map the engine, denormalize the reference duty cycle based on the new map and retest the engine using the new denormalized duty cycle.

(iii) If the last speed is less than 90% of the first speed, reduce maximum test torque by 5%, and proceed as follows:

(A) Denormalize the entire duty cycle based on the reduced maximum test torque according to § 1065.512.

(B) Retest the engine using the denormalized test cycle that is based on the reduced maximum test torque.

(C) If your engine still fails the cycle criteria, reduce the maximum test torque by another 5% of the original maximum test torque.

(D) If your engine fails after repeating this procedure four times, such that your engine still fails after you have reduced the maximum test torque by 20% of the original maximum test torque, notify us and we will consider specifying a more appropriate duty cycle for your engine under the provisions of § 1065.10(c).

69. Section 1065.545 is amended by revising paragraph (b)(2) to read as follows:

§ 1065.545 Validation of proportional flow control for batch sampling.

* * * * *

(b) * * *

(2) *Positive-displacement pump option.* You may use the 1 Hz (or more frequently) recorded pump-inlet conditions. Demonstrate that the flow density at the pump inlet was constant within ±2.5% of the mean or target density over each test interval. For a CVS pump, you may demonstrate this by showing that the absolute temperature at the pump inlet was constant within ±2% of the mean or target absolute temperature over each test interval.

* * * * *

70. Section 1065.550 is revised to read as follows:

§ 1065.550 Gas analyzer range validation, drift validation, and drift correction.

(a) *Range validation.* If an analyzer operated above 100% of its range at any time during the test, perform the following steps:

(1) For batch sampling, re-analyze the sample using the lowest analyzer range that results in a maximum instrument response below 100%. Report the result from the lowest range from which the analyzer operates below 100% of its range.

(2) For continuous sampling, repeat the entire test using the next higher analyzer range. If the analyzer again operates above 100% of its range, repeat the test using the next higher range. Continue to repeat the test until the analyzer always operates at less than 100% of its range.

(b) *Drift validation and drift correction.* Calculate two sets of brake-specific emission results. Calculate one set using the data before drift correction and calculate the other set after correcting all the data for drift according to § 1065.672. Use the two sets of brake-specific emission results as follows:

(1) If the difference between the corrected and uncorrected brake-specific emissions are within ±4% of the uncorrected results or within ±4% of the applicable standard for all regulated emissions, the test is validated for drift. If not, the entire test is void.

(2) If the test is validated for drift, you must use only the drift-corrected emission results when reporting emissions, unless you demonstrate to us that using the drift-corrected results adversely affects your ability to demonstrate that your engine complies with the applicable standards.

71. Section 1065.590 is amended by revising paragraph (j)(9) to read as follows:

§ 1065.590 PM sample preconditioning and tare weighing.

* * * * *

(j) * * *

(9) Once weighing is completed, follow the instructions given in paragraphs (g) through (i) of this section.

72. Section 1065.595 is amended by revising paragraph (e) to read as follows:

§ 1065.595 PM sample post-conditioning and total weighing.

* * * * *

(e) To stabilize PM samples, place them in one or more containers that are open to the PM-stabilization environment, which is described in § 1065.190. A PM sample is stabilized as long as it has been in the PM-stabilization environment for one of the following durations, during which the stabilization environment has been within the specifications of § 1065.190:

(1) If you expect that a filter's total surface concentration of PM will be greater than about 0.5 μg/mm², expose the filter to the stabilization environment for at least 60 minutes before weighing.

(2) If you expect that a filter's total surface concentration of PM will be less than about 0.5 μg/mm², expose the filter to the stabilization environment for at least 30 minutes before weighing.

(3) If you are unsure of a filter s total surface concentration of PM, expose the filter to the stabilization environment for at least 60 minutes before weighing.

(4) Note that 0.5 μg/mm[2] is approximately equal to 567 μg of net PM mass on a PM filter with a 38 mm diameter stain area. It is also an approximate surface concentration at 0.07 g/kW·hr for a hot-start test with compression-ignition engines tested according to 40 CFR part 86, subpart N, or 50 mg/mile for a light-duty vehicle tested according to 40 CFR part 86, subpart B.

* * * * *

Subpart G—[Amended]

73. Section 1065.610 is amended by revising paragraph (b)(1) before the equation to read as follows:

§ 1065.610 Duty cycle generation.

* * * * *

(b) *Maximum test torque, T_{test}.* For constant-speed engines, determine the measured T_{test} from the power-versus-speed map, generated according to § 1065.510, as follows:

(1) Based on the map, determine maximum power, P_{max}, and the speed at which maximum power occurs, f_{nPmax}. Divide every recorded power by P_{max} and divide every recorded speed by f_{nPmax}. The result is a normalized power-versus-speed map. Your measured T_{test} is the torque at which the sum of the squares of normalized speed and power is maximum, as follows:

74. Section 1065.642 is amended as follows:

a. By revising the reference ''Eq. 1065.640–4'' to read ''Eq. 1065.640–5''.

b. By revising the reference ''Eq. 1065.640–5'' in paragraph (b) to read ''Eq. 1065.640–6''.

c. By revising the reference ''Eq. 1065.640–6'' in paragraph (b) to read ''Eq. 1065.640–7''.

75. Section 1065.650 is amended by revising the reference to ''1065.650–5'' in paragraph (e)(4) to be ''Eq. 1065.650–5'' and adding Equation 1065.650–5 after Equation 1065.650–4 in paragraph (b)(2)(i) to read as follows:

§ 1065.650 Emission calculations.

* * * * *

(b) * * *

(2) * * *

(i) * * *

Where:

$\Delta t = 1/f_{record}$ Eq. 1065.650–5

* * * * *

76. Section 1065.655 is amended by revising paragraphs (c) introductory text and (d)(1)(ii) to read as follows:

§ 1065.655 Chemical balances of fuel, intake air, and exhaust.

* * * * *

(c) *Chemical balance procedure.* The calculations for a chemical balance involve a system of equations that require iteration. We recommend using a computer to solve this system of equations. You must guess the initial values of up to three quantities: the amount of water in the measured flow, x_{H2O}, fraction of dilution air in diluted exhaust, x_{dil}, and the amount of products on a C_1 basis per dry mole of dry measured flow, $x_{Cproddry}$. For each emission concentration, x, and amount of water, x_{H2O}, you must determine their completely dry concentrations, x_{dry} and x_{H2Odry}. You must also use your fuel's atomic hydrogen-to-carbon ratio, α, and oxygen-to-carbon ratio, β. For your fuel, you may measure α and β or you may use the default values in Table 1 of § 1065.650. Use the following steps to complete a chemical balance:

* * * * *

(d) * * *

(1) * * *

(ii) During emission testing you route open crankcase flow to the exhaust according to § 1065.130(i).

* * * * *

Subpart H—[Amended]

77. Section 1065.701 is amended by revising paragraphs (c) introductory text and (e) to read as follows:

§ 1065.701 General requirements for test fuels.

* * * * *

(c) *Fuels not specified in this subpart.* If you produce engines that run on a type of fuel (or mixture of fuels) that we do not specify in this subpart, you must get our written approval to establish the appropriate test fuel. See the standard-setting part for provisions related to fuels not specified in this subpart. We will generally allow you to use the fuel if you show us all the following things are true:

(1) Show that this type of fuel is commercially available.

(2) Show that your engines will use only the designated fuel in service.

(3) Show that operating the engines on the fuel we specify would unrepresentatively increase emissions or decrease durability.

* * * * *

(e) *Service accumulation and field testing fuels.* If we do not specify a service-accumulation or field-testing fuel in the standard-setting part, use an appropriate commercially available fuel such as those meeting minimum specifications from the following table:

TABLE 1 OF § 1065.701.—EXAMPLES OF SERVICE-ACCUMULATION AND FIELD-TESTING FUELS

Fuel category	Subcategory	Reference procedure [1]
Diesel	Light distillate and light blends with residual	ASTM D975–04c
	Middle distillate	ASTM D6751–03a
	Biodiesel (B100)	ASTM D6985–04a
Intermediate and residual fuel	All	See § 1065.705
Gasoline	Motor vehicle gasoline	ASTM D4814–04b
	Minor oxygenated gasoline blends	ASTM D4814–04b
Alcohol	Ethanol (Ed75–85)	ASTM D5798–99
	Methanol (M70–M85)	ASTM D5797–96
Aviation fuel	Aviation gasoline	ASTM D910–04a
	Gas turbine	ASTM D1655–04a
	Jet B wide cut	ASTM D6615–04a
Gas turbine fuel	General	ASTM D2880–03

[1] ASTM specifications are incorporated by reference in § 1065.1010.

78. Section 1065.703 is amended by revising Table 1 to read as follows:

§ 1065.703 Distillate diesel fuel.

* * * * *

TABLE 1 OF § 1065.703.—TEST FUEL SPECIFICATIONS FOR DISTILLATE DIESEL FUEL

Item	Units	Ultra low sulfur	Low sulfur	High sulfur	Reference procedure [1]
Cetane Number		40–50	40–50	40–50	ASTM D 613–03b
Distillation range	°C.				
Initial boiling point		171–204	171–204	171–204	ASTM D 86–04b
10 pct. point		204–238	204–238	204–238	
50 pct. point		243–282	243–282	243–282	
90 pct. point		293–332	293–332	293–332	
Endpoint		321–366	321–366	321–366	
Gravity	°API	32–37	32–37	32–37	ASTM D 287–92
Total sulfur	mg/kg	7–15	300–500	2000–4000	ASTM D 2622–03
Aromatics, min. (Remainder shall be paraffins, naphthalenes, and olefins).	g/kg	100	100	100	ASTM D 5186–03
Flashpoint, min	°C	54	54	54	ASTM D 93–02a
Kinematic Viscosity	cSt	2.0–3.2	2.0–3.2	2.0–3.2	ASTM D 445–04

[1] ASTM procedures are incorporated by reference in § 1065.1010. See § 1065.701(d) for other allowed procedures.

79. Section 1065.705 is revised to read as follows:

§ 1065.705 Residual and intermediate residual fuel.

This section describes the specifications for fuels meeting the definition of residual fuel in 40 CFR 80.2, including fuels marketed as intermediate fuel. Residual fuels for service accumulation and any testing must meet the following specifications:

(a) The fuel must be a commercially available fuel that is representative of the fuel that will be used by the engine in actual use.

(b) The fuel must meet the specifications for one of the categories in the following table:

TABLE 1 OF § 1065.705.—SERVICE ACCUMULATION AND TEST FUEL SPECIFICATIONS FOR RESIDUAL FUEL

Characteristic	Unit	Category ISO–F–										Test method reference [1]
		RMA 30	RMB 30	RMD 80	RME 180	RMF 180	RMG 380	RMH 380	RMK 380	RMH 700	RMK 700	
Density at 15 °C, max	kg/m³	960.0	975.0	980.0	991.0		991.0		1010.0	991.0	1010.0	ISO 3675 or ISO 12185: 1996/Cor 1:2001 (see also ISO 8217:2005(E) 7.1).
Kinematic viscosity at 50 °C, max.	cSt	30.0		80.0	180.0		380.0		700.0			ISO 3104:1994/Cor 1:1997.
Flash point, min	°C	60		60	60		60		60			ISO 2719 (see also ISO 8217:2005(E) 7.2).
Pour point (upper) Winter quality, max.	°C	0	24	30	30		30		30			ISO 3016.
Summer quality, max		6	24	30	30		30		30			ISO 3016.
Carbon residue, max	(kg/kg)%	10		14	15	20	18	22	22			ISO 10370:1993/Cor 1:1996.
Ash, max	(kg/kg)%	0.10		0.10	0.10	0.15	0.15		0.15			ISO 6245.
Water, max	(m³/m³)%	0.5		0.5	0.5		0.5		0.5			ISO 3733.
Sulfur, max	(kg/kg)%	3.50		4.00	4.50		4.50		4.50			ISO 8754 or ISO 14596: 1998/Cor 1:1999 (see also ISO 8217:2005(E) 7.3).
Vanadium, max	mg/kg	150		350	200	500	300	600	600			ISO 14597 or IP 501 or IP 470 (see also ISO 8217:2005(E) 7.8).
Total sediment potential, max.	(kg/kg)%	0.10		0.10	0.10		0.10		0.10			ISO 10307–2 (see also ISO 8217:2005(E) 7.6).
Aluminium plus silicon, max.	mg/kg	80		80	80		80		80			ISO 10478 or IP 501 or IP 470 (see also ISO 8217:2005(E) 7.9).
Used lubricating oil (ULO), max.	mg/kg	Fuel shall be free of ULO. We consider a fuel to be free of ULO if one or more of the elements zinc, phosphorus, or calcium is at or below the specified limits. We consider a fuel to contain ULO if all three elements exceed the specified limits.										
Zinc		15										IP 501 or IP 470 (see ISO 8217:2005(E) 7.7).

TABLE 1 OF § 1065.705.—SERVICE ACCUMULATION AND TEST FUEL SPECIFICATIONS FOR RESIDUAL FUEL—Continued

Characteristic	Unit	Category ISO–F–										Test method reference [1]
		RMA 30	RMB 30	RMD 80	RME 180	RMF 180	RMG 380	RMH 380	RMK 380	RMH 700	RMK 700	
Phosphorus		15										IP 501 or IP 500 (see ISO 8217:2005(E) 7.7).
Calcium		30										IP 501 or IP 470 (see ISO 8217:2005(E) 7.7).

[1] ISO procedures are incorporated by reference in § 1065.1010. See § 1065.701(d) for other allowed procedures.

80. Section 1065.710 is amended by revising Table 1 to read as follows:

§ 1065.710 Gasoline.

* * * * *

TABLE 1 OF § 1065.710.—TEST FUEL SPECIFICATIONS FOR GASOLINE

Item	Units	General testing	Low-temperature testing	Reference procedure [1]
Distillation Range	°C.			
Initial boiling point		24–35 2	24–36	ASTM D 86–04b
10% point		49–57	37–48.	
50% point		93–110	82–101	
90% point		149–163	158–174	
End point		Maximum, 213	Maximum, 212	
Hydrocarbon composition:	m^3/m^3.			
Olefins		Maximum, 0.10	Maximum 0.175	ASTM D 1319–03
Aromatics		Maximum, 0.35	Maximum, 0.304.	
Saturates		Remainder	Remainder.	
Lead (organics)	g/liter	Maximum, 0.013	Maximum, 0.013	ASTM D 3237–02
Phosphorous	g/liter	Maximum, 0.0013	Maximum, 0.005	ASTM D 3231–02
Total sulfur	mg/kg	Maximum, 80	Maximum, 80	ASTM D 1266–98
Volatility (Reid Vapor Pressure).	kPa	60.0–63.4[2 3]	77.2–81.4	ASTM D 323–99a

[1] ASTM procedures are incorporated by reference in § 1065.1010. See § 1065.701(d) for other allowed procedures.
[2] For testing at altitudes above 1 219 m, the specified volatility range is (52.0 to 55.2) kPa and the specified initial boiling point range is (23.9 to 40.6 °C.
[3] For testing unrelated to evaporative emissions, the specified range is (55.2 to 63.4) kPa.

81. Section 1065.715 is revised to read as follows:

§ 1065.715 Natural gas.

(a) Except as specified in paragraph (b) of this section, natural gas for testing must meet the specifications in the following table:

TABLE 1 OF § 1065.715.—TEST FUEL SPECIFICATIONS FOR NATURAL GAS

Item	Value [1] (mol/mol)
Methane, CH_4	Minimum, 0.87.
Ethane, C_2H_6	Maximum, 0.055.
Propane, C_3H_8	Maximum, 0.012.
Butane, C_4H_{10}	Maximum, 0.0035.
Pentane, C_5H_{12}	Maximum, 0.0013.
C_6 and higher	Maximum, 0.001.
Oxygen	Maximum, 0.001.
Inert gases (sum of CO_2 and N_2).	Maximum, 0.051.

[1] All parameters are based on the reference procedures in ASTM D 1945–03 (incorporated by reference in § 1065.1010). See § 1065.710(d) for other allowed procedures.

(b) In certain cases you may use test fuel not meeting the specifications in paragraph (a) of this section, as follows:

(1) You may use fuel that your in-use engines normally use, such as pipeline natural gas.

(2) You may use fuel meeting alternate specifications if the standard-setting part allows it.

(3) You may ask for approval to use fuel that does not meet the specifications in paragraph (a) of this section, but only if using the fuel would not adversely affect your ability to demonstrate compliance with the applicable standards.

(c) When we conduct testing using natural gas, we will use fuel that meets the specifications in paragraph (a) of this section.

(d) At ambient conditions, natural gas must have a distinctive odor detectable down to a concentration in air not more than one-fifth the lower flammable limit.

82. Section 1065.720 is revised to read as follows:

§ 1065.720 Liquefied petroleum gas.

(a) Except as specified in paragraph (b) of this section, liquefied petroleum gas for testing must meet the specifications in the following table:

TABLE 1 OF § 1065.720.—TEST FUEL SPECIFICATIONS FOR LIQUEFIED PETROLEUM GAS

Item	Value	Reference Procedure [1]
Propane, C_3H_8	Minimum, 0.85 m^3/m^3	ASTM D 2163–91

TABLE 1 OF § 1065.720.—TEST FUEL SPECIFICATIONS FOR LIQUEFIED PETROLEUM GAS—Continued

Item	Value	Reference Procedure [1]
Vapor pressure at 38°C	Maximum, 1400 kPa	ASTM D 1267–02 or 2598–02[2]
Volatility residue (evaporated temperature, 35 °C)	Maximum, −38°C	ASTM D 1837–02a
Butanes	Maximum, 0.05 m^3/m^3	ASTM D 2163–91
Butenes	Maximum, 0.02 m^3/m^3	ASTM D 2163–91
Pentenes and heavier	Maximum, 0.005 m^3/m^3	ASTM D 2163–91
Propene	Maximum, 0.1 m^3/m^3	ASTM D 2163–91
Residual matter (residue on evap. of 100) ml oil stain observ.)	Maximum, 0.05 ml pass[3]	ASTM D 2158–04
Corrosion, copper strip	Maximum, No. 1	ASTM D 1838–03
Sulfur	Maximum, 80 mg/kg	ASTM D 2784–98
Moisture content	pass	ASTM D 2713–91

[1] ASTM procedures are incorporated by reference in § 1065.1010. See § 1065.701(d) for other allowed procedures.
[2] If these two test methods yield different results, use the results from ASTM D 1267–02.
[3] The test fuel must not yield a persistent oil ring when you add 0.3 ml of solvent residue mixture to a filter paper in 0.1 ml increments and examine it in daylight after two minutes.

(b) In certain cases you may use test fuel not meeting the specifications in paragraph (a) of this section, as follows:

(1) You may use fuel that your in-use engines normally use, such as commercial-quality liquefied petroleum gas.

(2) You may use fuel meeting alternate specifications if the standard-setting part allows it.

(3) You may ask for approval to use fuel that does not meet the specifications in paragraph (a) of this section, but only if using the fuel would not adversely affect your ability to demonstrate compliance with the applicable standards.

(c) When we conduct testing using liquefied petroleum gas, we will use fuel that meets the specifications in paragraph (a) of this section.

(d) At ambient conditions, liquefied petroleum gas must have a distinctive odor detectable down to a concentration in air not more than one-fifth the lower flammable limit.

83. Section 1065.750 is amended by revising paragraphs (a)(2), (a)(3), and (a)(4) to read as follows:

§ 1065.750 Analytical Gases.

* * * * *

(a) * * *

(2) Use the following gases with a FID analyzer:

(i) *FID fuel.* Use FID fuel with a stated H_2 concentration of (0.400 ±0.004) mol/mol, balance He, and a stated total hydrocarbon concentration of 0.05 µmol/mol or less.

(ii) *FID burner air.* Use FID burner air that meets the specifications of purified air in paragraph (a)(1) of this section. For field testing, you may use ambient air.

(iii) *FID zero gas.* Zero flame-ionization detectors with purified gas that meets the specifications in paragraph (a)(1) of this section, except that the purified gas O_2 concentration may be any value. Note that FID zero balance gases may be any combination of purified air and purified nitrogen. We recommend FID analyzer zero gases that contain approximately the flow-weighted mean concentration of O_2 expected during testing.

(iv) *FID propane span gas.* Span and calibrate THC FID with span concentrations of propane, C_3H_8. Calibrate on a carbon number basis of one (C_1). For example, if you use a C_3H_8 span gas of concentration 200 µmol/mol, span a FID to respond with a value of 600 µmol/mol. Note that FID span balance gases may be any combination of purified air and purified nitrogen. We recommend FID analyzer span gases that contain approximately the flow-weighted mean concentration of O_2 expected during testing. If the expected exhaust O_2 concentration is zero, we recommend using a balance gas of purified nitrogen.

(v) *FID methane span gas.* If you always span and calibrate a CH_4 FID with a nonmethane cutter, then span and calibrate the FID with span concentrations of methane, CH_4. Calibrate on a carbon number basis of one (C_1). For example, if you use a CH_4 span gas of concentration 200 µmol/mol, span a FID to respond with a value of 200 µmol/mol. Note that FID span balance gases may be any combination of purified air and purified nitrogen. We recommend FID analyzer span gases that contain approximately the flow-weighted mean concentration of O_2 expected during testing. If the expected exhaust O_2 concentration is zero, we recommend using a balance gas of purified nitrogen.

(3) Use the following gas mixtures, with gases traceable within ±1.0% of the NIST accepted value or other gas standards we approve:

(i) CH_4, balance purified synthetic air and/or N_2 (as applicable).

(ii) C_2H_6, balance purified synthetic air and/or N_2 (as applicable).

(iii) C_3H_8, balance purified synthetic air and/or N_2 (as applicable).

(iv) CO, balance purified N_2.

(v) CO_2, balance purified N_2.

(vi) NO, balance purified N_2.

(vii) NO_2, balance purified synthetic air.

(viii) O_2, balance purified N_2.

(ix) C_3H_8, CO, CO_2, NO, balance purified N_2.

(x) C_3H_8, CH_4, CO, CO_2, NO, balance purified N_2.

(4) You may use gases for species other than those listed in paragraph (a)(3) of this section (such as methanol in air, which you may use to determine response factors), as long as they are traceable to within ±1.0% of the NIST accepted value or other similar standards we approve, and meet the stability requirements of paragraph (b) of this section.

* * * * *

Subpart I—[Amended]

84. Section 1065.805 is amended by revising paragraph (a) to read as follows:

§ 1065.805 Sampling system.

(a) Proportionally dilute engine exhaust, and use batch sampling to collect flow-weighted dilute samples of the applicable alcohols and carbonyls at a constant flow rate. You may not use raw sampling for alcohols and carbonyls.

* * * * *

Subpart J—[Amended]

85. Section 1065.901 is amended by revising paragraph (b) introductory text to read as follows:

§ 1065.901 Applicability.

* * * * *

(b) *Laboratory testing.* You may use PEMS for any testing in a laboratory or similar environment without restriction or prior approval if the PEMS meets all the specifications for the laboratory equipment that it replaces. You may also use PEMS for any testing in a laboratory or similar environment if we approve it in advance, subject to the following provisions:

* * * * *

86. Section 1065.905 is amended by revising paragraph (e) introductory text to read as follows:

§ 1065.905 General provisions.

* * * * *

(e) *Laboratory testing using PEMS.* You may use PEMS for testing in a laboratory as described in § 1065.901(b). Use the following procedures and specifications when using PEMS for laboratory testing:

* * * * *

87. Section 1065.910 is revised to read as follows:

§ 1065.910 PEMS auxiliary equipment for field testing.

For field testing you may use various types of auxiliary equipment to attach PEMS to a vehicle or engine and to power PEMS.

(a) When you use PEMS, you may route engine intake air or exhaust through a flow meter. Route the engine intake air or exhaust as follows:

(1) *Flexible connections.* Use short flexible connectors where necessary.

(i) You may use flexible connectors to enlarge or reduce the pipe diameters to match that of your test equipment.

(ii) Use flexible connectors that do not exceed a length of three times their largest inside diameter.

(iii) Use four-ply silicone-fiberglass fabric with a temperature rating of at least 315 °C for flexible connectors. You may use connectors with a spring-steel wire helix for support and you may use Nomex™ coverings or linings for durability. You may also use any other nonreactive material with equivalent permeation-resistance and durability, as long as it seals tightly.

(iv) Use stainless-steel hose clamps to seal flexible connectors, or use clamps that seal equivalently.

(v) You may use additional flexible connectors to connect to flow meters.

(2) *Tubing.* Use rigid 300 series stainless steel tubing to connect between flexible connectors. Tubing may be straight or bent to accommodate vehicle geometry. You may use T or Y fittings made of 300 series stainless steel tubing to join multiple connections, or you may cap or plug redundant flow paths if the engine manufacturer recommends it.

(3) *Flow restriction.* Use flowmeters, connectors, and tubing that do not increase flow restriction so much that it exceeds the manufacturer s maximum specified value. You may verify this at the maximum exhaust flow rate by measuring pressure at the manufacturer-specified location with your system connected. You may also perform an engineering analysis to verify an acceptable configuration, taking into account the maximum exhaust flow rate expected, the field test system s flexible connectors, and the tubing s characteristics for pressure drops versus flow.

(b) For vehicles or other motive equipment, we recommend installing PEMS in the same location where a passenger might sit. Follow PEMS manufacturer instructions for installing PEMS in cargo spaces, engine spaces, or externally such that PEMS is directly exposed to the outside environment. Locate PEMS where it will be subject to minimal sources of the following parameters:

(1) Ambient temperature changes.

(2) Ambient pressure changes.

(3) Electromagnetic radiation.

(4) Mechanical shock and vibration.

(5) Ambient hydrocarbons—if using a FID analyzer that uses ambient air as FID burner air.

(c) Use mounting hardware as required for securing flexible connectors, ambient sensors, and other equipment. Use structurally sound mounting points such as vehicle frames, trailer hitch receivers, walkspaces, and payload tie-down fittings. We recommend mounting hardware such as clamps, suction cups, and magnets that are specifically designed for your application. We also recommend considering mounting hardware such as commercially available bicycle racks, trailer hitches, and luggage racks where applicable.

(d) Field testing may require portable electrical power to run your test equipment. Power your equipment, as follows:

(1) You may use electrical power from the vehicle, equipment, or vessel, up to the highest power level, such that all the following are true:

(i) The power system is capable of safely supplying power, such that the power demand for testing does not overload the power system.

(ii) The engine emissions do not change significantly as a result the power demand for testing.

(iii) The power demand for testing does not increase output from the engine by more than 1 % of its maximum power.

(2) You may install your own portable power supply. For example, you may use batteries, fuel cells, a portable generator, or any other power supply to supplement or replace your use of vehicle power. However, you must not supply power to the vehicle, vessel, or equipment s power system under any circumstances.

88. Section 1065.915 is amended by revising paragraph (a) before the table and paragraphs (d)(1) and (d)(5)(iii)(B) to read as follows:

§ 1065.915 PEMS instruments.

(a) *Instrument specifications.* We recommend that you use PEMS that meet the specifications of subpart C of this part. For unrestricted use of PEMS in a laboratory or similar environment, use a PEMS that meets the same specifications as each lab instrument it replaces. For field testing or for testing with PEMS in a laboratory or similar environment, under the provisions of § 1065.905(b), the specifications in the following table apply instead of the specifications in Table 1 of § 1065.205.

* * * * *

(d) * * *

(1) *Recording ECM signals.* If your ECM updates a broadcast signal more or less frequently than 1 Hz, process data as follows:

(i) If your ECM updates a broadcast signal more frequently than 1 Hz, use PEMS to sample and record the signal s value more frequently. Calculate and record the 1 Hz mean of the more frequently updated data.

(ii) If your ECM updates a broadcast signal less frequently than 1 Hz, use PEMS to sample and record the signal s value at the most frequent rate. Linearly interpolate between recorded values and record the interpolated values at 1 Hz.

(iii) Optionally, you may use PEMS to electronically filter the ECM signals to meet the rise time and fall time specifications in Table 1 of this section. Record the filtered signal at 1 Hz.

* * * * *

(5) * * *

(iii) * * *

(B) Use a single BSFC value that approximates the BSFC value over a test nterval (as defined in subpart K of this part). This value may be a nominal BSFC value for all engine operation determined over one or more laboratory duty cycles, or it may be any other BSFC that you determine. If you use a nominal BSFC, we recommend that you select a value based on the BSFC measured over laboratory duty cycles that best represent the range of engine operation that defines a test interval for field-testing. You may use the methods of this paragraph (d)(5)(iii)(B) only if it does not adversely affect your ability to demonstrate compliance with applicable standards.

* * * * *

89. Section 1065.920 is amended by revising paragraphs (a) and (b)(7) introductory text to read as follows:

§ 1065.920 PEMS Calibrations and verifications.

(a) *Subsystem calibrations and verifications.* Use all the applicable calibrations and verifications in subpart D of this part, including the linearity verifications in § 1065.307, to calibrate and verify PEMS. Note that a PEMS does not have to meet the system-response specifications of § 1065.308 if it meets the overall verification described in paragraph (b) of this section. This section does not apply to ECM signals.

(b) * * *

(7) The PEMS passes this verification if any one of the following are true for each constituent:

* * * * *

90. Section 1065.925 is amended by revising paragraph (h)(8) to read as follows:

§ 1065.925 PEMS preparation for field testing.

* * * * *

(h) * * *

(8) If corrective action does not resolve the deficiency, you may use a contaminated HC system if it does not prevent you from demonstrating compliance with the applicable emission standards.

91. Section 1065.935 is amended by revising paragraph (e)(1) to read as follows:

§ 1065.935 Emission test sequence for field testing.

* * * * *

(e) * * *

(1) Continue sampling as needed to get an appropriate amount of emission measurement, according to the standard setting part. If the standard-setting part does not describe when to stop sampling, develop a written protocol before you start testing to establish how you will stop sampling. You may not determine when to stop testing based on emission results.

* * * * *

Subpart K—[Amended]

92. Section 1065.1001 is amended by revising the definitions for ''Regression statistics'' and ''Tolerance'' and adding definitions in alphabetical order for ''Mode'', ''NIST accepted'', and ''Recommend'' to read as follows:

§ 1065.1001 Definitions.

* * * * *

Mode means one of the following:

(1) A distinct combination of engine speed and load for steady-state testing.

(2) A continuous combination of speeds and load specifying a transition during a ramped-modal test.

(3) A distinct operator demand setting, such as would occur when testing locomotives or constant-speed engines.

NIST accepted means relating to a value that has been assigned or named by NIST.

* * * * *

Recommend has the meaning given in § 1065.201.

Regression statistics means any of the regression statistics specified in § 1065.602.

* * * * *

Tolerance means the interval in which 95% of a set of recorded values of a certain quantity must lie, with the remaining 5% of the recorded values deviating from the tolerance interval. Use the specified recording frequencies and time intervals to determine if a quantity is within the applicable tolerance.

* * * * *

93. Section 1065.1005 is amended by revising paragraph (g) to add defined acronyms for ''CITT'' and ''FEL'' in the table to read as follows:

§ 1065.1005 Symbols, abbreviations, acronyms, and units of measure.

* * * * *

(g) * * *

* * * * *

CITT ...	Curb Idle Transmission Torque.
FEL	Family Emission Limit.

* * * * *

94. Section 1065.1010 is amended by revising paragraph (b) and adding paragraph (f) to read as follows:

§ 1065.1010 Reference materials.

* * * * *

(b) *ISO material.* Table 2 of this section lists material from the International Organization for Standardization that we have incorporated by reference. The first column lists the number and name of the material. The second column lists the section of this part where we reference it. Anyone may purchase copies of these materials from the International Organization for Standardization, Case Postale 56, CH–1211 Geneva 20, Switzerland or *http://www.iso.org.* Table 2 follows:

TABLE 2 OF § 1065.1010.—ISO MATERIALS

Document No. and name	Part 1065 reference
ISO 14644–1, Cleanrooms and associated controlled environments	1065.190
ISO 8217:2005, Petroleum products—Fuels (class F)—Specifications of marine fuels	1065.705
ISO 3675:1998, Crude petroleum and liquid petroleum products—Laboratory determination of density—Hydrometer method	1065.705
ISO 12185:1996/Cor 1:2001, Crude petroleum and petroleum products—Determination of density—Oscillating U-tube method	1065.705
ISO 3104:1994/Cor 1:1997, Petroleum products—Transparent and opaque liquids—Determination of kinematic viscosity and calculation of dynamic viscosity	1065.705
ISO 2719:2002, Determination of flash point—Pensky-Martens closed cup method	1065.705
ISO 3016:1994, Petroleum products—Determination of pour point	1065.705
ISO 10370:1993/Cor 1:1996, Petroleum products—Determination of carbon residue—Micro method	1065.705
ISO 6245:2001, Petroleum products—Determination of ash	1065.705
ISO 3733:1999, Petroleum products and bituminous materials—Determination of water—Distillation method	1065.705
ISO 8754:2003, Petroleum products—Determination of sulfur content—Energy-dispersive X-ray fluorescence spectrometry	1065.705
ISO 14596:1998/Cor 1:1999, Petroleum products—Determination of sulfur content—Wavelength-dispersive X-ray fluorescence spectrometry	1065.705
ISO 14597:1997, Petroleum products—Determination of vanadium and nickel content—Wavelength-dispersive X-ray fluorescence spectrometry	1065.705
ISO 10307–2:1993, Petroleum products—Total sediment in residual fuel oils—Part 2: Determination using standard procedures for aging	1065.705

TABLE 2 OF § 1065.1010.—ISO MATERIALS—Continued

Document No. and name	Part 1065 reference
ISO 10478:1994, Petroleum products—Determination of aluminum and silicon in fuel oils—Inductively coupled plasma emission and atomic absorption spectroscopy methods	1065.705
IP–470, Aluminum, silicon, vanadium, nickel, iron, calcium, zinc and sodium in residual fuels, by AAS finish	1065.705
IP–500 Phosphorus content of residual fuels by ultra-violet spectrometry	1065.705
IP–501 Aluminum, silicon, vanadium, nickel, iron, sodium, calcium, zinc and phosphorus in residual fuel oil, by ICP finish	1065.705

* * * * *

(f) *Institute of Petroleum material.* Table 6 of this section lists the Institute of Petroleum standard test methods material from the Energy Institute that we have incorporated by reference. The first column lists the number and name of the material. The second column lists the section of this part where we reference it. Anyone may purchase copies of these materials from the Energy Institute, 61 New Cavendish Street, London, W1G 7AR, UK, +44 (0)20 7467 7100 or *http://www.energyinst.org.uk.* Table 6 follows:

TABLE 6 OF § 1065.1010.—INSTITUTE OF PETROLEUM MATERIALS

Document No. and name	Part 1065 reference
IP–470, Aluminum, silicon, vanadium, nickel, iron, calcium, zinc and sodium in residual fuels, by AAS finish	1065.705
IP–500 Phosphorus content of residual fuels by ultra-violet spectrometry	1065.705
IP–501 Aluminum, silicon, vanadium, nickel, iron, sodium, calcium, zinc and phosphorus in residual fuel oil, by ICP finish	1065.705

95. The authority citation for part 1068 continues to read as follows:

Authority: 42 U.S.C. 7401–7671q.

96. Section 1068.1 is amended by revising paragraphs (a) and (b) to read as follows:

§ 1068.1 Does this part apply to me?

(a) The provisions of this part apply to everyone with respect to the following engines and to equipment using the following engines (including owners, operators, parts manufacturers, and persons performing maintenance).

(1) Locomotives and locomotive engines we regulate under 40 CFR part 1033.

(2) Land-based nonroad compression-ignition engines we regulate under 40 CFR part 1039.

(3) Stationary compression-ignition engines certified to the provisions of 40 CFR part 1039, as indicated under 40 CFR part 60, subpart IIII.

(4) Stationary spark-ignition engines certified to the provisions of 40 CFR parts 1048 or 1054, as indicated under 40 CFR part 60, subpart JJJJ.

(5) Marine compression-ignition engines we regulate under 40 CFR part 1042.

(6) Marine spark-ignition engines we regulate under 40 CFR part 1045.

(7) Large nonroad spark-ignition engines we regulate under 40 CFR part 1048.

(8) Recreational SI engines and vehicles we regulate under 40 CFR part 1051 (such as snowmobiles and off-highway motorcycles).

(9) Small nonroad spark-ignition engines we regulate under 40 CFR part 1054.

(b) This part does not apply to any of the following engine or vehicle categories:

(1) Light-duty motor vehicles (see 40 CFR part 86).

(2) Heavy-duty motor vehicles and motor vehicle engines (see 40 CFR part 86).

(3) Aircraft engines (see 40 CFR part 87).

(4) Land-based nonroad diesel engines we regulate under 40 CFR part 89.

(5) Small nonroad spark-ignition engines we regulate under 40 CFR part 90.

(6) Marine spark-ignition engines we regulate under 40 CFR part 91.

(7) Locomotives and locomotive engines we regulate under 40 CFR part 92.

(8) Marine diesel engines we regulate under 40 CFR parts 89 or 94.

* * * * *

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