DRAFT 02-28-2003

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 86

[AMS-FRL-]

RIN 2060-AK27

Control of Emissions of Air Pollution from Nonroad Diesel Engines and Fuel

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice of Proposed Rulemaking.

SUMMARY: Nonroad diesel engines are the largest remaining contributor to the overall mobile source emissions inventory. We have already taken steps to dramatically reduce emissions from light-duty vehicles and heavy-duty vehicles and engines through the Tier 2 and 2007 highway diesel programs. With expected growth in the nonroad sector, the relative emissions contribution is projected to be even larger in later years. This proposed rule sets out emissions standards for nonroad engines used in construction, farming, and mining operation that will achieve over 90% reduction in emissions levels from today's engines. Additionally, we are proposing to reduce sulfur levels in nonroad diesel fuel, including diesel fuel used in locomotive and marine applications, first to 500 parts per million (ppm) and then a further reduction to 15 ppm. Taken together, controls included in this proposal would result in large public health and welfare benefits. As was the case with the Tier 2 and 2007 highway diesel programs, this proposed program would treat vehicles and fuels as a system, combining requirements for much cleaner vehicles with requirements for much lower levels of sulfur in diesel fuel.

Today's proposal sets out new engine exhaust emissions standards, sulfur control requirements for nonroad diesel fuel, and new engine emissions test procedures. The proposed exhaust standards would result in particulate matter (PM) and nitrogen oxide (NOx) emissions levels that are in excess of 95 percent and 90 below comparable levels in effect today. They will be in effect starting in the 2008 model year, with a phase-in of standards across five different engine power rating groupings. Nonroad diesel fuel, including that used in locomotive and marine applications, would meet a 500 ppm cap starting in September 2007, a reduction of almost 85%. There are large benefits to taking this first sulfur reduction action, especially in the reduction of particulate matter from the in-use fleet. Then, sulfur levels in nonroad diesel fuel (though not locomotive or marine diesel fuel) would meet a 15 ppm cap in 2010, an additional 97% reduction. While there are health benefits associated with the reduction from 500 ppm to 15 ppm, the primary benefit will be to facilitate the introduction of advanced aftertreatment devices on nonroad engines, which would in turn lead to significant benefits. The new engine emissions test procedures are meant to better approximate real-world engine operation and would also help

provide for effective compliance determination.

The requirements in today's proposal would result in substantial benefits to public health and welfare and the environment through significant reductions in emissions of NOx, PM as well as nonmethane hydrocarbons (NMHC), carbon monoxide (CO), sulfur oxides (SOx) and air toxics. We project that by 2030, this program would reduce annual emissions of NOx, NMHC, and PM by __ million, ___, and ___ tons, respectively. These emission reductions would prevent ___ premature deaths, over __ hospitalizations, and __ million work days lost, among quantifiable benefits. All told the benefits of this rule would be ___ annually once the program is fully phased in. Costs for both the engine and fuel requirements would be significantly less, at approximately __ billion annually.

DATES: *Comments*: Send written comments on this proposal by **[insert date 60 days after date of publication]**. See Section IX for more information about written comments.

Hearings: We will hold public hearings on the following dates: **[insert date]**; **[insert date]**; **[insert date]**. Each hearing will start at **[insert time]** local time. If you want to testify at a hearing, notify the contact person listed below at least ten days before the hearing. See Section IX for more information about public hearings.

ADDRESSES: *Comments*: Comments may be submitted electronically, by mail, by facsimile, or through hand delivery/courier. Follow the detailed instructions as provided in Section IX of the **SUPPLEMENTARY INFORMATION** section.

Hearings: We will hold public hearings at the following three locations.

Los Angeles, California [insert date] [insert time]
[insert location detail]

Chicago, Illinois [insert date] [insert time]
[insert location detail]

New York City, New York [insert date] [insert time]
[insert location detail]

See Section IX, "Public Participation" below for more information on the comment procedure and public hearings.

FOR FURTHER INFORMATION CONTACT: [insert contact information]

SUPPLEMENTARY INFORMATION:

Regulated Entities

This action would affect you if you produce or import new heavy-duty diesel engines which are intended for use in nonroad vehicles such as [insert example[s]], or produce or import such nonroad vehicles, or convert heavy-duty vehicles or heavy-duty engines used in nonroad vehicles to use alternative fuels. It would also affect you if you produce, import, distribute, or sell nonroad diesel fuel, or sell nonroad diesel fuel.

The following table gives some examples of entities that may have to follow the regulations. But because these are only examples, you should carefully examine the regulations in 40 CFR parts **[insert CFR parts]**. If you have questions, call the person listed in the FOR FURTHER INFORMATION CONTACT section of this preamble:

Category	NAICS codes[a]	SIC codes[b]	Examples of potentially regulated entities
Industry.....	[insert]	[insert]	[insert]

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

[b] Standard Industrial Classification (SIC) system code.

How Can I Get Copies of This Document and Other Related Information?

Docket. EPA has established an official public docket for this action under Docket ID No. A-2001-28. The official public docket consists of the documents specifically referenced in this action, any public comments received, and other information related to this action. Although a part of the official docket, the public docket does not include Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. The official public docket is the collection of materials that is available for public viewing at the Air Docket in the EPA Docket Center, (EPA/DC) EPA West, Room B102, 1301 Constitution Ave., NW, Washington, DC. The EPA Docket Center 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 Reading Room is (202) 566-1742, and the telephone number for the Air Docket is (202) 566-1742).

Electronic Access. You may access this Federal Register document electronically through the EPA Internet under the "Federal Register" listings at *http://www.epa.gov/fedrgstr/*.

An electronic version of the public docket is available through EPA's electronic public docket and comment system, EPA Dockets. You may use EPA Dockets at http://www.epa.gov/edocket/ to submit or view public comments, access the index listing of the contents of the official public docket, and to access those documents in the public docket that are available electronically. Once in the system, select "search," then key in the appropriate docket identification number.

Certain types of information will not be placed in the EPA Dockets. Information claimed as CBI and other information whose disclosure is restricted by statute, which is not included in the official public docket, will not be available for public viewing in EPA's electronic public docket. EPA's policy is that copyrighted material will not be placed in EPA's electronic public docket but will be available only in printed, paper form in the official public docket. To the extent feasible, publicly available docket materials will be made available in EPA's electronic public docket. When a document is selected from the index list in EPA Dockets, the system will identify whether the document is available for viewing in EPA's electronic public docket. Although not all docket materials may be available electronically, you may still access any of the publicly available docket materials through the docket facility identified in Unit I.B.

For public commenters, it is important to note that EPA's policy is that public comments, whether submitted electronically or in paper, will be made available for public viewing in EPA's electronic public docket as EPA receives them and without change, unless the comment contains copyrighted material, CBI, or other information whose disclosure is restricted by statute. When EPA identifies a comment containing copyrighted material, EPA will provide a reference to that material in the version of the comment that is placed in EPA's electronic public docket. The entire printed comment, including the copyrighted material, will be available in the public docket.

Public comments submitted on computer disks that are mailed or delivered to the docket will be transferred to EPA's electronic public docket. Public comments that are mailed or delivered to the Docket will be scanned and placed in EPA's electronic public docket. Where practical, physical objects will be photographed, and the photograph will be placed in EPA's electronic public docket along with a brief description written by the docket staff.

For additional information about EPA's electronic public docket visit EPA Dockets online or see 67 FR 38102, May 31, 2002.

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I. Overview

Nonroad diesel engines are the largest remaining contributor to the overall mobile source emissions inventory. We have already taken steps to dramatically reduce emissions from light-duty vehicles and heavy-duty vehicles and engines through the Tier 2 and 2007 highway diesel programs.[1] With expected growth in the nonroad sector, the relative emissions contribution is projected to be even larger in future years. This proposed rule sets out emissions standards for nonroad diesel engines used in construction, farming, and mining operation that will achieve over 90% reduction in emissions levels from today's engines. Additionally, we are proposing to reduce sulfur levels in nonroad diesel fuel to 15 parts per million (ppm) and to 500 ppm for diesel fuel used in locomotive and marine applications. Taken together, controls included in this proposal would result in large public health and welfare benefits.

The proposed standards for nonroad diesel engines and sulfur reductions for nonroad diesel fuel represent a dramatic step in emissions control, based on the use of advanced emissions control technology. Until the mid-90's, these engines had no emissions requirements. As a comparison, cars and trucks have been subject to a series of increasingly stringent emissions control programs since the 1970s. Additionally, diesel engines used in highway applications will meet, for the first time, the same level of stringency as comparable gasoline vehicles starting in 2007. In terms of fuel quality requirements, nonroad diesel fuel is currently uncontrolled at the federal level. Today's proposal would bring nonroad diesel fuel to the same 15 ppm cap for sulfur that will be required for highway diesel fuel starting in 2006. We believe it is highly appropriate to propose dramatic steps forward in emissions standards and reductions in sulfur levels in nonroad diesel fuel because, as discussed throughout this proposal, such steps are cost-effective, provide very large public health and welfare benefits, and represent a feasible progression in the application of advanced emissions control technologies.

We followed certain principles when developing the elements of today's proposal. First, the program must achieve reductions in NOx and PM emissions as early as possible. This includes reductions from the in-use fleet of nonroad diesel engines. Second, as we did in the 2007 highway diesel program, we are treating vehicles and fuels as a system since we believe this is the best way to achieve the most emissions reductions overall. Third, the implementation of low sulfur requirements for nonroad diesel fuel should in no way interfere with the implementation and expected benefits of introducing ultra low sulfur fuel in the highway market, as required by the 2007 highway diesel program. Lastly, a program should provide sufficient lead time to allow the integration of advanced emissions control technologies from the highway sector onto nonroad diesel engines as well as the introduction of ultra-low sulfur fuel.

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[1] See 65 FR 6698 (February 10, 2000) and 66 FR 5001 (January 18, 2001) for the final rules regarding the Tier 2 and 2007 highway diesel programs, respectively.

Today's proposal sets out new engine exhaust emissions standards, emissions test procedures for nonroad engines, and sulfur control requirements for nonroad, locomotive, and marine diesel fuel. The proposed exhaust standards would result in particulate matter (PM) and nitrogen oxide (NOx) emissions levels that are in excess of 95 percent and 90 percent below comparable levels in effect today. They will begin to take effect in the 2008 model year, with a phase-in of standards across five different engine power rating groupings. New engine emissions test procedures are proposed to take effect with these new standards to better ensure emissions control over real-world engine operation and to help provide for effective compliance determination. Diesel fuel used in nonroad, locomotive, and marine applications would meet a 500 ppm cap starting in June, 2007, a reduction of approximately 90%. There are large benefits to taking this first sulfur reduction action, especially in the reduction of particulate matter from the in-use fleet. In 2010, sulfur levels in nonroad diesel fuel (though not locomotive or marine diesel fuel) would meet a 15 ppm cap, for a total reduction of over 99%. We are also seriously considering and seeking comment on applying the 15 ppm cap to locomotive and marine diesel fuel. While there are health and welfare benefits associated with the reduction from 500 ppm to 15 ppm, the primary benefit will be to facilitate the introduction of advanced aftertreatment devices on nonroad engines, which would in turn lead to significant benefits.

The requirements in today's proposal would result in substantial benefits to public health and welfare and the environment through significant reductions in emissions of Nox and PM, as well as nonmethane hydrocarbons (NMHC), carbon monoxide (CO), sulfur oxides (SOx) and air toxics. We project that by 2030, this program would reduce annual emissions of NOx, and PM by 827,000, and 121,000 tons, respectively. These annual emission reductions would prevent 9,600 premature deaths, over 4,500 hospitalizations, and almost a million work days lost, among quantifiable benefits. All told the benefits of this rule would be approximately $80 billion annually once the program is fully phased in. Costs for both the engine and fuel requirements would be significantly less, at approximately $1.4 billion annually.

A. What is EPA Proposing?

There are two basic parts to this proposed program: (1) new exhaust emission standards for nonroad diesel engines and vehicles, and (2) new sulfur limits for nonroad, locomotive, and marine diesel fuel. The systems approach of combining the engine and fuel standards into a single program is critical to the success of our overall efforts to reduce emissions, because the emission standards will not be feasible without the fuel change. The fuel change would also produce immediate emissions and maintenance benefits in the existing fleet of diesel equipment, especially from the reduction to 500 ppm sulfur. These benefits include reduced sulfate PM and sulfur oxides emissions, reduced engine wear, less frequent oil changes, and longer-lasting exhaust gas recirculation (EGR) components on engines equipped with EGR.

We looked at a number of alternative program options, as discussed in more detail in Section VI below and Chapter 12 of the draft RIA. For example, we analyzed a program that would require refiners to produce 15 ppm nonroad diesel fuel starting in 2008, with appropriate engine standards phased-in beginning in 2009. Many of these alternatives provided a very similar level of projected emissions control and health and welfare benefits as our proposed program. However, taking into account the need for appropriate lead time, achieving the greatest possible emissions reductions as early as possible, and the interaction of requirements in today's proposal with existing highway diesel engine environmental programs, we believe our proposed program provides the best opportunity for achieving our goal of timely and significant emissions reductions from nonroad diesel engines and the associated introduction of ultra-low sulfur nonroad diesel fuel. We are asking for comments on the alternatives discussed in today's proposal.

The elements of the rule are outlined below. Detailed provisions and justifications for our proposed rule are discussed in subsequent sections and the draft RIA

1. Nonroad Diesel Engine Emission Standards

Today's action proposes standards for nonroad diesel engines ranging from 3 to over 3,000 horsepower. Applicable emissions standards are determined by year for each of five engine power band categories. For engines less than 25 hp, we are proposing new engine standards for PM (0.30 g/bhp-hr) and CO (4.9 g/bhp-hr) to go along with existing NOx standards beginning in 2008. For engines between 25-75 hp, we are proposing standards reflecting approximately 50% reduction in PM control from today's engines applicable in 2008. Then, starting in 2013, PM standards of 0.02 g.bhp-hr and NOx standards of 3.5 g/bhp-hr would apply. For engines between 75-175 hp, the proposed standards would be 0.01 g/bhp-hr for PM, 0.30 g/bhp-hr for NOx, and 0.14 g/bhp-hr for HC beginning in 2012. These same standards would apply for both engines between 175-750 hp and greater than 750 hp starting in 2011. These PM, NOx, and NMHC standards are similar in stringency to the final standards included in the 2007 highway diesel program and are expected to require the use of high-efficiency aftertreatment systems to ensure compliance. Thus, virtually all nonroad diesel engines after 2013 would likely be using advanced aftertreatment systems. We are phasing in many of these proposed standards over a period of three years in order to address lead time, workload, and feasibility considerations.

We are also proposing to continue the averaging, banking, and trading nonroad emissions credits provisions to demonstrate compliance with the standards. In addition, we are proposing to include turbocharged diesels in the existing prohibition on crankcase emissions, effective in the same year that the proposed Tier 4 standards first apply in each power category. More specific information on the proposed standards can be found in Section III below.

To better ensure the benefits of the standards are realized in-use and throughout the useful life of these engines, we are also proposing new test procedures and related certification requirements. We believe the new supplemental transient test, Constant Speed Variable Load transient duty cycle, cold start transient test, and not-to-exceed test procedures and standards will all help achieve our goal. This is a significant and important aspect of this proposal that would bring greater confidence and certainty to the compliance program.

The proposal also includes provisions to facilitate the transition to the new engine and fuel standards and to encourage the early introduction of clean technologies. We are also including proposed adjustments to various fuel and engine testing and compliance requirements. These provisions are described further in Sections III, IV, and VI.

2. Nonroad, Locomotive, and Marine Diesel Fuel Quality Standards

We are proposing that sulfur levels for nonroad diesel fuel be reduced from current uncontrolled levels ultimately to 15 ppm, though we are proposing an interim cap of 500 ppm. Beginning June 1, 2007, refiners would therefore be required to produce nonroad, locomotive, and marine diesel fuel that meets a maximum sulfur level of 500 ppm. This does not include diesel fuel for home heating, industrial boiler, or stationary power uses or diesel fuel used in aircraft. We estimate there are significant health and welfare benefits associated with this proposed reduction, including reductions in sulfate emissions and reduced engine operating expenses. Then, beginning in June 1, 2010, fuel used for nonroad diesel applications (excluding locomotive and marine engines) is proposed to meet a maximum sulfur level of 15 ppm, since all 2011 and later model year nonroad diesel-fueled engines with aftertreatment must be refueled with this new low sulfur diesel fuel. This sulfur standard is based on our assessment of the impact of sulfur on advanced exhaust emission control technologies and a corresponding assessment of the feasibility of low sulfur fuel production and distribution. We are also asking for comment on bringing sulfur levels for locomotive and marine fuel to 15 ppm in 2010 and note that we anticipate beginning the process of developing new engine controls for these two sources in 2004. Today's proposal includes a combination of provisions available to refiners, especially small refiners, to ensure a smooth transition to low sulfur nonroad diesel fuel.

In addition, today's proposal includes unique provisions for implementing the low sulfur diesel fuel program in the State of Alaska. We are also proposing that certain U.S. territories be excluded from both the nonroad engine standards and diesel fuel standards. Similar actions were taken as part of the 2007 highway diesel program.

The compliance provisions for ensuring diesel fuel quality are essentially consistent with those that have been in effect since 1993 for highway diesel fuel, reflecting updated requirements that were included in the 2007 highway diesel program. Additional compliance provisions are proposed for the transition years of the program concerning the interaction of the nonroad, locomotive, and marine sulfur control requirements with existing highway diesel sulfur control provisions. These provisions could also help discourage misfueling of nonroad equipment utilizing high-efficiency aftertreatment devices.

B. Why Is EPA Making This Proposal?

1. Nonroad, Locomotive, and Marine Diesels Contribute to Serious Air Pollution Problems

As discussed in detail in Section II and Chapter 2 and 3 of draft RIA, emissions from nonroad, locomotive, and marine diesel engines contribute greatly to a number of serious air pollution problems, and these emissions would have continued to do so into the future absent further controls to reduce them. First, these engines contribute to the health and welfare effects associated with ozone, PM, NOx, SOx, and volatile organic compounds (VOCs), including toxic compounds such as formaldehyde. These adverse effects include premature mortality, aggravation of respiratory and cardiovascular disease (as indicated by increased hospital admissions and emergency room visits, school absences, work loss days, and restricted activity days), changes in lung function and increased respiratory symptoms, changes to lung tissues and structures, altered respiratory defense mechanisms, chronic bronchitis, and decreased lung function.[2] Second and importantly, in addition to its contribution to ambient PM inventories, diesel exhaust is of specific concern because it has been judged to pose a lung cancer hazard for humans as well as a hazard from noncancer respiratory effects. The Agency has classified diesel exhaust as likely to be carcinogenic to humans by inhalation at environmental exposures. Third, ozone and PM cause significant public welfare harm. Specifically, ozone causes damage to vegetation which leads to economic crop and forestry losses, as well as harm to national parks, wilderness areas, and other natural systems. PM causes damage to materials and soiling of commonly used building materials and culturally important items such as statues and works of art. Fourth, NOx, SOx and direct emissions of PM contribute to substantial visibility impairment in many parts of the U.S. where people live, work, and recreate, including mandatory Federal Class I areas. Finally, NOx emissions from nonroad diesel engines contribute to the acidification, nitrification and eutrophication of water bodies.

Millions of Americans live in areas with unhealthful air quality that currently endangers public health and welfare. Based upon data for 1999 - 2001, there are 291 counties that are violating the 8-hour ozone NAAQS, totaling 111 million people. In addition, at least 65 million people in 129 counties live in areas where annual design values of ambient $PM_{2.5}$ violate the

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[2] U.S. EPA (1996) Air Quality Criteria for Particulate Matter - Volumes I, II, and III, EPA Office of Research and Development, National Center for Environmental Assessment, July 1996. Report No. EPA/600/P-95/001aF, EPA/600/P-95/001bF, EPA/600/P-95/001cF.

U.S. EPA (2002), Air Quality Criteria for Particulate Matter - Volumes I and II (Third External Review Draft). This material is available electronically at http://cfpub.epa.gov/ncea/cfm/partmatt.cfm.

U.S. EPA (1996) Air Quality Criteria for Ozone and Related Photochemical Oxidants. EPA Office of Research and Development, National Center for Environmental Assessment, July 1996. Report No. EPA/600/P-93/004aF. The document is available on the internet at http://www.epa.gov/ncea/ozone.htm.

$PM_{2.5}$ NAAQS. There are an additional 9 million people in 20 counties where levels above the $PM_{2.5}$ NAAQS are being measured, but the data are incomplete. Without emission reductions from the proposed new standards for nonroad engines, there is a significant future risk that 32 counties with 47 million people across the country may violate the 8-hour ozone national ambient air quality standard (NAAQS) in 2030, based on our modeling. Similarly, modeled $PM_{2.5}$ concentrations in 107 counties where 85 million people live are above specified levels in 2030. An additional 64 million people are projected to live in counties within 10 percent of the $PM_{2.5}$ standard in 2030, and 44 million people are projected to live in counties within 10 percent of the level of the 8-hour standard in 2030. Thus, our analyses show that these counties face a significant risk of exceeding or failing to maintain the $PM_{2.5}$ and the 8-hour ozone NAAQS without significant additional controls between 2007 and 2030.

Federal, state, and local governments are working to bring ozone and particulate levels into compliance with the NAAQS through State Implementation Plan (SIP) attainment and maintenance plans, and to ensure that future air quality reaches and continues to achieve these health- and welfare-based standards. The reductions in this proposed rulemaking will play a critical part in these important efforts to attain and maintain the NAAQS. In addition, reductions from this action will also reduce public health and welfare effects associated with maintenance of the 1-hour ozone and PM_{10} NAAQS.

Emissions from nonroad, locomotive, and marine diesel engines account for substantial portions of the country's ambient PM and NOx levels. NOx is a key precursor to ozone formation. We estimate that these engines account for about ten percent of total NOx emissions and about ten percent of total PM emissions. These proportions are even higher in some urban areas, where these engines contribute up to 14 percent of the total NOx emissions and up to 18 percent of the total PM emissions inventory. Over time, the relative contribution of these diesel engines to air quality problems will go even higher unless EPA takes action to further reduce pollution levels. For example, EPA has already taken steps to bring emissions levels from light-duty and heavy-duty vehicles and engines to near-zero levels by the end of this decade. The PM and NOx standards for nonroad, locomotive, and marine diesel engines in this proposal would have a substantial impact on emissions. By 2030, NOx emissions from these diesel engines under today's standards will be reduced by 827,000 tons, and PM emissions will decline by about 121,000 tons, dramatically reducing this source of NOx and PM emissions. Urban areas, which include many poorer neighborhoods, can be disproportionately impacted by such diesel emissions, and these neighborhoods will thus receive a relatively larger portion of the benefits expected from proposed emissions controls. Diesel exhaust is of special concern because it has been implicated in an increased risk of lung cancer and respiratory disease. EPA recently issued its *Health Assessment Document for Diesel Exhaust*.[3] The Agency has classified diesel exhaust

[3] 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

as likely to be carcinogenic to humans by inhalation at environmental exposures. State and local governments, in their efforts to protect the health of their citizens and comply with requirements of the Clean Air Act (CAA or "the Act"), have recognized the need to achieve major reductions in diesel PM emissions, and have been seeking Agency action in setting stringent new standards to bring this about.[4]

2. Technology and Fuel Based Solutions

Although the air quality problems caused by nonroad diesel exhaust are challenging, we believe they can be resolved through the application of high-efficiency emissions control technologies. As discussed in much greater detail in Section III, the development of diesel emissions control technology has advanced in recent years so that very large emission reductions (in excess of 90 plus percent) are possible, especially through the use of catalytic emission control devices installed in the nonroad equipment's exhaust system and integrated with the engine controls. These devices are often referred to as "exhaust emission control" or "aftertreatment" devices. Exhaust emission control devices, in the form of the well-known catalytic converter, have been used in gasoline-fueled automobiles for 28 years, but have had only limited application in diesel engines and vehicles.

Based on the Clean Air Act requirements in section 213, we are proposing stringent new emission standards that will result in the use of these diesel exhaust emission control devices. We are also proposing changes to nonroad diesel fuel quality standards, per section 211 (c) of the Act, in order to enable these high-efficiency technologies.

To meet the proposed new standards, application of high-efficiency exhaust emission controls for both PM and NOx will be needed for most engines. High-efficiency PM exhaust emission control technology has been available for several years. This technology has continued to improve over the years, especially with respect to durability and robust operation in use. It has also proved extremely effective in reducing exhaust hydrocarbon emissions. Thousands of such systems are now in use, especially in Europe. However, as discussed in detail in Section III, these systems are very sensitive to sulfur in the fuel. For the technology to be viable and capable of meeting the standards, we believe it will require diesel fuel with sulfur content capped at the 15 ppm level.

Similarly, high-efficiency NOx exhaust emission control technology will be needed if

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

[4] For example, see letters dated April 9, 2002 from Agency Secretary of California EPA, Commissioner of NY State DEC, and Commissioner of Texas NRCC to Governor Whitman; and dated Dec 17, 2002, from State and Territorial Air Pollution Program Administrators and Association of Local Air Pollution Control Officials and Northeast States for Coordinated Air Use Mangement (and other organizations)

nonroad diesel engines are to attain the proposed standards. This is the same technology that we anticipate will be applied to heavy-duty highway diesel engines to meet the NOx standards included in the 2007 highway diesel program. This technology, like the PM technology, is depended on the 15 ppm maximum nonroad diesel fuel levels being proposed in this action to be feasible and capable of achieving the standards. Similar high-efficiency NOx exhaust emission control technology has been quite successful in gasoline direct injection engines that operate with an exhaust composition fairly similar to diesel exhaust and is expected to be used to meet the 2007 and later heavy-duty highway diesel standards. As discussed in Section III, application of this technology to nonroad diesels has some additional engineering challenges. In that section, we discuss the current status of this technology as well as the major development issues still to be addressed and the development steps that can be taken. With the lead-time available and the introduction of low-sulfur nonroad diesel fuel, we are confident the proposed application of this technology to nonroad diesels would proceed at a reasonable rate of progress and will result in systems capable of achieving the standards.

This view is further supported by the fact that manufacturers are already working on developing high-efficiency aftertreatment devices in order to have them available for introduction on highway diesel engines by 2007. EPA issued a progress report in June, 2002 which discussed our findings that industry was making substantial progress in developing these devices. Additionally, the Clean Diesel Independent Review Panel issued a report in October, 2002 on similar questions and concluded that, while technical issues remain, there were no technical hurdles identified that would prevent market introduction of high-efficiency aftertreatment devices on schedule.

The need to reduce sulfur in nonroad diesel fuel is driven by the requirements of the exhaust emission control technology that we project will be needed to meet the proposed standards for most nonroad diesel engines. The challenge in accomplishing the sulfur reduction is driven by the capacity to implement the needed refinery modifications, and by the costs of making the modifications and running the equipment. Today, a number of refiners are acting to provide low sulfur diesel to some markets. In consideration of the impacts that sulfur has on the efficiency, reliability, and fuel economy impact of diesel engine exhaust emission control devices, we believe that controlling the sulfur content of highway diesel fuel to the 15 ppm level is necessary, feasible, and cost-effective.

Additionally, there are health and welfare benefits associated with the initial step of reducing the sulfur level of nonroad, locomotive, and marine diesel fuel to 500 ppm. This proposed action will provide dramatic, immediate reductions in direct sulfate PM and SO_2 emissions from the in-use fleet. As described in today’s proposal, we believe this fuel control strategy is a cost-effective air quality solution as well.

3. Basis For Action Under the Clean Air Act

Section 213 of the Act gives us the authority to establish emissions standards for nonroad engines and vehicles. In section 213(a)(3), the Administrator may set standards to control ozone or carbon monoxide, where "... 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." As part of this determination, the Administrator shall give appropriate consideration to cost, lead time, noise, energy, and safety factors associated with the application of such technology. The authority set out in section 213(a)(4) applies for standards addressing public health and welfare problems other than ozone or carbon monoxide, which" may reasonably be anticipated to endanger public health and welfare". Here, the Administrator may promulgate regulations that are deemed appropriate for new nonroad vehicles and engines which cause or contribute to such air pollution, taking into account costs, noise, safety, and energy factors.

We believe the evidence provided in Section III and the Draft Regulatory Impact Analysis (RIA) indicates that the stringent emission standards finalized today are feasible and reflect the greatest degree of emission reduction achievable in the model years to which they apply. We have given appropriate consideration to costs in choosing 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 or could be required in the future. We have also reviewed and given appropriate consideration to the energy factors of this rule in terms of fuel efficiency and effects on diesel fuel supply, production, and distribution, as discussed below, as well as any safety factors associated with these standards.

The information regarding air quality and the contribution of nonroad, locomotive, and marine diesel engines to air pollution in Section II and the draft RIA provides strong evidence that emissions from such engines significantly and adversely impact public health or welfare. First, there is a significant risk that several areas will fail to attain or maintain compliance with the NAAQS for 8-hour ozone concentrations or $PM_{2.5}$ concentrations during the period that these new vehicle and engine standards will be phased into the vehicle population, and that nonroad, locomotive, and marine diesel engines contribute to such concentrations, as well as to concentrations of other NAAQS-related pollutants. This risk will be significantly reduced by the standards adopted today. However, the evidence indicates that some risk remains even after the reductions achieved by these new controls on nonroad diesel engines and nonroad, locomotive, and marine diesel fuel. Second, EPA believes that diesel exhaust is likely to be carcinogenic to humans. The risk associated with exposure to diesel exhaust includes the particulate and gaseous components. Some of the toxic air pollutants associated with emissions from nonroad diesel engines include benzene, formaldehyde, acetaldehyde, acrolein, and 1,3-butadiene. Third, emissions from nonroad diesel engines (including locomotive and marine diesel engines) contribute to regional haze and impaired visibility across the nation, as well as acid deposition, POM deposition, eutrophication and nitrification, all of which are serious environmental welfare problems. Based on this evidence, EPA believes that, for purposes of section 213, emissions of NOx, VOCs, SOx and PM from nonroad, locomotive, and marine diesel engines can reasonably be anticipated to endanger the public health or welfare.

Section 211(c) of the CAA allows us to regulate fuels where emission products of the fuel either: 1) cause or contribute to air pollution that reasonably may be anticipated to endanger public health or welfare, or 2) will impair to a significant degree the performance of any emission control device or system which is in general use, or which the Administrator finds has been developed to a point where in a reasonable time it will be in general use were such a regulation to be promulgated. This rule meets each of these criteria. SOx and sulfate PM emissions from nonroad, locomotive, marine and diesel vehicles are due to sulfur in diesel fuel. As discussed above, emissions of these pollutants cause or contribute to ambient levels of air pollution that endanger public health and welfare. Control of sulfur to 500 ppm for this fuel will lead to significant, cost-effective reductions in emissions of these pollutants. The substantial adverse effect of high sulfur levels on diesel control devices or systems expected to be used to meet the nonroad standards is discussed in depth in Section III. Control of sulfur to 15 ppm in this fuel will enable emissions control technology that will achieve significant, cost-effective reduction in emissions of these pollutants. In addition, our authority under section 211(c) is discussed in more detail in Appendix A to the draft RIA.

II. What Is the Air Quality Impact of the Sources Covered by the Proposed Rule?

With today's proposal, EPA is acting to extend highway types of emission controls to another major source of diesel engine emissions, nonroad diesel engines. These emissions are significant contributors to atmospheric pollution from particulate matter, ozone and a variety of toxic air pollutants. In our most recent nationwide inventory used for this proposal (1996), the nonroad diesels affected by this proposal[5] contribute over 40 percent of diesel PM emissions, up to 18 percent of PM2.5 emissions in urban areas, and up to 14 percent of urban NOx emissions.

Without further control beyond those standards we have already adopted, by the year 2020, these engines will emit 60 percent of all diesel PM, up to 19 percent of PM2.5 emissions in urban areas, and up to 20 percent of urban NOx. When fully implemented, today's proposal would reduce nonroad diesel PM2.5 emissions by almost 90 percent and NOx by almost 70 percent. It will also virtually eliminate nonroad diesel SOx emissions, which amounted to nearly 300,000 tons in 1996, and would otherwise grow to approximately 380,000 tons by 2020.

These dramatic reductions in nonroad emissions are a critical part of the effort by federal, state and local governments to reduce the health related impacts of air pollution and to reach attainment of the NAAQS for PM and ozone, as well as to improve other environmental effects such as atmospheric visibility. Based on the most recent data available for this rule (1999-2001), such problems are widespread in the United States. There are over 70 million people living in counties with PM2.5 levels exceeding the PM2.5 NAAQS, and 111 million people living in counties exceeding the 8hour ozone NAAQS. Figure II.-1 illustrates the widespread nature of these problems. Shown in this figure are counties exceeding either or both of the two NAAQS plus mandatory Federal Class I areas, which have particular needs for reductions in atmospheric haze.

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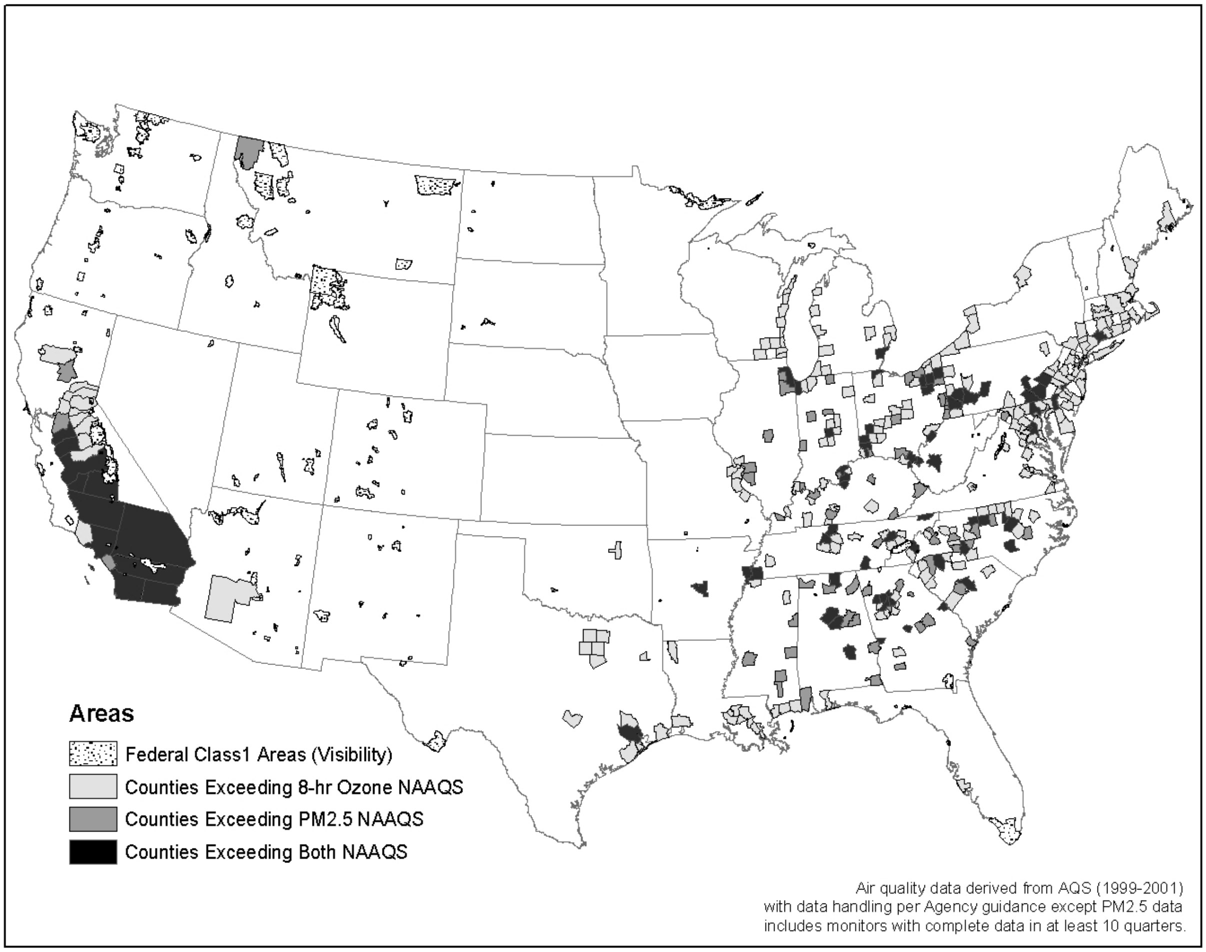
[5] For NOx and $PM_{2.5}$ this includes all land based nonroad diesel engines, but not locomotive, commercial marine vessel, and recreational marine vessel engines. Since the latter three engine categories are affected by the fuel sulfur portions of the proposal, they are included for SO_2.

FIGURE II-1 -- NONROAD DIESEL-RELATED AIR QUALITY PROBLEMS ARE WIDESPREAD



As we will describe later in this preamble, the air quality improvements expected from this proposal would produce major benefits to human health and welfare, with a combined value in excess of half a trillion dollars between 2010 and 2030. By the year 2030, this proposed rule would be expected to prevent approximately 9,600 deaths per year from premature mortality, and 16,000 nonfatal heart attacks. It would also prevent 14,000 acute bronchitis attacks in children and recover nearly 1 million lost work days in 2030.

In the remainder of this section we will describe in more detail the air pollution problems associated with emissions from non-road diesel engines, and the emission and air quality benefits we expect to realize from the fuel and engine controls in this proposal.

A. Overview

The emissions from nonroad engines that are being directly controlled by the standards in this rulemaking are NOx, PM and NMHC, and to a lesser extent, CO. Gaseous air toxics from nonroad diesels will also be reduced as a consequence of the proposed standards. In addition there will be a substantial reduction in SOx emissions resulting from the proposed reduction in sulfur level in diesel fuel .

From a public health perspective, we are primarily concerned with nonroad engine contributions to atmospheric levels of particulate matter, diesel PM and various gaseous air toxics emitted by diesel engines, and ozone[6]. We will first review important public health effects caused by these pollutants, briefly describing the human health effects and reviewing the current and expected future ambient levels of direct or indirectly caused pollution. Our presentation will show that substantial further reductions of these pollutants, and the underlying emissions from nonroad diesel engines, will be needed to protect public health.

Following discussion of health effects, we will discuss a number of welfare effects associated with emissions from diesel engines. These effects include atmospheric visibility impairment, ecological and property damage caused by acid deposition, eutrophication and nitrification of surface waters, environmental and human health threats posed by POM deposition, and plant and crop damage from ozone. Once again, the information available to us indicates a continuing need for further nonroad emission reductions to bring about improvements in air quality.

Next, we will describe our understanding of the engine emission inventories for the primary pollutants affected by the proposal. As noted above, these include PM, NOx, SOx, Air Toxics and HC. We will 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 will identify expected emission reductions from nonroad engines. These reductions will make important contributions to controlling the health and welfare problems associated with ambient PM and ozone levels and with diesel related air toxics.

While the material we will present in this section will describe our understanding of the need for control of nonroad engine emissions and the air quality improvements we expect to realize, this section is not an exhaustive treatment of these issues. For a fuller understanding of the topics treated here, you should refer to the more extended presentations in the Draft

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[6] Ambient particulate matter from nonroad diesel engine is associated with the direct emission of diesel particulate matter, and with particulate matter formed indirectly in the atmosphere by NOx and SOx emissions (and to a lesser extent NMHC emissions). Both NOx and NMHC participate in the atmospheric chemical reactions that produce ozone.

Regulatory Impact Analysis accompanying today's proposal.

B. Public Health Impacts

1. Particulate Matter

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_{10} refers to particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers. Fine particles refer to those particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers (also known as $PM_{2.5}$), and coarse fraction particles are those particles with an aerodynamic diameter greater than 2.5 microns, but less than or equal to a nominal 10 micrometers. Ultrafine PM refers to particles with diameters of less than 100 nanometers (0.1 micrometers). The health and environmental effects of PM are strongly related to the size of the particles.

The emission sources, formation processes, chemical composition, atmospheric residence times, transport distances and other parameters of fine and coarse particles are distinct. Fine particles are directly emitted from combustion sources and are formed secondarily from gaseous precursors such as sulfur dioxide, nitrogen oxides, or organic compounds. Fine particles are generally composed of sulfate, nitrate, chloride, ammonium compounds, organic carbon, elemental carbon, and metals. Combustion of coal, oil, diesel, gasoline, and wood, as well as high temperature process sources such as smelters and steel mills, produce emissions that contribute to fine particle formation. In contrast, coarse particles are typically mechanically generated by crushing or grinding. They generally contain resuspended dusts and crustal material from paved roads, unpaved roads, construction, farming, and mining activities. Fine particles can remain in the atmosphere for days to weeks and travel through the atmosphere hundreds to thousands of kilometers, while coarse particles deposit to the earth within minutes to hours and within tens of kilometers from the emission source.

The relative contribution of various chemical components to $PM_{2.5}$ varies by region of the country. Data on $PM_{2.5}$ composition are available from the EPA Speciation Trends Network in 2001 and the IMPROVE Network in 1999 covering both urban and rural areas in numerous regions of the United States. These data show that carbonaceous $PM_{2.5}$ makes up the major component for $PM_{2.5}$ in both urban and rural areas in the western U.S. Carbonaceous $PM_{2.5}$ includes both elemental and organic carbon. Nitrates formed from NOx also plays a major role in the western U.S., especially in the California area where it is responsible for about a quarter of the ambient $PM_{2.5}$ concentrations. Sulfate plays a lesser role in these regions. For the eastern and mid U.S., these data show that both sulfates and carbonaceous $PM_{2.5}$ are major contributors to ambient $PM_{2.5}$ in both urban and rural areas. In some eastern areas, carbonaceous $PM_{2.5}$ is responsible for up to half of ambient $PM_{2.5}$ concentrations. Sulfate is also a major contributor to ambient $PM_{2.5}$ in the eastern U.S. and in some areas make greater contributions than carbonaceous $PM_{2.5}$.

Nonroad engines, and most importantly nonroad diesel engines, contribute significantly to ambient $PM_{2.5}$ levels, largely through emissions of carbonaceous $PM_{2.5}$. Carbonaceous $PM_{2.5}$ is a major portion of ambient $PM_{2.5}$, especially in populous urban areas. Nonroad diesels also emit high levels of NOx which react in the atmosphere to form secondary $PM_{2.5}$ (namely nitrate). Nonroad diesels also emit SO_2 and NMHC which react in the atmosphere to form secondary $PM_{2.5}$ (namely sulfates and organic carbonaceous $PM_{2.5}$). For more details, consult the draft RIA for this proposed rule.

Diesel particles from nonroad diesel are a component of both coarse and fine PM, but fall mainly in the fine (and even ultrafine) size range. As discussed later, diesel PM also contains small quantities of numerous mutagenic and carcinogenic compounds associated with the particulate (and also organic gases). In addition, while toxic trace metals emitted by nonroad diesel engines represent a very small portion of the national emissions of metals (less than one percent) and a small portion of diesel PM (generally less than one percent of diesel PM), we note that several trace metals of potential toxicological significance and persistence in the environment are emitted by diesel engines. These trace metals include chromium, manganese, mercury and nickel. In addition, small amounts of dioxins have been measured in highway engine diesel exhaust, some of which may partition into the particulate phase; dioxins through out the environment are a major health concern (although the diesel contribution has not been judged significant at this point). Diesel engines also emit polycyclic organic matter (POM), including polycyclic aromatic hydrocarbons (PAH), which can be present in both gas and particle phases of diesel exhaust. Many PAH compounds are classified by EPA as probable human carcinogens.

For additional, detailed, information on PM beyond that summarized below, see the draft Regulatory Impact Analysis.

a. Health Effects of $PM_{2.5}$ and PM_{10}

Scientific studies show ambient PM (which is attributable to a number of sources, including nonroad diesel) is associated with a series of adverse health effects. These health effects are discussed in detail in the EPA Criteria Document for PM as well as the draft updates of this document released in the past year.[7] In addition, EPA recently released its final "Health Assessment Document for Diesel Engine Exhaust," (the Diesel HAD) which also reviews health

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[7] U.S. EPA (1996) Air Quality Criteria for Particulate Matter - Volumes I, II, and III, EPA, Office of Research and Development. Report No. EPA/600/P-95/001a-cF. This material is available electronically at http://www.epa.gov/ttn/oarpg/ticd.html.

U.S. EPA (2002) Air Quality Criteria for Particulate Matter - Volumes I and II (Third External Review Draft) This material is available electronically at http://cfpub.epa.gov/ncea/cfm/partmatt.cfm.

effects information related to diesel exhaust as a whole including diesel PM, which is one component of ambient PM.[8]

Health effects associated with ambient $PM_{2.5}$ include premature mortality, aggravation of respiratory and cardiovascular disease (as indicated by increased hospital admissions and emergency room visits, school absences, work loss days, and restricted activity days), aggravated asthma, and acute respiratory symptoms. Both the Harvard Six Cities Study and the American Cancer Society Study suggest an association between exposure to ambient PM and premature mortality, including deaths attributed to lung cancer.[9,10] Two studies further analyzing the Harvard Six Cities Study's air quality data have also established a specific influence of mobile source-related $PM_{2.5}$ on daily mortality[11] and a concentration-response function for mobile source-associated $PM_{2.5}$ and daily mortality.[12] Another recent study in 14 U.S. cities examining the effect of PM_{10} on daily hospital admissions for cardiovascular disease found that the effect of PM_{10} was significantly greater in areas with a larger proportion of PM_{10} coming from motor vehicles, indicating that PM_{10} from these sources may have a greater effect on the toxicity of ambient PM_{10} when compared with other sources.[13] Additional studies have associated changes in heart rate and/or heart rhythm in addition to changes in blood characteristics with exposure to ambient PM.[14,15] For additional information on health effects, see the draft RIA.

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[8] 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.

[9] 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.

[10] Pope, CA, III; Thun, MJ; Namboordiri, MM; et al. (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.

[11] Laden F; Neas LM; Dockery DW; et al. (2000) Association of fine particulate matter from different sources with daily mortality in six U.S. cities. Environ Health Perspect 108(10):941-947.

[12] Schwartz J; Laden F; Zanobetti A. (2002) The concentration-response relation between PM(2.5) and daily deaths. Environ Health Perspect 110(10): 1025-1029.

[13] Janssen NA; Schwartz J; Zanobetti A.; et al. (2002) Air conditioning and source-specific particles as modifiers of the effect of PM_{10} on hospital admissions for heart and lung disease. Environ Health Perspect 110(1):43-49.

[14] Pope CA III, Verrier RL, Lovett EG; et al. (1999) Heart rate variability associated with particulate air pollution. Am Heart J 138(5 Pt 1):890-899.

[15] Magari SR, Hauser R, Schwartz J; et al. (2001) Association of heart rate variability with occupational and environmental exposure to particulate air pollution. Circulation 104(9):986-991.

The health effects of PM_{10} are similar to those of $PM_{2.5}$, since PM_{10} includes all of $PM_{2.5}$ plus the coarse fraction from 2.5 to 10 micrometers in size. EPA is also evaluating the health effects of PM between 2.5 and 10 micrometers in the draft revised Criteria Document. As discussed in the Diesel HAD and other studies, most diesel PM is smaller than 2.5 micrometers[16]. Both fine and coarse fraction particles can enter and deposit in the respiratory system.

In addition to the information in the draft revised Criteria Document, the relevance of health effects associated with on-road diesel engine-generated PM to nonroad applications is supported by the observation in the Diesel HAD that the particulate characteristics in the zone around nonroad diesel engines is likely to be substantially the same as published air quality measurements made along busy roadways.

Of particular relevance to this rule is a recent cohort study which examined the association between mortality and residential proximity to major roads in the Netherlands. Examining a cohort of 55 to 69 year-olds from 1986 to1994, the study indicated that long-term residence near major roads, an index of exposure to primary mobile source emissions (including diesel exhaust), was significantly associated with increased cardiopulmonary mortality.[17] Several epidemiologic models show that cardiopulmonary mortality was associated with living near a major road with heavy vehicle traffic including diesel trucks. Black smoke, an index associated with elemental carbon and frequently used in European studies, was found to be associated with cardiopulmonary mortality in some models. Other studies have shown children living near roads with high truck traffic density have decreased lung function and greater prevalence of lower respiratory symptoms compared to children living on other roads.[18] A recent review of epidemiologic studies examining associations between asthma and roadway proximity concluded that some coherence was evident in the literature, indicating that asthma, lung function decrement, respiratory symptoms, and atopic illness appear to be higher among people living near busy roads.[19] As discussed later, nonroad diesel engine emissions, especially particulate, are similar in composition to those from highway diesel vehicles. Although difficult to associate directly with $PM_{2.5}$, these studies indicate that direct emissions from mobile sources and diesel engines, specifically, may explain a portion of respiratory health effects observed in larger-scale

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[16] U.S. EPA (1985) Size specific total particulate emission factor for mobile sources. EPA 460/3-85-005. Office of Mobile Sources, Ann Arbor, MI.

[17] Hoek, G; Brunekreef, B; Goldbohm, S; et al. (2002) Association between mortality and indicators of traffic-related air pollution in the Netherlands: a cohort study. Lancet 360(9341):1203-1209.

[18] Brunekreef, B; Janssen NA; de Hartog, J; et al. (1997) Air pollution from traffic and lung function in children living near motor ways. Epidemiology (8): 298-303.

[19] Delfino RJ. (2002) Epidemiologic evidence for asthma and exposure to air toxics: linkages between occupational, indoor, and community air pollution research. Env Health Perspect Suppl 110(4): 573-589.

epidemiologic studies. Recent studies conducted in Los Angeles have illustrated that a substantial increase in the concentration of ultrafine particles is evident in locations near roadways, indicating substantial differences in the nature of PM immediately near mobile source emissions.[20]

Also, as discussed in more detail later, in addition to its contribution to ambient PM inventories, diesel PM is of special concern because diesel exhaust has been associated with an increased risk of lung cancer. As also discussed later in more detail, we concluded that diesel exhaust ranks with other substances that the national-scale air toxics assessment suggests pose the greatest relative risk.

b. Current and Projected Levels

There are NAAQS for both PM_{10} and $PM_{2.5}$. Violations of the annual $PM_{2.5}$ standard are much more widespread than are violations of the PM_{10} standards. Emission reductions needed to attain the $PM_{2.5}$ standards will also assist in attaining and maintaining compliance with the PM_{10} standards. Thus, since most PM emitted by diesel nonroad engines is fine PM, the emission controls proposed today should contribute to attainment and maintenance of the existing PM NAAQS. More broadly, the proposed standards will benefit public health and welfare through reductions in direct diesel PM and reductions of NOx, SOx, and NMHCs which contribute to secondary formation of PM.

i. PM_{10} Levels

The reductions from today's proposed rules will assist States as they implement local controls, including the development and adoption of additional controls as needed to help their areas attain and maintain the standards.

The current NAAQS for PM_{10} were established in 1987. The primary (health-based) and secondary (public welfare based) standards for PM_{10} include both short- and long-term NAAQS. The short-term (24 hour) standard of 150 ug/m^3 is not to be exceeded more than once per year on average over three years. The long-term standard specifies an expected annual arithmetic mean not to exceed 50 ug/m^3 averaged over three years.

Currently, 29 million people live in PM_{10} nonattainment areas. There are currently 58 moderate PM_{10} nonattainment areas with a total population of 6.8 million. The attainment date for the initial moderate PM_{10} nonattainment areas, designated by operation of law on November

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[20] Yifang Zhu, William C. Hinds, Seongheon Kim, Si Shen and Constantinos Sioutas
Zhu Y; Hinds WC; Kim S; et al. (2002) Study of ultrafine particles near a major highway with heavy-duty diesel traffic. Atmos Environ 36(27): 4323-4335.

15, 1990, was December 31, 1994. Several additional PM_{10} nonattainment areas were designated on January 21, 1994, and the attainment date for these areas was December 31, 2000. There are an additional 8 serious PM_{10} nonattainment areas with a total affected population of 22.7 million. According to the Act, serious PM_{10} nonattainment areas must attain the standards no later than 10 years after designation. The initial serious PM_{10} nonattainment areas were designated January 18, 1994 and had an attainment date set by the Act of December 31, 2001. The Act provides that EPA may grant extensions of the serious area attainment dates of up to 5 years, provided that the area requesting the extension meets the requirements of Section 188(e) of the Act. Two serious PM_{10} nonattainment areas (Phoenix, Arizona and Owens Valley, California) have received extensions of the December 31, 2001 attainment date and thus have new attainment dates of December 31, 2006.[21] While all of these areas are expected to be in attainment before the emission reductions from this proposed rule are expected to occur, these reductions will be important to assist these areas in maintaining the standards.

ii. $PM_{2.5}$ Levels

The need for reductions in the levels of $PM_{2.5}$ is widespread. Figure II-1 at the beginning of this air quality section highlighted monitor locations measuring concentrations above the level of the NAAQS. As can be seen from that figure, high ambient levels are widespread throughout the country.

The NAAQS for $PM_{2.5}$ were established by EPA in 1997 (62 Fed. Reg., 38651, July 18, 1997). The short term (24-hour) standard is set at a level of 65 $\mu g/m^3$ 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 long-term standard specifies an expected annual arithmetic mean not to exceed 15 ug/m^3 averaged over three years.

Current $PM_{2.5}$ monitored values for 1999-2001, which cover counties having about 75 percent of the country’s population, indicate that at least 65 million people in 129 counties live in areas where annual design values of ambient fine PM violate the $PM_{2.5}$ NAAQS. There are an additional 9 million people in 20 counties where levels above the NAAQS are being measured, but there are insufficient data at this time to calculate a design value in accordance with the standard, and thus determine whether these areas are violating the $PM_{2.5}$ NAAQS. In total, this represents 37 percent of the counties and 64 percent of the population in the areas with monitors with levels above the NAAQS. Furthermore, an additional 14 million people live in 41 counties that have air quality measurements within 10 percent of the level of the standard. These areas, although not currently violating the standard, will also benefit from the additional reductions

[21] EPA has proposed to grant extensions of the attainment date to three additional areas: Coachella Valley, California, South Coast (Los Angeles), California; and Las Vegas, Nevada. If approved, these areas would also be required to come into attainment by December 31, 2006.

from this rule in order to ensure long term maintenance.

Our air quality modeling performed for this proposal also indicates that similar conditions are likely to continue to exist in the future in the absence of additional controls. For example, in 2020 based on emission controls currently adopted, we project that 66 million people will live in 79 counties with average $PM_{2.5}$ levels above 15 ug/m^3. In 2030, the number of people projected to live in areas exceeding the $PM_{2.5}$ standard is expected to increase to 85 million in 107 counties. An additional 24 million people are projected to live in counties within 10 percent of the standard in 2020, which will increase to 64 million people in 2030.

Our modeling also indicates that the reductions we are expecting will make a substantial contribution to reducing exposures in these areas.[22] In 2020, the number of people living in counties with $PM_{2.5}$ levels above the NAAQS would be reduced from 66 million to 60 million living in 67 counties, which reflects a reduction of 9 percent in potentially exposed population and 15 percent of the number of counties. In 2030, there would be a reduction from 85 million people to 71 million living in 84 counties. These represent even greater improvements than projected for 2020 (numbers of people potentially exposed down 16 percent and number of counties down 21 percent). Furthermore, our modeling also shows that the emission reductions would assist areas with future maintenance of the standards.

We estimate that the reduction of this proposed rule would produce nationwide air quality improvements in PM levels. On a population weighted basis, the average change in future year annual averages would be a decrease of 0.33 ug/m^3 in 2020, and 0.46 ug/m^3 in 2030. The reductions are discussed in more detail in Chapter 2 of the draft RIA.

While the final implementation process for bringing the nation's air into attainment with the $PM_{2.5}$ NAAQS is still being completed in a separate rulemaking action, the basic framework is well defined by the statute. EPA's current plans call for designating $PM_{2.5}$ nonattainment areas in late-2004. Following designation, Section 172(b) of the Clean Air Act allows states up to three years to submit a revision to their state implementation plan (SIP) that provides for the attainment of the $PM_{2.5}$ standard. Based on this provision, states could submit these SIPs as late as the end of 2007. Section 172(a)(2) of the Clean Air Act requires that these SIP revisions demonstrate that the nonattainment areas will attain the $PM_{2.5}$ standard as expeditiously as practicable but no later than five years from the date that the area was designated nonattainment. However, based on the severity of the air quality problem and the availability and feasibility of control measures, the Administrator may extend the attainment date "for a period of no greater than 10 years from the date of designation as nonattainment." Therefore, based on this

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[22] The results illustrate the type of PM changes for the preliminary control option, as discussed in the Draft RIA in Section 3.7. The proposal differs from the modeled control case based on updated information; however, we believe that the net results would approximate future emissions, although we anticipate the PM reductions might be slightly smaller.

information, we expect that most or all areas will need to attain the $PM_{2.5}$ NAAQS in the 2009 to 2014 time frame, and then be required to maintain the NAAQS thereafter.

Since the emission reductions expected from today's proposal would begin in this same time frame, the projected reductions in nonroad emissions would be used by states in meeting the $PM_{2.5}$ NAAQS. States and state organizations have told EPA that they need nonroad diesel engine reductions in order to be able to meet and maintain the $PM_{2.5}$ NAAQS as well as visibility regulations, especially in light of the otherwise increasing emissions from nonroad sources without more stringent standards. [23, 24, 25] Furthermore, this action would ensure that nonroad diesel emissions will continue to decrease as the fleet turns over in the years beyond 2014; these reductions will be important for maintenance of the NAAQS following attainment. The future reductions are also important to achieve visibility goals, as discussed later.

2. Air Toxics

a. Diesel exhaust

A number of health studies have been done on diesel exhaust, including epidemiologic studies of lung cancer in groups of workers and animal studies focusing on non-cancer effects specific to diesel exhaust. Diesel exhaust PM (including the associated organic compounds which are generally high molecular weight hydrocarbon types but not the more volatile gaseous hydrocarbon compounds) is generally used as a surrogate measure for diesel exhaust.

i. Potential Cancer Effects of Diesel Exhaust

In addition to its contribution to ambient PM inventories, diesel exhaust is of specific concern because it has been judged to pose a lung cancer hazard for humans as well as a hazard from noncancer respiratory effects.

EPA recently released its "Health Assessment Document for Diesel Engine Exhaust,"

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[23] CARB and New York State Department of Environmental Conservation (April 9, 2002), Letter to EPA Administrator Christine Todd Whitman.

[24] State and Territorial Air Pollution Program Administrators (STAPPA) and Association of Local Air Pollution Control Officials (ALAPCO) (December 17, 2002), Letter to EPA Assistant Administrator Jeffrey R. Holmstead.

[25] Western Regional Air Partnership (WRAP) January 28, 2003), Letter to Governor Christine Todd Whitman.

(the Diesel HAD).[26] There, 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 US Department of Health and Human Services) have made similar classifications. It should be noted that the conclusions in the Diesel HAD were based on diesel engines currently in use, including nonroad diesel engines such as those found in bulldozers, graders, excavators, farm tractor drivers and heavy construction equipment. As new diesel engines with significantly cleaner exhaust emissions replace existing engines, the conclusions of the Diesel HAD will need to be reevaluated.

For the Diesel HAD, EPA reviewed 22 epidemiologic studies in detail. Increased lung cancer risk was evident in 8 out of 10 cohort studies and 10 out of 12 case-control studies. Increases in relative risk for lung cancer generally ranged from 1.2 to 1.5 compared to the control group of workers. Expected rates with one study showed relative risks as high as 2.6. In addition, other investigators pooled numerous epidemiologic studies to calculate a pooled relative risk. One such study pooled together results from 23 diesel epidemiologic studies which met criteria for inclusion in the pooled analysis. The overall analysis showed a relative risk of 1.33. Another pooled analysis examined 30 epidemiologic studies and reported a relative risk of 1.47. That is, these two studies show an overall increase in lung cancer for the exposed groups of 33 percent and 47 percent compared to the groups not exposed to diesel exhaust. In the Diesel HAD, EPA selected 1.4 as a reasonable estimate of relative risk for exploratory analysis of possible risk ranges in the population.

EPA generally derives cancer unit risk estimates to calculate population risk more precisely from exposure to carcinogens. In the simplest terms, the cancer unit risk is the increased risk associated with average lifetime exposure of 1 ug/m^3. EPA 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 lack of an adequate dose-response relationship between exposure and cancer incidence.

However, in the absence of a cancer unit risk, the Diesel HAD sought to provide additional insight into the possible ranges of risk that might be present in the population. Such insights, while not confident or definitive, nevertheless contribute to an understanding of the possible public health significance of the lung cancer hazard. The possible risk range analysis was developed by comparing the environmental exposure levels to the occupational exposure levels and then scaling the occupationally observed risks to environmentally based risks based on

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[26] 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.

the ratios of exposure. If the two exposures are similar, the environmental risk would approach the risk seen in the occupational studies. A comparison of environmental and occupational exposures showed that for certain occupations the exposures are similar to environmental exposures while, for others, they differ by a factor of about 200 or more.

A fundamental step in this process is to note that the occupational relative risk of 1.4, or a 40 percent increased risk compared to the typical 5 percent lung cancer risk in the U.S. population, translates to an increased risk of 2 percent (or 10^{-2}) for these workers. The Diesel HAD derived a typical nationwide average environmental exposure level of 0.8 ug./m^3 for diesel PM from on-road sources for 1996. The Diesel HAD occupational exposures, after accounting for differences in the modes and duration of exposure, range from about 25 to almost 200 times environmental exposure. For purposes of sensitivity analysis, EPA then doubled the high estimate of 200 ug/m^3 to about 400 ug/m^3. After scaling the occupational risk of 2% to account for differences in environmental and occupational exposure, the resulting environmental risk would range from about 10^{-3} to 10^{-5}. Risk levels of this magnitude are of regulatory concern to EPA.

Also, as discussed in the Diesel HAD, there is a relatively small difference between some occupational settings where increased lung cancer risk is reported and ambient environmental exposures. The potential for small exposure differences underscores the concern that some degree of occupational risk may also be present in the environmental setting and that extrapolation of occupational risk to ambient environmental exposure levels is reasonable and appropriate.

While these risk estimates are exploratory and not intended to provide a definitive characterization of cancer risk, they are useful in gauging the possible range of risk based on reasonable judgement. It is important to note that the possible risks could also be higher or lower and a zero risk cannot be ruled out. Some individuals in the population may have a high tolerance to exposure from diesel PM and thus a low cancer susceptibility. Also, one cannot rule out the possibility of a threshold of exposure below which there is no cancer risk, although evidence has not been seen or substantiated on this point. The Diesel HAD states that its conclusions apply to diesel exhaust from on-road and nonroad engines. However, the Diesel HAD does caution that these conclusions will need to be reevaluated, for example, as newer on-road diesels meeting strict emission standards replace those diesels currently in the fleet.

EPA also recently completed an assessment of air toxic emissions (the National-Scale Air Toxics Assessment or NATA) and their associated risk, and we concluded that diesel exhaust ranks with other substances that the national-scale assessment suggests pose the greatest relative risk.[27] This assessment estimates average population inhalation exposures to diesel PM in 1996 for nonroad as well as on-road sources. These are the sum of ambient levels in various locations weighted by the amount of time people spend in each of the locations. This analysis shows a somewhat higher diesel exposure level than the 0.8 ug/m^3 used to develop the risk perspective in the Diesel HAD. The NATA levels are 1.4 ug/m^3 total with an on-road source contribution of 0.5 ug/m^3 to average nationwide exposure in 1996 and a nonroad source contribution of 0.9 ug/m^3. The average urban exposure concentration was 1.6 ug/m^3 and the average rural concentration was 0.55 ug/m^3. In five percent of urban census tracts across the United States, average concentrations were above 4.3 ug/m^3. The Diesel HAD states that use of the NATA exposure number results instead of the 0.8 ug/m^3 results in a similar risk perspective.

In 2001, EPA completed a rulemaking on mobile source air toxics with a determination that diesel particulate matter and diesel exhaust organic gases be identified as a Mobile Source Air Toxic (MSAT).[28] This determination was based on a draft of the Diesel HAD on which the Clean Air Scientific Advisory Committee of the Science Advisory Board had reached closure. The purpose of the MSAT list is to provide a screening tool that identifies compounds emitted from motor vehicles or their fuels for which further evaluation of emissions controls is appropriate.

In summary, even though EPA does not have a specific carcinogenic potency with which to accurately estimate the carcinogenic impact of diesel PM, the likely hazard to humans at environmental exposure levels leads us to conclude that diesel exhaust emissions of PM and organic gases should be reduced from nonroad engines in order to protect public health.

ii. Other Health Effects of Diesel Exhaust

The acute and chronic exposure-related effects of diesel exhaust emissions are also of concern to the Agency. The Diesel HAD established an inhalation Reference Concentration (RfC) specifically based on animal studies of diesel exhaust. An RfC is defined by EPA as "an estimate of a continuous inhalation exposure to the human population, including sensitive subgroups, with uncertainty spanning perhaps an order of magnitude, that is likely to be without appreciable risks of deleterious noncancer effects during a lifetime." EPA derived the RfC from consideration of four well-conducted chronic rat inhalation studies showing adverse pulmonary effects. The diesel RfC is based on a "no observable adverse effect" level of 144 ug/m^3 that is further reduced by applying uncertainty factors of 3 for interspecies extrapolation and 10 for human variations in sensitivity. The resulting RfC derived in the Diesel HAD is 5 ug/m^3 for

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[27] U.S. EPA (2002), National-Scale Air Toxics Assessment. This material is available electronically at http://www.epa.gov/ttn/atw/nata/

[28] U.S. EPA (2001) Control of Emissions of Hazardous Air Pollutants from Mobile Sources; Final Rule. 66 FR at 17230 – 17273 (March 29, 2001).

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 that diesel exhaust can exacerbate these effects, but the exposure-response data is presently lacking to derive an RfC. Again, this RfC is based on animal studies and is meant to estimate exposure that is unlikely to have deleterious effects on humans based on those studies alone.

The Diesel HAD also briefly summarizes health effects associated with ambient PM and the EPA's annual NAAQS for $PM_{2.5}$ of 15 ug/m^3. 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 RfC is not meant to say that 5 ug/m^3 provides adequate public health protection or that there is no need to reduce diesel PM below 5 ug/m^3 with resultant reductions in ambient PM. In fact, there are benefits to reducing diesel PM below 5 ug/m^3 since diesel PM is a major contributor to ambient $PM_{2.5}$. Furthermore, recent epidemiologic studies of ambient $PM_{2.5}$ do not indicate a threshold of effects at low concentrations. [29]

Also, as mentioned earlier in the health effects discussion for $PM_{2.5}$, there are a number of other health effects associated with PM in general, and motor vehicle exhaust including diesels in particular, that provide additional evidence for the need for significant emission reductions from nonroad diesel sources. For example, the Diesel HAD notes that acute or short-term exposure to diesel exhaust can cause acute irritation (e.g., eye, throat, bronchial), neurophysiological symptoms (e.g., lightheadedness, nausea), and respiratory symptoms (e.g., cough, phlegm). There is also evidence for an immunologic effect such as the exacerbation of allergenic responses to know allergens and asthma-like symptoms. All of these health effects plus the designation of diesel exhaust as a likely human carcinogen provide ample health justification for control.

iii. Ambient levels and exposure to diesel exhaust PM

Because diesel PM is part of overall ambient PM and cannot be easily distinguished from overall PM, we do not have direct measurements of diesel PM in the ambient air. Ambient diesel PM concentrations are estimated instead using one of three approaches: 1) ambient air quality modeling based on diesel PM emission inventories; 2) using elemental carbon concentrations in monitored data as surrogates; or 3) using the chemical mass balance (CMB) model in conjunction with ambient PM measurements. (Also, in addition to CMB, UNMIX/PMF have also been used). Estimates using these three approaches are described below. In addition, estimates developed using the first two approaches above are subjected to a statistical comparison to evaluate overall reasonableness of estimated concentrations. It is important to

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[29] EPA-SAB-Council-ADV-99-012, 1999. The Clean Air Act Amendments Section 812 Propsoective Study of Costs and Benefits (1999): Advisory by the Health and Ecological Effects Subcommittee on Initial Assessments of Health and Ecological Effects, Part 1. July 28, 1999.

note that, while there are inconsistencies in some of these studies on the relative importance of gasoline and diesel PM, the studies which are discussed in the Diesel HAD all show that diesel PM is a significant contributor to overall ambient PM. Some of the studies differentiate nonroad from on-road diesel PM.

(1) Air Quality Modeling

In addition to the general ambient PM modeling conducted for this proposal, diesel PM concentrations specifically were recently estimated for 1996 as part of NATA. In this assessment, the PM inventory developed for the recent regulation promulgating 2007 heavy duty vehicle standards was used. Note that the nonroad inventory used in this modeling was based on an older version of the draft NONROAD Model which showed higher diesel PM than the current version. Ambient impacts of mobile source emissions were predicted using the Assessment System for Population Exposure Nationwide (ASPEN) dispersion model. Overall mean annual national levels for both on-road and nonroad diesels of 2.06 ug/m^3 diesel PM were calculated with a mean of 2.41 in urban counties and 0.74 in rural counties. These are ambient levels such as would be seen at monitors rather than the exposure levels discussed earlier. Over half of the diesel PM comes from nonroad diesels.

Diesel PM concentrations were also recently modeled across a representative urban area, Houston, for 1996, using the Industrial Source Complex Short Term (ISCST3) model. This modeling is designed to more specifically account for local traffic patterns including diesel truck traffic along specific roadways. The modeling in Houston suggests strong spatial gradients for Diesel PM and indicates that "hotspot" concentrations can be very high, up to 8 ug/m^3 at receptor versus a 3 ug/m^3 average in Houston. Such concentrations are above the RfC for diesel exhaust and indicate a potential for adverse health effects from chronic exposure to diesel PM. These results also suggest that PM from diesel vehicles makes a major contribution to total ambient PM concentrations. Such "hot spot" concentrations along certain roadways suggest the presence of both high localized exposures plus higher estimated average annual exposure levels for urban centers than what has been estimated in assessments such as NATA, which are designed to focus on regional and national scale averages. There are similar "hot spot" concentrations in the immediate vicinity of use of nonroad equipment such as in urban construction sites.

(2) Elemental Carbon Measurements

As mentioned before, the carbonaceous component is significant in ambient PM. The carbonaceous component consists of organic carbon and elemental carbon. Monitoring data on elemental carbon concentrations can be used as a surrogate to determine ambient diesel PM concentrations. Elemental carbon is a major component of diesel exhaust, contributing to approximately 60 to 80 percent of diesel particulate mass, depending on engine technology, fuel type, duty cycle, lube oil consumption, and state of engine maintenance. In most areas, diesel engine emissions are major contributors to elemental carbon in the ambient air, with other potential sources including gasoline exhaust, combustion of coal, oil, or wood (including forest fires), charbroiling, cigarette smoke, and road dust. Because of the large portion of elemental carbon in diesel particulate matter, and the fact that diesel exhaust is one of the major contributors to elemental carbon in most areas, ambient diesel PM concentrations can be bounded using elemental carbon measurements.

The measured mass of elemental carbon at a given site varies depending on the measurement technique used. Moreover, to estimate diesel PM concentration based on elemental carbon level, one must first estimate the percentage of PM attributable to diesel engines and the percentage of elemental carbon in diesel PM. Thus, there are significant uncertainties in estimating diesel PM concentrations using an elemental carbon surrogate. Depending on the measurement technique used, and assumptions made, average nationwide concentrations for current years of diesel PM estimated from elemental carbon data range from about 1.2 to 2.2 ug/m^3. EPA has compared these estimates based on elemental carbon measurements to modeled concentrations in NATA and concluded that the two sets of data agree reasonably well. This performance compares favorably with the model to monitor results for other pollutants assessed in NATA, with the exception of benzene, for which the performance of the NATA modeling was better. These comparisons are discussed in greater detail in the draft RIA.

(3) Chemical Mass Balance

The third approach for estimating ambient diesel PM concentrations uses the CMB model for source apportionment in conjunction with ambient PM measurements and chemical source "fingerprints" to estimate ambient diesel PM concentrations. The CMB model uses a statistical fitting technique to determine how much mass from each source would be required to reproduce the chemical fingerprint of each speciated ambient monitor. This source apportionment technique presently does not distinguish between on-road and nonroad but, instead, gives diesel PM as a whole. This source apportionment technique can though distinguish between diesel and gasoline PM. Caution in interpreting CMB results is warranted, as the use of fitting species that are not specific to the sources modeled can lead to misestimation of source contributions. Ambient concentrations using this approach are generally about 1 ug/m^3 annual average. UNMIX/PMF models show similar results. Results from various studies are discussed in the draft RIA.

iv. Diesel Exhaust 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 (such as particulate) in those locations. The major difference between ambient levels of diesel particulate and exposure levels for diesel particulate exposure accounts for a person moving from location to location while ambient levels are specific for a particular location.

(1) Occupational Exposures

Diesel particulate exposures have been measured for a number of occupational groups over various years but generally for more recent years (1980s and later) rather than earlier years. Occupational exposures had a wide range varying from 2 to 1,280 ug/m^3 for a variety of occupational groups including miners, railroad workers, firefighters, air port crew, public transit workers, truck mechanics, utility linemen, utility winch truck operators, fork lift operators, construction workers, truck dock workers, short-haul truck drivers, and long-haul truck drivers. These individual studies are discussed in the Diesel HAD. 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 equipment.

Many measured or estimated occupational exposures are for on-road diesel engines although some (especially the higher ones) are for occupational groups (e.g., fork lift operators, construction workers, or mine workers) who would be exposed to nonroad diesel exhaust. Sometimes, as is the case for the nonroad engines, there are only estimates of exposure based on the length of employment or similar factors rather than a ug/m^3 level. Estimates for exposures to diesel PM for diesel fork lift operators have been made that range from 7 to 403 ug/m^3 as reported in the Diesel HAD. In addition, the Northeast States for Coordinated Air Use Management (NESCAUM) is presently measuring occupational exposures to particulate and elemental carbon near the operation of various diesel non-road equipment. Exposure groups include agricultural farm operators, grounds maintenance personnel (lawn and garden equipment), heavy equipment operators conducting multiple job tasks at a construction site, and a saw mill crew at a lumber yard. Samples will be obtained in the breathing zone of workers. Some initial results are expected in late 2003.

(2) General Ambient Exposures

There are presently no individual exposure data based on people carrying PM monitors that can differentiate diesel from other PM in their daily activities. Thus, we use modeling to estimate exposures. Specifically, exposures for the general population are estimated by first conducting dispersion modeling of both on-road and non-road diesel emissions, described above, and then by conducting exposure modeling. The most comprehensive modeling for cumulative exposures to diesel PM is the NATA. This assessment calculates exposures of the national population as a whole to a variety of air toxics, including diesel PM. As discussed previously, the ambient levels are calculated using the ASPEN dispersion model. The preponderance of modeled diesel PM concentrations are within a factor of 2 of diesel PM concentrations estimated from elemental carbon measurements.[30] This comparison adds credence to the modeled ASPEN

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[30] EPA. 2002. Diesel PM model-to-measurement comparison. Prepared by ICF Consulting for EPA, Office of Transportation and Air Quality. Report No. EPA420-D-02-004.

results and associated exposure assessment.

The modeled ambient concentrations are used as inputs into the Hazardous Air Pollution Exposure Model (HAPEM4) to calculate exposure levels. Average exposures calculated nationwide are 1.44 ug/m^3 with levels of 1.64 ug/m^3 for urban counties and 0.55 ug/m^3 for rural counties. Again, nonroad diesels account for over half of the this modeled exposure.

(3) Ambient Exposures - Microenvironments

One common microenvironment for diesel exposure is beside freeways. Although freeway locations are associated mostly with on-road rather than nonroad diesels, there are many similarities between on-road and nonroad diesel emissions as discussed in the Diesel HAD. The California Air Resources Board (CARB) measured elemental carbon near the Long Beach Freeway in 1993. Levels measured ranged from 0.4 to 4.0 ug/m^3 (with one value as high as 7.5 ug/m^3) above background levels. Microenvironments associated with nonroad engines would include construction zones. PM and elemental carbon samples are being collected by NESCAUM in the immediate area of the nonroad engine operations (such as at the edge or fence line of the construction zone). Besides PM and elemental carbon levels, various toxics such as benzene, 1,3-butadiene, formaldehyde, and acetaldehyde will be sampled. Some initial results should be available in late 2003 and will be especially useful since they focus on those microenvironements affected by nonroad diesels.

Also, EPA is funding research in Fresno to measure indoor and outdoor PM component concentrations in the homes of over 100 asthmatic children. Some of these homes are located near agricultural, construction, and utility nonroad equipment operations. This work will measure infiltration of elemental carbon and other PM components to indoor environments. The project also evaluates lung function changes in the asthmatic children during fluctuations in exposure concentrations and compositions. This information may allow an evaluation of adverse health effects associated with exposures to elemental carbon and other PM components from on-road and nonroad sources. Some initial results may be available in late 2003.

b. Gaseous air toxics

In addition, nonroad diesel engine emissions contain several substances that are known or suspected human or animal carcinogens, or have serious noncancer health effects. Most of these compounds cause cancers other than lung cancers so their effects were not noted in the epidemiology studies on diesel exhaust which found increased lung cancer incidents. These other compounds include benzene,1,3-butadiene, formaldehyde, acetaldehyde, acrolein, dioxin, and polycyclic organic matter (POM). For some of these pollutants, nonroad diesel engine emissions are believed to account for a significant proportion of total nation-wide emissions. All of these compounds were identified as national or regional “risk” drivers in the 1996 NATA. That is, these compounds pose a significant portion of the total inhalation cancer risk to a significant portion of the population. Mobile sources contribute significantly to total emissions of these air toxics. As discussed later in this section, this proposed rulemaking will result in significant reductions of these emissions.

Benzene**:** Nonroad diesel engines account for about 3 percent of ambient benzene emissions in 1996. Of ambient benzene levels due to mobile sources, 5 percent in urban and 3 percent in rural areas come from nonroad diesel.

The EPA has recently reconfirmed that benzene is a known human carcinogen by all routes of exposure (including leukemia at high, prolonged air exposures), and is associated with additional health effects including genetic changes in humans and animals and increased proliferation of bone marrow cells in mice.[31, 32, 33] EPA believes that the data indicate a causal relationship between benzene exposure and acute lymphocytic leukemia and suggest a relationship between benzene exposure and chronic non-lymphocytic leukemia and chronic lymphocytic leukemia. Respiration is the major source of human exposure and at least half of this exposure is attributable to gasoline vapors and automotive emissions. A number of adverse noncancer health effects including blood disorders, such as preleukemia and aplastic anemia, have also been associated with low-dose, long-term exposure to benzene.

1,3-Butadiene: Nonroad diesel engines account for about 1.5 percent of ambient butadiene emissions in 1996. Of ambient butadiene levels due to mobile sources, 4 percent in urban and 2 percent in rural areas come from nonroad diesel.

EPA earlier identified 1,3-butadiene as a probable human carcinogen and recently redesignated it as a known human carcinogen (but with a lower carcinogenic potency than previously used).[34] 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; nevertheless, there are insufficient data from which to draw any

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[31] 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.

[32] Irons, R.D., W.S. Stillman, D.B. Colagiovanni, and V.A. Henry, 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, 1992.

[33] Environmental Protection Agency, Carcinogenic Effects of Benzene: An Update, National Center for Environmental Assessment, Washington, DC. 1998.

[34] 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. EPA/600/P-98/001F.

conclusions on potentially 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.

Formaldehyde: Nonroad diesel engines account for about 22 percent of ambient formaldehyde emissions in 1996. Of ambient formaldehyde levels due to mobile sources, 37 percent in urban and 27 percent in rural areas come form nonroad diesel. These figures are for tailpipe emissions of formaldehyde. Formaldehyde in the ambient air comes not only from tailpipe (of direct) emissions but is also formed from photochemical reactions of hydrocarbons.

EPA has classified formaldehyde as a probable human carcinogen based on evidence in humans and in rats, mice, hamsters, and monkeys.[35] Epidemiological studies in occupationally exposed workers suggest that long-term inhalation of formaldehyde may be associated with tumors of the nasopharyngeal cavity (generally the area at the back of the mouth near the nose), nasal cavity, and sinus. 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. Sensitive individuals may experience these adverse effects at lower concentrations than the general population and in persons with bronchial asthma, the upper respiratory irritation caused by formaldehyde can precipitate an acute asthmatic attack. The agency is currently conducting a reassessment of risk from inhalation exposure to formaldehyde.

Acetaldehyde: Nonroad diesel engines account for about 34 percent of acetaldehyde emissions in 1996. Of ambient acetaldehyde levels due to mobile sources, 24 percent in urban and 17 percent in rural areas come form nonroad diesel. Also, acetaldehyde can be formed photochemically in the atmosphere. Counting both direct emissions and photochemically formed acetaldehyde, mobile sources are responsible for the major portion of acetaldehyde in the ambient air according to the National-Scale Air Toxics Assessment for 1996.

Acetaldehyde is classified as a probable human carcinogen and is considered moderately toxic by the inhalation, oral, and intravenous routes. The primary acute effect of exposure to acetaldehyde vapors is irritation of the eyes, skin, and respiratory tract. At high concentrations, irritation and pulmonary effects can occur, which could facilitate the uptake of other contaminants. The agency is currently conducting a reassessment of risk from inhalation exposure to acetaldehyde.[36]

Acrolein: Nonroad diesel engines account for about 17.5 percent of acrolein emissions

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[35] Environmental Protection Agency, Assessment of Health Risks to Garment Workers and Certain Home Residents from Exposure to Formaldehyde, Office of Pesticides and Toxic Substances, April 1987.

[36] U.S. EPA (1991) Environmental Protection Agency, Integrated Risk Information System (IRIS), National Center for Environmental Assessment, Cincinnati, OH.

in 1996. Of ambient acrolein levels due to mobile sources, 28 percent in urban and 18 percent in rural areas come form nonroad diesel.

Acrolein is extremely toxic to humans when inhaled, with acute exposure resulting in upper respiratory tract irritation and congestion. The Agency has developed a reference concentration for inhalation (RfC) of acrolein of 0.02 micrograms/m^3.[37] Although no information is available on its carcinogenic effects in humans, based on laboratory animal data, EPA considers acrolein a possible human carcinogen.

Polycyclic Organic Matter (POM): POM is generally defined as a large class of chemicals consisting of organic compounds having multiple benzene rings and a boiling point greater than 100 degrees C. Polycyclic aromatic hydrocarbons (PAHs) are a chemical class that is a subset of POM. POM are naturally occurring substances that are byproducts of the incomplete combustion of fossil fuels and plant and animal biomass (e.g., forest fires). They occur as byproducts from steel and coke productions and waste incineration. They also are a component of diesel particulate emissions. 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. In particular, EPA frequently obtains data on 7 of the POM compounds, which we analyzed separately as a class in the 1996 NATA. Nonroad diesel engines account for less than 1 percent of these 7 POM compounds with total mobile sources responsible for only 4 percent of the total; most of the 7 POMs come from area sources. For total POM compounds, mobile sources as a whole are responsible for only 1 percent. The mobile source emission numbers used to derive these inventories are based on only particulate phase POM and do not include the semi-volatile phase POM levels. Were those additional POMs included (which is now being done), these inventory numbers would be substantially higher.

Even though mobile sources are responsible for only a small portion of total POM emissions, the particulate reductions from today's action will reduce these emissions.

Dioxins: Recent studies have confirmed that dioxins are formed by and emitted from diesels (both heavy-duty diesel trucks and non-road diesels although in very small amounts) and are estimated to account for about 1 percent of total dioxin emissions in 1995. Recently EPA has proposed, and the Scientific Advisory Board has concurred, to classify one dioxin compound, 2,3,7,8-tetrachlorodibenzo-p-dioxin as a human carcinogen and the complex mixtures of dioxin-like compounds as likely to be carcinogenic to humans using the draft 1996 carcinogen risk assessment guidelines. EPA is working on its final assessment for dioxin.[38]

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[37] U.S. EPA (1993) Environmental Protection Agency, Integrated Risk Information System (IRIS), National Center for Environmental Assessment, Cincinnati, OH.

[38] US EPA (June 2000) Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds, External Review Draft, EPA/600/P-00/001Ag. This material is available

3. Ozone

a. What are the health effects of ozone pollution?

Ground-level ozone pollution (sometimes called "smog") is formed by the reaction of volatile organic compounds (VOC) and nitrogen oxides (NOx) 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, including on-road and off-road motor vehicles and engines, power plants and industrial facilities, and smaller "area" sources.

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 normal activity. Ozone also can aggravate asthma, leading to more asthma attacks that require a doctor's attention and/or the use of additional medication. In addition, ozone can inflame and damage the lining of the lungs, which may lead to permanent changes in lung tissue, irreversible reductions in lung function, and a lower quality of life if the inflammation occurs repeatedly over a long time period (months, years, a lifetime). People who are particularly susceptible to the effects of ozone include children and adults who are active outdoors, people with respiratory disease, such as asthma, and people with unusual sensitivity to ozone. Beyond its human health effects, ozone has been shown to injure plants, which has the effect of reducing crop yields and reducing productivity in forest ecosystems.

The 8-hour ozone standard, established by EPA in 1997, is based on well-documented science demonstrating that more people are experiencing adverse health effects at lower levels of exertion, over longer periods, and at lower ozone concentrations than addressed by the one-hour ozone standard. (See, e.g., 62 FR at 38861-62, July 18, 1997). The 8-hour standard 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.

There has been more recent research that reinforces health effects research which was used to support the 1997 decisions to set the 8-hour ozone health standards and suggests more serious health effects of ozone than had been known at the time when the 8-hour ozone standards were promulgated. Since 1997, over 1,700 new health and welfare studies relating to ozone have been published in peer-reviewed journals. Many of these studies have investigated the impact of ozone exposure on such health effects as changes in lung structure and biochemistry, inflammation of the lungs, exacerbation and causation of asthma, respiratory illness-related

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electronically at http://www.epa.gov/ncea/dioxin.htm.

school absence, hospital and emergency room visits for asthma and other respiratory causes, and premature mortality. EPA is currently in the process of evaluating these and other studies as part of the ongoing review of the air quality criteria and NAAQS for ozone. A revised Air Quality Criteria Document for Ozone and Other Photochemical Oxidants will be prepared in consultation with EPA's Clean Air Science Advisory Committee (CASAC). Key new health information falls into four general areas: development of new-onset asthma, hospital admissions for young children, school absence rate, and premature mortality.

Aggravation of existing asthma resulting from ambient ozone exposure was reported prior to the 1997 decision and has been observed in studies published subsequently.[39] Although preliminary, an important new finding is evidence suggesting that air pollution and outdoor exercise could contribute to the development of new-onset asthma. In particular, a relationship between long-term ambient ozone concentrations and the incidence of asthma in adults was reported by McDonnell et al. (1999).[40] Subsequently, an additional study suggests that incidence of new diagnoses of asthma in children is associated with heavy exercise in communities with high concentrations of ozone.[41]

Previous studies have shown relationships between ozone and hospital admissions in the general population. A study in Toronto reported a significant relationship between 1-hour maximum ozone concentrations and respiratory hospital admissions in children under the age of two.[42] Given the relative vulnerability of children in this age category, this is an important addition to the literature on ozone and hospital admissions.

Increased school absence rate caused by respiratory illness has been associated with 1-

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[39] Thurston, G.D., M.L. Lippman, M.B. Scott, and J.M. Fine. 1997. Summertime Haze Air Pollution and Children with Asthma. *American Journal of Respiratory Critical Care Medicine*, 155: 654-660.

Ostro, B, M. Lipsett, J. Mann, H. Braxton-Owens, and M. White (2001) Air pollution and exacerbation of asthma in African-American children in Los Angeles. *Epidemiology* 12(2): 200-208.

[40] McDonnell, W.F., D.E. Abbey, N. Nishino and M.D. Lebowitz. 1999. "Long-term ambient ozone concentration and the incidence of asthma in nonsmoking adults: the ahsmog study." *Environmental Research*. 80(2 Pt 1): 110-21.

[41] McConnell, R.; Berhane, K.; Gilliland, F.; London, S. J.; Islam, T.; Gauderman, W. J.; Avol, E.; Margolis, H. G.; Peters, J. M. (2002) Asthma in exercising children exposed to ozone: a cohort study. Lancet 359: 386_391.

[42] Burnett, R. T.; Smith_Doiron, M.; Stieb, D.; Raizenne, M. E.; Brook, J. R.; Dales, R. E.; Leech, J. A.; Cakmak, S.; Krewski, D. (2001) Association between ozone and hospitalization for acute respiratory diseases in children less than 2 years of age. Am. J. Epidemiol. 153: 444_452.

hour daily maximum and 8-hour average ozone concentrations in studies conducted in Nevada[43] in kindergarten to 6th grade and in Southern California in grades 4- through 6.[44] These studies suggest that higher ambient ozone levels may result in increased school absenteeism.

The air pollutant most clearly associated with premature mortality is PM, with dozens of studies reporting such an association. However, repeated ozone exposure is a likely contributing factor for premature mortality, causing an inflammatory response in the lungs which may predispose elderly and other sensitive individuals to become more susceptible to other stressors, such as PM.[45] The findings of three recent analyses provide consistent data suggesting that ozone exposure is associated with increased mortality. Although the National Morbidity, Mortality, and Air Pollution Study (NMMAPS) did not report an effect of ozone on total mortality across the full year, the investigators who conducted the NMMAPS study did observe an effect after limiting the analysis to summer when ozone levels are highest.[46] Similarly, other studies have shown associations between ozone and mortality.[47] Specifically, Toulomi et al. (1997) found that

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[43] Chen, L.; Jennison, B. L.; Yang, W.; Omaye, S. T. (2000) Elementary school absenteeism and air pollution. Inhalation Toxicol. 12: 997_1016.

[44] Gilliland, FD, K Berhane, EB Rappaport, DC Thomas, E Avol, WJ Gauderman, SJ London, HG Margolis, R McConnell, KT Islam, JM Peters (2001) The effects of ambient air pollution on school absenteeism due to respiratory illnesses *Epidemiology* 12:43-54.

[45] Samet JM, Zeger SL, Dominici F, Curriero F, Coursac I, Dockery DW, Schwartz J, Zanobetti A. 2000. The National Morbidity, Mortality and Air Pollution Study: Part II: Morbidity, Mortality and Air Pollution in the United States. Research Report No. 94, Part II. Health Effects Institute, Cambridge MA, June 2000.

Devlin, R. B.; Folinsbee, L. J.; Biscardi, F.; Hatch, G.; Becker, S.; Madden, M. C.; Robbins, M.; Koren, H. S. (1997) Inflammation and cell damage induced by repeated exposure of humans to ozone. Inhalation Toxicol. 9: 211-235.

Koren HS, Devlin RB, Graham DE, Mann R, McGee MP, Horstman DH, Kozumbo WJ, Becker S, House DE, McDonnell SF, Bromberg, PA. 1989. Ozone-induced inflammation in the lower airways of human subjects. Am. Rev. Respir. Dies. 139: 407-415.

[46] Samet JM, Zeger SL, Dominici F, Curriero F, Coursac I, Dockery DW, Schwartz J, Zanobetti A. 2000. The National Morbidity, Mortality and Air Pollution Study: Part II: Morbidity, Mortality and Air Pollution in the United States. Research Report No. 94, Part II. Health Effects Institute, Cambridge MA, June 2000.

Samet JM, Zeger SL, Dominici F, Curriero F, Coursac I, Zeger, S. Fine Particulate Air Pollution and Mortality in 20 U.S. Cities, 1987 - 1994. The New England Journal of Medicine. Vol. 343, No. 24, December 14, 2000. P. 1742-1749.

[47] Thurston, G. D.; Ito, K. (2001) Epidemiological studies of acute ozone exposures and mortality. J. Exposure Anal. Environ. Epidemiol. 11: 286-294.

Touloumi, G.; Katsouyanni, K.; Zmirou, D.; Schwartz, J.; Spix, C.; Ponce de Leon, A.; Tobias, A.; Quennel, P.;

1-hour maximum ozone levels were associated with daily numbers of deaths in 4 cities (London, Athens, Barcelona, and Paris), and a quantitatively similar effect was found in a group of four additional cities (Amsterdam, Basel, Geneva, and Zurich).

In all, the new studies that have become available since the 8-hour ozone standard was adopted in 1997 continue to demonstrate the harmful effects of ozone on public health, and the need to attain and maintain the NAAQS.

b. Current and projected 8-hour ozone levels

Although the nation has made significant progress since 1970 in reducing ground-level ozone pollution, ozone remains a significant public health concern. As shown earlier (Figure II-1), unhealthy ozone concentrations exceeding the level of the 8-hour standard occur over wide geographic areas, including most of the nation's major population centers. These areas include much of the eastern half of the U.S. and large areas of California.

Based upon the years 1999 - 2001, there are 291 counties that are violating the 8-hour ozone NAAQS, totaling 111 million people. An additional 37 million people live in 155 counties that have air quality measurements within 10 percent of the level of the standard. These areas, though currently not violating the standard, will also benefit from the additional reductions from this rule in order to ensure long term maintenance.

Based upon our air quality modeling for this proposal, we anticipate that without further reductions, ozone nonattainment will likely persist into the future. With reductions from programs already in place, the number of counties violating the ozone 8-hour standard is expected to decrease in 2020 to 30 counties where 43 million people are projected to live. Thereafter, exposure to unhealthy levels of ozone is expected to begin to increase again. In 2030 the number of counties violating the ozone 8-hour NAAQS is projected to increase to 32 counties where 47 million people are projected to live. In addition, in 2030, 82 counties where 44 million people are projected to live will be within 10 percent of violating the ozone 8-hour NAAQS.

While the final implementation process for bringing the nation's air into attainment with the ozone 8-hour NAAQS is still being completed, the basic Clean Air Act framework still applies. EPA's current plans call for designating ozone 8-hour nonattainment areas in April 2004. EPA is planning to propose that States submit SIPs that address the 8-hour ozone standard within three years after nonattainment designation regardless of their classification. EPA is also planning to propose that certain SIP components, such as those related to reasonably available control technology (RACT) and reasonable further progress (RFP) be submitted within 2 years

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Rabczenko, D.; Bacharova, L.; Bisanti, L.; Vonk, J. M.; Ponka, A. (1997) Short-term effects of ambient oxidant exposure on mortality: a combined analysis within the APHEA project. Am. J. Epidemiol. 146: 177_185.

after designation. We therefore expect States to submit their attainment demonstration SIPs by April 2007. Section 172(a)(2) of the Clean Air Act requires that SIP revisions for areas that may be covered only under subpart 1 of part D, Title I of the Act demonstrate that the nonattainment areas will attain the ozone 8-hour standard as expeditiously as practicable but no later than five years from the date that the area was designated nonattainment. However, based on the severity of the air quality problem and the availability and feasibility of control measures, the Administrator may extend the attainment date "for a period of no greater than 10 years from the date of designation as nonattainment." Based on these provisions, we expect that most or all areas covered under subpart 1 will attain the ozone standard in the 2009 to 2014 time frame. For areas covered under subpart 2, however, the maximum attainment dates provided under the Act range from 3 to 20 years after designation, depending on an area's classification.

Since the emission reductions expected from today's proposal would begin in this same time frame as many areas' period for attainment, the projected reductions in nonroad emissions would be extremely important to States in meeting the new NAAQS. It is our expectation that States will be relying on such nonroad reductions in order to help them attain and maintain the 8-hour NAAQS. Furthermore, since the nonroad emission reductions will continue to grow in the years beyond 2014, they will also be important for maintenance of the NAAQS following attainment.

Using air quality modeling of the impacts of emission reductions, we have made estimates of the change in future ozone levels that would result from the proposed rule.[48] That modeling shows that this rule would produce nationwide air quality improvements in ozone levels. On a population-weighted basis, the average change in future year design values would be a decrease of 1.6 ppb in 2020, and 2.6 ppb in 2030. Within areas predicted to violate the NAAQS in the projected base case, the average decrease would be somewhat higher: 1.9 ppb in 2020 and 3.0 ppb in 2030.[49]

The model predictions of whether specific counties will violate the NAAQS or not is uncertain, especially for counties with design values falling very close to the standard. This makes us more confident in our prediction of average air quality changes than in our prediction of the exact numbers of counties projected as exceeding the NAAQS. Furthermore, actions by States to meet their SIP obligations will change the number of counties violating the NAAQS in

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48 These results are ozone changes projected for the preliminary control option used for our modeling, as discussed in the Draft RIA in Section 3.6. The proposal differs from the modeled control case based on updated information; however, we believe that the net results would approximate future emissions, although we anticipate the ozone changes might be slightly different.

49 This is in spite of the fact that NOx reductions can at certain times in some areas cause ozone levels to increase. Such "disbenefits" are predicted in our modeling, but these results make clear that the overall effect of the proposed rule is positive. See the draft RIA for more information.

the time frame we are modeling for this rule. If State actions resulted in an increase in the number of areas that are very close to, but still above, the NAAQS, then this rule might bring many of those counties down sufficiently to eliminate remaining violations. In addition, if State actions brought several counties we project to be very close to the standard in the future down sufficiently to eliminate violations, then the air quality improvements from today's proposal might serve more to assist these areas in maintaining the standards than in changing their status. Bearing this in mind, our modeling indicates that, out of 32 counties predicted to violate the NAAQS, the proposal would reduce the number of violating counties by 2 in 2020 and by 4 in 2030, without consideration of new State or Federal programs.

C. Other Environmental Effects

The following section presents information on five categories of public welfare and environmental impacts related to nonroad heavy-duty vehicle emissions: visibility impairment, acid deposition, eutrophication of water bodies, plant damage from ozone, and water pollution resulting from deposition of toxic air pollutants with resulting effects on fish and wildlife.

1. Visibility

a. Visibility is Impaired by Fine PM and Precursor Emissions From Nonroad Engines Subject to this Proposed Rule

Visibility can be defined as the degree to which the atmosphere is transparent to visible light.[50] Visibility degradation is an easily noticeable effect of fine PM present in the atmosphere, and fine PM is the major cause of reduced visibility in parts of the U.S., in places across the country where people live, work, and recreate including many of our national parks and wilderness areas. Fine particles with significant light-extinction efficiencies include organic matter, sulfates, nitrates, elemental carbon (soot), and soil. Size and chemical composition of particles strongly affects their ability to scatter or absorb light. Sulfates contribute to visibility impairment especially on the haziest days across the U.S., accounting in the rural Eastern U.S. for more than 60 percent of annual average light extinction on the best days and up to 86 percent of average light extinction on the haziest days. Nitrates and elemental carbon each typically contribute 1 to 6 percent of average light extinction on haziest days in rural Eastern U.S.

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[50] 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 on the internet at http://www.nap.edu/books/0309048443/html/. See also U.S. EPA Air Quality Criteria Document for Particulate Matter (1996) (available on the internet at http://cfpub.epa.gov/ncea/cfm/partmatt.cfm) and Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information. These documents can be found in Docket A-99-06, Documents No. II-A-23 and IV-A-130-32.

locations.[51]

Visibility is an important effect 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, both in where they live and work, and in places where they enjoy recreational opportunities. Visibility is highly valued in significant natural areas such as national parks and wilderness areas, because of the special emphasis given to protecting these lands now and for future generations.

To quantify changes in visibility, we compute a light-extinction coefficient, which shows the total fraction of light that is decreased per unit distance. Visibility can be described in terms of visual range or light extinction and is reported using an indicator called deciview.[52] In addition to limiting the distance that one can see, the scattering and absorption of light caused by air pollution can also degrade the color, clarity, and contrast of scenes.

In addition, visibility impairment can be described by its impact over various periods of time, by its source, and the physical conditions in various regions of the country. Visibility impairment can be said to have a time dimension in that it might relate to short-term excursions or to longer periods (e.g., worst 20 percent of days and annual average levels). Anthropogenic contributions account for about one-third of the average extinction coefficient in the rural West and more than 80 percent in the rural East. In the Eastern U.S., reduced visibility is mainly attributable to secondarily formed particles, particularly those less than a few micrometers in diameter. While secondarily formed particles still account for a significant amount in the West, primary emissions contribute a larger percentage of the total particulate load than in the East. Because of significant differences related to visibility conditions in the Eastern and Western U.S., we present information about visibility by region.

Furthermore, it is important to note that even in those areas with relatively low concentrations of anthropogenic fine particles, such as the Colorado Plateau, small increases in anthropogenic fine particulate concentrations can lead to significant decreases in visual range. This is one of the reasons mandatory Federal Class I areas have been given special consideration

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[51] US EPA Trends Report 2001. This document is available on the internet at htp://www.epa.gov/airtrends/

[52] Visual range can be defined as the maximum distance at which one can identify a black object against the horizon sky. It is typically described in miles or kilometers. Light extinction is the sum of light scattering and absorption by particles and gases in the atmosphere. It is typically expressed in terms of inverse megameters (Mm^{-1}), with larger values representing worse visibility. The deciview metric describes perceived visual changes in a linear fashion over its entire range, analogous to the decibel scale for sound. A deciview of 0 represents pristine conditions. Under many scenic conditions, a change of 1 deciview is considered perceptible by the average person.

under the Clean Air Act.[53]

Nonroad land-based diesel engines that would be subject to this proposed rule contribute to ambient fine PM levels in two ways. First, they contribute through direct emissions of fine particles. As shown in Table II.E-3, land-based diesel engines emitted 162,000 tons of $PM_{2.5}$ in 2000 and are projected to emit 126,000 tons $PM_{2.5}$ in 2020 (about 17 percent of all mobile source $PM_{2.5}$). Second, as explained earlier, emissions from these engines contribute to indirect formation of PM through their emissions of gaseous precursors which are then transformed in the atmosphere into particles. In Section II.E below and Chapter 3 of the draft RIA, we discuss the other emissions. Using these emissions inputs, we conducted air quality modeling to examine how these emissions are expected to affect visibility in the future.

b. Visibility Impairment Where People Live, Work and Recreate

The secondary PM NAAQS is designed to protect against adverse welfare effects which includes visibility impairment. In 1997, EPA established the secondary $PM_{2.5}$ NAAQS as equal to the primary (health-based) NAAQS of 15 ug/m^3 (based on a 3-year average of the annual mean) and 65 ug/m^3 (based on a 3-year average of the 98th percentile of the 24-hour average value) (62 FR at 38669, July 18, 1997). 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. In 1997, EPA demonstrated that visibility impairment is an important effect on public welfare and that unacceptable visibility impairment is experienced throughout the U.S., in multi-state regions, urban areas, and remote federal Class I areas. In many cities having annual mean $PM_{2.5}$ concentrations exceeding annual standard, improvements in annual average visibility resulting from the attainment of the annual $PM_{2.5}$ standard are expected to be perceptible to the general population. Based on annual mean monitored $PM_{2.5}$ data, many cities in the Northeast, Midwest, and Southeast as well as Los Angeles would be expected to experience perceptible improvements in visibility if the $PM_{2.5}$ annual standard were attained.

The updated monitoring data and air quality modeling, summarized above and presented in detail in the draft RIA, confirm that the visibility situation identified during the NAAQS review in 1997 is still likely to exist, and it will continue to persist when these proposed standards for nonroad diesel engines take effect. Thus, the determination in the NAAQS rulemaking about broad visibility impairment and related benefits from NAAQS compliance are still relevant.

Furthermore, in setting the $PM_{2.5}$ NAAQS, EPA acknowledged that levels of fine

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[53] The Clean Air Act designates 156 national parks and wilderness areas as mandatory Federal Class I areas for visibility protection.

particles below the NAAQS may also contribute to unacceptable visibility impairment and regional haze problems in some areas, and section 169 of the Act provides additional authorities to remedy existing impairment and prevent future impairment in the 156 national parks, forests and wilderness areas labeled as mandatory Federal Class I areas (62 FR at 38680-81, July 18, 1997).

In making determinations about the level of protection afforded by the secondary PM NAAQS, EPA considered how the section 169 regional haze program and the secondary NAAQS would function together.[54] Regional strategies are expected to improve visibility in many urban and non-Class I areas as well.

Fine particles may remain suspended for days or weeks and travel hundreds to thousands of kilometers, and thus fine particles emitted or created in one county may contribute to ambient concentrations in a neighboring region.[55]

The 1999-2001 $PM_{2.5}$ monitored values indicate that at least 74 million people live in areas where long-term ambient fine PM levels are at or above 15 $\mu g/m^3$.[56] Thus, at least these populations (plus those who travel to those areas) are experiencing significant visibility impairment, and emissions of PM and its precursors from nonroad diesel engines contribute to this impairment.[57]

Because of the importance of chemical composition and size to visibility, we used EPA's Regional Modeling System for Aerosols and Deposition (REMSAD)[58] model to project visibility

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54 U.S. EPA Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information OAQPS Staff Paper. EPA-452/R-96-013. 1996. Docket Number A-99-06, Documents Nos. II-A-18, 19, 20, and 23. The particulate matter air quality criteria documents are also available at http://www.epa.gov/ncea/partmatt.htm.

55 Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment for Scientific and Technical Information, OAQPS Staff Paper, EPA-452\R-96-013, July, 1996, at IV-7. This document is available from Docket A-99-06, Document II-A-23.

56 US EPA Technical Support Document (used Fred Dimmick, OAQPS, Nov 2002). Air Docket A-__, Document No. II-B-__.

57 These populations would also be exposed to PM concentrations associated with the adverse health impacts discussed above.

58 Additional information about the Regional Modeling System for Aerosols and Deposition (REMSAD) and our modeling protocols can be found in our Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, document EPA420-R-00-026, December 2000. Docket No. A-2000-01, Document No. A-II-13. This document is also available at http://www.epa.gov/otaq/disel.htm#documents.

conditions in 2020 and 2030 in terms of deciview, accounting for the chemical composition of the particles and transport of precursors. Our projections included anticipated emissions from the nonroad diesel engines subject to this proposed rule as well as all other sources.

Based on this modeling, we predict that in 2030, 85 million people (25 percent of the future population) would be living in areas with visibility degradation where fine PM levels are above 15 µg/m^3 annually.[59] Thus, at least a quarter of the population would experience visibility impairment in areas where they live, work and recreate.

As shown in Table I.C-1, accounting for the different visibility impact of the chemical constituents of the $PM_{2.5}$, in 2030 we expect visibility in the East to be about 20.5 deciviews (or visual range of 50 kilometers) on average, with poorer visibility in urban areas, compared to the average Eastern visibility conditions without man-made pollution of 9.5 deciviews (or visual range of 150 kilometers). Likewise, we expect visibility in the West to be about 8.8 deciviews (or visual range of 162 kilometers) on average in 2030, with poorer visibility in urban areas, compared to the average Western visibility conditions without man-made pollution of 5.3 deciviews (or visual range of 230 kilometers). Thus, the emissions from these nonroad diesel sources, especially SOx emissions that become sulfates in the atmosphere, contribute to future visibility impairment summarized in the table.

Control of nonroad land-based engines emissions, as shown in Table I.C-1, will improve visibility across the nation. Taken together with other programs, reductions from today's proposal will help to improve visibility. Control of these emissions in and around areas with PM levels above the annual $PM_{2.5}$ NAAQS will likely improve visibility in other locations such as mandatory Federal Class I areas. Specifically, for a preliminary control option described in the draft RIA Chapter 3.6 that is similar to our proposal, we expect on average for visibility to improve to about 0.33 deciviews in the East and 0.35 deciviews in the West. The improvement from our proposal is likely to be similar but slightly smaller than what was modeled due to the differences in emission reductions between the proposal and the modeled scenario.

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[59] Technical Memorandum, EPA Air Docket A-99-06, Eric O. Ginsburg, Senior Program Advisor, Emissions Monitoring and Analysis Division, OAQPS, Summary of Absolute Modeled and Model-Adjusted Estimates of Fine Particulate Matter for Selected Years, December 6, 2000, Table P-2. Docket Number 2000-01, Document Number II-B-14.

TABLE I.C-1 – SUMMARY OF MODELED 2030 NATIONAL VISIBILITY CONDITIONS (AVERAGE ANNUAL DECIVIEWS)

Regions[a]	Predicted 2030 Visibility Baseline	Predicted 2030 Visibility with Rule Controls[b]	Change in Annual Average Deciviews
Eastern U.S.	20.54	20.21	0.33
Urban	21.94	21.61	0.33
Rural	19.98	19.65	0.33
Western U.S.	8.83	8.58	0.25
Urban	9.78	9.43	0.35
Rural	8.61	8.38	0.23

[a] Eastern and Western Regions are separated by 100 degrees north longitude. Background visibility conditions differ by region. Natural background is 9.5 deciviews in the East and 5.3 in the West.
[b] The results illustrate the type of visibility improvements for the preliminary control option, as discussed in the Draft RIA. The proposal differs based on updated information; however, we believe that the net results would approximate future PM emissions, although we anticipate the visibility improvements would be slightly smaller.

c. Visibility Impairment in Mandatory Federal Class I Areas

The Clean Air Act establishes special goals for improving visibility in many national parks, wilderness areas, and international parks. In the 1990 Clean Air Act amendments, Congress provided additional emphasis on regional haze issues (see CAA section 169B). In 1999, EPA finalized a rule that calls for States to establish goals and emission reduction strategies for improving visibility in all 156 mandatory Federal Class I areas. In that rule, EPA established a “natural visibility” goal, and also encouraged the States to work together in developing and implementing their air quality plans. The regional haze program is focused on long-term emissions decreases from the entire regional emissions inventory comprised of major and minor stationary sources, area sources and mobile sources. The regional haze program is designed to improve visibility and air quality in our most treasured natural areas from these broad sources. At the same time, control strategies designed to improve visibility in the national parks and wilderness areas are expected to improve visibility over broad geographic areas. For mobile sources, there is a need for a Federal role in reduction of those emissions, especially because mobile source engines are regulated primarily at the Federal level.

Because of evidence that fine particles are frequently transported hundreds of miles, all 50 states, including those that do not have mandatory Federal Class I areas, participate in planning, analysis, and, in many cases, emission control programs under the regional haze regulations. Virtually all of the 156 mandatory Federal Class I areas experience impaired visibility, requiring all States with those areas to prepare emission control programs to address it. Even though a given State may not have any mandatory Federal Class I areas, pollution that occurs in that State may contribute to impairment in such Class I areas elsewhere. The rule encourages states to work together to determine whether or how much emissions from sources in a given state affect visibility in a downwind mandatory Federal Class I area.

The regional haze program also calls for states to establish goals for improving visibility in national parks and wilderness areas to improve visibility on the haziest 20 percent of days and to ensure that no degradation occurs on the clearest 20 percent of days (64 FR 35722. July 1, 1999). The rule requires states to develop long-term strategies including enforceable measures designed to meet reasonable progress goals toward natural visibility conditions. Under the regional haze program, States can take credit for improvements in air quality achieved as a result of other Clean Air Act programs, including national mobile source programs.[60]

In the PM air quality modeling described above, we also modeled visibility conditions in the mandatory Federal Class I areas, and we summarize the results by region in Table I.C-2. The information shows that these areas also are predicted to have high annual average deciview levels in the future. Emissions from nonroad land-based diesel engines and locomotive and marine engines contributed significantly to these levels, because these diesel engines represent a sizeable portion of the total inventory of anthropogenic emissions related to $PM_{2.5}$ (as shown in the tables above.). Furthermore, numerous types of nonroad engines may operate in or near mandatory Federal Class I areas (e.g., mining, construction, and agricultural equipment). As summarized in the table, we expect visibility improvements in mandatory Federal Class I areas from the reductions of emissions from nonroad diesel engines subject to this proposed rule.

[60] In a recent case, American Corn Growers Association v. EPA, 291 F. 3d 1 (D.C. Cir 2002), the court vacated the Best Available Retrofit Technology (BART) provisions of the Regional Haze rule, but the court denied industry's challenge to EPA's requirement that states' SIPs provide for reasonable progress towards achieving natural visibility conditions in national parks and wilderness areas and the "no degradation" requirement. Industry did not challenge requirements to improve visibility on the haziest 20 percent of days. A copy of this decision can be found in Docket A-2000-01, Document IV-A-113.

TABLE I.C-2 – SUMMARY OF MODELED 2030 VISIBILITY CONDITIONS IN MANDATORY FEDERAL CLASS I AREAS (ANNUAL AVERAGE DECIVIEW)

Region[a]	Predicted 2030 Visibility Baseline[b]	Predicted 2030 Visibility with Rule Controls[c]	Change in Annual Average Deciviews
Eastern			
Southeast	21.62	21.38	0.24
Northeast/Midwest	18.56	18.32	0.24
Western			
Southwest	7.03	6.82	0.21
California	9.56	9.26	0.3
Rocky Mountain	8.55	8.34	0.21
Northwest	12.18	11.94	0.24
National Class I Area Average	11.8	11.56	0.24

[a] Regions are depicted in Figure VI-5 in the Regulatory Support Document. Background visibility conditions differ by region: Eastern natural background is 9.5 deciviews (or visual range of 150 kilometers) and in the West natural background is 5.3 deciviews (or visual range of 230 kilometers).
[b] The results average visibility conditions for mandatory Federal Class I areas in the regions.
[c] The results illustrate the type of visibility improvements for the preliminary control option, as discussed in the draft RIA. The proposal differs based on updated information; however, we believe that the net results would approximate future PM emissions, although we anticipate the improvements would be slightly smaller.

2. Acid Deposition

Acid deposition, or acid rain as it is commonly known, occurs when SO_2 and NOx 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.[61] It contributes to damage of trees at high elevations and in extreme cases may cause lakes and streams to become

[61] Much of the information in this subsection was excerpted from the EPA document, *Human Health Benefits from Sulfate Reduction*, written under Title IV of the 1990 Clean Air Act Amendments, U.S. EPA, Office of Air and Radiation, Acid Rain Division, Washington, DC 20460, November 1995.

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. To reduce damage to automotive paint caused by acid rain and acidic dry deposition, some manufacturers use acid-resistant paints, at an average cost of $5 per vehicle--a total of $80-85 million per year when applied to all new cars and trucks sold in the U.S.

Acid deposition primarily affects bodies of water that rest atop soil with a limited ability to neutralize acidic compounds. The National Surface Water Survey (NSWS) investigated the effects of acidic deposition in over 1,000 lakes larger than 10 acres and in thousands of miles of streams. It found that acid deposition was the primary cause of acidity in 75 percent of the acidic lakes and about 50 percent of the acidic streams, and that the areas most sensitive to acid rain were the Adirondacks, the mid-Appalachian highlands, the upper Midwest and the high elevation West. The NSWS found that approximately 580 streams in the Mid-Atlantic Coastal Plain are acidic primarily due to acidic deposition. Hundreds of the lakes in the Adirondacks surveyed in the NSWS have acidity levels incompatible with the survival of sensitive fish species. Many of the over 1,350 acidic streams in the Mid-Atlantic Highlands (mid-Appalachia) region have already experienced trout losses due to increased stream acidity. Emissions from U.S. sources contribute to acidic deposition in eastern Canada, where the Canadian government has estimated that 14,000 lakes are acidic. Acid deposition also has been implicated in contributing to degradation of high-elevation spruce forests that populate the ridges of the Appalachian Mountains from Maine to Georgia. This area includes national parks such as the Shenandoah and Great Smoky Mountain National Parks.

A study of emissions trends and acidity of water bodies in the Eastern U.S. by the General Accounting Office (GAO) found that from 1992 to 1999 sulfates declined in 92 percent of a representative sample of lakes, and nitrate levels increased in 48 percent of the lakes sampled.[62] The decrease in sulfates is consistent with emissions trends, but the increase in nitrates is inconsistent with the stable levels of nitrogen emissions and deposition. The study suggests that the vegetation and land surrounding these lakes have lost some of their previous capacity to use nitrogen, thus allowing more of the nitrogen to flow into the lakes and increase their acidity. Recovery of acidified lakes is expected to take a number of years, even where soil and vegetation have not been "nitrogen saturated," as EPA called the phenomenon in a 1995 study.[63] This situation places a premium on reductions of SOx and especially NOx from all sources, including nonroad diesel engines, in order to reduce the extent and severity of nitrogen saturation and acidification of lakes in the Adirondacks and throughout the U.S.

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[62] *Acid Rain: Emissions Trends and Effects in the Eastern United States, US General Accounting Office*, March, 2000 (GOA/RCED-00-47).

[63] *Acid Deposition Standard Feasibility Study: Report to Congress*, EPA 430R-95-001a, October, 1995.

The SOx and NOx reductions from today's action will help reduce acid rain and acid deposition, thereby helping to reduce acidity levels in lakes and streams throughout the country and help 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 our historic buildings and monuments, and of buildings, 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 sulfur and nitrogen acid deposition will be roughly proportional to the reduction in SOx and NOx emissions, respectively, the precise impact of today's action will differ across different areas.

3. Eutrophication and Nitrification

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 also adversely affect fish and shellfish populations.

In 1999, NOAA published the results of a five year national assessment of the severity and extent of estuarine eutrophication. An estuary is defined as the inland arm of the sea that meets the mouth of a river. The 138 estuaries characterized in the study represent more than 90 percent of total estuarine water surface area and the total number of US estuaries. The study found that estuaries with moderate to high eutrophication conditions represented 65 percent of the estuarine surface area. Eutrophication is of particular concern in coastal areas with poor or stratified circulation patterns, such as the Chesapeake Bay, Long Island Sound, or the Gulf of Mexico. In such areas, the "overproduced" algae tends to sink to the bottom and decay, using all or most of the available oxygen and thereby reducing or eliminating populations of bottom-feeder fish and shellfish, distorting the normal population balance between different aquatic organisms, and in extreme cases causing dramatic fish kills.

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.

In recent decades, human activities have greatly accelerated nutrient inputs, such as nitrogen and phosphorous, causing excessive growth of algae and leading to degraded water quality and associated impairments of freshwater and estuarine resources for human uses.[64] Since 1970, eutrophic conditions worsened in 48 estuaries and improved in 14. In 26 systems, there was no trend in overall eutrophication conditions since 1970. [65] On the New England coast, for example, the number of red and brown tides and shellfish problems from nuisance and toxic plankton blooms have increased over the past two decades, a development thought to be linked to increased nitrogen loadings in coastal waters. Long-term monitoring in the U.S., Europe, and other developed regions of the world shows a substantial rise of nitrogen levels in surface waters, which are highly correlated with human-generated inputs of nitrogen to their watersheds.

Between 1992 and 1997, experts surveyed by National Oceanic and Atmospheric Administration (NOAA) most frequently recommended that control strategies be developed for agriculture, wastewater treatment, urban runoff, and atmospheric deposition.[66] In its Third Report to Congress on the Great Waters, EPA reported that atmospheric deposition contributes from 2 to 38 percent of the nitrogen load to certain coastal waters.[67] A review of peer reviewed literature in 1995 on the subject of air deposition suggests a typical contribution of 20 percent or higher.[68] Human-caused nitrogen loading to the Long Island Sound from the atmosphere was estimated at 14 percent by a collaboration of federal and state air and water agencies in 1997.[69] The National Exposure Research Laboratory, US EPA, estimated based on prior studies that 20 to 35 percent of the nitrogen loading to the Chesapeake Bay is attributable to atmospheric deposition.[70] The mobile source portion of atmospheric NOx contribution to the Chesapeake

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[64] *Deposition of Air Pollutants to the Great Waters, Third Report to Congress*, June, 2000.

[65] *Deposition of Air Pollutants to the Great Waters, Third Report to Congress*, June, 2000. Great Waters are defined as the Great Lakes, the Chesapeake Bay, Lake Champlain, and coastal waters. The first report to Congress was delivered in May, 1994; the second report to Congress in June, 1997.

[66] 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.

[67] *Deposition of Air Pollutants to the Great Waters, Third Report to Congress*, June, 2000.

[68] Valigura, Richard, et al., *Airsheds and Watersheds II: A Shared Resources Workshop,* Air Subcommittee of the Chesapeake Bay Program, March, 1997.

[69] *The Impact of Atmospheric Nitrogen Deposition on Long Island Sound*, The Long Island Sound Study, September, 1997.

[70] Dennis, Robin L., *Using the Regional Acid Deposition Model to Determine the Nitrogen Deposition Airshed of the Chesapeake Bay Watershed*, SETAC Technical Publications Series, 1997.

Bay was modeled at about 30 percent of total air deposition.[71]

Deposition of nitrogen from nonroad diesel engines contributes to elevated nitrogen levels in waterbodies. The proposed standards for nonroad diesel engines will reduce total NOx emissions by 831,000 tons in 2030. The NOx reductions will 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.

4. Polycyclic Organic Matter Deposition

EPA's Great Waters Program has identified 15 pollutants whose deposition to water bodies has contributed to the overall contamination loadings to the these Great Waters.[72] One of these 15 pollutants, a group known as polycyclic organic matter (POM), are compounds that are mainly adhered to the particles emitted by mobile sources and later fall to earth in the form of precipitation or dry deposition of particles. The mobile source contribution of the 7 most toxic POM is at least 62 tons/year and represents only those POM that adhere to mobile source particulate emissions.[73] The majority of these emissions are produced by diesel engines.

The PM reductions from today's proposed action will help reduce not only the PM emissions from nonroad diesel engines but also the deposition of the POM adhering to the particles, thereby helping to reduce health effects of POM in lakes and streams, accelerate the recovery of affected lakes and streams, and revive the ecosystems adversely affected.

5. Plant Damage from Ozone

Ground-level ozone can also cause adverse welfare effects. Specifically, ozone enters the leaves of plants where it interferes with cellular metabolic processes. This interference can be manifest either as visible foliar injury from cell injury or death, and/or as decreased plant growth and yield due to a reduced ability to produce food. With fewer resources, the plant reallocates existing resources away from root storage, growth and reproduction toward leaf repair and maintenance. Plants that are stressed in these ways become more susceptible to disease, insect attack, harsh weather and other environmental stresses. Because not all plants are equally sensitive to ozone, ozone pollution can also exert a selective pressure that leads to changes in

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[71] Dennis, Robin L., *Using the Regional Acid Deposition Model to Determine the Nitrogen Deposition Airshed of the Chesapeake Bay Watershed*, SETAC Technical Publications Series, 1997.

[72] *Deposition of Air Pollutants to the Great Waters-Third Report to Congress, June, 2000*, Office of Air Quality Planning and Standards *Deposition of Air Pollutants to the Great Waters-Second Report to Congress*, Office of Air Quality Planning and Standards, June 1997, EPA-453/R-97-011.

[73] *The 1996 National Toxics Inventory*, Office of Air Quality Planning and Standards, October 1999.

plant community composition.

Since plants are at the base of the food chain in many ecosystems, changes to the plant community can affect associated organisms and ecosystems (including the suitability of habitats that support threatened or endangered species and below ground organisms living in the root zone). Given the range of plant sensitivities and the fact that numerous other environmental factors modify plant uptake and response to ozone, it is not possible to identify threshold values above which ozone is toxic and below which it is safe for all plants. However, in general, the science suggests that ozone concentrations of 0.10 ppm or greater can be phytotoxic to a large number of plant species, and can produce acute foliar injury responses, crop yield loss and reduced biomass production. Ozone concentrations below 0.10 ppm (0.05 to 0.09 ppm) can produce these effects in more sensitive plant species, and have the potential over a longer duration of creating chronic stress on vegetation that can lead to effects of concern such as reduced plant growth and yield, shifts in competitive advantages in mixed populations, and decreased vigor leading to diminished resistance to pests, pathogens, and injury from other environmental stresses.

Studies indicate that these effects described here are still occurring in the field under ambient levels of ozone. The economic value of some welfare losses due to ozone can be calculated, such as crop yield loss from both reduced seed production (e.g., soybean) and visible injury to some leaf crops (e.g., lettuce, spinach, tobacco) and visible injury to ornamental plants (i.e., grass, flowers, shrubs), while other types of welfare loss may not be fully quantifiable in economic terms (e.g., reduced aesthetic value of trees growing in Class I areas).

As discussed above, nonroad diesel engine emissions of VOCs and NOx contribute to ozone. This proposed rule would reduce ozone and, therefore, help to reduce crop damage and stress from ozone on vegetation.

D. Other Criteria Pollutants Affected by This NPRM

The standards being proposed today would also help reduce levels of other pollutants for which NAAQS have been established: carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2). Currently every area in the United States has been designated to be in attainment with the NO_2 NAAQS. As of November 4, 2002, there were 24 areas designated as non-attainment with the SO2 standard, and 14 designated CO non-attainment areas.

The current primary NAAQS for CO are 35 parts per million for the one-hour average and 9 parts per million for the eight-hour average. These values are not to be exceeded more than once per year. Over 22 million people currently live in the 14 non-attainment areas for the CO NAAQS. See the draft RIA for a detailed discussion of the emission benefits of this proposed rule.

Carbon monoxide is a colorless, odorless gas produced through the incomplete combustion of carbon-based fuels. Carbon monoxide enters the bloodstream through the lungs and reduces 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.

High concentrations of CO generally occur in areas with elevated mobile-source emissions. Peak concentrations typically occur during the colder months of the year when mobile-source CO emissions are greater and nighttime inversion conditions are more frequent. This is due to the enhanced stability in the atmospheric boundary layer, which inhibits vertical mixing of emissions from the surface.

Land-based nonroad engines contributed about one percent of CO from mobile sources in 1996. EPA previously determined that the category of nonroad diesel engines cause or contribute to ambient CO and ozone in more than one non-attainment area (65 FR 76790, December 7, 2000). In that action EPA found that nonroad engines contribute to CO non-attainment in areas such as Los Angeles, Phoenix, Spokane, Anchorage, and Las Vegas. Nonroad land-based diesel engines emitted 927,500 tons of CO in 1996 (1 % of mobile source CO). Thus, nonroad diesel engines contribute to CO non-attainment in more than one of these areas.

E. Emissions From Nonroad Diesel Engines

Emissions from nonroad diesel engines will continue to be a significant part of the emissions inventory in the coming years. In the absence of new emission standards, we expect overall emissions from nonroad diesel engines subject to this proposal to generally decline across the nation for the next 10 to 15 years, depending on the pollutant.[74] Although nonroad diesel engine emissions will decline during this period, this trend will not be enough to adequately reduce the large amount of emissions that these engines contribute. For example, the declines are insufficient to prevent significant contributions to nonattainment of $PM_{2.5}$ and ozone NAAQS, or to prevent widespread exposure to significant concentrations of nonroad engine air toxics. In addition, after the 2010 to 2015 time period we project that this trend reverses and emissions rise into the future in the absence of additional regulation of these engines. (This phenomenon is further described later in this section.) The initial downward trend occurs as the nonroad fleet becomes increasingly dominated over time by engines that comply with existing emission regulations. The upturn in emissions beginning around 2015 results as growth in the nonroad sector overtakes the effect of the existing emission standards.

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[74] As defined here, nonroad diesel engines include land-based, locomotive, commercial marine vessel, and recreational marine engines.

The engine and fuel standards in this proposal will affect fine particulate matter ($PM_{2.5}$), oxides of nitrogen (NOx), sulfur oxides (SO_2), volatile organic hydrocarbons (VOC), and air toxics. For locomotive, commercial marine vessel (CMV), and recreational marine vessel (RMV) engines, the proposed fuel standards will affect $PM_{2.5}$ and SO_2. CO is not specifically targeted in this proposal but its reductions are discussed in the draft RIA.[75]

Each sub-section within Section II discusses the emissions of a pollutant that the proposal addresses.[76] This is followed by a discussion of the expected emission reductions associated with the proposed standards for land-based nonroad diesel engines.[77] The tables and figures illustrate the Agency's projection of future emissions from nonroad diesel engines for each pollutant.[78] The baseline case represents future emissions from land-based nonroad diesel engines with current standards. The controlled case estimates the future emissions of these engines based on the proposed standards in this notice.

1. $PM_{2.5}$

As described earlier in this section of the preamble, the Agency believes that reductions of diesel $PM_{2.5}$ emissions are needed as part of the Nation's progress toward clean air and to reach attainment of the NAAQS for $PM_{2.5}$. The nonroad engines controlled by today's proposal are the major sources of nonroad diesel emissions. Table II.E-1 shows that the $PM_{2.5}$ emissions from land-based nonroad diesels amount to increasingly large percentages of total manmade

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[75] We are proposing only a few minor adjustments of a technical nature to current CO standards.

[76] The estimates of baseline emissions and emissions reductions from the proposed rule reported here for nonroad land-based, recreational marine, locomotive, and commercial marine vessel diesel engines are based on 50 state emissions inventory estimates. However, 50 state emissions inventory data are not available for other emission sources. Thus, emissions estimates for other sources are based on a 48 state inventory that excludes Alaska and Hawaii. The 48 state inventory was done for air quality modeling that EPA uses to analyze regional ozone transport, of which Alaska and Hawaii are not a part. In cases where land-based nonroad diesel engine emissions are summed or compared with other emissions sources, we use a 48 state emissions inventory.

[77] For the purpose of this proposal, land-based nonroad diesel engines include engines used in equipment modeled by the draft NONROAD emissions model, except for recreational marine engines. Recreational marine diesel engines are not subject to the exhaust emission standards contained in this proposal but would be affected by the fuel sulfur requirements applicable to locomotive and commercial marine vessel engines.

[78] The air quality modeling results described in Sections II.B and II.C use a slightly different emissions inventory based on earlier, preliminary modeling assumptions. Chapter 3 of the draft RIA and the technical support documents fully describe this inventory, as well as the differences between it and the inventory reflecting the proposal.

diesel $PM_{2.5}$ in the years 1996, 2020 and 2030.[79]

TABLE II.E-1 – BASE-CASE NATIONAL (48 STATE) DIESEL $PM_{2.5}$ (SHORT TONS)

Year	Total Diesel $PM_{2.5}$	Nonroad Land-Based Diesel $PM_{2.5}$	Nonroad Land-Based Percent of Total Diesel $PM_{2.5}$
1996	416,000	177,000	42%
2020	207,000	124,000	60%
2030	222,000	140,000	63%

The contribution of land-based nonroad CI engines to $PM_{2.5}$ inventories can be significant, especially in densely populated urban areas.[80] As illustrated in Table II.E.-2, our city-specific analysis of selected metropolitan areas for 1996 and 2020 shows that the land-based nonroad diesel engine contribution to total $PM_{2.5}$ ranges up to 18 percent in 1996 and 19 percent in 2020.[81]

79 Nitrate and sulfate secondary fine particulate as described in Section II.B and are not included in the values reported here or elsewhere, but are discussed in the Regulatory Impact Analysis, Chapter X.

80 Construction, industrial, and commercial nonroad diesel equipment comprise most of the land-based nonroad emissions inventory. These types of equipment are more concentrated in urban areas where construction projects, manufacturing, and commercial operations are prevalent. For more information, please refer to the report, "Geographic Allocation of State Level Nonroad Engine Population Data to the County Level," NR-014b, EPA 420-P-02-009.

81 We selected these cities to show a collection of typical cities spread across the United States in order to compare typical urban inventories with national average ones.

TABLE II.E-2 – LAND-BASED NONROAD PERCENT CONTRIBUTION TO $PM_{2.5}$ INVENTORIES IN SELECTED URBAN AREAS IN 1996 AND 2020

MSA, State	Land-Based Nonroad $PM_{2.5}$ Contribution to Total $PM_{2.5}$ [a] in 1996	Land-Based Nonroad $PM_{2.5}$ Contribution to Total $PM_{2.5}$ [a] in 2020
Atlanta, GA	7%	6%
Boston, MA	18%	18%
Chicago, IL	8%	7%
Dallas-Ft. Worth, TX	13%	10%
Indianapolis, IN	15%	13%
Minneapolis-St. Paul, MN	10%	8%
New York, NY	13%	12%
Orlando, FL	14%	12%
Sacramento, CA	7%	7%
San Diego, CA	9%	7%
Denver, CO	11%	8%
El Paso, TX	15%	19%
Las Vegas, NV	15%	12%
Phoenix-Mesa, AZ	15%	12%
Seattle, WA	7%	7%
National Average[b]	**8%**	**6%**

[a] Includes only direct exhaust emissions; see Section II.C for a discussion of secondary fine PM levels.
[b] This is a 48 state national average.

Emissions of $PM_{2.5}$ from land-based nonroad diesel engines based on a 50 state inventory are shown in Table II.E-3, along with our estimates of the reductions in 2020 and 2030 we expect would result from our proposal for a $PM_{2.5}$ exhaust emission standard and changes in the sulfur level in nonroad diesel fuel. For comparison purposes, $PM_{2.5}$ emissions based on lowering nonroad diesel fuel sulfur levels to about 340 ppm in-use[82] (500 ppm maximum) without any other controls are shown, along with the estimated emissions with the proposed $PM_{2.5}$ standard and a sulfur level of 11 ppm in-use (15 ppm maximum). Figure II.E-1 shows our estimate of

[82] This value (340 ppm) represents the average in-use sulfur concentration of fuel produced to meet a 500 ppm sulfur standard. In practice, off-highway equipment will sometimes be refueled with diesel fuel meeting the more stringent highway standard of 15 ppm. Therefore, the actual average in-use sulfur level of the fuel used by off-highway equipment will be somewhat lower than 340 ppm. The emission benefits shown here reflect this lower in-use sulfur level.

$PM_{2.5}$ emissions between 2000 and 2030 both without and with the proposed $PM_{2.5}$ standard (along with an assumed sulfur level of 11 ppm in-use, 15 ppm maximum). By 2030, we estimate that $PM_{2.5}$ emissions from this source would be reduced by 86 percent in that year.

TABLE II.E-3 – ESTIMATED NATIONAL (50 STATE) REDUCTIONS IN $PM_{2.5}$ EMISSIONS FROM NONROAD LAND-BASED DIESEL ENGINES

Year	$PM_{2.5}$* Without Rule [short tons]	$PM_{2.5}$ With 500 ppm Fuel Sulfur (340 in-use) and No Other Controls [short tons]	$PM_{2.5}$ Reductions With 500 ppm Fuel Sulfur (340 in-use) and No Other Controls [short tons]	$PM_{2.5}$ With Rule (15 ppm sulfur level, 11 in-use) [short tons]	$PM_{2.5}$ Reductions With Rule (15 ppm sulfur level, 11 in-use) [short tons]
2020	125,000	108,000	17,000	45,000	80,000
2030	140,000	120,000	20,000	19,000	121,000

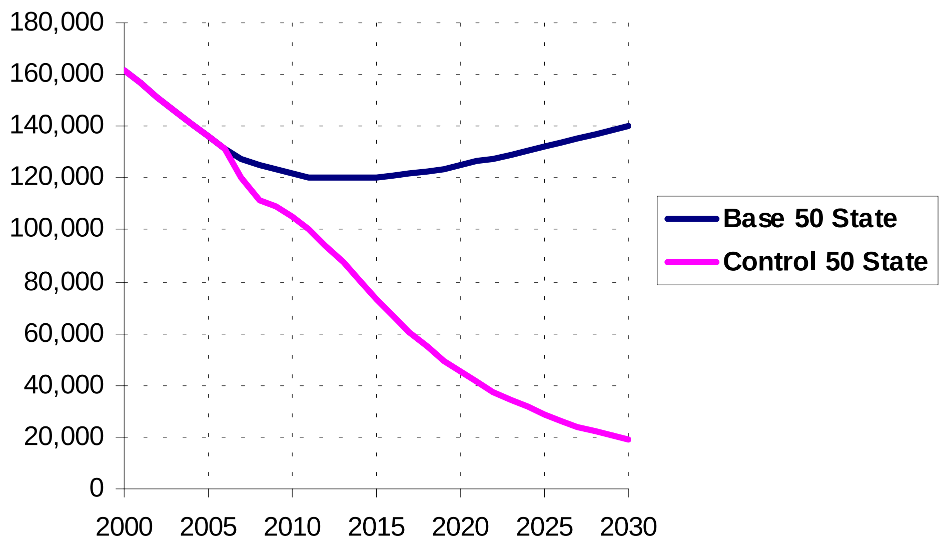

Figure II.E-1: Estimated Reductions in PM2.5 Emissions From Land-Based Nonroad Diesel Engines (tons/year)

Nonroad diesel engines used in locomotives, commercial marine vessels, and recreational marine vessels are not affected by the emission standards of this proposal. $PM_{2.5}$ emissions from these engines would be reduced by the reductions in diesel fuel sulfur for these types of engines from an in-use average of between 2,300 and 2,400 ppm today to an in-use average of about 340 ppm (500 ppm maximum) in 2007. The estimated reductions in $PM_{2.5}$ emissions from these engines based on the proposed change in diesel fuel sulfur are about 6,000 tons in 2020 and 7,000 tons in 2030.[83] For more information on proposed fuel sulfur reductions, please see Chapter X, Section X.X of the draft RIA.

2. NOx

Table II.E-4 shows the 50 state estimated tonnage of NOx emissions for 2020 and 2030 without the proposed rule and the estimated tonnage of emissions eliminated with the proposed rule in place. These results are shown graphically in Figure II.E-2. By 2030, we estimate that NOx emissions from these engines will be reduced by 67 percent in that year.

TABLE II.E.-4 – ESTIMATED NATIONAL (50 STATE) REDUCTIONS IN NOX EMISSIONS FROM NONROAD LAND-BASED DIESEL ENGINES

Calendar Year	NOx Without Rule [short tons]	NOx With Rule [short tons]	NOx Reductions With Rule [short tons]
2020	1,147,000	640,000	507,000
2030	1,239,000	412,000	827,000

[83] These reductions are based on a 50 state emissions inventory estimate.

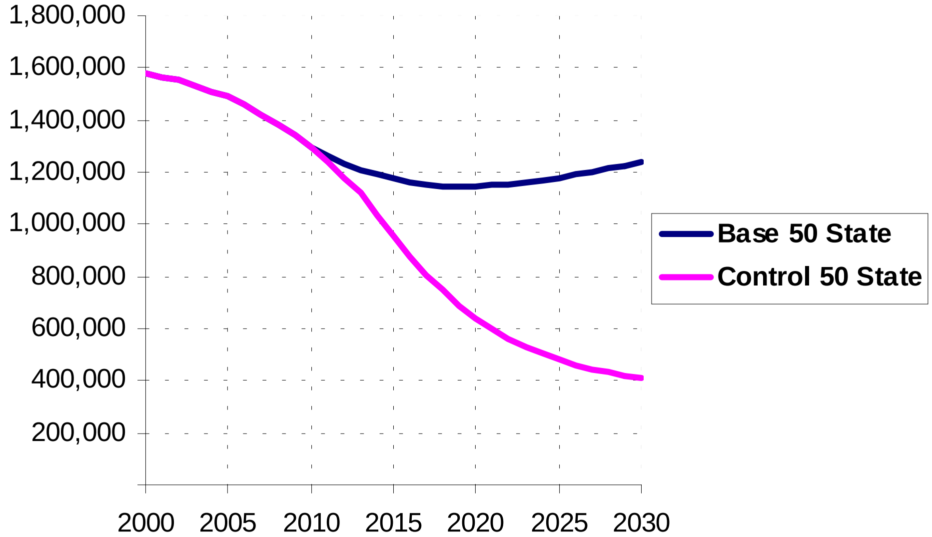

Figure II.E-2: Estimated Reductions in NOx Emissions From Land-Based Nonroad Diesel Engines (tons/year)

Table E.II-5 shows that the engines affected by the proposal emit a significant portion of total NOx emissions in 1996 and 2020, especially in cities. This is not surprising given the high density of these engines operating in urban areas.[84] We selected a variety of cities from across the nation and found that these engines contribute up to 14 percent of the total NOx inventories in 1996 and as much as 20 percent to total NOx inventories in 2020.[85]

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[84] Construction, industrial, and commercial nonroad diesel equipment comprise most of the land-based nonroad emissions inventory. These types of equipment are more concentrated in urban areas where construction projects, manufacturing, and commercial operations are prevalent. For more information, please refer to the report, "Geographic Allocation of State Level Nonroad Engine Population Data to the County Level," NR-014b, EPA 420-P-02-009.

[85] We selected these cities to show a collection of typical cities spread across the United States in order to compare typical urban inventories with national average ones.

TABLE II.E-5 – LAND-BASED NONROAD PERCENT CONTRIBUTION TO NOX INVENTORIES IN SELECTED URBAN AREAS IN 2020

MSA, State	Land-Based NR NOx as Percentage of Total NOx in 1996	Land-Based NR NOx as Percentage of Total NOx in 2020
Atlanta, GA	5%	7%
Boston, MA	14%	19%
Chicago, IL	6%	7%
Dallas-Fort Worth, TX	10%	13%
Indianapolis, IN	8%	12%
Minneapolis-St. Paul, MN	6%	6%
New York, NY	11%	20%
Orlando, FL	10%	13%
Sacramento, CA	10%	19%
San Diego, CA	9%	14%
Denver, CO	8%	8%
El Paso, TX	8%	15%
Las Vegas, NV-AZ	11%	12%
Phoenix-Mesa, AZ	9%	11%
Seattle, WA	8%	11%
National Average [a]	**6%**	**7%**

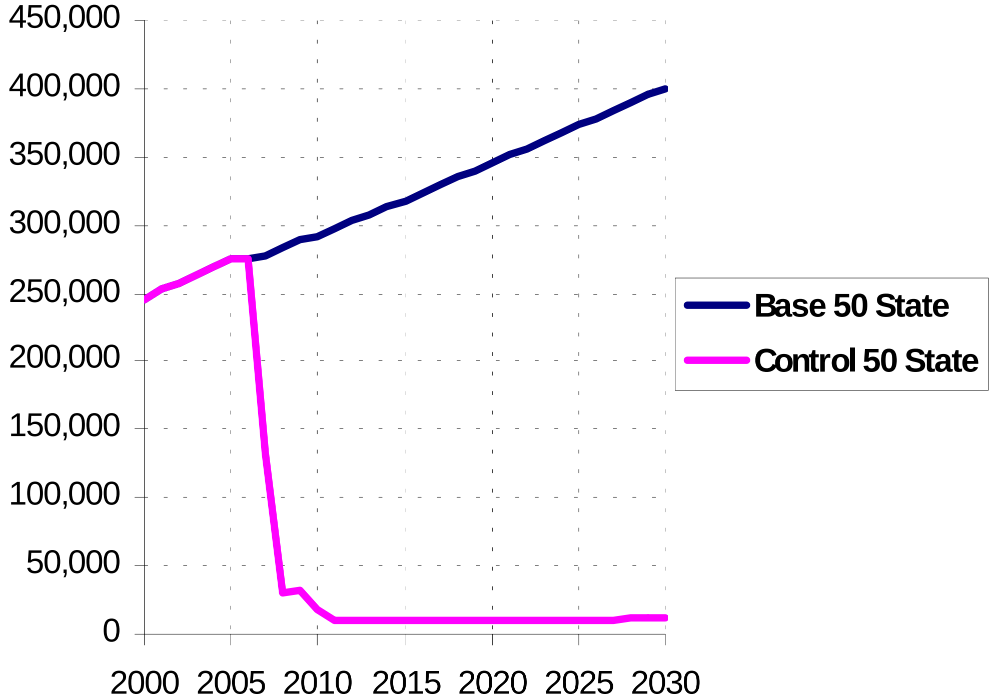
[a] This is a 48 state national average.

3. SO_2

We estimate that land-based nonroad, CMV, RMV, and locomotive diesel engines emitted about 227,000 tons of SO_2 in 1996, accounting for about 30 percent of the SO_2 from mobile sources (based on a 48 state inventory). With no reduction in diesel fuel sulfur levels, we estimate that these emissions will continue to increase, accounting for about 60 percent of mobile source SO_2 emissions by 2030.

As part of this proposal, sulfur levels in fuel would be significantly reduced, leading to large reductions in nonroad diesel SO_2 emissions. By 2007, the sulfur in diesel fuel used by all nonroad diesel engines would be reduced from the current average in-use level of between 2,300 and 2,400 ppm to an average in-use level of about 340 ppm with a maximum level of 500 ppm. By 2010, the sulfur in diesel fuel used by land-based nonroad engines would be reduced to an average in-use level of 11 ppm with a maximum level of 15 ppm. The sulfur in diesel fuel used by locomotives, CMVs, and RMVs would remain at an average in-use level of about 340 ppm. Figure II.E-3 shows the estimated reductions from these sulfur changes. For more information on this topic, please see Chapter 7 of the RIA.[86]

FIGURE II.E-3 – ESTIMATED SO2 REDUCTIONS FROM REDUCING DIESEL SULFUR FOR LAND-BASED NONROAD ENGINES, CMVS, RMVS, AND LOCOMOTIVES (TONS/YEAR)



[86] Under this proposal, the introduction of 340 ppm (approximate average in-use level, 500 ppm maximum)) sulfur diesel fuel for all nonroad diesel engines would take place in June of 2007. The introduction of 11 ppm sulfur diesel fuel (average in-use, 15 ppm maximum) for land-based nonroad engines would take place in June 2010.

Table II.E-6 shows 50 state estimates of total SO_2 emissions without the proposed rule and how SO_2 emissions would be reduced by the diesel fuel sulfur reductions in 2020 and 2030.

TABLE II.E-6 – ESTIMATED NATIONAL (50 STATE) EMISSIONS OF LAND-BASED NONROAD, LOCOMOTIVE, COMMERCIAL MARINE VESSEL, AND RECREATIONAL MARINE VESSEL SO_2 EMISSIONS FROM LOWERING DIESEL FUEL SULFUR LEVELS

Year	Total SO_2 Emissions at 2400 ppm Sulfur Without Proposed Rule [short tons]	500 ppm Sulfur (340 ppm in-use) Locomotives, CMVs, RMVs [a] [short tons]	500 ppm Sulfur (340 in-use) Land-Based Nonroad [short tons]	15 ppm Sulfur (11 ppm in-use) Land-Based Nonroad [short tons]
1996	229,000			
2020	345,000	9,000	26,000	1,000
2030	401,000	10,000	30,000	1,000

[a] CMV = commercial marine vessels, RMV = Recreational marine vessels

4. VOC and Air Toxics

Based on a 48 state emissions inventory, we estimate that land-based nonroad diesel engines emitted over 221 thousand tons of VOC in 1996. Between 1996 and 2030, we estimate that land-based nonroad diesel engines will contribute about 2 to 3 percent to mobile source VOC emissions. Without further controls, land-based nonroad diesel engines will emit over 97 thousand tons/year of VOC in 2020 and 2030 nationally.[87]

Tables II.E-7 shows our projection of the reductions in 2020 and 2030 for VOC emissions that we expect from implementing the proposed NMHC standards. This estimate is based on a 50 state emissions inventory. By 2030, VOC reductions would be reduced by 30 percent.

[87] VOC emissions remain about the same in 2030 as 2020 because the nonroad diesel emission factors decrease and newer engines continue to be introduced into the fleet, but engine/equipment population continues to increase. The increase in engine/equipment population offsets the effect of decreasing emission factors.

TABLE II.E-7 – ESTIMATED NATIONAL (48 STATE) REDUCTIONS IN VOC EMISSIONS FROM NONROAD LAND-BASED DIESEL ENGINES

Calendar Year	VOC Without Rule [short tons]	VOC With Rule [short tons]	VOC Reductions With Rule [short tons]
2020	97,000	79,000	18,000
2030	98,000	68,000	30,000

Air toxics pollutants are in VOCs and are included in the total land-based nonroad diesel VOC emissions estimate. We base these numbers on the assumption that air toxic emissions are a constant fraction of hydrocarbon exhaust emissions.

Although we are not proposing any specific gaseous air toxics standards, air toxics emissions would nonetheless be reduced through NMHC standards included in the proposed rule. By 2030, we estimate that emissions of air toxics pollutants, such as benzene, formaldehyde, acetaldehyde, 1,3-butadiene, and acrolein, would be reduced by 30 percent from land-based nonroad diesel engines. In Section II.B.2 we discuss the health effects of these pollutants.

III. Nonroad Engine Standards

In this section we describe the nonroad diesel emission standards we are proposing in order to address the serious air quality problems discussed in Section II. Specifically, we discuss:

- The Clean Air Act and why we are proposing new emission standards.
- The technology opportunity for nonroad diesel emissions control.
- Our proposed engine standards, and our proposed schedule for implementing them.
- Proposals for supplemental test requirements to help control emissions during transient operating modes and engine start-up.
- Proposals and future plans to help ensure robust emissions control in use.
- The feasibility of the proposed standards (in conjunction with the proposed low-sulfur nonroad diesel fuel requirement discussed in section IV).
- How diesel fuel sulfur affects an engine's ability to meet the proposed standards.
- Plans for a future reassessment of the technology needed to comply with proposed standards for engines below 75 hp.

Additional program provisions being proposed for engine and equipment manufacturers are discussed in detail in section VII. Briefly, these include changes to our averaging, banking, and trading (ABT) program, changes to our flexibility program for equipment manufacturers, special provisions to aid small businesses in implementing our requirements, and an incentive program to encourage innovative technologies and the early introduction of new technologies.

We welcome comment on all facets of this discussion, including the levels and timing of the proposed emissions standards and our assessment of technological feasibility, as well as on the supporting analyses contained in the Draft Regulatory Impact Analysis (RIA). We also request comment on the timing of the proposed diesel fuel standard in conjunction with these proposed emission standards. We ask that commenters provide any technical information that supports the points made in their comments.

A. Why are We Setting New Engine Standards?

1. The Clean Air Act and Air Quality

We believe that Agency action is needed to address the air quality problems discussed in section II. We are therefore proposing new engine standards and related provisions under sections 213(a)(3) and (4) of the Clean Air Act which, among other things, direct us to establish (and from time to time revise) emission standards for new nonroad diesel engines. Because these engines contribute greatly to a number of serious air pollution problems, especially the health and welfare effects of ozone, PM, and air toxics, we believe that the air quality need for stringent nonroad diesel standards is well established. This, and our belief that a significant degree of emission reduction from these engines is achievable through the application of diesel emission control technology that will be available in the lead time provided (giving appropriate consideration to cost, noise, safety, and energy factors as required by the Act), along with coordinated reductions in nonroad diesel fuel sulfur levels, leads us to believe that these new emission standards are warranted and appropriate.

We also believe that the proposed engine standards are consistent with the Clean Air Act Section 213(a) requirements on availability of technology. The basis for our conclusion is described in this section and in the Draft Regulatory Impact Analysis

2. The Technology Opportunity for Nonroad Diesel Engines

Substantial progress has been made in recent years in controlling diesel exhaust emissions through the use of robust, high-efficiency catalytic devices placed in the exhaust system. Particularly promising are the catalytic soot filter or particulate trap for PM and hydrocarbon control, and the NOx adsorber. These technologies are expected to be applied to highway heavy-duty diesel engines (HDDEs) beginning in 2007 to meet stringent new standards for these engines. The final EPA rule establishing those standards contains extensive discussion of how these devices work, how effective they are at reducing emissions, and what their limitations are, particularly their dependence on very-low sulfur diesel fuel to function properly (66 FR 5002, January 18, 2001; see especially Section III of the preamble starting at 5035). Reviews of ongoing progress in the development of these technologies have recently been performed by EPA and by an independent review panel.[88, 89] These reviews found that good progress has been made since the final rule was published, reinforcing our confidence that the highway engine standards can be met. (Our consideration of these highway engine standards is consistent with the requirement in Clean Air Act section 213(a)(3) that EPA consider nonroad engine standards equivalent in stringency to those adopted for comparable highway engines regulated under section 202 of the Act.)

Although there are important differences, nonroad diesel engines operate fundamentally like heavy-duty highway diesel engines. In fact, many nonroad engine designs are derived from highway engine platforms. We believe that, given the availability of very low sulfur nonroad diesel fuel and adequate development lead time, nonroad diesel engines can be designed to successfully employ the same high-efficiency exhaust emission control technologies now being

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[88] "Highway Diesel Progress Review", U.S. EPA, June 2002. EPA420-R-02-016. (www.epa.gov/air/caaac/dieselreview.pdf).

[89] "Meeting Technology Challenges For the 2007 Heavy-Duty Highway Diesel Rule", Final Report of the Clean Diesel Independent Review Subcommittee, Clean Air Act Advisory Committee, October 30, 2002. (www.epa.gov/air/caaac/diesel/finalcdirpreport103002.pdf).

developed for highway use. Indeed, some nonroad diesel applications, such as in underground mining, have pioneered the use of similar technologies for many years. These technologies, the experience gained with them in nonroad applications, the issues involved in transferring technology from highway to nonroad applications, and the appropriate standards and test procedures for this nonroad Tier 4 program are discussed in detail in the remainder of this section.

B. What Engine Standards are We Proposing?

1. Exhaust Emissions Standards

The PM, NOx, and NMHC emissions standards being proposed for nonroad diesel engines are summarized in Figures III.B-1 and 2. We are also making minor adjustments to CO standards as discussed in section III.B.1.f. All of these standards would apply to covered nonroad engines over the useful life periods described in 40 CFR 89.104, except where temporary in-use compliance margins would apply as discussed in section VII.L.[90] We are not proposing changes to useful life periods because we do not have any relevant new information that would lead us to propose changes. However, we do ask for comment on whether or not changes are warranted and, if so, on what the useful life periods should be. The testing requirements by which compliance with the standards would be measured are discussed in section III.C. In addition we are proposing new "not-to-exceed" (NTE) emission standards to help ensure robust control of emissions in use. These standards are discussed as part of a broader outline of proposed NTE provisions in sections III.D and VII.H.

[90] The useful life for engines ≥50 hp is 8,000 hours or 10 years, whichever occurs first. For engines <25 hp, and for 25-50 hp engines that operate at constant speed at or above 3000 rpm, it is 3000 hours or 5 years. For other 25-50 hp engines, it is 5000 hours or 7 years.

FIGURE III.B-1 – PROPOSED PM STANDARDS (G/BHP-HR) AND SCHEDULE

Engine Power	Model Year					
	2008	2009	2010	2011	2012	2013
hp < 25 (kW < 19)	0.30					
25 ≤ hp < 75 (19 ≤ kW < 56)	0.22 [a]					0.02
75 ≤ hp < 175 (56 ≤ kW < 130)					0.01	
175 ≤ hp ≤ 750 (130 ≤ kW ≤ 560)				0.01		
hp > 750 (kW > 560)				0.01 note b	note b	note b

[a] A manufacturer has the option of skipping the 0.22 g/bhp-hr PM standard for all 50-75 hp engines; the 0.02 g/bhp-hr PM standard would then take effect one year earlier for all 50-75 hp engines (in 2012).
[b] 50% of a manufacturer's U.S.-directed production must meet the 0.01 g/bhp-hr PM standard in this model year. In 2014, 100% must comply.

FIGURE III.B-2 – PROPOSED NOX AND NMHC STANDARDS AND SCHEDULE

Engine Power	**Standard** (g/bhp-hr)	
	NOx	NMHC
25 ≤ hp < 75 (19 ≤ kW < 56)	3.5 NMHC+NOx [a]	
75 ≤ hp < 175 (56 ≤ kW < 130)	0.30	0.14
175 ≤ hp ≤ 750 (130 ≤ kW ≤ 560)	0.30	0.14
hp > 750 (kW > 560)	0.30	0.14

Engine Power	Phase-in Schedule			
	2011	2012	2013	2014
25 ≤ hp < 75 (19 ≤ kW < 56)			100%	
75 ≤ hp < 175 (56 ≤ kW < 130)		50%	50%	100%
175 ≤ hp ≤ 750 (130 ≤ kW ≤ 560)	50%	50%	50%	100%
hp > 750 (kW > 560)	50%	50%	50%	100%

Percentages are U.S.-directed production required to comply with the Tier 4 standards in the indicated model year.
[a] This is the existing Tier 3 combined NMHC+NOx standard level for the 50-75 hp engines in this category; in 2013 it would apply to the 25-50 hp engines as well.

The proposed long-term 0.01 and 0.02 g/bhp-hr Tier 4 PM standards for >75 hp and 25-75 hp engines, respectively, combined with the fuel change and proposed new requirements to ensure robust control in the field, represent a reduction of over 95% from in-use levels expected with Tier 2/Tier 3 engines. The proposed 0.30 g/bhp-hr Tier 4 NOx standard for >75 hp engines represents a NOx reduction of roughly 90% from in-use levels expected with Tier 3 engines. The basis for the proposed standard levels is presented in section III.E.

a. Standards Timing

The timing of the Tier 4 NOx, PM, and NMHC standards is closely tied to the proposed timing of fuel quality changes discussed in section IV, in keeping with the systems approach we are taking for this program. The earliest Tier 4 standards would take effect in model year 2008, in conjunction with the introduction of 500 ppm maximum sulfur nonroad diesel fuel in mid-2007.[91] This fuel change serves a dual environmental purpose: first, it provides a large immediate reduction in PM emissions for the existing fleet of engines in the field, and second, its widespread availability by the end of 2007 aids engine designers in employing emission controls capable of achieving the proposed standards for model year 2008 and later engines, because the performance and durability of such technologies as exhaust gas recirculation (EGR) and

[91] Note that we are grouping all standards proposed in this rule under the general designation of "Tier 4 standards", including those proposed to take effect in 2008. As a result, there are no Tier 3 standards in the multi-tier nonroad program for engines below 50 hp or above 750 hp.

oxidation catalysts is improved by lower sulfur fuel.[92]

We are not, however, proposing new 2008 standards for engines at or above 100 hp because these engines are subject to existing Tier 3 NMHC+NOx standards (Tier 2 for engines above 750 hp) in 2006 or 2007. Setting new 2008 standards would provide only one or two years of Tier 3 stability before another round of design changes must be made for Tier 4. Engines between 50-100 hp also have a Tier 3 NMHC+NOx standard, but it takes effect in 2008, providing an opportunity to coordinate with Tier 4 to provide the desired pull-ahead of PM control. We believe that we can accomplish this PM pull-ahead without hampering manufacturers' Tier 3 compliance efforts by providing two Tier 4 compliance options for 50-75 hp engines (reflecting the splitting of the 50-100 hp group of engines to match the new power categories shown in Figures III.B-1 and 2). We are proposing to provide manufacturers with the option to skip the 2008 PM standard (see note a to Figure III-B.1) and instead focus design efforts on introducing PM filters for these engines one year earlier, in 2012. This option would ensure that Tier 3 compliance is not jeopardized by new Tier 4 standards in the same timeframe, if that were to become a concern for a manufacturer. Note that we are not proposing the optional 2008 PM standard for engines between 75 and 100 hp, even though they, like the 50-75 hp engines, are subject to a 2008 Tier 3 standard. This is because we believe that these larger engines, proposed to be grouped into a new 75-175 hp category, would be subject to stringent new PM and NOx standards beginning in 2012, and adding a 2008 PM component to this program for a quarter of this 75-175 hp range would complicate manufacturers' efforts to comply in 2012 for the overall category.

We view the early phase of the Tier 4 program as highly important because it provides substantial PM and SOx emissions reductions during the several years prior to 2011. Initiating Tier 4 in 2008 also fits well with the lead time and stability considerations of the overall program.[93] Initiating earliest Tier 4 standards in 2008 would provide three to four years of stability after the start of Tier 2 for engines under 50 hp. As mentioned above, it also coincides with the start date of Tier 3 NOx+NMHC standards for engines between 50 and 75 hp and so introduces no stability issue for these engines. As the Agency expects to finalize this rule in early 2004, the 2008 start date provides almost 4 years of lead time to accomplish redesign and testing. The evolutionary character of the 2008 standards, based as they are on proven technologies, and the fact that some certified engines already meet these standards as discussed

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[92] "Nonroad Diesel Emissions Standards Staff Technical Paper", EPA420-R-01-052, October 2001.

[93] Section 213(b) of the Clean Air Act does not specify a specific lead time period, nor does it explicitly require EPA to account for stability (differing in these respects from the comparable provision section (202(a)(3)(C)) applicable to highway engines). However, we consider adequate lead time and stability to be important in avoiding disruptions in the engine and equipment manufacturing industries caused by redesign mandates that are too frequent or too soon after a final rulemaking, and thus appropriate factors to consider in determining "the lead time necessary to permit the development and application of the requisite technology", as required under section 213 (b).

in section III.E leads us to conclude that this will provide adequate lead time.

The second fuel change, to 15 ppm maximum sulfur in mid-2010, and the related engine standards that begin to phase-in in the 2011 model year, provide most of the environmental benefit of the program. These standards are also timed to provide adequate lead time for manufacturers, and to phase in over time to allow for the orderly transfer of technology from the highway sector. We believe that the high-efficiency exhaust emission technologies being developed to meet our 2007 emission standards for heavy-duty highway diesel engines can be adapted to nonroad diesel applications. The engines for which we believe this adaptation from highway applications will be most straightforward are those in the over 175 hp power range, and thus under our proposal these engines would be subject to new standards requiring high-efficiency exhaust emission controls as soon as the 15 ppm sulfur diesel fuel is widely available, that is, in the 2011 model year. Engines between 75 and 175 hp would be subject to the new standards in the following model year, 2012, reflecting the greater effort involved in adapting highway technologies to these engines. Lastly, engines between 25 and 75 hp would be subject to the new PM standard in 2013, reflecting the even greater challenge of adapting PM filter technology to these engines which typically do not have highway counterparts. There are additional phase-in provisions discussed in section III.B.1.b aimed at further drawing from the highway technology experience.

In addition to addressing technology transfer, this approach also reflects the need to distribute the workload for engine and equipment redesign over three model years, as was provided for in Tier 3. Overall, this approach provides 4 to 6 years of real world experience with the new technology in the highway sector, involving millions of engines (in addition to the several additional years provided by demonstration fleets already on the road), before the new standards take effect.

b. Phase-In of NOx and NMHC Standards

Because the Tier 4 NOx emissions control technology (like PM control technology) is expected to be derived from technology first introduced in highway HDDEs, we believe that the implementation of the Tier 4 NOx standard should follow the pattern we adopted for the highway program. This will help to ensure a focused, orderly drive toward robust high-efficiency NOx control in the nonroad sector and will also help to ensure that manufacturers take maximum advantage of the highway engine development program, with resulting cost savings. The heavy-duty highway rule allows for a gradual phase-in of the NOx and NMHC requirements (though not the PM requirement for most power categories) over multiple model years: 50 percent of each manufacturer’s U.S. sales fleet must meet the new standard in 2007-2009, and 100 percent must do so by 2010. We also provided flexibility for highway engine manufacturers to meet that program’s environmental goals by allowing somewhat less-efficient NOx controls on more than 50% of their sales before 2010 via emissions averaging. Thus we are proposing to phase in the NOx standards for nonroad diesels over 2011-2013 as indicated in Figure III.B-2, based on compliance with the Tier 4 standards for 50% of a manufacturer's U.S.-directed production in each power category at or above 75 hp in each phase-in model year.

With a NOx phase-in, manufacturers who also make highway engines are able to match their highway compliance strategy if desired, and all manufacturers are able to introduce their new technologies on a limited number of engines, thereby gaining valuable experience with the technology prior to implementing it on their entire product line. In tandem with the equipment manufacturer flexibilities discussed in section VII.C, the phase-in provides a great degree of implementation flexibility for the industry while ensuring timely progress to the Tier 4 standards levels.

Note that proposing this "percent of production phase-in" to take maximum advantage of highway program technology development adds a new dimension of implementation flexibility to the staggered "phase-in by power category" used in the nonroad program for Tiers 1, 2 and 3 (but not in the HDDE program). We do not believe these two approaches are duplicative for Tier 4 because for the most part they are intended to ameliorate different potential problems (technology migration and workload), although not exclusively so. On the other hand, we recognize that these approaches are not simply additive, so some thought is required as to how they should be integrated to meet the environmental goals of the program. We propose that this is best accomplished by deferring new NOx requirements for 75-175 hp engines for the first year of the 2011-2013 phase-in (in effect creating a 0-50-50% phase-in for this category). This staggers the Tier 4 start years by power category as in past tiers: 2011 for engines at or above 175 hp, 2012 for 75-175 hp engines, and 2013 for 25-75 hp engines (for which no NOx adsorber-based standard and thus no percentage phase-in is being proposed), while still providing a production-based phase-in for NOx control. Additional special considerations for the 75-175 hp engine implementation schedule are taken up in section VII.E. We request comment on this approach to phasing in standards for 75-175 hp engines, and in particular on whether the additional third year (2014) at a 50% phase-in level that we propose to provide for other power categories is appropriate for this category as well.

Note also that we have chosen to phase in the Tier 4 NMHC standard with the NOx standard, as is being done in the highway program. Engines certified to the new NOx requirement would be expected to certify to the NMHC standard as well. As discussed in section III.E, we believe that the NMHC standard is readily achievable through the application of PM traps to meet the PM standard (which for most engines does not involve a phase-in). However, in the highway program we chose to phase the NMHC standard in with the NOx standard for administrative reasons, to simplify the phase-in under the percent-of-production approach taken there, thus avoiding subjecting the "phase-out" engines (the 50 percent not certified to the new NOx standard) to separate standards for NMHC and NMHC+NOx. The same reasoning applies here because, as in the highway program, the previous-tier standards are combined NMHC+NOx standards.

Because of the tremendous variety of engine sizes represented in the nonroad diesel sector, we are proposing that the 50 percent phase-in requirement be met separately in each of the three power categories for which a phase-in is proposed (75-175 hp, 175-750 hp, and >750 hp). For example, a manufacturer that produces 1000 engines for the 2011 U.S. market in the 175 to 750 hp range would have to demonstrate compliance to the proposed NOx and NMHC standards on at least 500 of these engines, regardless of how many complying engines the manufacturer produces in other hp categories. (However, note the proposed exceptions provided in sections VII.E and VII.F.) We believe that this restriction is needed to avoid erosion of environmental benefits that might occur if a manufacturer with a diverse product offering were to meet the phase-in with relatively low cost smaller engines, thereby delaying compliance on larger engines with much higher lifetime emissions potential. Even so, the hp ranges for these power categories are fairly broad, so this restriction allows ample freedom to manufacturers to structure compliance plans in the most cost-effective manner. We could as well choose to handle this concern by weighting complying engines by such parameters as horsepower and annual usage factors, as we do in the ABT program, but we believe that creating a simple phase-in structure based simply on counting engines, as we did in the highway HDDE rule, avoids unnecessary complexity and functional overlap with ABT.

c. PM Standards for Smaller Engines

i. <25 hp

We believe that PM filter-forcing standards should not be proposed at this time for very small diesel engines, those below 25 hp. Although we are convinced that this technology could be adapted to these engines, the cost of doing so with known technology could be unacceptably high, relative to the cost of producing the engines themselves. Based on past experience, we are hopeful that advancements in reducing these costs will occur over time, and therefore we do not believe it appropriate to make a final determination regarding the long-term standards for these engines. Instead we plan to reassess the appropriate long-term standards in a technology review as discussed in section III.G. For the nearer-term, we believe that other proven PM-reducing technologies such as diesel oxidation catalysts and engine optimization can be applied to engines under 25 hp for very cost-efficient PM control, as discussed in sections III.E and V.A. When implemented, the PM standard proposed in Figure III.B-1 for these engines, along with the proposed transient test cycle, will yield an in-use PM reduction of **[over 50%]** for these engines, and large reductions in toxic hydrocarbons as well. Achieving these emission reductions is very important, considering the fact that many of these smaller engines operate in close proximity to people– in mowers, portable electric power generators, skid steer loaders, and the like. We invite comment on this proposed approach to controlling harmful emissions from very small nonroad diesel engines.

ii. 25-75 hp

The proposed 2008 PM standard applies to 25-75 hp engines. For engines below 50 hp, we believe this standard is warranted because the PM standard in Tier 2, 0.45 g/bhp-hr measured on a steady-state test, does not represent the maximum achievable reduction using technology which will be available, but that (for reasons explained in section III.B.1.a) filter-based technology for these engines will not be available until the 2013 model year. The proposed 2008 PM standard for these engines should maximize reduction of PM emissions based on technology available in that year. We believe that the 2008 standards are feasible for these engines, based on the same engine or oxidation catalyst technologies feasible for engines under 25 hp in 2008, following the proposed introduction of nonroad diesel fuel with sulfur levels reduced below 500 ppm. We expect in-use PM reductions for these engines of **[over 50%]**, and large reductions in toxic hydrocarbons as well over the five model years this standard would be in effect (2008-2012). These engines will constitute a large portion of the in-use population of nonroad diesel engines for many years after 2008.

d. Rationale for Restructured Horsepower Categories

We are proposing to regroup the power categories in the proposed Tier 4 program compared to the previous tiers of standards.[94] We are doing so because this will more closely match the degree of challenge involved in transferring advanced emissions control technology from highway engines to nonroad engines. For a variety of reasons, highway engines have in the past been equipped with new emission control technologies some years before nonroad engines. As a result, the nonroad engine platforms that are directly derived from highway engine designs in turn become the lead application point for the migration of emission control technologies into the nonroad sector. Smaller and larger nonroad engines, as well as similar-sized engines that cannot directly use a highway base engine (such as farm tractor engines that are structurally part of the tractor chassis), may then employ these technologies after additional lead time for needed adaptation. This progression has been reflected in EPA standards-setting activity to date, especially in implementation schedules, in which the earliest standards are applied to engines in the most “highway-like” power categories.

Although there is not an abrupt power cutpoint above and below which the highway-derived nonroad engine families do and do not exist, we believe that 75 hp is a more appropriate cutpoint for this purpose than either of the closest previously adopted power category cutpoints of 50 or 100 hp. These two cutpoints were first adopted in a 1994 final rule that chose them in order to establish categories for a staggered implementation schedule designed to spread out development costs (59 FR at 31306, June 17, 1994). Nonroad diesels produced today with rated

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[94] The Tier 1 / 2 / 3 programs make use of 9 categories divided by horsepower: <11, 11-25, 25-50, 50-100, 100-175, 175-300, 300-600, 600-750, and >750 hp.

power above 75 hp (up to several hundred hp) are mostly variants of nonroad engine platforms with four or more cylinders and per-cylinder displacements of one liter or more. These in turn are derived from or similar to heavy-duty highway engine platforms. Even where nonroad engine models above 75 hp are not so directly derived from highway models, they typically share many common characteristics such as displacements of one liter per cylinder or more, direct injection fueling, turbocharging, and, increasingly, electronic fuel injection. These common features provide key building blocks in transferring high-efficiency exhaust emission control technology from highway to similar nonroad diesel engines.

We are therefore proposing to regroup power ratings using the 75 hp cutpoint. Some have expressed that this may somewhat complicate the transition from tier to tier and efforts to harmonize with the European Union's nonroad diesel program (which currently uses power cutpoints corresponding to 50 and 100 hp),. However, we believe that it provides substantial long-term benefits for the environment (for example, by linking NOx standard-setting to an engine technology-based 75 hp cutpoint rather than to more arbitrary 50 or 100 hp cutpoints). We will continue working with key entities to advance harmonization as this rule is developed.

Some engine manufacturers have indicated that a slightly higher cutpoint of 80 hp is a more appropriate choice for this purpose, and, given the diversity of this industry, it is not surprising that there is some disparity among manufacturers on this point, though it is worth noting the general industry consensus on the "correct" value being somewhere in the rather narrow range of 70 to 80 hp. We welcome comment on whether a slightly higher cutpoint of 80 hp or a slightly lower cutpoint of 70 hp would be more appropriate then the proposed 75 hp, and we particularly solicit engine product information that would help establish the rated power above which smaller engine platforms, not derived from highway platforms, tend to no longer play a major role in the market, and vice versa.

We are also proposing to consolidate some power categories that were created in the past to allow for variations in standards levels and timing appropriate for Tiers 1, 2 and 3 (and that remain in effect for those tiers), but which under this proposal are no longer distinct from each other with respect to standards levels and timing. These consolidations are: (1) the less than 11 hp and 11-25 hp categories into a single category of less than 25 hp, (2) the 50-100 hp category (actually the 75-100 hp portion of this category as discussed above) and 100-175 hp categories into a single category of 75-175 hp, and (3) the 175-300 hp, 300-600 hp, and 600-750 hp categories into a single category of 175-750 hp. The result is the 5 power bands shown in Figures III.B-1 and 2 instead of the former 9. This will also help to facilitate use of equipment manufacturer flexibility allowances which can be applied only within each power band (as discussed in section VII.C). We ask for comment on this regrouping, especially with regard to the appropriate power cutpoint for the typically highway-derived engine families. Again, most useful in this regard would be information showing how highway and nonroad engines in this range do or do not share common design bases.

e. Engines Above 750 hp

For engines above 750 hp we believe that additional Tier 4 implementation flexibility is warranted due to the relatively long product design cycles typical of these high-cost, low-sales volume engines and machines compared to smaller engines and machines. Accordingly, we are proposing to structure the standards implementation schedule for these engines to provide this flexibility. The long product design cycle issue is the primary reason we did not set Tier 3 standards for these engines in the 1998 rule and are not proposing to do so now. Instead, we are proposing that these engines move from the Tier 2 standards first taking effect in 2006 to Tier 4 standards beginning in 2011, providing a minimum of 5 years of stability. Moreover, we are proposing that the Tier 4 PM standard be phased in for these engines on the same 50-50-50-100% schedule as the NOx phase-in schedule (with similar added flexibility afforded by the ABT program), rather than all at once in 2011 as for engines between 175 and 750 hp. This would provide engine manufacturers with up to 8 years of design stability to address concerns associated with product design cycles and low sales volumes typical of this category. Even longer stability periods could exist for equipment manufacturers using these engines because they have their own flexibility provisions available on top of the engine standard phase-in. This is especially significant because many of these large machines are built by manufacturers who build their own engines, or who work closely with their engine suppliers, and can thus create a long-term product plan making coordinated use of engine and equipment flexibility provisions. We think that, taken together, these provisions appropriately balance need for expeditious emission reductions with issues relating to availability and cost of utilizing Tier 4 technologies for these engines and machines.

f. CO Standards

We are proposing minor changes in CO standards for some engines solely for the purpose of helping to consolidate power categories. These amount to a change for engines under 11 hp from 6.0 to 4.9 g/bhp-hr in 2008 to match the existing Tier 2 CO standard for 11-25 hp engines, and a change for engines at or above 25 hp but below 50 hp from 4.1 to 3.7 g/bhp-hr to match the existing Tier 3 CO standard for 50-75 hp engines, also in 2008. These minor proposed changes are not expected to add a notable compliance burden. Nevertheless, we expect that the use of high-efficiency exhaust emission controls will yield a substantial reduction in CO emissions, as discussed in Chapter 3 of the draft RIA.

These minor adjustments to the CO standard are based solely on our desire to simplify the administrative process for the engine manufacturers which arises from the reduction in the number of the engine power categories we have proposed for Tier 4. We are not exercising our authority to revise the CO standard for nonroad diesel engines for the purpose of improving air quality at this time, and therefore the minor adjustments we have proposed today are not based on an evaluation of the capabilities of advanced exhaust aftertreatment technology to reduce CO levels which could enable the setting of more stringent CO standards.

2. Crankcase Emissions Control

Crankcase emissions are the pollutants that are emitted in the gases that are vented from an engine's crankcase. These gases are also referred to as "blowby gases" because they result from engine exhaust from the combustion chamber "blowing by" the piston rings into the crankcase. These gases are often vented to prevent high pressures from occurring in the crankcase. Our existing emission standards require control of crankcase emissions from all nonroad diesel engines except turbocharged engines. The most common way to eliminate crankcase emissions has been to vent the blowby gases into the engine air intake system, so that the gases can be recombusted. Following the precedent we set for heavy-duty highway diesel engines in an earlier rulemaking, we made the exception for turbocharged nonroad diesel engines because of concerns about fouling that could occur by routing the diesel particulates (including engine oil) into the turbocharger and aftercooler. Our concerns are now alleviated by newly developed closed crankcase filtration systems, specifically designed for turbocharged diesel engines. These new systems are already required in parts of Europe for new highway diesel engines under the EURO III emission standards, and are expected to be used in meeting new U.S. EPA crankcase emission control standards for heavy-duty highway diesel engines beginning in 2007 (see section III.C.1.c of the preamble to the 2007 heavy-duty highway final rule).

We are therefore proposing to eliminate the exception for turbocharged nonroad diesel engines starting in the same model year that Tier 4 exhaust emission standards first apply in each power category. This is 2008 for engines below 75 hp, except for 50-75 hp engines for which a manufacturer opts to skip the 2008 PM standard. The crankcase requirement applies to “phase-in” engines above 750 hp under the 50% phase-in requirement for 2011-2013, but not to the “phase-out” engines in that power category during those years. This is an environmentally significant proposal since many nonroad machine models use turbocharged engines, and a single engine can emit over 100 pounds of NOx, NMHC, and PM from the crankcase over the lifetime of the engine.

Our existing regulatory requirement for controlling crankcase emissions from naturally-aspirated nonroad engines allows manufacturers to route the crankcase gases into the exhaust stream instead of the engine air intake system, provided they keep the combined total of the crankcase emissions and the exhaust emissions below the applicable exhaust emission standards. We are proposing to extend this allowance to the turbocharged engines as well. We are also proposing to give manufacturers the option to measure crankcase emissions instead of completely eliminating them, and adding the measured emissions to exhaust emissions in assessing compliance with exhaust emissions standards. This allowance was adopted for highway HDDEs in 2001 (see section VI.A.3 of the preamble to the 2007 heavy-duty highway final rule). As in the highway program, manufacturers choosing to use this allowance rather than to seal the crankcase would need to modify their exhaust deterioration factors or to develop separate deterioration factors to account for increases in crankcase emissions as the engine ages. Manufacturers would also be responsible for ensuring that crankcase emissions would be readily measurable in use.

C. What Test Procedure Changes Are Being Proposed?

1. Supplemental Transient Test

EPA has long recognized that nonroad diesel engines and equipment and their emissions differ significantly from their on-highway diesel counterparts and that a different or supplemental testing regime may therefore be required for nonroad diesel engines, especially for PM control. One can read, for example, the discussion in 63 FR 56983-84. However, nonroad test regulations have developed along lines similar to those of on-highway testing out of a lack of appropriate nonroad emission test duty cycles to reflect these technical and operating differences (see 63 FR 56983-84). To remedy this situation, EPA proposes to add transient test procedures to cover these operating modes which are essentially unique to nonroad engine operation as a supplement to the current steady-state nonroad diesel engine certification test procedures. At present, EPA certification regulations only require steady-state emission testing for nonroad engines and equipment.

Steady-state emission measurements give a good, but incomplete, indication of engine emissions which will be consistent with the data from manufacturers' certification prototypes. The proposed Nonroad Transient Composite (NRTC) test cycle, because it captures transient operation engine emissions over most of the available operating range of engine speed and load, represents engine operations not adequately represented by current steady-state nonroad diesel engine test procedures. This will ensure more effective control of NOx and PM during in-use transient engine operation. The transient test requirement reflects a significant improvement over current test procedures applicable to nonroad diesel engines, especially as regards the control of transient PM emissions. A transient test procedure also affords additional assurance of in-use control of emissions of NOx from some post-combustion emissions control technologies. A more detailed discussion of the benefits to engine emission control and EPA's NRTC cycle for nonroad diesel engine certification may be found in Preamble Section VII Part G, "Provisions for Test and Measurement Procedure Changes" and in Chapter 4 of the Draft RIA for this rulemaking.

The Agency is proposing today that, by 2013, all power categories of nonroad diesel engines will be required to comply (50% phase-in for engines greater than 56 kW (75 hp)) with Tier 4 emission standards on both the current steady-state and the new NRTC transient duty cycle requirements (see Preamble Chapter 3, parts A and B, and Table 3.B.1 for PM and Table 3.B.2 for NOx). Specifically, nonroad diesel engines greater than 131 kW (175 hp) must comply with a transient certification test requirement beginning in 2011 (50% phase-in for engines greater than 560 kW (750 hp)). Engines greater than 56 kW (75 hp) up to 131 kW (175 hp) must comply with transient test requirements beginning in the 2012 time frame. The balance of nonroad diesel engines must comply with transient emission test requirements by 2013.

Beginning in 2008, however, nonroad diesel engines under 56 kW (75 hp) will have the option to be certified to transient emission test requirements when they demonstrate that their engine(s) meet the Agency's new nonroad engine emission standards.

Beginning, as well, in 2008, all nonroad diesel engine manufacturers must demonstrate that their engine(s) comply with EPA's new Tier 3 PM (and shortly thereafter, a combined NOx-NMHC) emission standard. Effectively, this will require nonroad engine manufacturers to demonstrate that their engines comply with EPA's transient emission standards in-use two to four years before these same manufacturers will be required to run the NRTC transient emission test. However, EPA projects that many nonroad engine manufacturers will have chosen, by the year 2008, to redesign their engine lines only once, so that their product lines will conform to both the new nonroad certification engine emission standards and transient emission test requirement. This will be most true for engines in the 75 kW (100hp) to 131 kW (175 hp) category. These engines most resemble on-highway diesel engines and should be the earliest to benefit from the transfer of new on-highway diesel engine emission control technologies to their nonroad counterparts. As these manufacturers of larger diesel engines develop more expertise with time in controlling transient emissions in their engines, their knowledge and testing experience can filter through to the other nonroad diesel engine power categories. Many of these manufacturers will have had more access to research and testing resources overall than the manufacturers of smaller engines, as they had earlier focused on transient, on-highway engine testing.

Smaller nonroad engine manufacturers, many of which do not have a significant on-highway presence and, especially, the under 56 kW (75 hp) engine makers, will need time to adopt and adapt the new diesel technologies and test regimes. They will benefit from the later implementation date (2013) for transient engine emission test requirements. This will allow these manufacturers the time to develop needed certification experience as, for example, they lower test-to-test variability and increase test repeatability. It makes sense to have the less-prepared sections of the industry follow those in implementation who may be more prepared, given their prior testing experience, for the new transient test regulations. It is also preferable to have the smaller engine manufacturers come under transient test requirements at about the same time as the rest of the regulated community and not to have the requirement apply years earlier (2008) than for the rest of the industry.

As an alternative to testing under the NRTC cycle provisions, the Agency is proposing that nonroad diesel engine manufacturers may certify that their engines meet emission standards using EPA's Constant Speed Variable Load (CSVL) transient duty cycle.[95] The CSVL transient

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[95] Memoranda from Kent Helmer to Cleophas Jackson, "Speed and Load Operating Schedule for the Constant Speed Variable Load (CSVL) transient test cycle" Docket A-2001-28, Document ###; and "CSVL Cycle Construction", Docket A-2001-28, Document ###; and Southwest Research Institute - Final Report " No." , Docket A-2001-28, Document ###.

cycle more closely matches the speed and load engine operating characteristics of many constant-speed nonroad diesel applications than EPA's proposed NRTC cycle.[96] However, the manufacturer would be obliged to assure EPA that its engines would be used only in constant-speed applications. Further details concerning this cycle and any applicable options for the engine manufacturer at certification may be found in Preamble Section VII Part G, "Provisions for Test and Measurement Procedure Changes". A more detailed discussion of both the proposed NRTC and CSVL supplemental transient test cycles is contained in Chapter 4 of the Draft RIA for this proposal.

The Agency has discussed and refined the many parts of the NRTC cycle in collaboration with representatives of various nonroad engine manufacturers (Engine Manufacturers Association[97], European Association of Internal Combustion Engine Manufacturers (EUROMOT) and others) and regulatory bodies in both the United States, the European Community and Japan over the last several years. Discussions regarding the technical provisions of the NRTC cycle have been substantive and technically-oriented and have resulted in test procedures which have broad acceptance in many parts of the world. For example, the NRTC duty cycle has been introduced into the global agreement of Working Party on Pollution and Energy[98]. EPA expects that the supplemental transient test provisions that we are proposing will significantly reduce emissions from nonroad diesel equipment operating in real-time under transient conditions. Transient tests force the engine to operate over the whole spectrum of possible engine speed and load combinations. As opposed to sampling engine operation at the isolated operating points of steady-state emission tests, EPA's transient testing will capture emissions from the broad range of operating modes that the engine is capable of attaining, many of which are not being sampled under existing emissions regulations.

2. Cold Start Testing

EPA is proposing to include a requirement for a cold start transient test to be run in conjunction with the Agency's proposed nonroad diesel engine transient duty cycles. Once a working day, the average piece of nonroad diesel equipment will be started and will "warm" to a point of heat-stable operation. This "cold start" period may recur several times over the course of the work day, depending on the application or function of the equipment, as the unit rests, is

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[96] Memorandum from Kent Helmer to Cleophas Jackson, "Brake-specific Emissions Impact of Nonroad Diesel Engine Testing Over the NRTC, AWQ, and AW1 duty cycles", Docket A-2001-28, Document ## # .

[97] Letter from Jed Mandel of the Engine Manufacturers Association to Chet France of USEPA, Office of Transportation and Air Quality, Docket A-2001-28, Document ### .

[98] Informal Document No.2, ISO - 45th GRPE, "Proposal for a Charter for the Working Group on a New Test Protocol for Exhaust Emissions from Nonroad Mobile Machinery", 13-17 January 2003, Docket A-2001-28, Document ###.

restarted, and again "warms"to peak operating temperatures. During those periods of "cold start" operation, it is reasonable to assume that the engine is producing emissions at a higher rate than when the engine is running efficiently at a stabilized operating temperature. The proposed requirement for an additional cold start transient emissions test is meant to recognize and quantify the diesel engine emissions generated for short periods at equipment start-up and at key-on after one or more periods of inactivity on a particular piece of nonroad equipment. EPA proposes to weight the cold start emission test results as one-tenth of the total with hot-start emissions accounting for the other nine-tenths. The Agency realizes that its one-tenth weighting is technology-dependant and may be subject to increase or decrease as time and regulations bring about change in the operation of nonroad diesel engines. EPA therefore requests comment on the robustness of its weighting factor for cold start emissions under transient operation. For more detailed information on this proposal, refer to Preamble Section VII, Part G "Provisions for Other Test and Measurement Changes" and Chapter 4 of the Draft RIA for this rulemaking.

D. What is Being Done to Help Ensure Robust Control In Use?

EPA's goal is to ensure real-world emissions control over the broad range of in-use operation that can occur, rather than just controlling emissions over prescribed test cycles executed under restricted laboratory conditions. An important tool for achieving this in-use emissions control is the setting of Not-To-Exceed (NTE) emission standards, which, in this notice, the Agency is proposing to adopt for new nonroad engines. EPA is also considering two additional means of in-use emissions control that will be proposed in separate notices. These are 1) a manufacturer-run in-use emissions test program and 2) on-board diagnostics (OBD) requirements for new nonroad diesel engines. When implemented, all three of these will help assure that in-use emissions control is achieved.

1. Not-to-Exceed Requirements

EPA proposes to adopt not-to-exceed (NTE) emission standards for all new nonroad diesel engines subject to the Tier 4 emissions standards proposed in Section III. B. of this proposal. EPA already has similar NTE standards set for on-highway heavy-duty diesel engines, compression ignition marine engines, and nonroad spark-ignition engines.

NTE standards are upper emissions values for NOx, PM, CO, and NMHC that may not be exceeded over the full range of speed and load combinations commonly experienced in-use by a specific engine family. NTE standards are applicable over a wide range of normal in-use operation and ambient conditions because no engine operating in the field can follow a prescribed duty cycle and because restricted ambient conditions would not cover all real-world applications, operations or conditions.

The Agency proposes to adopt for new Tier 4 non-road diesel engines similar NTE specifications as those finalized as part of the heavy-duty on-highway diesel engine rulemaking

(66 Fed. Reg. 5001 January 18, 2001). These specifications are currently published in 40 CFR Part 86 Subpart A §86.007-11 and 40 CFR Part 86 Subpart N §86.1370-2007. Briefly, these specifications define 1.25x to 1.50x NTE multipliers to an engine family's FEL of the FTP engine emission standards and they define torque, speed, power, engine temperature, and aftertreatment temperature zones under which the engine must meet these NTE standards. The proposed FEL thresholds for transitioning from the 1.25x multiplier to the 1.5x multiplier is specified for each regulated emission below.

TABLE -- THRESHOLDS FOR APPLYING 1.25X NTE MULTIPLIER VERSUS 1.5X NTE MULTIPLIER

Emission	Apply 1.25x NTE when...	Apply 1.5x when...
NOx	NOx std or FEL≥2.00 g/kw-hr	NOx std or FEL<2.00 g/kw-hr
NMHC	NOx std or FEL≥2.00 g/kw-hr	NOx std or FEL<2.00 g/kw-hr
PM	PM std or FEL≥0.07 g/kw-hr	PM std or FEL<0.07 g/kw-hr
CO	All stds or FELs	No stds or FELs

These on-highway specifications also define a fixed minimum averaging time interval of thirty seconds over which NTE standards must be met. EPA may modify the on-highway control area (or "zone") to reflect nonroad engine operation.

In addition the Agency requests comment on the following set of NTE specifications as an alternative to those NTE provisions finalized in the on-highway rule. The Agency believes that these alternative specifications will provide for similar, if not, more robust nonroad engine compliance compared to the application of the on-highway specifications to nonroad engines. These alternative provisions have been developed to emphasize compliance over all engine operation. In addition these specifications were developed specifically to greatly simplify any on-vehicle testing for NTE compliance. Briefly, these alternative specifications would also have the same 1.25x to 1.5x NTE multipliers (same as tabulated above) to an engine family's FEL of the FTP emissions standards. However, all control areas are eliminated, so as to include all engine operation. The averaging time intervals over which NTE standards must be met are greater than the 30-second minimum set in on-highway rule, and they are variable in time but constant as a function of work. The constant averaging work interval is determined as ten percent (10%) of the total work performed by the engine over a six to twelve hour work-day. This 10% window "moves" through data at one percent (1%) increments so as to always return about ninety (90) individual data points for direct comparison to the NTE standards. Also for these alternative provisions, EPA requests comment on a 1.0x multiplier applied to an engine family's FEL of the FTP emissions standards for the overall average workday emissions. The Agency believes that a 1.0x multiplier is appropriate considering the long six to twelve hour averaging period and considering that the intention of the FTP standards is to ensure that on-average, an engine is emitting at or below the FTP standards.

Comments should address the potential exclusive use of these alternative provisions for nonroad diesel engine NTE compliance and the option to allow nonroad engine manufacturers to choose compliance under either the on-highway based NTE specifications or the alternative NTE provisions outlined here. For more detailed information on these alternative NTE provisions, refer to Preamble Chapter VII, Section G "Provisions for Test and Measurement Changes" and Chapter 4 of the draft RIA of this proposal.

2. Plans for Future In-Use Testing and Onboard Diagnostics

In addition to the proposals in this notice, EPA is currently reviewing several related regulatory provisions concerning control of emissions from nonroad diesel equipment and engines. EPA believes that there are several aspects of an effective emission control program that will benefit from further evaluation and development prior to their proposal. EPA intends to explore these provisions further in the coming months and publish a separate notice of proposed rulemaking dealing with these issues. In particular, there are two issues which will be discussed: 1) a manufacturer-run in-use emissions testing program; and 2) OBD requirements for nonroad diesel engines. However, before EPA proposes regulations in these areas, the Agency believes that it is appropriate to proceed with the current rulemaking with the expectation that these two issues will be proposed in the near future. EPA expects these programs to be in place in advance of the effective date of the standards. This will allow us to gather information and work with interested parties in a separate process regarding these issues. EPA will work with all parties involved, including states and environmental organizations, to develop robust, creative, environmentally protective and cost-effective proposals addressing these issues.

a. Manufacturer-Run In-Use Test Program

To ensure that nonroad diesel engines are meeting applicable emission standards throughout their useful lives and to sustain those emission benefits over the broadest range of in-use operating conditions, the Agency must be reasonably certain that these engines comply in-use with their certification emission standards. The Agency currently feels that a manufacturer-run in-use testing program is essential to ensure that EPA's proposed Tier 4 nonroad engine standards are achieved in actual use throughout the useful lives of the nonroad engines to which they apply. The Agency is committed to propose such a program for nonroad diesel engines in the December 2004 time frame and will co-ordinate this work with a similar proposal the Agency will promulgate for heavy-duty on-highway vehicles, expected in the June 2004 time frame. This schedule will allow time for EPA to gather information and work with all interested parties, both on-highway and nonroad. However, the Agency does feel that it is appropriate at this time to outline several elements that would make for an effective manufacturer-run in-use testing program. The Agency feels that presenting this information within this proposal helps put into context EPA's intent for setting NTE standards and their associated test procedures as part of this proposal. The elements of an effective manufacturer-run in-use testing program are presented in Chapter 4 of the draft RIA of this proposal.

b. Onboard Diagnostics

Today's notice does not propose to require onboard diagnostic (OBD) systems for non-road diesel vehicles and engines. However, EPA has committed to creating OBD requirements for Heavy-Duty On-Highway engines/ vehicles over 14,000 lbs GVWR and will develop OBD requirements for Non-Road in conjunction with or following the On-Highway OBD development. The Agency will propose Non-Road Diesel OBD requirements, along with Heavy Duty On-Highway OBD requirements, because OBD is necessary for maintaining and ensuring compliance with emission standards over the lifetime of engines. We will gather further information and coordinate with the Heavy Duty On-Highway and Non-Road diesel industry and other stakeholders to develop proposed OBD system requirements.

E. Are the Proposed New Standards Feasible?

Prior to 1990, diesel engines could be broadly grouped into two categories; indirect-injection (IDI) diesel engines that were relatively inexpensive while providing somewhat better fuel economy compared to gasoline engines, and direct-injection (DI) diesel engines that were substantially more expensive but which offered better fuel economy. The majority of diesel engines fell into the first category, especially in the case of passenger cars, smaller heavy-duty trucks and most nonroad engines below 200 horsepower.

Diesel engine technology has changed rapidly since the early 1990s with the widespread use of electronics, onboard computers and the rise to preeminence of turbocharged direct-injection diesel engines. While some IDI engines remain, especially in the low horsepower portion of the nonroad market, most new diesel engines (including higher horsepower nonroad diesel engines) are turbocharged and direct-injected. Today's diesel engine has significantly improved, compared to historic engines with regard to issues of most concern to the user including noise, vibration, visible smoke emissions, startability, and performance. At the same time environmental benefits have also been realized with lower NOx emissions, lower PM emissions, and improving fuel economy. These changes have been most pronounced for smaller diesel engines applied in passenger cars and light heavy trucks. Acceptance of the technology by the public, especially in Europe, has lead to a rapid increase in diesel use for smaller vehicles with diesel sales for passenger cars exceeding 50 percent in some countries.

At the end of the 1990s continuing concern regarding the serious risk to public health and welfare from diesel emissions and the emergence of new emission control technologies enabled by low sulfur fuels led policy makers to set new future diesel fuel specifications and to set challenging new diesel emission standards for on-highway vehicles. In the United States, the

EPA has set stringent new diesel emission standards for heavy-duty on-highway engines which will go into effect in 2007. These new standards are predicated on the use of Catalyzed Diesel Particulate Filters (CDPFs) which when used with less than 15ppm sulfur diesel fuel can reduce PM emissions by well over 90%, and on the use of NOx adsorber catalyst technology which when used with less than 15 ppm diesel fuel can reduce NOx emissions by more than 90%. When these technologies are fully implemented, the resulting diesel engine emissions will be 98% lower than the levels common to these diesel engines before 1990.

EPA has been conducting an ongoing technology progress review to measure industry progress to develop and introduce the needed clean fuel and clean engine technologies by 2007. The first in what will be a series of reports was published by EPA in June of 2002.[99] In the report, we concluded that technology developments by industry were progressing rapidly and that the necessary catalyzed diesel particulate filter and NOx adsorber technologies would be available for use by 2007.

Nonroad diesel engines are fundamentally similar to on-highway diesel engines. As noted above in section III.B, in many cases, virtually identical engines are certified and sold for use in on-highway vehicles and nonroad equipment. Thus, emission control technologies developed for diesel engines can in general be applied to both on-highway and nonroad engines giving appropriate considerations to unique aspects of each application.

Today, we are proposing to set stringent new standards for a broad category of nonroad diesel engines. At the same time we are proposing to dramatically lower the sulfur level in nonroad diesel fuel ultimately to 15 ppm. We believe these standards are feasible given the availability of the clean 15 ppm sulfur fuel and the rapid progress to develop the needed emission control technologies. We acknowledge that these standards will be challenging for industry to meet in part due to differences in operating conditions and duty cycles for nonroad diesel engines. Also, we recognize that transferring and effectively applying these technologies, which have largely been developed for on-highway engines, will require additional lead time. We have given consideration to these issues in determining the appropriate timing and emission levels for the standards proposed today.

The following sections will discuss how these technologies work, issues specific to the application of these technologies to new nonroad engines, and why we believe that the emission standards proposed here are feasible. A more in-depth discussion of these technologies can be found in the draft RIA associated with this proposal, in the final RIA for the HD2007 emission

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[99] Highway Diesel Progress Review, United States Environmental Protection Agency, June 2002, EPA 420-R-02-016, Air Docket A-2001-28.

standards and in the recently completed 2002 Highway Diesel Progress Review.[100] The following discussion summarizes the more detailed discussion found in the Draft RIA.

1. Technologies to Control NOx and PM Emissions from Mobile Source Diesel Engines

Present mobile source rules control the emissions of non-methane hydrocarbons (NMHC), oxides of nitrogen (NOx), carbon monoxide (CO), air toxics and particulate matter (PM) from diesel engines. Of these, PM and NOx emissions are typically the most difficult to control. CO and NMHC emissions are inherently low from diesel engines and under most conditions are not problematic to control. NMHC emissions also serve as a proxy for some of the air toxic emissions from these engines, since many air toxics are a component of NMHC and are typically reduced in proportion to NMHC reductions. Most diesel engine emission control technologies are designed to reduce PM and NOx emissions without increasing CO and NMHC emissions above the already low diesel levels. Technologies to control PM and NOx emissions are described below separately. We also discuss the potential for these technologies to decrease CO and NMHC emissions as well as their potential to reduce emissions of air toxics.

a. PM Control Technologies

Particulate matter from diesel engines is made of three components;
- solid carbon soot,
- volatile and semi-volatile organic matter, and
- sulfate.

The formation of the solid carbon soot portion of PM is inherent in diesel engines due to the heterogenous distribution of fuel and air in a diesel combustion system. Diesel combustion is designed to allow for overall lean (excess oxygen) combustion giving good efficiencies and low CO and HC emissions with a small region of rich (excess fuel) combustion within the fuel injection plume. It is within this excess fuel region of the combustion that PM is formed when high temperaturesand a lack of oxygen cause the fuel to pyrolize, forming soot. Much of the soot formed in the engine is burned during the combustion process as the soot is mixed with oxygen in the cylinder at high temperatures. Any soot that is not fully burned before the exhaust valve is opened will be emitted form the engine as diesel PM.

The soot portion of PM emissions can be reduced by increasing the availability of oxygen within the cylinder for soot oxidation during combustion. Oxygen can be made more available by either increasing the oxygen content in cylinder or by increasing the mixing of the fuel and oxygen in-cylinder. A number of technologies exist that can influence oxygen content and in-

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[100] Highway Diesel Progress Review, United States Environmental Protection Agency, June 2002, EPA 420-R-02-016, Air Docket A-2001-28.

cylinder mixing including improved fuel injection systems, air management systems, and combustion system designs.[101] Many of these PM reducing technologies offer better control of combustion in general, and better utilization of fuel allowing for improvements in fuel efficiency concurrent with reductions in PM emissions. Improvements in combustion technologies and refinements of these systems is an ongoing effort for on-highway engines and for some nonroad engines where emission standards or high fuel use encourage their introduction. The application of better combustion system technologies across the broad range of nonroad engines in order to meet the new emission standards proposed here offers an opportunity for significant reductions in engine-out PM emissions and possibly for reductions in fuel consumption. The soot portion of PM can be reduced further with aftertreatment technologies as discussed later in this section.

The volatile and semi-volatile organic material in diesel PM is often simply referred to as the soluble organic fraction (SOF) in reference to a test method used to measure its level. SOF is primarily composed of engine oil which passes through the engine with no or only partial oxidation and which condenses in the atmosphere to form PM. The SOF portion of diesel PM can be reduced through reductions in engine oil consumption and through oxidation of the SOF catalytically in the exhaust.

The sulfate portion of diesel PM is formed from sulfur present in diesel fuel and engine lubricating oil that oxidizes to form sulfuric acid (H_2SO_4) and then condenses in the atmosphere to form sulfate PM. Approximately two percent of the sulfur that enters a diesel engine from the fuel is emitted directly from the engine as sulfate PM.[102] The balance of the sulfur content is emitted from the engine as SO2. Oxidation catalyst technologies applied to control the SOF and soot portions of diesel PM can inadvertently oxidize SO2 in the exhaust to form sulfate PM. The oxidation of SO2 by oxidation catalysts to form sulfate PM is often called sulfate make. Without low sulfur diesel fuel, oxidation catalyst technology to control diesel PM is limited by the formation of sulfate PM in the exhaust as discussed in more detail in section III.F below.

There are two common forms of exhaust aftertreatment designed to reduce diesel PM, the diesel oxidation catalyst (DOC) and the diesel particulate filter (DPF). DOCs reduce diesel PM

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[101] The most effective means to reduce the soot portion of diesel PM engine-out is to operate the diesel engine with a homogenous method of operation rather than the typical heterogenous operation. In homogenous combustion, also called premixed combustion, the fuel is dispersed evenly with the air throughout the combustion system. This means there are no fuel rich / oxygen deprived regions of the system where fuel can be pyrolized rather than burned. Gasoline engines are typically premixed combustion engines. Homogenous combustion is possible with a diesel engine under certain circumstances, and is used in limited portions of engine operation by some engine manufacturers. Unfortunately, homogenous diesel combustion is not possible for most operation in today's diesel engine. We believe that more manufacturers will utilize this means to control diesel emissions within the limitations of the technology. A more in-depth discussion of homogenous diesel combustion can be found in the draft RIA.

[102] Exhaust Emission Factors for Nonroad Engine Modeling– Compression-Ignition Report No. NR-009A February 13, 1998, revised June 15, 1998, Air Docket A-2001-28.

by oxidizing a small fraction of the soot emissions and a significant portion of the SOF emissions. Total DOC effectiveness to reduce PM emissions is normally limited to approximately 30 percent because the SOF portion of diesel PM for modern diesel engines is typically less than 30 percent and because the DOC increases sulfate emissions reducing the overall effectiveness of the catalyst. Limiting fuel sulfur levels to 15ppm, as we have proposed today, allows DOCs to be designed for maximum effectiveness (nearly 100% control of SOF with highly active catalyst technologies) since their control effectiveness is not reduced by sulfate make (i.e., there sulfate make rate is high but because the sulfur level in the fuel is low the resulting PM emissions are well controlled). DOCs are also very effective at reducing the air toxic emissions from diesel engines. Test data shows that emissions of toxics such as polycyclic aromatic hydrocarbons (PAHs) can be reduced by more than 80 percent with a DOC.[103] DOCs also significantly reduce (by more than 80 percent) the already low HC and CO emissions of diesel engines.[104] DOCs are ineffective at controlling the solid carbon soot portion of PM. Therefore, even with 15 ppm sulfur fuel DOCs would not be able to achieve the level of PM control needed to meet the standard proposed today.

DPFs control diesel PM by capturing the soot portion of PM in a filter media, typically a ceramic wall flow substrate, and then by oxidizing (burning) it in the oxygen-rich atmosphere of diesel exhaust. The SOF portion of diesel PM can be controlled through the addition of catalytic materials to the DPF to form a catalyzed diesel particulate filter (CDPF).[105] The catalytic material is also very effective to promote soot burning. This burning off of collected PM is referred to as “regeneration.” In aggregate over an extended period of operation, the PM must be regenerated at a rate equal to or greater that its accumulation rate, or the DPF will clog. For a non-catalyzed DPF the soot can regenerate only at very high temperatures, in excess of 600˚C, a temperature range which is infrequently realized in normal diesel engine operation (for many engines exhaust temperatures may never reach 600˚C). With the addition of a catalytic coating to make a CDPF, the temperature necessary to ensure regeneration is decreased significantly to approximately 250˚C, a temperature within the normal operating range for most diesel engines.[106]

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[103] “Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-Duty Engines to Achieve Low Emission Levels”, Manufacturers of Emission Controls Association, June 1999 Air Docket A-2001-28.

[104] “Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-Duty Engines to Achieve Low Emission Levels”, Manufacturers of Emission Controls Association, June 1999 Air Docket A-2001-28.

[105] With regard to gaseous emissions such as NMHCs and CO, the CDPF works in the same manner with similar effectiveness as the DOC (i.e., NMHC and CO emissions are reduced by more than 80 percent).

[106] Reference one of the JM SAE papers or the DECSE report?

However, the catalytic materials that most effectively promote soot and SOF oxidation are significantly impacted by sulfur in diesel fuel. Sulfur both degrades catalyst oxidation efficiency (i.e. poisons the catalyst) and forms sulfate PM. Both catalyst poisoning by sulfur and increases in PM emissions due to sulfate make influence our decision to limit the sulfur level of diesel fuel to 15 ppm as discussed in greater detail in section III.F.

Filter regeneration is affected by catalytic materials used to promote oxidation, sulfur in diesel fuel, engine-out soot rates, and exhaust temperatures. At higher exhaust temperatures soot oxidation occurs at a higher rate. Catalytic materials accelerate soot oxidation at a single exhaust temperature compared to non-catalyst DPFs, but even with catalytic materials increasing the exhaust temperature further accelerates soot oxidation.

Having applied 15 ppm sulfur diesel fuel and the best catalyst technology to promote low temperature oxidation (regeneration), the regeneration balance of soot oxidation equal to or greater than soot accumulation over aggregate operation simplifies to: are the exhaust temperatures high enough on aggregate to oxidize the engine out PM rate?[107] The answer is yes, for most highway applications and many nonroad applications, as demonstrated by the widespread success of retrofit CDPF systems for nonroad equipment and the use of both retrofit and original equipment CDPF systems for on-highway vehicles.[108,109,110] However, it is possible that for some nonroad applications the engine out PM rate may exceed the soot oxidation rate even with low sulfur diesel fuel and the best catalyst technologies. Should this occur, successful regeneration requires that either engine out PM rates be decreased or exhaust temperatures be increased, both feasible strategies. In fact, we expect both to occur as highway based technologies are transferred to nonroad engines. As discussed earlier, engine technologies to lower PM emissions while improving fuel consumption are continuously being developed and refined. As these technologies are applied to nonroad engines driven by both new emission standards and market pressures for better products, engine out PM rates will decrease. Similarly, techniques to raise exhaust temperatures periodically in order to initiate soot oxidation in a PM filter have been developed for on-highway diesel vehicles as typified by the PSA system used on

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[107] If the question was asked, "without 15 ppm sulfur fuel and the best catalyst technology, are the exhaust temperatures high enough on aggregate to oxidize the engine out PM rate?" the answer would be no, for all but a very few nonroad or on-highway diesel engines.

[108] "Particulate Traps for Construction Machines, Properties and Field Experience," 2000, SAE 2000-01-1923, Air Docket A-2001-28

[109] Letter from Dr. Barry Cooper, Johnson Matthey, to Don Kopinski, US EPA, Air Docket A-2001-28.

[110] EPA Recognizes Green Diesel Technology Vehicles at Washington Ceremony, Press Release from International Truck and Engine Company, July 27, 2001, Air Docket A-2001-28.

more than 400,000 vehicles in Europe.[111]

During our 2002 Highway Diesel Progress Review, we investigated the plans of on-highway engine manufacturers to use CDPF systems to comply with the HD2007 emission standards for PM. We learned that all diesel engine manufacturers intend to comply through the application of CDPF system technology. We also learned that the manufacturers are developing means to raise the exhaust temperature, if necessary, to ensure that CDPF regeneration occurs.[112] These technologies include modifications to fuel injection strategies, modifications to EGR strategies, and modifications to turbocharger control strategies. These systems are based upon the technologies used by the engine manufacturers to comply with the 2004 on-highway emission standards. In general, the systems anticipated to be used by highway manufacturers to meet the 2004 emission standards are the same technologies that engine manufacturers have indicated to EPA that they will use to comply with the Tier 3 nonroad regulations (e.g., electronic fuel systems).[113] In a manner similar to highway engine manufacturers, we expect nonroad engine manufacturers to adapt their Tier 3 emission control technologies to provide back-up regeneration systems for CDPF technologies in order to comply with the standards we are proposing today. We have estimated costs for such systems in our cost analysis.

Emission levels from CDPFs are determined by a number of factors. Filtering efficiencies for solid particle emissions like soot are determined by the characteristics of the PM filter, including wall thickness and pore size. Filtering efficiencies for diesel soot can be 99 percent with the appropriate filter design.[114] Given an appropriate PM filter design the contribution of the soot portion of PM to the total PM emissions are negligible (less than 0.001 g/bhp-hr). This level of soot emission control is not dependent on engine test cycle or operating conditions due to the mechanical filtration characteristics of the particulate filter.

Control of the SOF portion of diesel soot is accomplished on a CDPF through catalytic oxidation. The SOF portion of diesel PM consists of primarily gas phase hydrocarbons in engine exhaust due to the high temperatures and only forms particulate in the environment when it condenses. Catalytic materials applied to CDPFs can oxidize a substantial fraction of the SOF in

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111 Nino, S. and Lagarrigue, M. "French Perspective on Diesel Engines and Emissions," presentation at the 2002 Diesel Engine Emission Reduction workshop in San Diego, California, Air Docket A-2001-28.

112 Highway Diesel Progress Review, United States Environmental Protection Agency, June 2002, EPA 420-R-02-016, Air Docket A-2001-28.

113 "Nonroad Diesel Emissions Standards Staff Technical Paper", EPA420-R-01-052, October 2001, Air Docket A-2001-28.

114 Miller, R. et. al, "Design, Development and Performance of a Composite Diesel Particulate Filter," March 2002, SAE 2002-01-0323, Air Docket A-2001-28.

diesel PM just as the SOF portion would be oxidized by a DOC. However, we believe that for engines with very high SOF emissions the emission rate may be higher than can be handled by a conventionally sized catalyst resulting in higher than zero SOF emissions. If a manufacturer's base engine technology has high oil consumption rates, and therefore high engine-out SOF emissions (i.e., higher than 0.04 g/bhp-hr), compliance with the 0.01 g/bhp-hr emission standard proposed today may require additional technology beyond the application of a CDPF system alone.[115]

Modern on-highway diesel engines have controlled SOF emission rates in order to comply with the existing 0.1 g/bhp-hr emission standards. Typically the SOF portion of PM from a modern on-highway diesel engine contributes less than 0.02 g/bhp-hr to the total PM emissions.[116] This level of SOF control is accomplished by controlling oil consumption through piston ring design and the use of valve stem seals.[117] Nonroad diesel engines may similarly need to control engine-out SOF emissions in order to comply with the standard proposed today. The means to control engine-out SOF emissions are well known and have additional benefits, as they decrease oil consumption reducing operating costs. With good engine-out SOF control (i.e., engine-out SOF < 0.02 g/bhp-hr) and the application of catalytic material to the DPF, SOF emissions from CDPF equipped nonroad engines will contribute only a very small fraction of the total tailpipe PM emissions (less than 0.004 g/bhp-hr). Alternatively, it may be less expensive or more practical for some applications to ensure that the SOF control realized by the CDPF is in excess of 90 percent, thereby allowing for higher engine-out SOF emission levels.

The best means to reduce sulfate emissions from diesel engines is by reducing the sulfur content of diesel fuel and lubricating oils. This is one of the reasons that we have proposed today to limit nonroad diesel fuel sulfur levels to be 15ppm or less. The catalytic material on the CDPF is crucial to ensuring robust regeneration and high SOF oxidation; however, it can also oxidize the sulfate in the exhaust with high efficiency. The result is that the predominant form of PM emissions from CDPF equipped diesel engines is sulfate PM. Even with 15ppm sulfur diesel fuel, total PM emissions can be as high as 0.009 g/bhp-hr using conventional diesel engine oils.[118] This level of emissions will allow for compliance with our proposed PM emissions

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[115] SOF oxidation efficiency is typically better than 80 percent and can be better than 90 percent. Given a base engine SOF rate of 0.04 g/bhp-hr and an 80 percent SOF reduction a tailpipe emission of 0.008 can be estimated from SOF alone. This level may be too high to comply with a 0.01 g/bhp-hr standard once the other constituents of diesel PM (soot and sulfate) are added. In this case, SOF emissions will need to be reduced engine-out or SOF control greater than 90 percent will need to be realized by the CDPF.

[116] Need reference from SAE / EPA lab testing?

[117] Can we find a paper on this back from the time of the 1998 standards xxxxxx

[118] See Table III.F.1 below

standard of 0.01 g/bhp-hr, and we believe that there is room for reductions from this level in order to provide engine manufacturers with additional compliance margin. During our 2002 Highway Progress Review, we learned that a number of engine lubricating oil companies are working to reduce the sulfur content in engine lubricating oils. Any reduction in the sulfur level of engine lubricating oils will be beneficial. Similarly, as discussed above, we expect engine manufacturers to reduce engine oil consumption in order to reduce SOF emissions and secondarily to reduce sulfate PM emissions. While we believe that sulfate PM emissions will be the single largest source of the total PM from diesel engines, we believe with the combination of technology, and the appropriate control of engine out PM, that sulfate and total PM emissions will be low enough to allow compliance with a 0.01 g/bhp-hr standard, except in the case of small engines with higher fuel consumption rates as described later in this section.

CDPFs have been shown to be very effective at reducing PM mass by reducing dramatically the soot and SOF portions of diesel PM. In addition, recent data show that they are also very effective at reducing the overall number of emitted particles when operated on low sulfur fuel. Hawker, et. al., found that a CDPF reduced particle count by over 95 percent, including some of the smallest measurable particles (< 50 nm), at most of the tested conditions. The lowest observed efficiency in reducing particle number was 86 percent. No generation of particles by the CDPF was observed under any tested conditions.[119] Kittelson, et al., confirmed that ultrafine particles can be reduced by a factor of ten by oxidizing volatile organics, and by an additional factor of ten by reducing sulfur in the fuel. Catalyzed PM traps efficiently oxidize nearly all of the volatile organic PM precursors (i.e. SOF), and the reduction of diesel fuel sulfur levels to 15ppm or less will substantially reduce the number of ultrafine PM emitted from diesel engines. The combination of CDPFs with low sulfur fuel is expected to result in very large reductions in both PM mass and the number of ultrafine particles.

As described here, the range of technologies available to reduce PM emissions is broad, extending from improvements to existing combustion system technologies to oxidation catalyst technologies to complete CDPF systems. The CDPF technology along with 15ppm or less sulfur diesel fuel is the system that we believe will allow engine manufacturers to comply with the 0.01 g/bhp-hr PM standard that we have proposed for a wide range of nonroad diesel engines. While it may be possible to apply CDPFS across the full range of nonroad diesel engine sizes, the complexity of full diesel particulate filter systems makes application to the smallest range of diesel engines difficult to accurately forecast at this time. As described in the following sections, the Agency has given consideration to the engineering complexity, cost and packaging of these systems in setting emission standards for various nonroad engine power categories.

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[119] Hawker, P., et. al., Effect of a Continuously Regenerating Diesel Particulate Filter on Non-Regulated Emissions and Particle Size Distribution, SAE 980189, Air Docket A-2001-28.

b. NOx Control Technologies

Oxides of nitrogen (NO and NO_2, collectively called NOx) are formed at high temperatures during the combustion process from nitrogen and oxygen present in the intake air. The NOx formation rate is exponentially related to peak cylinder temperatures and is also strongly related to nitrogen and oxygen content (partial pressures). NOx control technologies for diesel engines have focused on reducing emissions by lowering the peak cylinder temperatures and by decreasing the oxygen content of the intake air. A number of technologies have been developed to accomplish these objectives including fuel injection timing retard, fuel injection rate control, charge air cooling, exhaust gas recirculation (EGR) and cooled EGR. The use of these technologies can result in significant reductions in NOx emissions, but are limited due to practical and physical constraints of heterogeneous diesel combustion.[120]

A new form of diesel engine combustion, commonly referred to as homogenous diesel combustion or premixed diesel combustion, can give very low NOx emissions over a limited range of diesel engine operation. In the regions of diesel engine operation over which this combustion technology is feasible (light load conditions), NOx emissions can be reduced enough to comply with the 0.3 g/bhp-hr NOx emission standard that we have proposed today.[121] Some engine manufacturers are today producing engines which utilize this technology over a narrow range of engine operation.[122] Unfortunately, it is not possible today to apply this technology over the full range of diesel engine operation. We do believe that more engine manufacturers will utilize this alternative combustion approach in the limited range over which it is effective, but will have to rely on conventional heterogenous diesel combustion for the bulk of engine operation. Therefore, we believe that catalytic NOx emission control technologies will be required in order to realize the NOx emission standards proposed today. Catalytic emission control technologies can extend the reduction of NOx emissions by an additional 90 percent or more over conventional "engine-out" control technologies alone.

NOx emissions from gasoline-powered vehicles are controlled to extremely low levels through the use of the three-way catalyst technology first introduced in the 1970s. Three-way-catalyst technology is very efficient in the stochiometric conditions found in the exhaust of properly controlled gasoline-powered vehicles. Today, an advancement upon this well-developed three-way catalyst technology, the NOx adsorber, has shown that it too can make

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[120] Reference Flynn paper.

[121] Stanglmaier, Rudolf and Roberts, Charles "Homogenous Charge Compression Ignition (HCCI): Benefits, Compromises, and Future Engine Applications". SAE 1999-01-3682, Air Docket A-2001-28.

[122] Kimura, Shuji, et al., "Ultra-Clean Combustion Technology Combining a Low-Temperature and Premixed Combustion Concept for Meeting Future Emission Standards", SAE 2001-01-0200, Air Docket A-2001-28.

possible extremely low NOx emissions from lean-burn engines such as diesel engines.[123] The potential of the NOx adsorber catalyst is limited only by its need for careful integration with the engine and engine control system (as was done for three-way catalyst equipped passenger cars in the 1980s and 1990s) and by poisoning of the catalyst from sulfur in the fuel. The Agency set stringent new NOx standards for on-highway diesel engines beginning in 2007 predicated upon the use of the NOx adsorber catalyst enabled by significant reductions in fuel sulfur levels (15 ppm sulfur or less). In today's action, we are proposing similarly stringent NOx emission standards for nonroad engines again using technology enabled by a reduction in fuel sulfur levels.

NOx adsorbers work to control NOx emissions by storing NOx on the surface of the catalyst during the lean engine operation typical of diesel engines. The adsorber then undergoes subsequent brief rich regeneration events where the NOx is released and reduced across precious metal catalysts. The NOx storage period can be as short as 15 seconds and as along as 10 minutes depending upon engine out NOx emission rates and exhaust temperature. A number of methods have been developed to accomplish the necessary brief rich exhaust conditions necessary to regenerate the NOx adsorber technology including late-cycle fuel injection, also called post injection, in exhaust fuel injection, and dual bed technologies with off-line regeneration.[124,125,126] This method for NOx control has been shown to be highly effective when applied to diesel engines but has a number of technical challenges associated with it. Primary among these is sulfur poisoning of the catalyst as described in section III.F below. In the HD2007 RIA we identified four issues related to NOx adsorber performance: performance of the catalyst across a broad range of exhaust temperatures, thermal durability of the catalyst when regenerated to remove sulfur (desulfated), management of sulfur poisoning, and system integration on a vehicle. In the HD 2007 RIA, we provided a description of the technology paths that we believed manufacturers would use to address these challenges. We are conducting an ongoing review of industry's progress to overcome these challenges and have updated our analysis of the progress to address these issues in the draft RIA associated with today's NPRM.

One of the areas that we have identified as needing improvement for the NOx adsorber catalyst is performance at low and high exhaust temperatures. NOx adsorber performance is

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[123] NOx adsorber catalysts are also called, NOx storage catalysts (NSCs), NOx storage and reduction catalysts (NSRs), and NOx traps.

[124] Reference/Docket DDC report for DOE/consent decrees

[125] Koichiro Nakatani, Shinya Hirota, Shinichi Takeshima, Kazuhiro Itoh, Toshiaki Tanaka, and Kazuhiko Dohmae, "Simultaneous PM and NOx Reduction System for Diesel Engines.", SAE 2002-01-0957, SAE Congress March 2002, Air Docket A-2001-28.

[126] Reference EPA SAE paper (first one)

limited at very high temperatures (due to thermal release of NOx under lean conditions) and very low temperatures (due to poor catalytic activity for NO oxidation under lean conditions and low activity for NOx reduction under rich conditions) as described extensively in the draft RIA. Our review of on-highway HD2007 technologies showed that significant progress has been made to broaden the temperature range of effective NOx control of the NOx adsorber catalysts (the temperature "window" of the catalyst). Every catalyst development company that we visited was able to show us new catalyst formulations with improved performance at both high and low temperatures. Similarly, many of the engine manufacturers we visited showed us data indicating that the improvements in catalyst formulations corresponded to improvements in emission reductions over the regulated test cycles. It is clear from the data presented to EPA that the progress with regard to NOx adsorber performance has been both substantial and broadly realized by most technology developers. The importance of this temperature window to nonroad engine manufacturers is discussed in more detail later in this section.

Long term durability has been the greatest concern for the NOx adsorber catalyst. We have concluded as described briefly in III.F below and in some detail in the draft RIA, that in order for NOx adsorbers to effectively control NOx emission throughout the life of a nonroad diesel engine the fuel sulfur level will have to be maintained at or below 15 ppm, that the NOx adsorber catalyst thermal durability will need to improve in order to allow for sulfur regeneration events (since adsorber thermal degradation, "sintering," is associated with each desulfation event, the number of desulfation events should be minimized), and that system improvements will have to be made in order to allow for appropriate management of sulfur poisoning. It is in this area of durability that NOx adsorbers had the greatest need for improvement, and it is here where some of the most impressive ongoing strides in technology development have been made. During our ongoing review, we have learned that catalyst companies are making significant improvements in the thermal durability of the catalyst materials used in NOx adsorbers. Similarly, the substrate manufacturers are developing new materials that address the problem of NOx storage material migration into the susbstrate.[127] The net gain from these simultaneous improvements are NOx adsorber catalysts which can be desulfated (go through a sulfur regeneration process) with significantly lower levels of thermal damage to the catalyst function. In addition, engine manufacturers and emission control technology vendors are developing new strategies to accomplish desulfation that allow for improved sulfur management while minimizing the damage due to sulfur poisoning. It was clear in our review that the total system improvements being made when coupled with changes to catalytic materials and catalyst substrates are delivering significantly improved catalyst durability to the NOx adsorber technology.

Practical application of the NOx adsorber catalyst in a vehicle was a major concern of the industry during the HD2007 rulemaking. Nonroad equipment manufacturers have expressed

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[127] Some NOx storage materials can interact with the catalyst substrate especially at elevated temperatures making the storage material unavailable for NOx storage and weakening the substrate.

similar misgivings regarding the application of NOx adsorbers to nonroad equipment. Although there is considerable evidence that NOx adsorbers are highly effective and that durability issues can be addressed, some worry that the application of the NOx adsorber systems to vehicles and nonroad equipment will be impractical due to packaging constraints and the potential for high fuel consumption. Our review of progress has left us more certain than ever that practical system solutions can be applied to control emissions using NOx adsorbers. We have tested a diesel passenger car (one of the most difficult packaging situations) with a complete NOx adsorber and particulate filter system that demonstrated both exceptional emission control and very low fuel consumption.[128] Heavy-duty engine manufacturers have shared with us their improvements in system design and means to regenerate NOx while minimizing fuel consumption.[129] Our own in-house testing program at the National Vehicle and Fuel Emissions Laboratory (NVFEL) is developing a number of novel ideas to reduce the total system package size while maintaining high levels of emission control and low fuel consumption rates.[130] Similarly a number of Department of Energy (DOE), Advanced Petroleum Based Fuel - Diesel Emission Control (APBF-DEC) program NOx adsorber projects are working to address the system integration challenges for a diesel passenger car, a large sport utility vehicle and for a heavy heavy-duty truck.[131] By citing these numerous examples, we are not intending to imply that the challenge of integrating and packaging advanced emission control technologies is easy. Rather, we believe these examples show that even though significant challenges exist, they can be overcome through careful design and integration efforts. Nonroad equipment manufacturers have addressed similar challenges in the past when they have added additional customer features (e.g., packaged an air-conditioning system) or in accommodating other emission control technologies (e.g., charge air cooling systems).

All of the issues described above and highlighted first during the HD2007 rulemaking are likely to be concerns to nonroad engine and nonroad equipment manufacturers. We believe the challenge to overcome these issues will be as great for nonroad engines and equipment as for on-highway manufacturers and in the case of NOx adsorber temperature window perhaps greater. Yet, we have documented substantial progress by industry in the last year to overcome these challenges, and we continue to believe based on the progress we have observed that the NOx adsorber catalyst technology will be mature enough for application to many diesel engines by 2007. In the case of NOx adsorber temperature window, which we believe may be more challenging for nonroad engines, we have performed an in-depth analysis summarized below in section III.E.2 and documented in the draft RIA, that leads us to conclude the technology can be

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[128] McDonald SAE Paper # xxxxx

[129] DDC DEER NOx adsorber project

[130] Schenk memo to the docket on the four leg system

[131] Reference APBF-DEC webpage? Or interim reports?

successfully applied to nonroad engines provided there is some additional lead time for further engine and catalyst system technology development. Similarly, we acknowledge that the diverse nature and sheer number of different nonroad equipment types makes the challenge of packaging advanced emission control technologies more difficult. Therefore, we have included a number of equipment manufacturer flexibilities in the program proposed today in order to allow equipment manufacturers to manage the engineering resource challenges imposed by these regulations.

Another NOx catalyst based emission control technology is selective catalytic reduction (SCR). SCR catalysts require a reductant, ammonia, to reduce NOx emissions. Because of the significant safety concerns with handling and storing ammonia, most SCR systems make ammonia within the catalyst system from urea. Such systems are commonly called urea SCR systems. (Throughout this document the term SCR and urea SCR may be used interchangeably and should be considered as referring to the same urea based catalyst system.) With the appropriate control system to meter urea in proportion to engine-out NOx emissions, urea SCR catalysts can reduce NOx emissions by over 90 percent for a significant fraction of the diesel engine operating range.[132] Although EPA has not done an extensive analysis to evaluate its effectiveness, we believe it may be possible to reduce NOx emissions with a urea SCR catalyst to levels consistent with compliance with today's proposed NOx standards.

We have significant concerns regarding a technology that requires extensive user intervention in order to function properly and the lack of the urea delivery infrastructure necessary to support this technology. Urea SCR systems consume urea in proportion to the engine-out NOx rate. The urea consumption rate can be on the order of five percent of the engine fuel consumption rate. Therefore, unless the urea tank is prohibitively large, the urea must be replenished frequently. Most urea systems are designed to be replenished every time fuel is added or at most every few times that fuel is added. Today, there is not a system in place to deliver or dispense automotive grade urea to diesel fueling stations. One study conducted for the National Renewable Energy Laboratory (NREL), estimated that if urea were to be distributed to every diesel fuel station in the United States, the cost would be more than $30 per gallon.[133]

We are not aware of a proven mechanism that ensures that the user will replenish the urea supply as necessary to maintain emissions performance. Further, we believe given the additional cost for urea, that there will be significant disincentives for the end-user to replenish the urea because the cost of urea could be avoided without equipment performance loss. See NRDC v. EPA, 655 F. 2d 318, 332 (D.C. Cir. 1981) (referring to "behavioral barriers to periodic restoration of a filter by a [vehicle] owner" as a basis for EPA considering a technology

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[132] "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-Duty Engines to Achieve Low Emission Levels", Manufacturers of Emissions Controls Association, June 1999 Air Docket A-2001-28.

[133] Docket AD Little / NREL report.

unavailable). Due to the lack of an infrastructure to deliver the needed urea, and the lack of a track record of successful ways to ensure urea use, we have concluded that the urea SCR technology is not likely to be available for general use in the time frame of the proposed standards. Therefore, we have not based the feasibility or cost analysis of this emission control program on the use or availability of the urea SCR technology. However, we would not preclude its use for compliance with the emission standards provided that a manufacturer could demonstrate satisfactorily to the Agency that urea would be used under all conditions. We believe that only a few unique applications will be able to be controlled in a manner such that urea use can be assured, and therefore believe it is inappropriate to base a national emission control program on a technology which can serve effectively only in a few niche applications.

This section has described a number of technologies that can reduce emissions from diesel engines. The following section describes the challenges to applying these diesel engine technologies to engines and equipment designed for nonroad applications.

2. Can These Technologies Be Applied to Nonroad Engines and Equipment?

The emission standards and the introduction dates for those standards, as described earlier in this section, are premised on the transfer of diesel engine technologies being or already developed to meet light-duty and heavy-duty vehicle standards that begin in 2007. The standards that we are proposing today for engines ≥75 horsepower will begin to go into effect four years later. This time lag between equivalent on-highway and nonroad diesel engine standards is necessary in order to allow time for engine and equipment manufacturers to further develop these on-highway technologies for nonroad engines and to align this program with nonroad Tier 3 emission standards that begin to go into effect in 2006.

The test procedures and regulations for the HD2007 on-highway engines include a transient test procedure, a broad steady-state procedure and NTE provisions that require compliant engines to emit at or below 1.5 times the regulated emission levels under virtually all conditions. An engine designed to comply with the 2007 highway emission standards would comply with the equivalent nonroad emission standards proposed today if it were to be tested over the transient and steady-state nonroad emission test procedures proposed today, which cover the same regions and types of engine operation. Said in another way, an on-highway diesel engine produced in 2007 could be certified in compliance with the transient and steady-state standards proposed today for nonroad diesel engines several years in advance of the date when these standards would go into effect. However, that engine, while compliant with certain of the nonroad emission standards proposed today, would not necessarily be designed to address the various durability and performance requirements of many nonroad equipment manufacturers. We expect that the engine manufacturers will need additional time to further develop the necessary emission control systems to address some of the nonroad issues described below as well as to develop the appropriate calibrations for engine rated speed and torque characteristics required by the diverse range of nonroad equipment. Furthermore, not all nonroad engine manufacturers produce on-highway diesel engines or produce nonroad engines that are developed from on-highway products. Therefore, there is a need for lead time between the Tier 3 emission standards which go into effect in 2006-2008 and the Tier 4 emission standards. We believe the technologies developed to comply with the Tier 3 emission standards such as improved air handling systems and electronic fuel systems will form an essential technology baseline which manufacturers will need to initiate and control the various regeneration functions required of the catalyst based technologies for Tier 4. The Agency has given consideration to all of these issues in setting the emission standards and the timing of those standards as proposed today.

This section describes some of the challenges to applying advanced emission control technologies to nonroad engines and equipment, and why we believe that technologies developed for on-highway diesel engines can be further refined to address these issues in a timely manner for nonroad engines consistent with the emission standards proposed today. This section paraphrases a more in-depth analysis in the draft RIA.

a. Nonroad Operating Conditions and Exhaust Temperatures

Nonroad equipment is highly diverse in design, application, and typical operating conditions. This variety of operating conditions affects emission control systems through the resulting variety in the torque and speed demands (i.e. power demands). This wide range in what constitutes typical nonroad operation makes the design and implementation of advanced emission control technologies more difficult. The primary concern for catalyst based emission control technologies is exhaust temperature. In general, exhaust temperature increases with engine power and can vary dramatically as engine power demands vary.

For most catalytic emission control technologies there is a minimum temperature below which the chemical reactions necessary for emission control do not occur. The temperature above which substantial catalytic activities is realized is often called the light-off temperature. For gasoline engines, the light-off temperature is typically only important in determining cold start emissions. Once gasoline vehicle exhaust temperatures exceed the light-off temperature, the catalyst is “lit-off” and remains fully functional under all operating conditions. Diesel exhaust is significantly cooler than gasoline exhaust due to the diesel engine’s higher thermal efficiency and its operation under predominantly lean conditions. Absent control action taken by an electronic engine control system, diesel exhaust may fall below the light-off temperature of catalyst technology even when the vehicle is fully warmed up.

The relationship between the exhaust temperature of a nonroad diesel engine and light-off temperature is an important factor for both CDPF and NOx adsorber technologies. For the CDPF technology, exhaust temperature determines the rate of filter regeneration and if too low causes a need for supplemental means to ensure proper filter regeneration. In the case of the CDPF, it is the aggregate soot regeneration rate that is important, not the regeneration rate at any particular moment in time. A CDPF controls PM emissions under all conditions and can function properly (i.e., not plug) even when exhaust temperatures are low for an extended time and the regeneration rate is lower than the soot accumulation rate, provided that occasionally exhaust temperatures and thus the soot regeneration rate are increased enough to regenerate the CDPF. A CDPF can passively (without supplemental heat addition) regenerate if exhaust temperatures remain above 250˚C for more than 40 percent of engine operation.[134] Similarly, there is a minimum temperature (e.g., 200˚C) for NOx adsorbers below which NOx regeneration is not readily possible and a maximum temperature (e.g., 500˚C) above which NOx adsorbers are unable to effectively store NOx. These minimum and maximum temperatures define a characteristic temperature window of the NOx adsorber catalyst. When the exhaust temperature is within the temperature window (above the minimum and below the maximum) the catalyst is highly effective. When exhaust temperatures fall outside this window of operation, NOx adsorber effectiveness is diminished. Therefore, there is a need to match diesel exhaust temperatures to conditions for effective catalyst operation under the various operating conditions of nonroad engines.

Although the range of products for on-highway vehicles is not as diverse as for nonroad equipment, the need to match exhaust temperatures to catalyst characteristics is still present. This is a significant concern for on-highway engine manufacturers and has been a focus of our ongoing diesel engine progress review. There we have learned that substantial progress is being made to broaden the operating temperature window of catalyst technologies while at the same time engine systems are being designed to better control exhaust temperatures. On-highway diesel engine manufacturers are working to address this need through modifications to engine design, modifications to engine control strategies and modifications to exhaust system designs. Engine design changes including the ability for multiple late fuel injections and the ability to control total air flow into the engine give controls engineers additional flexibility to change exhaust temperature characteristics. Modifications to the exhaust system, including the use of insulated exhaust manifolds and exhaust tubing, can help to preserve the temperature of the exhaust gases. New engine control strategies designed to take advantage of engine and exhaust system modifications can then be used to manage exhaust temperatures across a broad range of engine operation. The technology solutions being developed for on-highway engines to better manage exhaust temperature are built upon the same emission control technologies (i.e., advanced air handling systems and electronic fuel injection systems) that we expect nonroad engine manufacturers to use in order to comply with the Tier 3 emission standards.

Matching the operating temperature window of the broad range of nonroad equipment may be somewhat more challenging for nonroad engines than for many on-highway diesel engines simply because of the diversity in equipment design and equipment use. Nonetheless, the problem has been successfully solved in on-highway applications facing low temperature performance situations as difficult to address as any encountered by nonroad applications. The

[134] Docket Engelhard / JM retrofit guidelines for CDPFs

most challenging temperature regime for on-highway engines are encountered at very light-loads as typified by congested urban driving. Under congested urban driving conditions exhaust temperatures may be too low for effective NOx reduction with a NOx adsorber catalyst. Similarly, exhaust temperatures may be too low to ensure passive CDPF regeneration. To address these concerns, light-duty diesel engine manufacturers have developed active temperature management strategies that provide effective emissions control even under these difficult light-load conditions. Toyota has shown with their prototype DPNR vehicles that changes to EGR and fuel injection strategies can realize an increase in exhaust temperatures of more than 100˚F under even very light-load conditions allowing the NOx adsorber catalyst to function under these normally cold exhaust conditions.[135] Similarly, PSA has demonstrated effective CDPF regeneration under demanding light-load taxi cab conditions with current production technologies.[136] Both of these are examples of technology paths available to nonroad engine manufacturers to increase temperatures under light-load conditions.

We are not aware of any nonroad equipment in-use operating cycles which would be more demanding of low temperature performance than on-highway urban driving. Both the Toyota and PSA systems are designed to function even with extended idle operation as would be typified by a taxi waiting to pick up a fare. By actively managing exhaust temperatures engine manufacturers can ensure highly effective catalyst based emission control performance (i.e., compliance with the emission standards) and reliable filter regeneration (failsafe operation) across a wide range of engine operation as would be typified by the broad range of in-use nonroad duty cycles and the new nonroad transient test proposed today.

The systems described here from Toyota and PSA are examples of highly integrated engine and exhaust emission control systems based upon active engine management designed to facilitate catalyst function. Because these systems are based upon the same engine control technologies likely to be used to comply with the Tier 3 standards and because they allow great flexibility to trade-off engine control and catalyst control approaches depending on operating mode and need, we believe most nonroad engine manufacturers will use similar approaches to comply with the emission standards proposed today. However, there are other technologies available that are designed to be added to existing engines without the need for extensive integration and engine management strategies. One example of such a system is an active DPF system developed by Deutz for use on a wide range on nonroad equipment. The Deutz system has been sold as an OEM retrofit technology that does not require changes to the base engine technology. The system is electronically controlled and uses supplemental in-exhaust fuel injection to raise exhaust temperatures periodically to regenerate the DPF. Deutz has sold over 2,000 of these units and reports that the systems have been reliable and effective. Some

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[135] Reference Aachen motor symposium paper or later SAE papers

[136] Reference SAE paper from 2002 Fall Fuels and Lubes

manufacturers may choose to use this approach for compliance with the PM standard proposed today, especially in the case of engines which may be able to comply with the proposed NOx standards with engine-out emission control technologies (i.e., engines rated between 25 and 75 horsepower).

High temperature operating regimes such as a heavy heavy-duty diesel truck at full payload driving up a grade are also challenging for the NOx catalyst technology. Although less common, similar high temperature conditions of full engine load operation can be imagined for nonroad equipment. However, because on-highway engines typically have higher power density (defined as rated power divided by engine displacement), the highest operating conditions would be expected to be encountered with on-highway vehicles. High exhaust temperatures (in excess of 500˚C) are challenging for the NOx adsorber catalyst technology because the stored NOx emissions can be released thermally without going through a reduction step, leading to increased NOx emissions. In the absence of a reductant (normally provided by the standard NOx regeneration function) the thermally released NOx is emitted from the exhaust system without treatment. To address this issue, NOx storage catalyst technologies with higher levels of thermal stability are being developed, but these technologies trade-off improved high temperature performance for even greater sensitivity to fuel sulfur. Beyond catalyst improvements, the exhaust temperature from the engine can be controlled prior to the NOx adsorber catalyst simply through heat loss in the exhaust system (i.e. by locating the catalyst further from the engine). Some GDI vehicle applications have even used relatively simple exhaust layout designs to channel air across the catalyst to promote cooling.[137] Additionally, exhaust temperatures well in excess of 500˚C are not frequently experienced by nonroad engines. In preparation for this proposal, EPA performed an analysis of nonroad engines tested under a variety of conditions and saw temperatures in excess of 500˚C only on a single engine, a small (50hp) naturally aspirated diesel engine (which under today's proposal would not be subject to a NOx standard based on performance of NOx adsorber technology). Higher exhaust temperatures would be expected from naturally aspirated engines due to their lower air flow (for the same power / heat input, naturally aspirated engines have less air to heat up and thus the exhaust reaches a higher temperature). Today, less than ten percent of nonroad diesel engines with rated power greater than 100 horsepower are naturally aspirated and we have projected that an even greater percentage of nonroad engines meeting the Tier 3 emission standards will be turbocharged.

We have conducted an extensive analysis of various nonroad equipment operating cycles and various nonroad engine power density levels to better understand the matching of nonroad engine exhaust temperatures and catalyst technologies. This analysis documented in the draft RIA showed that for many engine power density levels and equipment operating cycles, exhaust temperatures are quite well matched to catalyst temperature window characteristics. In particular, the agricultural tractor cycle (AGT) and the nonroad transient cycle (NRTC) are

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[137] Find SAE paper or other on the VW Lupo system

estimated to be well matched to the NOx adsorber characteristics with estimated performance in excess of 90 percent for a turbocharged diesel engine tested under a range of power density levels. The analysis also showed that some nonroad engines with low power density (i.e, less than 25 horsepower per liter of engine displacement) and tested on relatively low load factor duty cycles (e.g, a backhoe cycle) may require active heating to ensure CDPF regeneration and may not be well matched to the operating range of a NOx adsorber catalyst without some changes to engine operation. One change, which is occurring independent of EPA's regulation is increasing power density for nonroad engines. EPA has documented a clear trend of certified engine ratings that indicates manufacturers are increasing engine power without increasing engine displacement.[138] Engine manufacturers are motivated to increase engine power density because engine pricing is largely done on a power basis, while the cost of manufacturing is more closely related to engine displacement. Therefore, increasing engine power levels without increasing displacement may increase the sale price of the engine more than it increases the cost of manufacturing. Increasing power density typically results in higher exhaust temperatures and, in this case, better matching to catalyst operating requirements. Alternatively, nonroad engine manufacturers can apply the same temperature management strategies previously described for on-highway engines.

The analysis suggests that the temperature challenge for nonroad equipment will be greater with regard to the NTE provisions of today's proposal than for the nonroad transient test (NRTC) provisions. In fact, the NRTC cycle appears to be a better match to the characteristics of the NOx adsorber catalyst than the FTP cycle used for heavy-duty on-highway truck certification. This is due to the higher average engine load experienced over the NRTC and thus the higher average temperature. Therefore, we believe that complying with the NOx standard over the transient test cycle proposed today for nonroad engines will not be significantly more difficult than complying with the HD2007 NOx emission standard over the FTP. The analysis also shows that many nonroad engines may operate in-use in a way different from the NRTC (i.e. even the NRTC is not an all-encompassing test; no single test realistically could be), and that NTE standards are therefore needed to assure that nonroad engine emissions are controlled for the full range of possible in-use operating conditions.[139] The technical challenge of controlling NOx emissions, even under these diverse conditions, is no more difficult on a per engine basis than for on-highway diesel engines which must comply with similar NTE test provisions. This is because both on-highway and nonroad engine manufacturers must address control at the same high load and low load conditions (minimum power from both are the same, 0 hp, and maximum power is

[138] Charmley memo to the docket or simply put in the RIA?

[139] The fact that developing compliant engines for the NTE provisions may be more difficult than developing for the transient test cycle does not diminish the value of the transient test as a means to evaluate the overall effectiveness of the emission control system under transient conditions. There is no doubt that controlling average emissions under transient conditions will be an important part of the emission control system and that evaluating overall performance under transient conditions is needed.

typically higher for on-highway engines, due to higher power density). Also, both engine manufacturers must be able to respond to changes in user demanded torque (transient conditions) that are similarly unpredictable. However, given the sheer number of different nonroad equipment types and engine ratings, this represents a real challenge for the nonroad industry which is one of the primary considerations given by the Agency in determining the appropriate timing for the emission standards proposed today.

We believe based on our analysis of nonroad engines and equipment operating characteristics that in-use some nonroad engines will experience conditions that require the use of temperature management strategies in order to effectively use the NOx adsorber and CDPF systems needed to meet the proposed standards. We have assumed in our cost analysis that all nonroad engines complying with a PM standard of 0.02 g/bhp-hr or lower will have an active means to control temperature (i.e. we have costed a backup regeneration system, although some applications may not need one). We have made this assumption believing that manufacturers will not be able to predict accurately, in-use conditions for every piece of equipment and will thus choose to provide the technologies on a back-up basis. As explained earlier, the technologies necessary to accomplish this temperature management are enhancements of the Tier 3 emission control technologies that will form the baseline for Tier 4 engines, and the control strategies being developed for on-highway diesel engines. We do not believe that there are any nonroad engine applications above 25 horsepower for which these highway engine approaches will not work. However, given the diversity in nonroad equipment design and application, we believe that additional time will be needed in order to match the engine performance characteristics to the full range of nonroad equipment.

We believe that given the timing of the emissions standards proposed today, and the availability and continuing development of technologies to address temperature management for on-highway engines which technologies are transferrable to all nonroad engines with greater than 25 hp power rating, that nonroad engines can be designed to meet the proposed standards in the lead time provided in today's proposal.

b. Nonroad Operating Conditions and Durability

Nonroad equipment is designed to be used in a wide range of tasks in some of the harshest operating environments imaginable, from mining equipment to crop cultivation and harvesting to excavation and loading. In the normal course of equipment operation the engine and its associated hardware will experience levels of vibration, impacts, and dust that may exceed conditions typical of on-highway diesel vehicles.

Specific efforts to design for the nonroad operating conditions will be required in order to ensure that the benefits of these new emission control technologies are realized for the life of nonroad equipment. Much of the engineering knowledge and experience to address these issues already exists with the nonroad equipment manufacturers. Vibration and impact issues are fundamentally mechanical durability concerns (rather than issues of technical feasibility of achieving emissions reductions) for any component mounted on a piece of equipment (e.g., an engine coolant overflow tank). Equipment manufacturers must design mounting hardware such as flanges, brackets, and bolts to support the new component without failure. Further, the catalyst substrate material itself must be able to withstand the conditions encountered on nonroad equipment without itself cracking or failing. There is a large body of real world testing with retrofit emission control technologies that demonstrates the durability of the catalyst components themselves even in the harshest of nonroad equipment applications.

Deutz, a nonroad engine manufacturer, sold approximately 2,000 diesel particulate filter systems for nonroad equipment in the period from 1994 through 2000. Many of these systems were sold for use in mining equipment. No other applications are likely to be more demanding than this. Mining equipment is exposed to extraordinarily high levels of vibration, experiences impacts with the mine walls and face, and high levels of dust. Yet in meetings with the Agency, Deutz shared their experience that no system had failed due to mechanical failure of the catalyst or catalyst housing.[140] The Deutz system utilized a conventional cordierite PM filter substrate as is commonly used for heavy-duty on-highway truck CDPF systems. The canning and mounting of the system was a Deutz design. Deutz was able to design the catalyst housing and mounting in such a way as to protect the catalyst from the harsh environment as evidenced by its excellent record of reliable function.

Other nonroad equipment manufacturers have also offered OEM diesel particulate filter systems in order to comply with requirements of some mining and tunneling worksite standards. Liebherr, a nonroad engine and equipment manufacturer, offers diesel particulater filter systems as an OEM option on 340 different nonroad equipment models.[141] We believe that this experience shows that appropriate design considerations, as are necessary with any component on a piece of nonroad equipment, will be adequate to address concerns with the vibration and impact conditions which can occur in some nonroad applications. This experience applies equally well to the NOx adsorber catalyst technologies as the mechanical properties of DOCs, CDPFs, and NOx adsorbers are all similar. We do not believe that any new or fundamentally different solutions will need to be invented in order to address the vibration and impact constraints for nonroad equipment. Our cost analysis includes the hardware costs for mounting and shrouding the aftertreatment equipment as well as the engineering cost for equipment redesign.

Certain nonroad applications, including some forms of harvesting equipment and mining equipment, may have specific limits on maximum surface temperature for equipment components in order to ensure that the components do not serve as ignition sources for

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140 Need memo to the docket summarizing the meeting and docketing materials shared by Deutz

141 Reference Liebherr paper xxxxx

flammable dust particles (e.g. coal dust or fine crop dust). Some have suggested that these design constraints might limit the equipment manufacturers ability to install advanced diesel catalyst technologies such as NOx adsorbers and CDPFs. This concern seems to be largely based upon anecdotal experience with gasoline catalyst technologies where under certain circumstances catalyst temperatures can exceed 1,000˚C and without appropriate design considerations could conceivably serve as an ignition source. We do not believe that these concerns are justified in the case of either the NOx adsorber catalyst or the CDPF technology. Catalyst temperatures for NOx adsorbers and CDPFs should not exceed the maximum exhaust manifold temperatures already commonly experienced by diesel engines (i.e, catalyst temperatures are expected to be below 800˚C).[142] CDPF temperatures are not expected to exceed approximately 700˚C in normal use and are expected to only reach the 650˚C temperature during periods of active regeneration. Similarly, NOx adsorber catalyst temperatures are not expected to exceed 700˚C and again only during periods of active sulfur regeneration as described in section III.F below. Under conditions where diesel exhaust temperatures are naturally as high as 650˚C, no supplemental heat addition from the emission control system will be necessary and therefore exhaust temperatures will not exceed their natural level. When natural exhaust temperatures are too low for effective emission system function then supplemental heating as described earlier may be necessary but would not be expected to produce temperatures higher than the maximum levels normally encountered in diesel exhaust. Furthermore, even if it were necessary to raise exhaust temperatures to a higher level in order to promote effective emission control, there are technologies available to isolate the higher exhaust temperatures from flammable materials such as dust. One approach would be the use of air-gapped exhaust systems (i.e., an exhaust pipe inside another concentric exhaust pipe separated by an air-gap) that serve to insulate the inner high temperature surface from the outer surface which could come into contact with the dust. The use of such a system may be additionally desirable in order to maintain higher exhaust temperatures inside the catalyst in order to promote better catalyst function. Another technology to control surface temperature already used by some nonroad equipment manufacturers is water cooled exhaust systems.[143] This approach is similar to the air-gapped system but uses engine coolant water to actively cool the exhaust system. We do not believe that flammable dust concerns will prevent the use of either a NOx adsorber or a CDPF because catalyst temperatures are not expected to be unacceptably high and because remediation technologies exist to address these concerns. In fact, catalyst based emission control technologies have already been designed and retrofitted to existing nonroad equipment without issue in applications where high levels of potentially flammable dust are

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[142] The hottest surface on a diesel engine is typically the exhaust manifold which connects the engines exhaust ports to the inlet of the turbocharger. The hot exhaust gases leave the engine at a very high temperature (800˚C at high power conditions) and then pass through the turbocharger where the gases expand driving the turbocharger providing work. The process of extracting work from the hot gases cools the exhaust gases. The exhaust leaving the turbocharger and entering the catalyst and the remaining pieces of the exhaust system is cooler (as much as 200˚C at very high loads) than in the exhaust manifold.

[143] Reference Liebherr paper

encountered.[144]

Nonroad engines greater than approximately 550 hp are unique in that they do not have direct on-highway equivalents. However, this does not mean that unique catalyst based emission control technologies need to be developed separately for these larger applications. Rather, larger engines can, and do in retrofit applications today, use multiple catalyst systems in a parallel configuration. As an example, an on-highway 12 liter displacement in-line six cylinder engine might use a single 18 liter CDPF, while a nonroad 24 liter displacement V12 cylinder (a vee engine has two rows of cylinders set at an angle to each other) engine would use two 18 liter CDPFs, one for each bank of the vee engine. Using two smaller catalysts in place of one larger catalyst can be easier to package and may allow for close coupling of the catalyst technology to the turbocharger exhaust outlet to improve temperature management in some applications. Today, many passenger cars and light-duty trucks with V6 or V8 engines use individual catalysts for each engine bank to improve packaging and better manage temperatures.

We agree that nonroad equipment must be designed to address durable performance for a wide range of operating conditions and applications that would not commonly be experienced by on-highway vehicles. We believe further as demonstrated by retrofit experiences around the world that technical solutions exist which allow catalyst based emission control technologies to be applied to nonroad equipment.

3. Are the Standards Proposed for Engines of 75 hp or Higher Feasible?

The standards proposed today for nonroad engines with rated power greater than or equal to 75 horsepower are based upon the technologies and standards for highway diesel engines which go into effect in 2007. As explained above, we believe these technologies, namely NOx adsorbers and catalyzed diesel particulate filters enabled by 15 ppm sulfur diesel fuel, can be applied to nonroad diesel engines in a similar manner as for on-highway diesel engines. We acknowledge that there are additional constraints on nonroad diesel engines which must be considered in setting these standards, and we have addressed those issues by allowing for additional lead time or slightly less stringent standards for nonroad diesel engines in comparison to on-highway diesel engines (and likewise have made appropriate cost estimates to account for the technology and engineering needed to address these constraints).

We have proposed a PM standard for engines in this category of 0.01 g/bhp-hr based upon the emissions reductions possible through the application of a CDPF and 15ppm sulfur diesel fuel. This is the same emissions level as for on-highway diesel engines in the HD2007 program. While baseline soot (the solid carbon fraction of PM) emission levels may be

[144] Find reference from MECA or SAE that documents explosion proof systems, where the Deutz systems among these, what about the Bobcat DOC systems??

somewhat higher for some nonroad engines when compared to on-highway engines, these emissions are virtually eliminated (reduced by 99 percent) by the CDPF technology. As discussed previously, the baseline (engine-out) SOF emissions levels may also need to be reduced through the application of modern piston ring pack designs and valve stem seals. With application of the CDPF technology, the SOF portion of diesel PM is predicted to be all but eliminated. The primary emissions from a CDPF equipped engine are sulfate PM emissions formed from sulfur in diesel fuel. The emissions rate for sulfate PM is determined primarily by the sulfur level of the diesel fuel and the rate of fuel consumption. With the 15 ppm sulfur diesel fuel the PM emissions level from a CDPF equipped nonroad diesel engine will be similar to the emissions rate of a comparable on-highway diesel engine. Therefore, the 0.01 g/bhp-hr emission level is feasible for nonroad engines tested on the NRTC cycle and on the steady-state cycles, the C1 and D2. Put another way, control of PM using CDPF technology is essentially independent of duty cycle given active catalyst technology (for reliable regeneration and SOF oxidation), adequate control of temperature (for reliable regeneration) and low sulfur diesel fuel (for reliable regeneration and low PM emissions).

The most challenging PM emissions control conditions for a CDPF are encountered under high engine load operation where high exhaust temperatures promote conversion of sulfur in diesel fuel to sulfate PM emissions. Under these high load conditions, soot and SOF oxidation rates will be very high and control of those portions of PM emissions will be highly effective. Sulfate PM emissions however will be high, perhaps as high as 0.02 g/bhp-hr.[145] This level of PM emissions would comply with our proposed NTE provisions once consideration is given to the 1.5 times multiplier on the emission standard for NTE test conditions.[146] Since this estimate is made at a worst case condition (assuming 100% conversion of sulfur to sulfate), we feel confident that the PM NTE provisions of this proposal can be met.

Under contract from the California Air Resources Board, two nonroad diesel engines were recently tested for PM emissions performance with the application of a CDPF.[147] The first engine is a 1999 Caterpillar 3408 (480 hp, 18 liter displacement) nonroad diesel engine certified to the Tier 1 standards. The engine was tested with and without a CDPF on 12 ppm sulfur diesel fuel. The resulting emissions are summarized in table III.E-1 below. The test results confirm the

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[145] An estimate of the maximum sulfate PM emissions rate can be made by assuming a fuel consumption rate (e.g., 0.5 lbm/bhp-hr), the fuel sulfur level (e.g., 15 ppm) and the sulfur to sulfate conversion (e.g., 100% maximum) resulting in a calculated sulfate PM emissions rate of 0.02 g/bhp-hr. This represents a worst case analysis (100% sulfur conversion with 15 ppm sulfur fuel). In-use emissions would be significantly lower.

[146] The PM standard is expressed to two significant digits 0.01 g/bhp-hr, so when the 1.5 NTE multiplier is applied, the NTE limit becomes 0.015 which is rounded to two significant figures as 0.02 g/bhp-hr.

[147] Application of Diesel Particulate Filters to Three Nonroad Engines - Interim Report, Air Docket A-2001-28.

excellent PM control performance realized by a CDPF with low sulfur diesel fuel across a wide range of nonroad operating cycles in spite of the relatively high engine-out PM emissions from this Tier 1 engine. We would expect engine-out PM emissions to be lower for production Tier 3 compliant diesel engines that will form the technology baseline for Tier 4 engines meeting today's proposed standard. The engine demonstrated PM emissions of 0.009 g/bhp-hr on the proposed Nonroad Transient Cycle (NRTC) from an engine out level of 0.256 g/bhp-hr, a reduction of 0.247 g/bhp-hr. The engine also demonstrated excellent PM performance on the existing steady-state ISO C1 cycle with PM emissions of 0.010 g/bhp-hr from a baseline from an engine out level of 0.127, a reduction of 0.107 g/bhp-hr. Thus this engine would be compliant with the emission standard proposed today for ≥75 hp variable speed nonroad engines.

When tested on the proposed constant speed variable load cycle (CSVL) the engine out PM emission levels were 0.407 g/bhp-hr and were reduced to 0.016 g/bhp-hr (a reduction of 0.391 g/bhp-hr) with the addition of the PM filter. As tested this engine would not be compliant with the proposed CSVL standard, but this is not surprising given that this Tier 1 engine was designed for variable speed engine operation and not for single speed operation. We have great confidence given the substantial PM reduction realized in this testing over the proposed CSVL cycle with a CDPF that a properly designed nonroad diesel engine will be able to meet the proposed CSVL standard of 0.01 g/bhp-hr.

Table III.E-1 PM Emissions for a Tier 1 NR Diesel Engine with a CDPF

1999 (Tier 1) Caterpillar 3408 (480hp, 18l)

	PM [g/bhp-hr]		Reduction
Test Cycle	Engine Out	w/ CDPF	%
Proposed Nonroad TransientCycle (NRTC)	0.256	0.009	96%
ISO C1 existing Nonroad Steady-State Cycle (C1)	0.127	0.010	92%
Proposed Constant Speed Variable Load Cycle (CSVL)	0.407	0.016	96%
On-Highway U.S. FTP Transient Cycle (FTP)	0.239	0.019	92%
Agricultural Tractor Cycle (AGT)	0.181	0.009	95%
Backhoe Loader Cycle (BHL)	0.372	0.022	94%
Crawler Tractor Dozer Cycle (CRT)	0.160	0.014	91%
Composite Excavator Duty Cycle (CEX)	0.079	0.009	88%
Skid Steer Loader Typical No. 1 (SST)	0.307	0.016	95%
Skid Steer Loader Typical No. 2 (SS2)	0.242	0.013	95%
Skid Steer Loader Highly Transient Speed (SSS)	0.242	0.008	97%
Skid Steer Loader Highly Transient Torque (SSQ)	0.351	0.004	99%
Arc Welder Typical No.1 (AWT)	0.510	0.018	96%
Arc Welder Typical No.2 (AW2)	0.589	0.031	95%
Arc Welder Highly Transient Speed (AWS)	0.424	0.019	96%
Rubber-Tired Loader Typical No.1 (RTL)	0.233	0.010	96%
Rubber-Tired Loader Typical No.2 (RT2)	0.236	0.011	96%
Rubber-Tired Loader Highly Transient Speed (RTS)	0.255	0.008	97%
Rubber-Tired Loader Highly Transient Torque (RTQ)	0.294	0.009	97%

Table III.E-1 also shows results over a large number of additional test cycles developed from real world in-use test data to represent typical operating cycles for different nonroad equipment applications (see Chapter 4.2 of the draft RIA for information on these test cycles). The results show that the CDPF technology is highly effective to control in-use PM emissions over any number of disparate operating conditions. Remembering that the base Tier 1 engine was not designed to meet a transient PM standard, the CDPF emissions demonstrated here show that very low emission levels are possible even when engine out emissions are exceedingly high (e.g., a reduction of 0.558 g/bhp-hr is demonstrated on the AW2 cycle).

The second engine tested was a prototype engine developed at Southwest Research Institute (SwRI) under contract to EPA.[148] The engine, dubbed Deere Development Engine 4045 (DDE-4045) because the prototype engine was based on a John Deere 4045 production engine, was also tested with a CDPF from a different manufacturer on the same 12 ppm diesel fuel. The engine is very much a prototype and experienced a number of part failures during testing including to the turbocharger actuator. Nevertheless, the results summarized in Table III.E-2 below show that substantial PM reductions are realized on this engine as well. The emission levels on the NRTC and the ISO C1 cycle would be compliant with the proposed PM standard of 0.01 g/bhp-hr once the appropriate rounding convention was applied.[149]

Table III.E-2 PM Emissions for a Prototype NR Diesel Engine with a CDPF

EPA Prototype Tier 3 DDE-4045 (108hp, 4.5l)

Test Cycle	PM [g/bhp-hr]		Reduction
	Engine Out	w/ CDPF	%
Proposed Nonroad TransientCycle (NRTC)	0.143	0.013	91%
ISO C1 existing Nonroad Steady-State Cycle (C1)	0.127	0.011	91%
Proposed Constant Speed Variable Load Cycle (CSVL)	0.218	0.018	92%
On-Highway U.S. FTP Transient Cycle (FTP)	0.185	0.023	88%
Agricultural Tractor Cycle (AGT)	0.134	0.008	94%
Backhoe Loader Cycle (BHL)	0.396	0.021	95%
Crawler Tractor Dozer Cycle (CRT)	0.314	0.008	97%
Composite Excavator Duty Cycle (CEX)	0.176	0.009	95%
Skid Steer Loader Typical No. 1 (SST)	0.288	0.012	96%
Skid Steer Loader Typical No. 2 (SS2)	0.641	0.013	98%
Skid Steer Loader Highly Transient Speed (SSS)	0.298	0.011	96%
Skid Steer Loader Highly Transient Torque (SSQ)	0.536	0.014	97%
Arc Welder Typical No.1 (AWT)	0.290	0.018	94%
Arc Welder Typical No.2 (AW2)	0.349	0.019	95%
Arc Welder Highly Transient Speed (AWS)	0.274	0.019	93%
Rubber-Tired Loader Typical No.1 (RTL)	0.761	0.014	98%
Rubber-Tired Loader Typical No.2 (RT2)	0.603	0.012	98%
Rubber-Tired Loader Highly Transient Speed (RTS)	0.721	0.010	99%
Rubber-Tired Loader Highly Transient Torque (RTQ)	0.725	0.009	99%

[148] Reference the Tier 3 white paper, or a report from SwRI and add to docket.

[149] The rounding procedures in ASTM E29-90 are applied to the emission standard, therefore, the emission results are rounded to the same number of significant digits as the specified standard, i.e., 0.0149 g/bhp-hr is rounded to 0.01 g/bhp-hr, while 0.015 g/bhp-hr would be rounded to 0.02 g/bhp-hr.

While the resulting PM emission levels for nonroad diesel engines are similar to the levels for on-highway diesel engines, the challenge of ensuring soot regeneration of the CDPF may be more difficult for some nonroad equipment types. As explained earlier, effective regeneration occurs when the aggregate soot rate into the CDPF over an extended period is less than or equal to the soot oxidation rate over the same period. Because the baseline PM soot rate into the CDPF level may be higher for some nonroad engines and because the average exhaust temperature may be lower for some operating cycles, additional engine and aftertreatment system development will be needed for some nonroad engines. These additional developments include improved thermal management and improved active back-up systems which can periodically raise exhaust temperatures in order to initiate regeneration. We expect these systems to be evolutionary advancements based primarily on the core technologies used by nonroad manufacturers to comply with the Tier 3 emission standards with enhancements from the on-highway technologies developed to comply with the HD2007 standards. The implementation dates for the standards proposed today were selected in part based upon the time we believe will be necessary to transfer and further develop these on-highway technologies to nonroad diesel engines and equipment.

We are proposing a NOx standard for engines in this category of 0.3 g/bhp-hr based upon the emission reductions possible from the application of NOx adsorber catalysts and the expected emission levels for Tier 3 compliant engines which form the baseline technology for Tier 4 engines. The Tier 3 emission standards are a combined NOx+NMHC standard of 3.0 g/bhp-hr for engines greater than 100 hp and less than 750 horsepower. For engines less than 100 hp but greater than 50 horsepower the Tier 3 NOx+NMHC emission standard is 3.5 g/bhp-hr. For engines greater than 750 horsepower there is no Tier 3 NOx+NMHC standard. We believe that in the time-frame of the Tier 4 emission standards proposed today, all engines of 75 horsepower or higher can be developed to control NOx emissions to engine-out levels of 3.0 g/bhp-hr or lower. This means that all engines will need to apply Tier 3 emission control technologies (i.e., turbochargers, charge-air-coolers, electronic fuel systems, and for some manufacturers EGR systems) to get to this baseline level, even those engines without a Tier 3 standard. As discussed in more detail in the draft RIA, our analysis of the NRTC indicates that the NOx adsorber catalyst can provide a 90 percent or greater NOx reduction level on the NRTC cycle. The proposed standard of 0.3 g/bhp-hr reflects a baseline emissions level of 3.0 g/bhp-hr and a 90 percent or greater reduction of NOx emissions through the application of the NOx adsorber catalyst. The additional lead time available to nonroad engine manufacturers and the substantial learning that will be realized from the introduction of these same technologies to on-highway diesel engines, plus the lack of any fundamental technical impediment, makes us confident that the proposed NOx standards can be met.

The proposed standard is 50 percent higher than the corresponding HD2007 standard of 0.2 g/bhp-hr because of the higher baseline NOx emissions for Tier 3 engines. The higher baseline (engine-out) NOx level is due primarily to a lack of ram-air for improved charge-air cooling for nonroad diesel engines when compared to on-highway diesel engines compliant with the 2004 on-highway emission standards. Although nonroad engine manufacturers may be able to lower engine-out NOx emissions below the levels required for Tier 3, we continue to expect that the lack of ram air will limit nonroad engine-out NOx performance, and therefore we have accounted for that difference by proposing this higher NOx emissions level.

We believe that the NOx adsorber technology developed for on-highway engines can be applied with equal effectiveness to nonroad diesel engines with additional developments in engine thermal management (as discussed in section III.E.2 above) to address the more widely varied nonroad operating cycles. In fact, as discussed previously, the NOx adsorber catalyst temperature window is particularly well matched to operating conditions as typified by the NRTC.

Compliance with the NTE provisions proposed today will be challenging for the nonroad engine industry due to the diversity of nonroad products and operating cycles. However, the technical challenge is reduced somewhat by the 1.5 multiplier used to calculate the NTE standard. Controlling NOx emissions under NTE conditions is fundamentally similar for both on-highway and nonroad engines. The range of control is the same and the amount of reduction required is also the same. We know of no technical impediment that would prevent achieving the NTE standard under the full range of operating conditions.

The proposed NOx standard is phased in over a number of years in a manner similar to the HD2007 NOx phase-in. In the early years of the program half of the engines produced by a manufacturer must be certified to the new emission standard while the remaining engines can continue to be sold at the previous standard. We provided this phase-in period for on-highway engines in the HD2007 rulemaking to allow manufacturers to focus resources on the portion of their products best suited to NOx catalysts first and then to apply the learning to the remainder of their products three years later.[150] Provisions of the averaging program in the HD2007 rulemaking allow manufacturers to alternatively comply with some engine families at an "averaged" standard that is approximately halfway between the old and new NOx standards. In fact, we have learned from a number of engine manufacturers that they are likely to employ this strategy for some fraction of their new on-highway engines in 2007. The averaging provisions that we have proposed today for Tier 4 would also allow for compliance with the proposed Tier 4 NOx standard with a single engine product during the transitional NOx phase-in period. This provision allows manufacturers to transfer the same on-highway NOx technologies to nonroad engines and to comply with an appropriately stringent standard. We believe as with the HD2007 rule that this provision is necessary in order to manage resource requirements to develop the necessary technologies and that this provision provides significant additional flexibility for manufacturers to comply with the proposed NOx standards. Similarly, we have proposed a

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[150] Reference 66 FR at xxxxx 2007 highway preamble.

modified phase-in schedule for the greater than 750 horsepower engines in part because of the lack of a Tier 3 standard for those engine and the extra work required to develop a full Tier 4 emission control system from a Tier 2 baseline.

Meeting the proposed NMHC standard under the lean operating conditions typical of the biggest portion of NOx adsorber operation should not present any special challenges to nonroad diesel engine manufacturers. Since CDPFs and NOx adsorbers contain platinum and other precious metals to oxidize NO to NO_2, they are also very efficient oxidizers of hydrocarbons. NMHC reductions of greater than 95 percent have been shown over transient and steady-state test procedures.[151] Given that typical engine out NMHC is expected to be in the 0.40 g/bhp-hr range or lower for engines meeting the Tier 3 standards, this level of NMHC reduction will mean that under lean conditions emission levels will be well below the standard.

The NOx regeneration strategies for the NOx adsorber technology may prove difficult to control precisely, leading to a possible increase in NMHC emissions under the rich operating conditions required for NOx regeneration. Even with precise control of the regeneration cycle, NMHC slip may prove to be a difficult problem due to the need to regenerate the NOx adsorber under net rich conditions (excess fuel) rather than the stoichiometric (fuel and air precisely balanced) operating conditions typical of a gasoline three-way catalyst. It seems possible therefore, that in order to meet the NMHC standards we have proposed, an additional clean up catalyst may be required. A diesel oxidation catalyst, like those applied historically for NMHC and partial PM control, can reduce NMHC emissions (including toxic HCs) by more than 90 percent.[152] This amount of additional control along with optimized NOx regeneration strategies will ensure very low NMHC emissions. Our cost analysis described in section V includes the cost for the application of a clean-up DOC catalyst for all engines which must comply with the 0.3 g/bhp-hr NOx standard.

Test results from a prototype integrated NOx/PM and NMHC control system for diesel engines documented in the draft RIA show that NMHC emissions can be controlled below 0.14 g/bhp-hr under transient and steady-state test conditions for on-highway diesel engines while simultaneously controlling NOx emissions below 0.2 g/bhp-hr and PM emissions below 0.01 g/bhp-hr. Since the slip of hydrocarbon emissions are predominantly a function of the NOx regeneration event and not engine transient events, the level of control demonstrated in this testing is expected to be the same for other operating conditions as represented by the proposed NRTC cycle and the NTE provisions of this rulemaking. Based on our engineering judgement

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[151] "The Impact of Sulfur in Diesel Fuel on Catalyst Emission Control Technology," report by the Manufacturers of Emission Controls Association, March 15, 1999, pp. 9 & 11 EPA Docket A-2001-28.

[152] "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-Duty Engines to Achieve Low Emission Levels", Manufacturers of Emissions Controls Association, June 1999 EPA Docket A-99-06 item II-G

and experience testing integrated NOx adsorber and PM filter systems with DOC clean-up catalyst technologies, we can conclude that the 0.14 g/bhp-hr NMHC standard will be feasible in the Tier 4 time frame.

We did not set new Tier 3 emission standards for >750 hp nonroad engines in the 1998 Tier 2/3 rulemaking because of the long lead time we believed appropriate, given the long product redesign cycles typical of these large engines and their low sales volumes. The Tier 2 standards set in that rulemaking for >750 hp engines do not go into effect until 2006. We reasoned in the Tier 2/3 rule that the uncertainties involved in setting a Tier 3 standard for >750hp nonroad engines that wouldn't go into effect before 2010 would be too large. Therefore, we deferred setting new standards for these engines at that time. Given new technology enabled by low sulfur diesel fuel, we believe that it is now appropriate to project the technologies which will be available for these engines in the future (i.e., CDPFs and NOx adsorbers) and to set new standards accordingly.

Although we have proposed a unique phase-in schedule for >750hp engines as explained in explained in section III.B, we do not doubt that these engines, like engines <750hp, can be developed to meet the standards proposed today. These large engines are fundamentally similar to other nonroad engines. The project emissions control mechanisms are the same. Retrofits of PM filter systems have been applied to large locomotives and other similar size engines. We are unaware of any fundamental difference in technology function that would lead us to conclude that the proposed standards are inappropriate for engines >750hp. We invite comment supported by data on this issue, particularly if a commenter believes there are fundamental technology differences which would make alternate standards more appropriate for >750hp nonroad engines.

The standards that we have proposed today for nonroad engines with rated horsepower levels ≥75 horsepower are based upon the same emission control technologies, clean 15ppm or lower sulfur diesel fuel, and relative levels of emission control effectiveness as the HD 2007 emission standards. We have given consideration to the diversity of nonroad equipment for which these technologies must be developed and the timing of the Tier 3 emissions standards in determining the appropriate timing for the Tier 4 standards we have proposed today. Based upon the availability of the emission control technologies, the proven effectiveness of the technologies to control diesel emissions to these levels, the technology paths identified here to address constraints specific to nonroad equipment, and the additional lead time afforded by the timing of the standards, we have concluded that the proposed standards are feasible.

4. Are the Standards Proposed for Engines ≥25 hp and <75 hp Feasible?

As discussed in section III.B, our proposal for standards for engines between 25 and 75 hp consists of a 2008 transitional standard and long-term 2013 standards. The proposed transitional standard is a 0.22 g/bhp-hr PM standard. The 2013 standards consist of a 0.02 g/bhp-hr PM standard and a 3.5 g/bhp-hr NMHC+NOx standard. As discussed in section III.B, the transitional standard is optional 50-75 hp engines, as the proposed 2008 implementation date is the same as the effective date of the Tier 3 standards. Manufactures may decided, at their option, not to undertake the 2008 transitional PM standard, in which case their implementation date for the 0.02 g/bhp-hr PM standard begins in 2012.

In addition, we have proposed a minor revision to the CO standard for the 25-50 hp engines beginning in 2008 to align these engines with the 50-75 hp engines. This proposed CO standard is 3.7 g/bhp-hr.

The remainder of this section discusses:
- what makes the 25-75 hp category unique;
- what engine technology is used today, and will be used for applicable Tier 2 and Tier 3 standards;
- why the proposed standards are technologically feasible; and,
- why EPA has not proposed more stringent NOx standards at this time for these engines.

a. What makes the 25 - 75 hp category unique?

As discussed in section III.B.1.d, many of the nonroad diesel engines ≥75 hp are either a direct derivative of highway heavy-duty diesel engines, or share a number of common traits with highway diesel engines. These include similarities in displacement, aspiration, fuel systems, and electronic controls. Table III.E-3 contains a summary of a number of key engine parameters from the 2001 engines certified for sale in the U.S.[153]

[153] Data in Table III.E-3 is derived from a combination of the publically available certification data for model year 2001 engines, as well as the manufacturers reported estimates of 2001 production targets, which is not public information.

Table III.E-3: Summary of Model Year 2001 Key Engine Parameters by Power Category

Engine Parameter	Percent of 2001 U.S. Production[a]			
	0-25 hp	25-75 hp	75-100 hp	>100 hp
IDI Fuel System	83%	47%	4%	<0.1%
DI Fuel System	17%	53%	96%	>99%
Turbocharged	0%	7%	62%	91%
1 or 2 Cylinder Engines	47%	3%	0%	0%
Electronic fuel systems (estimated)	not available today	limited availability today	available today	commonly available today

[a] Based on sales weighting of 2001 engine certification data

As can be seen in Table III.E-3, the engines in the 25-75 hp category have a number of technology differences from the larger engines. These include a higher percentage of indirect-injection fuel systems, and a low fraction of turbocharged engines. (The distinction in the <25 hp category is quite different, with no turbocharged engines, nearly one-half of the engines have two cylinders or less, and a significant majority of the engines have indirect-injection fuel systems.)

The distinction is particularly marked with respect to electronically controlled fuel systems. These are commonly available in the $\geq$ 75 hp power categories, but, based on the available certification data as well as our discussions with engine manufacturers, we believe there are very limited, if any in the 25-75 hp category (and no electronic fuel systems in the less than 25 hp category). The research and development work being performed today for the heavy-duty highway market is targeted at engines which are 4-cylinders or more, direct-injection, electronically controlled, turbocharged, and with per-cylinder displacements greater than 0.5 liters. As discussed in more detail below, as well as in section III.E.5 (regarding the <25 hp category), these engine distinctions are important from a technology perspective and warrant a different set of standards for the 25-75 hp category (as well as for the <25 hp category).

b. What engine technology is used today, and will be used for the applicable Tier 2 and Tier 3 standards?

In the 1998 nonroad diesel rulemaking, we established Tier 1 and Tier 2 standards for engines in the 25-50 hp category. Tier 1 standards were implemented in 1999, and the Tier 2 standards take effect in 2004. The 1998 rule also established Tier 2 and Tier 3 standards for engines between 50 and 75 hp. The Tier 2 standards take effect in 2004, and the Tier 3 standards take effect in 2008. The Tier 1 standards for engines between 50 and 75 hp took effect in 1998. Therefore, all engines in the 25-75 hp range have been meeting Tier 1 standards for the past several years, and the data presented in Table III.E-3 represent performance of Tier 1 technology for this power range.

As discussed in section III.E.4.a, engines in the 25-75 hp category use either indirect injection (IDI) or direct injection (DI) fuel systems. The IDI system injects fuel into a pre-chamber rather than directly into the combustion chamber as in the DI system.[154] This difference in fuel systems results in substantially different emission characteristics, as well as several important operating parameters. In general, the IDI engine has lower engine-out PM and NOx emissions, while the DI engine has better fuel efficiency and lower heat rejection.[155]

We expect a significant shift in the engine technology which will be used in this power category as a result of the upcoming Tier 2 and Tier 3 standards, in particular for the 50-75 hp engines. In the 50-75 hp category, the 2008 Tier 3 standards will likely result in the significant use of turbocharging and electronic fuel systems, as well as the introduction of both cooled and uncooled exhaust gas recirculation by some engine manufacturers and possibly the use of charge-air-cooling.[156] In addition, we have heard from some engine manufactures that the engine technology used to meet Tier 3 for engines in the 50-75 hp range will also be made available on those engines in the 25-50 hp range which are built on the same engine platform. For the Tier 2 standards for the 25-50 hp products, a large number of engines meet these standards today, and therefore we expect to see only moderate changes in these engines, including the potential additional use of turbocharging on some models.[157]

c. Are the proposed standards for 25 - 75 hp engines technologically feasible?

This section will discuss the technical feasibility of both the proposed 2008 PM standard and the 2013 standards. For an explanation and discussion of the proposed implementation dates, please refer to Section III.B of this today's proposal.

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[154] See for example "Diesel-engine Management" published by Robert Bosch GmbH, 1999, second edition, pages 6-8 for a more detailed discussion of the differences between and IDI and DI engines.

[155] See Chapter 14, section 4 of "Turbocharging the Internal Combustion Engine, N. Watson and M.S. Janota, published by John Wiley and Sons, 1982.

[156] See Section 2.2 through 2.3 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

[157] See Table 3-2 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

i. 2008 PM Standards[158]

As just discussed in section III.E.4.b, engines in the 25-50 hp category must meet Tier 1 NMHC+NOx and PM standards today. We have examined the model year 2002 engine certification data for engines in the 25-50 hp category. These data indicate that over 10 percent of the engine families meet the proposed 2008 0.22 g/bhp-hr PM standard and 5.6 g/bhp-hr NMHC+NOx standard (unchanged from Tier 2 in 2008) today. These include a variety of engine families using a mix of engine technologies (IDI and DI, turbocharged and naturally aspirated) tested on a variety of certification test cycles.[159] Five engine families are more than 20 percent below the proposed 0.22 g/bhp-hr PM standard, and an additional 24 engine families are within 30 percent of the proposed 2008 PM standards while meeting the NMHC+NOx standard. A detailed discussion of these data is contained in the draft RIA. Unfortunately, similar data do not exist for engines between 50 and 75 hp. There is no Tier 1 PM standard for engines in this power range, and therefore engine manufacturers are not required to report PM emission levels until Tier 2 starts in 2004. However, in general, the 50-75 hp engines are more technologically advanced than the smaller horsepower engines and would be expected to perform as well as, if not better than, the engines in the 25 - 50 hp range.

The model year 2002 engines in this power range use well known engine-out emission control technologies, such as optimized combustion chamber design and fuel injection timing control strategies, to comply with the existing standards. These data have a two-fold significance. First, they indicate that a number of engines in this power range can already achieve the proposed 2008 standard for PM using only engine-out technology, and that other engines should be able to achieve the standard making improvements just to engine-out performance. Despite being certified to the same emission standards with similar engine technology, the emission levels from these engines vary widely. Figure III.E-1 is a graph of the model year 2002 HC+NOx and PM data for engines in the 25-50 hp range. As can be seen in the figure, the emission levels cover a wide range. Figure III.E-1 highlights a specific example of this wide range: engines using naturally aspirated DI technology and tested on the 8-mode test cycle. Even for this subset of DI engines achieving approximately the same HC+NOx level of ~6.5 g/bhp-hr, the PM rates vary from approximately 0.2 to more than 0.5 g/bhp-hr. There is limited information available to indicate why for these small diesel engines with similar technology operating at approximately the same HC+NOx level the PM emission rates cover such a broad range. We are therefore not predicating the proposed 2008 PM standard on the combination of diesel oxidation catalysts and

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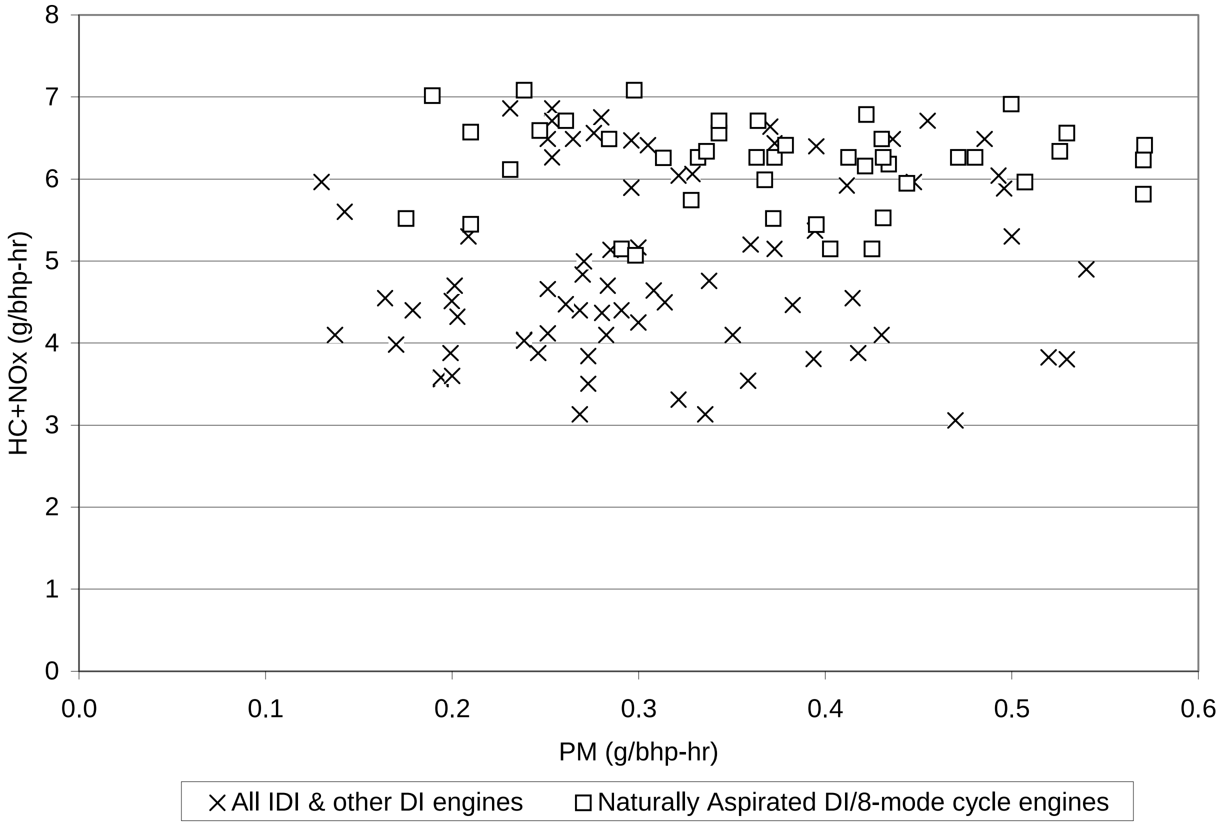
158 As discuss in Section III.B., manufacturers can choose, at their option, to pull-ahead the 2013 PM standard for the 50-75 hp engines to 2012, in which case they do not need to comply with the transitional 2008 PM standard.

159 The Tier 1 standards for this power category must be demonstrated on one of a variety of different engine test cycles. The appropriate test cycle is selected by the engine manufacturer based on the intended in-use application of the engine.

the lowest engine-out emissions being achieved today, because it is uncertain whether or not additional engine-out improvements would lower all engines to the proposed 2008 PM standard. Instead, we believe there are two likely means by which companies can comply with the proposed 2008 PM standard. First, some engine manufacturers can comply with this standard using known engine-out techniques (e.g., optimizing combustion chamber designs, fuel-injection strategies). However, based on the available data it is unclear whether engine-out techniques will work in all cases. Therefore, we believe some engine companies will choose to use a combination of engine-out techniques and diesel oxidation catalysts, as discussed below.

Figure III.E-1 Emission Certification Data for 25-50 HP Model Year 2002 Engines



For those engines which do not already meet the proposed 2008 Tier 4 PM standard, a number of engine-out technologies are available to achieve the standards by 2008. In our recent Staff Technical Paper on the feasibility of the Tier 2 and Tier 3 standards, we projected that in order to comply with the Tier 3 standards, engines greater than 50 hp would rely on some combination of a number of technologies, including electronic fuel systems such as electronic rotary pumps or common-rail fuel systems.[160] In addition to enabling the Tier 3 NMHC+NOx standards, electronic fuel systems with high injection pressure and the capability to perform pilot-injection and rate-shaping, have the potential to substantially reduce PM emissions.[161] Even for mechanical fuel systems, increased injection pressures can reduce PM emissions substantially.[162] As discussed above, we are projecting that the Tier 3 engine technologies used in engines between 50 and 75 hp, such as turbocharging and electronic fuel systems, will make their way into engines in the 25-50 hp range. However, we do not believe this technology will be required to achieve the proposed 2008 PM standard. As demonstrated by the 2002 certification data, engine-out techniques such as optimized combustion chamber design, fuel injection pressure increases and fuel injection timing can be used to achieve the proposed standards for many of the engines in the 25-75 hp category without the need to add turbocharging or electronic fuel systems.

For those engines which are not able to achieve the proposed standards with known engine-out techniques, we project that diesel oxidation catalysts can be used to achieve the proposed standards. DOCs are passive flow-through emission control devices which are typically coated with a precious metal or a base-metal washcoat. DOCs have been proven to be durable in use on both light-duty and heavy-duty diesel applications. In addition, DOCs have already been used to control PM or carbon monoxide on some nonroad applications.[163]

Certain DOC formulations can be sensitive to diesel fuel sulfur level, and depending on

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[160] See Section 2.2 through 2.3 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

[161] Ikegami, M., K. Nakatani, S. Tanaka, K. Yamane: "Fuel Injection Rate Shaping and Its Effect on Exhaust Emissions in a Direct-Injection Diesel Engine Using a Spool Acceleration Type Injection System", SAE paper 970347, 1997. Dickey D.W., T.W. Ryan III, A.C. Matheaus: "NOx Control in Heavy-Duty Engines-What is the Limit?", SAE paper 980174, 1998. Uchida N, K. Shimokawa, Y. Kudo, M. Shimoda: "Combustion Optimization by Means of Common Rail Injection System for Heavy-Duty Diesel Engines", SAE paper 982679, 1998.

[162] "Effects of Injection Pressure and Nozzle Geometry on DI Diesel Emissions and Performance," Pierpont, D., and Reitz, R., SAE Paper 950604, 1995.

[163] EPA Memorandum "Documentation of the Availability of Diesel Oxidation Catalysts on Current Production Nonroad Diesel Equipment", William Charmley. Copy available in EPA Air Docket A-2001-28.

the level of emission reduction necessary, sulfur in diesel fuel can be an impediment to PM reductions. As discussed in section III.E.1.a, precious metal oxidation catalysts can oxidize the sulfur in the fuel and form particulate sulfates. However, even with today's high sulfur nonroad fuel, some manufacturers have demonstrated that a properly formulated DOC can be used to achieve the existing Tier 2 PM standards for larger engines (i.e., the 0.15 g/bhp-hr standard).[164] However, given the high level of sulfur in nonroad fuel today, the use of DOCs as a PM reduction technology is severely limited. Data presented by one engine manufacturer regarding the existing Tier 2 PM standard shows that while a DOC can be used to meet the current standard even when tested on 2,000 ppm sulfur fuel, lowering the fuel sulfur level to 380 ppm enabled the DOC to reduce PM by 50 percent from the 2,000 ppm sulfur fuel.[165] Without the availability of 500 ppm sulfur fuel in 2008, DOCs would be of limited use for nonroad engine manufacturers and would not provide the emissions necessary to meet the proposed standards for most engine manufacturers. With the availability of 500 ppm sulfur fuel, DOC's can be designed to provide PM reductions on the order of 20 to 50%, while suppressing particulate sulfate reduction.[166] These levels of reductions have been seen on transient duty cycles as well as highway and nonroad steady-state duty cycles. As discussed above, 24 engine families in the 25-50 hp range are within 30 percent of the proposed 2008 PM standard and are at or below the 2008 NMHC+NOx standard for this power range, indicating that use of DOCs should readily achieve the incremental improvement necessary to meet the proposed 2008 PM standard.

Based on the existence of a number of engine families which already comply with the proposed 0.22 g/bhp-hr PM standard (and the 2008 NMHC+NOx standard), and the availability of well known PM reduction technologies such as engine-out improvements and diesel oxidation catalysts, we project the proposed 0.22 g/bhp-hr PM standards is technologically feasible by model year 2008. All of these are conventional technologies which have been used on both highway and nonroad diesel engines in the past. As such, we do not expect there to be any negative impacts with respect to noise or safety. In addition, PM reduction technologies such as improved combustion through the use of higher pressure fuel injection systems have the potential to improve fuel efficiency. DOCs are not predicted to have any substantial impact on fuel efficiency.

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[164] See Table 2-4 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

[165] See Table 2-4 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

[166] "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-duty Engines to Achieve Low Emission Levels: Interim Report Number 1 - Oxidation Catalyst Technology, copy available in EPA Air Docket A-2001-28. "Reduction of Diesel Exhaust Emissions by Using Oxidation Catalysts," Zelenka et. al., SAE Paper 90211, 1990. See Table 2-4 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001, copy available in EPA Air Docket A-2001-28.

[NOTE - ADDITIONAL DISCUSSION AND DATA REGARDING TEST CYCLES AND RELATED STANDARDS TO BE ADDED]

As discussed in Section III.B, we have also proposed a minor change in the CO standard for the 25-50 hp engines, in order to align it with the standard for the 50-75 hp engines. As discussed in Section III.B., this small change in the CO standard is intended to simplify EPA's regulations as part of our decision to propose a reduction in the number of engine power categories for Tier 4. The current CO standard for this category is 4.1 g/bhp-hr, and the proposed standard is 3.7 g/bhp-hr (i.e., the current standard for engines in the 50-75 hp range). The model year 2002 certification data shows that more than 95 percent of the engine families in the 25-50 hp engine range meet the proposed CO standard today. In addition, a recent EPA test program run by a contractor on two nonroad diesel engines in this power range showed that CO emissions were well below the proposed standards not only when tested on the existing steady-state 8-mode test procedure, but also when tested on the nonroad transient duty cycle we are proposing in today's action.[167] Finally, DOCs typically reduce CO emissions on the order of 50 percent or more, on both transient and steady-state duty cycles.[168] Given that more than 95 percent of the engines in this category meet the proposed standard today, and the ready availability of technology which can easily achieve the proposed standard, we project this CO standard will be achievable by model year 2008.

i. 2013 Standards

For engines in the 25-50 range, we are proposing standards commencing in 2013 of 3.5 g/bhp-hr for NMHC+NOx and 0.02 g/bhp-hr for PM. For the 50-75 hp engines, we are proposing a 0.02 g/bhp-hr PM standard which will be implemented in 2013, and for those manufacturers who choose to pull-ahead the standard one-year, 2012 (manufacturers who choose to pull-ahead the 2013 standard for engine in the 50-75 range do not need to comply with the transitional 2008 PM standard).

PM Standard

Sections III.E.1 through III.E.3 have already discussed catalyzed diesel particulate filters, including explanations of how CDPFs reduce PM emissions, and how to apply CDPFs to nonroad engines. We concluded there that CDPFs can be used to achieve the proposed PM standard for engines ≥75 hp. As also discussed in Section III.E.2.a, PM filters will require active

[167] See Tables 6, 8, and 14 of "Nonroad Emission Study of Catalyzed Particulate Filter Equipped Small Diesel Engines" Southwest Research Institute, September 2001. Copy available in EPA Air Docket A-2001-28.

[168] "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-duty Engines to Achieve Low Emission Levels: Interim Report Number 1 - Oxidation Catalyst Technology. **Insert a reference regarding CO reductions from a DOC over steady-state Tests**

back-up regeneration systems for many nonroad applications. A number of secondary technologies are likely required to enable proper regeneration, including possibly electronic fuel systems such as common rail systems which are capable of multiple post-injections which can be used to raise exhaust gas temperatures to aid in filter regeneration.

Particulate filter technology, with the requisite trap regeneration technology, can also be applied to engines in the 25 to 75 hp range. The fundamentals of how a filter is able to reduce PM emissions as described in Section III.E.1. are not a function of engine power, and CDPF's are just as effective at capturing soot emissions and oxidizing SOF on smaller engines as on larger engines. As discussed in more detail below, particulate sulfate generation rates are slightly higher for for the smaller engines, however, we have addressed this issue in our proposal. The PM filter regeneration systems described in Section III.E.1 and 2 are also applicable to engines in this size range and are therefore likewise feasible. There are specific trap regeneration technologies which we believe engine manufacturers in the 25-75 hp category may prefer over others. Specifically, an electronically-controlled secondary fuel injection system (i.e., a system which injects fuel into the exhaust upstream of a PM filter). Such a system has been commercially used successfully by at least one nonroad engine manufacturer, and other systems have been tested by technology companies.[169]

We are, however, proposing a slightly higher PM standard (0.02 g/bhp-hr rather than 0.01) for these engines. As discussed in section III.E.1.a, with the use of a CDPF, the PM emissions emitted by the filter are primarily derived from the fuel sulfur. The smaller power category engines tend to have higher fuel consumption than larger engines. This occurs for a number of reasons. First, the lower power categories include a high fraction of IDI engines which by their nature consume approximately 15 percent more fuel than a DI engine. Second, as engine displacements get smaller, the engine's combustion chamber surface-to-volume ratio increases. This leads to higher heat-transfer losses and therefor lower efficiency and higher fuel consumption. In addition, frictional losses are a higher percentage of total power for the smaller displacement engines which also results in higher fuel consumption. Because of the higher fuel consumption rate, we expect a higher particulate sulfate level, and therefore we have proposed a 0.02 g/bhp-hr standard.

Test data confirm that this proposed standard, as well as the NTE of 1.5 times the standard, are achievable. In 2001, EPA completed a test program run by a contractor on two small nonroad diesel engines (a 25 hp IDI engine and a 50 hp IDI engine) which demonstrated

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[169] "The Optimized Deutz Service Diesel Particulate Filter System II", H. Houben et. al., SAE Technical Paper 942264, 1996 and "Development of a Full-Flow Burner DPF System for Heavy Duty Diesel Engines, P. Zelenka et. al., SAE Technical Paper 2002-01-2787, 2002.

the proposed 0.02 g/bhp-hr standard can be achieved with the use of a CDPF.[170] This test program included testing on the existing 8-mode steady-state test cycle as well as the nonroad transient cycle proposed in today's action. The 0.02g/bhp-hr level was achieved on each engine over both test cycles. In addition, the 0.02 g/bhp-hr level was achieved on a variety of nonroad test cycles which are intended to represent several specific applications, such as skid-steer loaders, arc-welders, and agricultural tractors. We believe these data are indicative of the robust emission reduction capability of particulate filters and demonstrates the proposed NTE standard of 1.5 x 0.02 g/bhp-hr standard (0.03 g/bhp-hr) can be achieved using the proposed not-to-exceed test requirements. This test program also demonstrates why EPA has proposed a slightly higher PM standard for the 25 - 75 hp category (0.02 g/bhp-hr vs 0.01). The data from the test program described above showed fuel consumption rates over the 8-mode test procedure between 0.4 and 0.5 lbs/bhp-hr, while typical values for a modern turbocharged DI engine with 4-valves per cylinder in the $\geq$75 hp categories are on the order of 0.3 to 0.35 lbs/hp-hr.

[NOTE - ADDITIONAL DISCUSSION AND DATA REGARDING TEST CYCLES AND RELATED STANDARDS TO BE ADDED]

NMHC+NOx Standard

We have proposed a 3.5 g/bhp-hr NMHC+NOx standard for engines in the 25 - 50 hp range for 2013. This will align the NMHC+NOx standard for engines in this power range with the Tier 3 standard for engines in the 50 - 75 hp range which are implemented in 2008. EPA's recent Staff Technical paper which reviewed the technological feasibility of the Tier 3 standards contains a detailed discussion of a number of technologies which are capable of achieving a 3.5 g/bhp-hr standard. These include cooled EGR, uncooled EGR, as well as advanced in-cylinder technologies relying on electronic fuel systems and turbocharging.[171] These technologies are capable of reducing NOx emission by as much as 50 percent. Given the Tier 2 NMHC+NOx standard of 5.6 g/bhp-hr, a 50 percent reduction would allow a Tier 2 engine to comply with the 3.5 g/bhp-hr NMHC+NOx standard proposed in this action. In addition, because this NMHC+NOx standard is concurrent with the 0.02 g/bhp-hr PM standards which we project will be achievable with the use of particulate filters, engine designers will have significant additional flexibility in reducing NOx because the PM filter will eliminate the traditional concerns with the engine-out NOx vs. PM trade-off.

[NOTE - ADDITIONAL DISCUSSION AND DATA REGARDING TEST CYCLES AND

[170] See Tables 6, 8, and 14 of "Nonroad Emission Study of Catalyzed Particulate Filter Equipped Small Diesel Engines" Southwest Research Institute, September 2001. Copy available in EPA Air Docket A-2001-28.

[171] See Section 2.2 through 2.3 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

RELATED STANDARDS TO BE ADDED]

Based on the information available to EPA and presented here, and giving appropriate consideration to the lead time necessary to apply the technology as well, we have concluded the proposed 0.02 g/bhp-hr PM standard for engines in the 25 - 75 hp category and the 3.5 g/bhp-hr NMHC+NOx standards for the 25 - 50 hp engines are achievable.

d. Why EPA has not proposed more stringent Tier 4 NOx standards

Today's notice proposes to revise the NMHC+NOx standard for engines between 25 and 50 hp to a level of 3.5 g/bhp-hr beginning in 2013 (the same numeric level as the Tier 3 standards for engines in the 50 - 75 hp range). As discussed below, we believe this standard can be met using a variety of technologies, including but not limited to cooled EGR. Similar technologies will be used on engines in the 50 - 100 hp range beginning in 2008. At this time, we are not proposing further reductions in the NOx standards for engines between 25 and 75 hp.

As discussed in section III.B.1.d, engines $\geq$75 hp are similar to, or are direct derivatives of, highway HDDEs. As discussed in section III.E.1 - III.E.3, NOx adsorber technology is being developed today in order to comply with the 2007 highway heavy-duty standards. However, NOx adsorber technologies will require additional development beyond what has occurred at this time in order to achieve the 2007 highway standards. Section III.E.1 - III.E.3 also discuss the high degree of complexity and engine/aftertreatment integration which will be required in order for NOx adsorbers to be applied successfully to nonroad diesel engines.
As discussed above, and illustrated in Table III.E-3, engines <75 hp include a significant fraction of naturally aspirated engines and engines with indirect-injection fuel systems, and we are not predicting a significant shift away from IDI technology engines. Given the relatively unsophisticated level of technology used in this power category today, as well as our prediction that even in the 20011-13 time frame these engines will lag significantly behind the $\geq$75 hp engines, we believe it is appropriate not to propose NOx adsorber based standards at this time. Rather, as discussed in section III.H, we have proposed to undertake a technology assessment in the 2007 time frame which would evaluate the status of emission control technologies for engines less than 75 hp, and such a review would revisit this issue. In addition, Section VI of this proposal contains additional discussion regarding our analysis of applying NOx adsorbers to engines in the 25-75 hp category.

5. Are the Standards Proposed for Engines <25 hp Feasible?

As discussed in section III.B, our proposal for standards for engines less than 25 hp is a new PM standard of 0.30 g/bhp-hr beginning in 2008. As discussed below, we are not proposing to set a new standard more stringent than the existing Tier 2 NMHC+NOx standard for this power category at this time. This section describes:

- what makes the <25 hp category unique;

- engine technology currently used in the <25 hp category;
- why the proposed standards are technologically feasible; and,
- why EPA has not proposed more stringent standards at this time.

a. What makes the < 25 hp category unique?

Nonroad engines less than 25 hp are the least sophisticated nonroad diesel engines from a technological perspective. All of the engines currently sold in this power category lack electronic fuel systems and turbochargers (see Table III.E-3). Nearly 50 percent of the products have two-cylinders or less, and 14 percent of the engines sold in this category are single-cylinder products, a number of these have no batteries and are crank-start machines, much like today's simple walk behind lawnmower engines. In addition, given what we know today and taking into account the Tier 2 standards which have not yet been implemented, we are not projecting any significant penetration of advanced engine technology, such as electronically controlled fuel systems, into this category in the next 5 to 10 years.

b. What engine technology is currently used in the <25 hp category?

In the 1998 nonroad diesel rulemaking we established Tier 1 and Tier 2 standards for these products. Tier 1 was implemented in model year 2000, and Tier 2 will be implemented in model year 2005. As discussed in EPA's recent Staff Technical Paper, we project the Tier 2 standards will be met by basic engine-out emission optimization strategies.[172] We are not predicting that Tier 2 will require electronic fuel systems, EGR, or turbocharging. As discussed in the Staff Technical Paper, a large number of engines in this power category already meet the Tier 2 standards by a wide margin.[173]

Two basic types of engine fuel injection technologies are currently present in the less than 25 hp category, mechanical indirect injection (IDI) and mechanical direct injection (DI). As discussed in Section III.D.4, the IDI system injects fuel into a pre-chamber rather than directly into the combustion chamber as in the DI system. This difference in fuel systems results in substantially different emission characteristics, as well as several important operating parameters. In general, as noted earlier, the IDI engine has lower engine-out PM and NOx emissions, while the DI engine has better fuel efficiency and lower heat rejection.

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172 See Section 3 of "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

173 See Table 3-2 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

c. What data indicates that the proposed standards are feasible?

We project the proposed Tier 4 PM standard can be met by 2008 based on:
-- the existence of a large number of engine families which meet the proposed standards today;
-- the use of engine-out reduction techniques; and
-- the use of diesel oxidation catalysts.

We have examined the recent model year (2002) engine certification data for nonroad diesel engines less than 25 hp. These data indicate that a number of engine families meet the proposed Tier 4 PM standard (and the 2008 NMHC+NOx standard, unchanged from Tier 2) today. The current data indicates approximately 28% of the engine families are at or below the proposed PM standard today, while meeting the 2008 NMHC+NOx standard. These include both IDI and DI engines, as well as a range of certification test cycles.[174] Many of the engine families are certified well below the proposed Tier 4 standard while meeting the 2008 NMHC+NOx level. Specifically, 15 percent of the engine families exceed the proposed Tier 4 PM standard by more than 20 percent. The public certification data indicate that these engines do not use turbocharging, electronic fuel systems, exhaust gas recirculation, or aftertreatment technologies.

These model year 2002 engines use well known engine-out emission control technologies, such as combustion chamber design and fuel injection timing control strategies, to comply with the existing standards. As with 25-75 hp engines, these data have a two-fold significance. First, they indicate that a number of engines in this power category can already achieve the proposed 2008 standard for PM using only engine-out technology, and that other engines should be able to achieve the standard making improvements just to engine-out performance. Despite being certified to the same emission standards with similar engine technology, the emission levels from these engines vary widely. Figure III.E-2 is a graph of the model year 2002 HC+NOx and PM data. As can be seen in the figure, the emission levels cover a wide range. Figure III.E-2 highlights a specific example of this wide range: engines using naturally aspirated IDI technology and tested on the 6-mode test cycle. Even for this subset of IDI engines achieving aproximately the same HC+NOx level of~4.5 g/bhp-hr, the PM rates vary from approximately 0.15 to 0.5 g/bhp-hr. (A more detailed discussion of this data is contained in the draft RIA.) There is limited information available to indicate why for these small diesel engines with similar technology operating at approximately the same HC+NOx level the PM emission rates cover such a broad range. We are therefore not predicating the proposed 2008 PM standard on the combination of diesel oxidation catalysts and the lowest engine-out emissions being achieved today, because it is uncertain whether or not additional engine-out

[174] The Tier 1 and Tier 2 standards for this power category must be demonstrated on one of a variety of different engine test cycles. The appropriate test cycle is selected by the engine manufacturer based on the intended in-use applications(s) of the engine.

improvements would lower all engines to the proposed 2008 PM standard. Instead, we believe there are two likely means by which companies can comply with the proposed 2008 PM standard. First, some engine manufacturers can comply with this standard using known engine-out techniques (e.g., optimizing combustion chamber designs, fuel-injection strategies). However, based on the available data it is unclear whether engine-out techniques will work in all cases. Therefore, we believe some engine companies will choose to use a combination of engine-out techniques and diesel oxidation catalysts, as discussed below.

PM emissions can be reduced through in-cylinder techniques for small nonroad diesel engines using similar techniques as used in larger nonroad and highway engines. As discussed in Section III.E.1.a, there are a number of technologies which exist that can influence oxygen content and in-cylinder mixing (and thus lower PM emissions) including improved fuel injection systems and combustion system designs. For example, increased injection pressure can reduce PM emissions substantially.[175] The wide-range of emission characteristics present in the existing engine certification data is likely a result of differences in fuel systems and combustion chamber designs. For many of the engines which have higher emission levels, further optimization of the fuel system and combustion chamber can provide additional PM reductions.

Diesel oxidation catalysts (DOC) also offer the opportunity to reduce PM emissions from the engines in this power category. DOCs are passive flow through emission control devices which are typically coated with a precious metal or a base-metal wash-coat. DOCs have been proven to be durable in-use on both light-duty and heavy-duty diesel applications. In addition, DOCs have already been used to control either PM or in some cases carbon monoxide on some nonroad applications.[176] However, as discussed in Section III.E.1.a., certain DOC formulations can be sensitive to diesel fuel sulfur level. Specifically, precious-metal based oxidation catalysts (which have the greatest potential for reducing PM) can oxidize the sulfur in the fuel and form particulate sulfates. Given the high level of sulfur in nonroad fuel today, the use of DOCs as a PM reduction technology is severely limited. Data presented by one engine manufacturer regarding the existing Tier 2 PM standard shows that while a DOC can be used to meet the current standard when tested on 2,000 ppm sulfur fuel, lowering the fuel sulfur level to 380 ppm enabled the DOC to reduce PM by 50 percent from the 2,000 ppm sulfur fuel.[177] Without the availability of 500 ppm sulfur fuel in 2008, DOCs would be of limited use for nonroad engine manufacturers and would not provide the emissions necessary to meet the proposed standards for most engine manufacturers. With the availability of 500 ppm sulfur fuel, DOC's can be designed to provide PM reductions on the order of 20 to 50%, while suppressing particulate sulfate reduction.[178] These levels of reductions have been seen on transient duty cycles as well as

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175 "Effects of Injection Pressure and Nozzle Geometry on DI Diesel Emissions and Performance," Pierpont, D., and Reitz, R., SAE Paper 950604, 1995.

176 EPA Memorandum "Documentation of the Availability of Diesel Oxidation Catalysts on Current Production Nonroad Diesel Equipment", William Charmley. Copy available in EPA Air Docket A-2001-28.

177 See Table 2-4 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

178 "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-duty Engines to Achieve Low Emission Levels: Interim Report Number 1 - Oxidation Catalyst Technology, copy available in EPA Air Docket A-2001-28. "Reduction of Diesel Exhaust Emissions by Using Oxidation Catalysts," Zelenka et. al., SAE Paper 90211, 1990. See Table 2-4 in "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001, copy available in EPA Air Docket A-2001-28.

highway and nonroad steady-state duty cycles.

[NOTE - ADDITIONAL DISCUSSION AND DATA REGARDING TEST CYCLES AND RELATED STANDARDS TO BE ADDED]

As discussed in Section III.B, we have also proposed a minor change in the CO standard for the <11 hp engines, in order to align those standards with the standards for the 11-25 hp engines. As discussed in Section III.B., the small change in the CO standard is intended to simplify EPA's regulations as part of our decision to propose a reduction in the number of engine power categories for Tier 4. The current CO standard for this category is 6.0 g/bhp-hr, and the proposed standard is 4.9 g/bhp-hr (i.e., the current standard for engines in the 11-25 hp range). The model year 2002 certification data shows that more than 90 percent of the engine families in this power category meet the proposed standards today. In addition, DOCs typically reduce CO emissions on the order of 50 percent or more.[179] Given that more than 90 percent of the engines in this category meet the proposed standard today, and the ready availability of technology which can easily achieve the proposed standard, we project this CO standard will be achievable by model year 2008.

Based on the existence of a number of engine families which already comply with the proposed Tier 4 PM standard (and the 2008 NMHC+NOx standard), and the availability of PM reduction technologies such as improved fuel systems, combustion chamber improvements, and in particular diesel oxidation catalysts, we project the proposed 0.30 g/bhp-hr PM standards is technologically feasible by model year 2008. All of these are conventional technologies which have been used on both highway and nonroad diesel engines in the past. As such, we do not expect there to be any negative impacts with respect to noise or safety. In addition, PM reduction technologies such as improved combustion through the use of higher pressure fuel injection systems as well as DOCs are not predicted to have any substantial impact on fuel efficiency.

d. Why has EPA not proposed more stringent PM or NOx standards for engines < 25 hp?

Section III.E.4 contains a detailed discussion of why we don't believe it is appropriate at this time to revise the NOx standards based on NOx absorber technology for engines between 25 and 75 hp. These same arguments apply for engines below 25 hp. In addition, we have not proposed to revise the NOx standard for <25 hp engines in this action, nor do we believe PM standards based on particulate filters are appropriate for this power category based on a number of factors, as discussed below.

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[179] "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-duty Engines to Achieve Low Emission Levels: Interim Report Number 1 - Oxidation Catalyst Technology.

In EPA's recent Staff Technical Paper regarding the feasibility of the Tier 3 NMHC+NOx standards for engines greater than 50 hp, we projected that a number of engine technologies can be used to meet the Tier 3 standards, including cooled EGR or hot EGR, both with advanced electronic fuel systems, as well as with internal combustion techniques using advanced electronic fuel systems, advanced turbocharging systems (e.g., waste-gated or variable geometry turbochargers), and possibly variable valve actuation.[180] In addition, we presumed the use of charge-air cooling In order to set more stringent NOx standards for <25 hp engines without increasing PM emissions, the most logical list of technologies is turbocharging, electronically controlled hot or cooled EGR, an electronic fuel system, and possibly charge-air-cooling. No nonroad diesel engine <25 hp uses any combination of these technologies today. While we are able to postulate that some of this technology could be applied to the <25 hp engines, the application of some of the technology (such as turbocharging) is technologically uncertain. It is the combination of these two issues (the traditional NOx-PM trade-off and the difficulties with turbocharging 1 and 2 cylinder engines) which is the primary reason we are not proposing to revise the NOx standard for engines in this size range. NOx reduction control technologies such as advancing fuel injection timing or using EGR will increase PM emissions. In order to reduce NOx emissions and reduce or maintain current PM levels additional technologies must be used. Fundamental among these is the need to increase oxygen content, which can be achieved principally with turbocharging. However, turbocharging systems do not lend themselves to 1 and 2 cylinder products, which are approximately 50 percent of the engines in this power category. In addition, even if these technologies could be applied to engines in the < 25 hp category, the costs would be substantial relative to both the base engine cost and to the cost of the nonroad equipment itself . Therefore, for the reasons discussed above, we have not proposed to revise the NOx standard for these engines at this time. As discussed in section III.H, we have proposed that a technology assessment occur in 2007 which would evaluate the status of emission control technologies for engines less than 75 hp, and such a review would revisit this issue.

In addition, we have not proposed to apply particulate filter based standards for engines less than 25 hp. As discussed in sections III.E.1 through 4, there are two basic types of particulate filter systems we believe could be used by engine manufacturers. The first is a CDPF which uses post-injection from a common-rail electronic fuel injection system in order to ensure filter regeneration. The second type of system would use a CDPF with a stand-alone (i.e., independent from the engine's fuel system) fuel injection system to ensure filter regeneration. In either case, an electronic control system is required, as well as the CDPF. Such systems are not being developed for engines of this size for either highway light-duty or heavy-duty diesel applications, and (as noted earlier) it is unclear whether the technology development which is being done for the highway market will transfer down to engines in this power category. In addition, based on currently available information, we believe the cost of these technologies are

[180] See Section 2.3.1 through 2.3.3 of "Nonroad Diesel Emission Standards - Staff Technical Paper", EPA Publication EPA420-R-01-052, October 2001. Copy available in EPA Air Docket A-2001-28.

relatively high compared to the overall cost of the equipment. As discussed in section III.H, we have proposed that a technology assessment occur in 2007 which would evaluate the status of emission control technologies for engines less than 75 hp, and such a review would revisit this issue.

6. Meeting the Crankcase Emissions Requirements

The most common way to eliminate crankcase emissions has been to vent the blow-by gases into the engine air intake system, so that the gases can be recombusted. Prior to the HD2007 rulemaking, we have required that crankcase emissions be controlled only on naturally aspirated diesel engines. We had made an exception for turbocharged diesel engines (both on-highway and nonroad) because of concerns in the past about fouling that could occur by routing the diesel particulates (including engine oil) into the turbocharger and aftercooler. However, this is an environmentally significant exception since most nonroad equipment over 70hp use turbocharged engines, and a single engine can emit over 100 pounds of NOx, NMHC, and PM from the crankcase over its lifetime.

Given the available means to control crankcase emissions, we eliminated this exception for highway engines in 2007 and are proposing to eliminate the exception for nonroad diesel engines as well. We anticipate that the diesel engine manufacturers will be able to control crankcase emissions through the use of closed crankcase filtration systems or by routing unfiltered blow-by gases directly into the exhaust system upstream of the emission control equipment. However, the proposed provision has been written such that if adequate control can be had without "closing" the crankcase then the crankcase can remain "open." Compliance would be ensured by adding the emission from the crankcase ventilation system to the emissions from the engine control system downstream of any emission control equipment.

We expect that in order to meet the stringent tailpipe emission standards set here, that manufacturers will have to utilize closed crankcase approaches as described here. Closed crankcase filtration systems work by separating oil and particulate matter from the blow-by gases through single or dual stage filtration approaches, routing the blow-by gases into the engine's intake manifold and returning the filtered oil to the oil sump. Oil separation efficiencies in excess of 90 percent have been demonstrated with production ready prototypes of two stage filtration systems.[181] By eliminating 90 percent of the oil that would normally be vented to the atmosphere, the system works to reduce oil consumption and to eliminate concerns over fouling of the intake system when the gases are routed through the turbocharger. Hatz, a nonroad engine manufacturer, currently has closed crankcase systems on many of its turbocharged engines.

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181 Letter from Marty Barris, Donaldson Corporation, to Byron Bunker US EPA, March 2000. Air Docket A-99-06.

F. Why Do We Need 15ppm Sulfur Diesel Fuel?

As stated earlier, we strongly believe that fuel sulfur control is critical to ensuring the success of NOx and PM aftertreatment technologies. In order to evaluate the effect of sulfur on diesel exhaust control technologies, we used three key factors to categorize the impact of sulfur in fuel on emission control function. These factors were efficiency, reliability, and fuel economy. Taken together these three factors lead us to believe that diesel fuel sulfur levels of 15 ppm will be required for the nonroad emission standards proposed here to be feasible. Brief summaries of these factors are provided below.

The **efficiency** of emission control technologies to reduce harmful pollutants is directly affected by sulfur in diesel fuel. Initial and long term conversion efficiencies for NOx, NMHC, CO and diesel PM emissions are significantly reduced by catalyst poisoning and catalyst inhibition due to sulfur. NOx conversion efficiencies with the NOx adsorber technology in particular are dramatically reduced in a very short time due to sulfur poisoning of the NOx storage bed. In addition, total PM control efficiency is negatively impacted by the formation of sulfate PM. As explained in the following sections, the CDPF, NOx adsorber, and urea SCR catalyst technologies described here have the potential to make significant amounts of sulfate PM under operating conditions typical of many nonroad engines. We believe that the formation of sulfate PM will be in excess of the total PM standard, unless diesel fuel sulfur levels are at or below 15 ppm. Based on the strong negative impact of sulfur on emission control efficiencies for all of the technologies evaluated, we believe that 15 ppm represents an upper threshold of acceptable diesel fuel sulfur levels.

Reliability refers to the expectation that emission control technologies must continue to function as required under all operating conditions for the life of the engine. As discussed in the following sections, sulfur in diesel fuel can prevent proper operation of both NOx and PM control technologies. This can lead to permanent loss in emission control effectiveness and even catastrophic failure of the systems. Sulfur in diesel fuel impacts reliability by decreasing catalyst efficiency (poisoning of the catalyst), increasing diesel particulate filter loading, and negatively impacting system regeneration functions. Among the most serious reliability concerns with sulfur levels greater than 15 ppm are those associated with failure to properly regenerate. In the case of the NOx adsorber, failure to regenerate the stored sulfur (desulfate) will lead to rapid loss of NOx emission control as a result of sulfur poisoning of the NOx adsorber bed. In the case of the diesel particulate filter, sulfur in the fuel reduces the reliability of the regeneration function. If regeneration does not occur, catastrophic failure of the filter could occur. It is only by the availability of low sulfur diesel fuels that these technologies become feasible.

Fuel economy impacts due to sulfur in diesel fuel affect both NOx and PM control technologies. The NOx adsorber sulfur regeneration cycle (desulfation cycle) can consume significant amounts of fuel unless fuel sulfur levels are very low. The larger the amount of sulfur in diesel fuel, the greater the adverse effect on fuel economy. As sulfur levels increase above 15 ppm, the adverse effect on fuel economy becomes more significant, increasing above one percent and doubling with each doubling of fuel sulfur level. Likewise, PM trap regeneration is inhibited by sulfur in diesel fuel. This leads to increased PM loading in the diesel particulate filter and increased work to pump exhaust across this restriction. With low sulfur diesel fuel, diesel particulate filter regeneration can be optimized to give a lower (on average) exhaust backpressure and thus better fuel economy. Thus, for both NOx and PM technologies the lower the fuel sulfur level the lower the operating costs of the vehicle.

1. Catalyzed Diesel Particulate Filters and the Need for Low Sulfur Fuel

CDPFs function to control diesel PM through mechanical filtration of the solid PM (soot) from the diesel exhaust stream and then oxidation of the stored soot (trap regeneration) and oxidation of the SOF. Through oxidation in the catalyzed diesel particulate filter the stored PM is converted to CO_2 and released into the atmosphere. Failure to oxidize the stored PM leads to accumulation in the trap, eventually causing the trap to become so full that it severely restricts exhaust flow through the device, leading to trap or vehicle failure.

Uncatalyzed diesel particulate filters require exhaust temperatures in excess of 650˚C in order for the collected PM to be oxidized by the oxygen available in diesel exhaust. That temperature threshold for oxidation of PM by exhaust oxygen can be decreased to 450˚C through the use of base metal catalytic technologies. For a broad range of operating conditions typical of in-use diesel engine operation, diesel exhaust can be significantly cooler than 400˚C. If oxidation of the trapped PM could be assured to occur at exhaust temperatures lower than 300˚C, then diesel particulate filters would be expected to be more robust for most applications and operating regimes. Oxidation of PM (regeneration of the trap) at such low exhaust temperatures can occur by using oxidants which are more readily reduced than oxygen. One such oxidant is NO_2.

NO_2 can be produced in diesel exhaust through the oxidation of the nitrogen monoxide (NO), created in the engine combustion process, across a catalyst. The resulting NO_2-rich exhaust is highly oxidizing in nature and can oxidize trapped diesel PM at temperatures as cool as 250˚C.[182] Some platinum group metals are known to be good catalysts to promote the oxidation of NO to NO_2. Therefore in order to promote more effective passive regeneration of the diesel particulate filters, significant amounts of platinum group metals (primarily platinum) are being used in the wash-coat formulations of advanced CDPFs. The use of platinum to promote the oxidation of NO to NO_2 introduces several system vulnerabilities affecting both the durability and the effectiveness of the CDPF when sulfur is present in diesel exhaust. (In essence, diesel engine exhaust temperatures are in a range necessitating use of precious metal catalysts in order to adequately regenerate the PM filter, but precious metal catalysts are in turn highly sensitive to sulfur in diesel fuel.) The two primary mechanisms by which sulfur in diesel fuel

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[182] Hawker, P. et al, *Experience with a New Particulate Trap Technology in Europe*, SAE 970182.

limits the robustness and effectiveness of CDPFs are inhibition of trap regeneration, through inhibition of the oxidation of NO to NO_2, and a dramatic loss in total PM control effectiveness due to the formation of sulfate PM. Unfortunately, these two mechanisms trade-off against one another in the design of CDPFs. Changes to improve the reliability of regeneration by increasing catalyst loadings lead to increased sulfate emissions and, thus, loss of PM control effectiveness. Conversely, changes to improve PM control by reducing the use of platinum group metals and, therefore, limiting "sulfate make" leads to less reliable regeneration. Even with an active regeneration system, reducing catalytic loading to reduce sulfate make unacceptably trades off regeneration effectiveness (i.e., robustness). We believe the best means of achieving good PM emission control and reliable operation is to reduce sulfur in diesel fuel, as shown in the following subsections.

a. Inhibition of Trap Regeneration Due to Sulfur

The CDPF technology relies on the generation of a very strong oxidant, NO_2, to ensure that the carbon captured by the PM trap's filtering media is oxidized under the exhaust temperature range of normal operating conditions. This prevents plugging and failure of the PM trap. NO_2 is produced through the oxidation of NO in the exhaust across a platinum catalyst. This oxidation is inhibited by sulfur poisoning of the catalyst surface.[183] This inhibition limits the total amount of NO_2 available for oxidation of the trapped diesel PM, thereby raising the minimum exhaust temperature required to ensure trap regeneration. Without sufficient NO_2, the amount of PM trapped in the diesel particulate filter will continue to increase and can lead to excessive exhaust back pressure and low engine power.

The failure mechanisms experienced by diesel particulate filters due to low NO_2 availability vary significantly in severity and long term consequences. In the most fundamental sense, the failure is defined as an inability to oxidize the stored particulate at a rate fast enough to prevent net particulate accumulation over time. The excessive accumulation of PM over time blocks the passages through the filtering media, making it more restrictive to exhaust flow. In order to continue to force the exhaust through the now more restrictive filter, the exhaust pressure upstream of the filter must increase. This increase in exhaust pressure is commonly referred to as increasing "exhaust backpressure" on the engine.

The increase in exhaust backpressure represents increased work being done by the engine to force the exhaust gas through the increasingly restrictive particulate filter. Unless the filter is frequently cleansed of the trapped PM, this increased work can lead to reductions in engine performance and increases in fuel consumption. This loss in performance may be noted by the equipment operator in terms of sluggish engine response.

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[183] Hawker, P. et al, *Experience with a New Particulate Trap Technology in Europe,* SAE 970182.

Full field test evaluations and retrofit applications of these catalytic trap technologies are occurring in parts of the United States and Europe where low sulfur diesel fuel is already available.[184] The experience gained in these field tests helps to clarify the need for low sulfur diesel fuel. In Sweden and some European city centers where below 10 ppm diesel fuel sulfur is readily available, more than 3,000 catalyzed diesel particulate filters have been introduced into retrofit applications without a single failure. Given the large number of vehicles participating in these test programs, the diversity of the vehicle applications which included intercity trains, airport buses, mail trucks, city buses and garbage trucks, and the extended time periods of operation (some vehicles have been operating with traps for more than 5 years and in excess of 300,000 miles[185]), there is a strong indication of the robustness of this technology on 10 ppm low sulfur diesel fuel. The field experience in areas where sulfur is capped at 50 ppm has been less definitive. In regions without extended periods of cold ambient conditions, such as the United Kingdom, field tests on 50 ppm cap low sulfur fuel have also been positive, matching the durability at 10 ppm, although sulfate PM emissions are much higher. However, field tests on 50 ppm fuel in Finland, where colder winter conditions are sometimes encountered (similar to many parts of the United States), showed a significant number of failures (~10 percent) due to trap plugging. This 10 percent failure rate has been attributed to insufficient trap regeneration due to fuel sulfur in combination with low ambient temperatures.[186] Other possible reasons for the high failure rate in Finland when contrasted with the Swedish experience appear to be unlikely. The Finnish and Swedish fleets were substantially similar, with both fleets consisting of transit buses powered by Volvo and Scania engines in the 10 to 11 liter range. Further, the buses were operated in city areas and none of the vehicles were operated in northern extremes such as north of the Arctic Circle.[187] Given that the fleets in Sweden and Finland were substantially similar, and given that ambient conditions in Sweden are expected to be similar to those in Finland, we believe that the increased failure rates noted here are due to the higher fuel sulfur level in a 50 ppm cap fuel versus a 10 ppm cap fuel.[188]

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[184] Through tax incentives 50 ppm cap sulfur fuel is widely available in the United Kingdom and 10 ppm sulfur fuel is available in Sweden and in certain European city centers.

[185] Allansson, et al. SAE 2000-01-0480.

[186] Letter from Dr. Barry Cooper, Johnson Matthey, to Don Kopinski, US EPA, Air Docket A-99-06.

[187] Telephone conversation between Dr. Barry Cooper, Johnson Matthey, and Todd Sherwood, EPA, Air Docket A-99-06.

[188] The average temperature in Helsinki, Finland, for the month of January is 21˚F. The average temperature in Stockholm, Sweden, for the month of January is 26˚F. The average temperature at the University of Michigan in Ann Arbor, Michigan, for the month of January is 24˚F. The temperatures reported here are from www.worldclimate.com based upon the Global Historical Climatology Network (GHCN) produced jointly by the National Climatic Data Center and Carbon Dioxide Information Analysis Center at Oak Ridge National Laboratory (ORNL).

Testing on an even higher fuel sulfur level of 200 ppm was conducted in Denmark on a fleet of 9 vehicles. In less than six months all of the vehicles in the Danish fleet had failed due to trap plugging.[189] The failure of some fraction of the traps to regenerate when operated on fuel with sulfur caps of 50 ppm and 200 ppm is believed to be primarily due to inhibition of the NO to NO_2 conversion as described here. Similarly the increasing frequency of failure with higher fuel sulfur levels is believed to be due to the further suppression of NO_2 formation when higher sulfur level diesel fuel is used. Since this loss in regeneration effectiveness is due to sulfur poisoning of the catalyst this real world experience would be expected to apply equally well to nonroad engines (i.e., operation on lower sulfur diesel fuel, 15 ppm versus 50 ppm, will increase regeneration robustness).

As shown above, sulfur in diesel fuel inhibits NO oxidation leading to increased exhaust backpressure and reduced fuel economy. Therefore, we believe that, in order to ensure reliable and economical operation over a wide range of expected operating conditions, nonroad diesel fuel sulfur levels should be at or below 15 ppm.

b. Loss of PM Control Effectiveness

In addition to inhibiting the oxidation of NO to NO_2, the sulfur dioxide (SO_2) in the exhaust stream is itself oxidized to sulfur trioxide (SO_3) at very high conversion efficiencies by the precious metals in the catalyzed particulate filters. The SO_3 serves as a precursor to the formation of hydrated sulfuric acid (H_2SO_4+H_2O), or sulfate PM, as the exhaust leaves the vehicle tailpipe. Virtually all of the SO_3 is converted to sulfate under dilute exhaust conditions in the atmosphere as well in the dilution tunnel used in heavy-duty engine testing. Since virtually all sulfur present in diesel fuel is converted to SO_2, the precursor to SO_3, as part of the combustion process, the total sulfate PM is directly proportional to the amount of sulfur present in diesel fuel. Therefore, even though diesel particulate filters are very effective at trapping the carbon and the SOF portions of the total PM, the overall PM reduction efficiency of catalyzed diesel particulate filters drops off rapidly with increasing sulfur levels due to the formation of sulfate PM downstream of the CDPF.

SO_2 oxidation is promoted across a catalyst in a manner very similar to the oxidation of NO, except it is converted at higher rates, with peak conversion rates in excess of 50 percent. The SO_2 oxidation rate for a platinum based oxidation catalyst typical of the type which might be used in conjunction with, or as a washcoat on, a CDPF can vary significantly with exhaust temperature. At the low temperatures the oxidation rate is relatively low, perhaps no higher than ten percent. However at the higher temperatures that might be more typical of agricultural tractor use pulling a plow and the on-highway Supplemental Emission Test (also called the EURO III or 13 mode test), the oxidation rate may increase to 50 percent or more. These high levels of sulfate

[189] Letter from Dr. Barry Cooper to Don Kopinski US EPA, Air Docket A-99-06.

make across the catalyst are in contrast to the very low SO_2 oxidation rate typical of diesel exhaust (typically less than 2 percent). This variation in expected diesel exhaust temperatures means that there will be a corresponding range of sulfate production expected across a CDPF.

The US Department of Energy in cooperation with industry conducted a study entitled DECSE to provide insight into the relationship between advanced emission control technologies and diesel fuel sulfur levels. Interim report number four of this program gives the total particulate matter emissions from a heavy-duty diesel engine operated with a diesel particulate filter on several different fuel sulfur levels. A straight line fit through this data is presented in Table III.F-1 below showing the expected total direct PM emissions from a diesel engine on the supplemental emission test cycle.[190] The SET test cycle, a 13 mode steady-state cycle, that this data was developed on is similar to the C1 eight mode steady-state nonroad test cycle. Both cycles include operation at full and intermediate load points at approximately rated speed conditions and torque peak speed conditions. As a result, the sulfate make rate for the C1 cycle and the SET cycle would be expected to be similar. The data can be used to estimate the PM emissions from diesel engines operated on fuels with average fuel sulfur levels in this range.

[190] Note that direct emissions are those pollutants emitted directly from the engine or from the tailpipe depending on the context in which the term is used, and indirect emissions are those pollutants formed in the atmosphere through chemical reactions between direct emissions and other atmospheric constituents.

Table III.F-1
Estimated PM Emissions from a Diesel Engine at the Indicated Fuel Sulfur Levels

	Steady State Emissions Performance	
Fuel Sulfur [ppm]	Tailpipe PM[b] [g/bhp-hr]	PM Increase Relative to 3 ppm Sulfur
3	0.003	--
7[a]	0.006	100%
15[a]	0.009	200%
30	0.017	470%
150	0.071	2300%

[a] The PM emissions at these sulfur levels are based on a straight-line fit to the DECSE data; PM emissions at other sulfur levels are actual DECSE data. (Diesel Emission Control Sulfur Effects (DECSE) Program - Phase II Interim Data Report No. 4, Diesel Particulate Filters-Final Report, January 2000. Table C1.) Although DECSE tested diesel particulate filters at these fuel sulfur levels, they do not conclude that the technology is feasible at all levels, but they do note that testing at 150 ppm is a moot point as the emission levels exceed the engine's baseline emission level.
[b] Total exhaust PM (soot, SOF, sulfate).

Table III.F-1 makes it clear that there are significant PM emission reductions possible with the application of catalyzed diesel particulate filters and low sulfur diesel fuel. At the observed sulfate PM conversion rates, the DECSE program results show that the 0.01 g/bhp-hr total PM standard is feasible for CDPF equipped engines operated on fuel with a sulfur level at or below 15 ppm. The results also show that diesel particulate filter control effectiveness is rapidly degraded at higher diesel fuel sulfur levels due to the high sulfate PM make observed with this technology. It is clear that PM reduction efficiencies are limited by sulfur in diesel fuel and that, in order to realize the PM emissions benefits sought in this rule, diesel fuel sulfur levels must be at or below 15 ppm.

c. Increased Maintenance Cost for Diesel Particulate Filters Due to Sulfur

In addition to the direct performance and durability concerns caused by sulfur in diesel fuel, it is also known that sulfur can lead to increased maintenance costs, shortened maintenance intervals, and poorer fuel economy for CDPFs. CDPFs are highly effective at capturing the inorganic ash produced from metallic additives in engine oil. This ash is accumulated in the filter and is not removed through oxidation, unlike the trapped soot PM. Periodically the ash must be removed by mechanical cleaning of the filter with compressed air or water. This maintenance step is anticipated to occur on intervals of well over 1,500 hours (depending on engine size). However, sulfur in diesel fuel increases this ash accumulation rate through the formation of metallic sulfates in the filter, which increases both the size and mass of the trapped ash. By increasing the ash accumulation rate, the sulfur shortens the time interval between the required maintenance of the filter and negatively impacts fuel economy.

2. Diesel NOx Catalysts and the Need for Low Sulfur Fuel

NOx adsorbers are damaged by sulfur in diesel fuel because the adsorption function itself is poisoned by the presence of sulfur. The resulting need to remove the stored sulfur (desulfate) leads to a need for extended high temperature operation which can deteriorate the NOx adsorber. These limitations due to sulfur in the fuel affect the overall performance and feasibility of the NOx adsorber technology.

a. Sulfur Poisoning (Sulfate Storage) on NOx Adsorbers

The NOx adsorber technology relies on the ability of the catalyst to store NOx as a metallic nitrate (MNO_3) on the surface of the catalyst, or adsorber (storage) bed, during lean operation. Because of the similarities in chemical properties of SOx and NOx, the SO_2 present in the exhaust is also stored by the catalyst surface as a sulfate (MSO_4). The sulfate compound that is formed is significantly more stable than the nitrate compound and is not released and reduced during the NOx release and reduction step (NOx regeneration step). Since the NOx adsorber is essentially 100 percent effective at capturing SO_2 in the adsorber bed, the sulfur build up on the adsorber bed occurs rapidly. As a result, sulfate compounds quickly occupy all of the NOx storage sites on the catalyst thereby rendering the catalyst ineffective for NOx storage and subsequent NOx reduction (poisoning the catalyst).

The stored sulfur compounds can be removed by exposing the catalyst to hot (over 650˚C) and rich (air-fuel ratio below the stoichiometric ratio of 14.5 to 1) conditions for a brief period.[191] Under these conditions, the stored sulfate is released and reduced in the catalyst.[192] While research to date on this procedure has been very favorable with regards to sulfur removal from the catalyst, it has revealed a related vulnerability of the NOx adsorber catalyst. Under the high temperatures used for desulfation, the metals that make up the storage bed can change in physical structure. This leads to lower precious metal dispersion, or “metal sintering,” (a less

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[191] Dou, Danan and Bailey, Owen, “Investigation of NOx Adsorber Catalyst Deactivation,” SAE 982594.

[192] Guyon, M. et al, “Impact of Sulfur on NOx Trap Catalyst Activity - Study of the Regeneration Conditions”, SAE 982607.

even distribution of the catalyst sites) reducing the effectiveness of the catalyst.[193] This degradation of catalyst efficiency due to high temperatures is often referred to as thermal degradation. Thermal degradation is known to be a cumulative effect. That is, with each excursion to high temperature operation, some additional degradation of the catalyst occurs.

One of the best ways to limit thermal degradation is by limiting the accumulated number of desulfation events over the life of the vehicle. Since the period of time between desulfation events is expected to be determined by the amount of sulfur accumulated on the catalyst (the higher the sulfur accumulation rate, the shorter the period between desulfation events) the desulfation frequency is expected to be proportional to the fuel sulfur level. In other words for each doubling in the average fuel sulfur level, the frequency and accumulated number of desulfation events are expected to double. We concluded in the HD2007 rulemaking, that this thermal degradation would be unacceptable high for fuel sulfur levels greater than 15 ppm. Some commenters to the HD2007 rule suggested that the NOx adsorber technology could meet the HD2007 NOx standard using diesel fuel with a 30 ppm average sulfur level. This would imply that the NOx adsorber could tolerate as much as a four fold increase in desulfation frequency (when compared to an expected seven to 10 ppm average) without any increase in thermal degradation. That conclusion was inconsistent with our understanding of the technology at the time of the HD2007 rulemaking and remains inconsistent with our understanding of progress made by industry since that time. Diesel fuel sulfur levels must be at or below 15 ppm in order to limit the number and frequency of desulfation events. Limiting the number and frequency of desulfation events will limit thermal degradation and, thus, enable the NOx adsorber technology to meet the NOx standard.

This conclusion remains true for the on-highway NOx adsorber catalyst technology that this proposal is based upon and will be equally true for nonroad engines applying the NOx adsorber technology to comply with our proposed Tier 4 standards.

Nonroad and on-highway diesel engines are similarly durable and thus over their lifetimes consume a similar amount of diesel fuel. This means that both nonroad and on-highway diesel engines will have the same exposure to sulfur in diesel fuel and thus will require the same number of desulfation cycles over their lifetimes. This is true independent of the test cycle or in-use operation of the nonroad engine.

Sulfur in diesel fuel for NOx adsorber equipped engines will also have an adverse effect on fuel economy. The desulfation event requires controlled operation under hot and net fuel rich exhaust conditions. These conditions, which are not part of a normal diesel engine operating

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[193] Though it was favorable to decompose sulfate at 800˚C, performance of the NSR (NOx Storage Reduction catalyst, i.e. NOx Adsorber) catalyst decreased due to sintering of precious metal. - Asanuma, T. et al, "Influence of Sulfur Concentration in Gasoline on NOx Storage -Reduction Catalyst", SAE 1999-01-3501.

cycle, can be created through the addition of excess fuel to the exhaust. This addition of excess fuel causes an increase in fuel consumption.

Future improvements in the NOx adsorber technology, as we have observed in our ongoing diesel progress reviews, are expected and needed in order to meet the NOx emission standards proposed today. Some of these improvements are likely to include improvements in the means and ease of removing stored sulfur from the catalyst bed. However because the stored sulfate species are inherently more stable than the stored nitrate compounds (from stored NOx emissions) and so will always be stored preferentially to NOx on the adsorber storage sites, we expect that a separate release and reduction cycle (desulfation cycle) will always be needed in order to remove the stored sulfur. Therefore, we believe that fuel with a sulfur level at or below 15 ppm sulfur will be necessary in order to control thermal degradation of the NOx adsorber catalyst and to limit the fuel economy impact of sulfur in diesel fuel.

b. Sulfate Particulate Production and Sulfur Impacts on Effectiveness of NOx Control Technologies

The NOx adsorber technology relies on a platinum based oxidation function in order to ensure high NOx control efficiencies. As discussed more fully in section III.F.1, platinum based oxidation catalysts form sulfate PM from sulfur in the exhaust gases significantly increasing PM emissions when sulfur is present in the exhaust stream. The NOx adsorber technology relies on the oxidation function to convert NO to NO_2 over the catalyst bed. For the NOx adsorber this is a fundamental step prior to the storage of NO_2 in the catalyst bed as a nitrate. Without this oxidation function the catalyst will only trap that small portion of NOx emissions from a diesel engine which is NO_2. This would reduce the NOx adsorber effectiveness for NOx reduction from in excess of 90 percent to something well below 20 percent. The NOx adsorber relies on platinum to provide this oxidation function due to the need for high NO oxidation rates under the relatively cool exhaust temperatures typical of diesel engines. Because of this fundamental need for a precious metal catalytic oxidation function, the NOx adsorber inherently forms sulfate PM when sulfur is present in diesel fuel, since sulfur in fuel invariably leads to sulfur in the exhaust stream.

The Compact-SCR technology, like the NOx adsorber technology, uses an oxidation catalyst to promote the oxidation of NO to NO_2 at the low temperatures typical of much of diesel engine operation. By converting a portion of the NOx emissions to NO_2 upstream of the ammonia SCR reduction catalyst, the overall NOx reductions are improved significantly at low temperatures. Without this oxidation function, low temperature SCR NOx effectiveness is dramatically reduced making compliance with the NOx standard impossible. Therefore, future Compact-SCR systems would need to rely on a platinum oxidation catalyst in order to provide the required NOx emission control. This use of an oxidation catalyst in order to enable good NOx control means that Compact SCR systems will produce significant amounts of sulfate PM when operated on anything but the lowest fuel sulfur levels due to the oxidation of SO_2 to sulfate

PM promoted by the oxidation catalyst.

Without the oxidation catalyst promoted conversion of NO to NO_2, neither of these NOx control technologies can meet the proposed NOx standard. Therefore, each of these technologies will require low sulfur diesel fuel to control the sulfate PM emissions inherent in the use of highly active oxidation catalysts. The NOx adsorber technology may be able to limit its impact on sulfate PM emissions by releasing stored sulfur as SO_2 under rich operating conditions. The Compact-SCR technology, on the other hand, has no means to limit sulfate emissions other than through lower catalytic function or lowering sulfur in diesel fuel. The degree to which the NOx emission control technologies increase the production of sulfate PM through oxidation of SO_2 to SO_3 varies somewhat from technology to technology, but it is expected to be similar in magnitude and environmental impact to that for the PM control technologies discussed previously, since both the NOx and the PM control catalysts rely on precious metals to achieve the required NO to NO_2 oxidation reaction.

At fuel sulfur levels below 15 ppm this sulfate PM concern is greatly diminished. Without this low sulfur fuel, the NOx control technologies are expected to create PM emissions well in excess of the PM standard regardless of the engine-out PM levels. Thus, we believe that diesel fuel sulfur levels will need to be at or below 15 ppm in order to apply the NOx control technology.

G. Reassessment of Control Technology in 2007

By structuring our program to benefit extensively from prior experience with core technologies in the highway sector, we believe that a nonroad diesel technology review of the extent being pursued for the heavy-duty highway engine program will not be needed.[194] Indeed the results of that ongoing review have had, and will continue to have, a very helpful impact in shaping this program. Nevertheless, there are some technology issues that will not be addressed in the highway program review. In particular we believe that a future review of particulate filter technology for engines under 75 hp may be warranted. Under our proposed schedule presented in section III.B, standards based on the performance of this technology will take effect in the 2013 model year for 25-75 hp engines (or in the 2012 model year for manufacturers opting to skip the transitional standards for 50-75 hp engines). No Tier 4 PM standards based on the performance of PM filters are being proposed for engines under 25 hp at this time, and the appropriateness of this approach will also be reassessed in the technology review as well.

We propose to conduct the technology review in 2007, and to conclude it by the end of that year, to give manufacturers lead time should an adjustment in the program be considered

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[194] See "Highway Diesel Progress Review", U.S. EPA, June 2002. EPA420-R-02-016. (www.epa.gov/air/caaac/dieselreview.pdf).

appropriate. We also plan to evaluate NOx control technologies for engines under 75 hp in the 2007 review, with a particular emphasis on progress made toward applying NOx adsorbers to engines under 75 hp. We do not intend to include in the technology review a reassessment of PM filter technology needed meet the optional 0.02 g/hp-hr PM standard for 50-75 hp engines in 2012. We assume that manufacturers would only choose this option if they had confidence that they could meet the 0.02 g/hp-hr standard in 2012, a year earlier than otherwise required.

We expect that any changes to the level or timing of emission standards found appropriate in the 2007 review would be made as part of a rulemaking process, and that process would take additional time after the review is completed. If the 2007 review should determine that PM trap technology is feasible for engine under 25 hp, or that advanced NOx control technology is feasible for engines under 75 hp, or that Tier 4 standards should be made more stringent in some other way, we would expect the rulemaking implementing such changes to provide for adequate lead time. Therefore, it would be premature for us to target 2013 or any specific model year for implementing such standards changes at this time. We solicit comment on the scope, timing, and need for a future reassessment of emissions control technology for nonroad diesel engines.

IV. Our Proposed Program for Controlling Nonroad, Locomotive and Marine Diesel Fuel Sulfur

We are proposing to restrict the sulfur content of nonroad, locomotive and marine (NRLM) diesel fuel nationwide to no more than 500 ppm beginning in 2007. We are also proposing to restrict the sulfur content of nonroad diesel fuel nationwide to no more than 15 ppm beginning in 2010. These provisions mirror controls on highway diesel fuel to 500 ppm in 1993[195] and 15 ppm in 2006.[196]

There are two reasons that we are proposing these standards. First, fuel sulfur significantly inhibits or impairs the function of the diesel exhaust emission control devices, which would be generally necessary to meet the proposed engine emission standards. In conjunction with the 15 ppm sulfur nonroad diesel fuel sulfur standard we are proposing today, we have concluded that this technology will be available to achieve the reductions required by the stringent NOx and PM emission standards we are proposing for model year 2011 and later nonroad diesel engines. Second, fuel sulfur is emitted from the engine as sulfate PM and sulfur dioxide, both of which cause adverse health and welfare impacts, as described in Section II. above. Reducing the level of sulfur to 500 ppm beginning in 2007 would achieve important emission reductions of these pollutants and provide significant public health and welfare benefits.

In developing the provisions of the proposed fuel program, we identified several principles that we wanted the program to achieve:

1) Maintain the benefits and program integrity of the highway diesel fuel program;

2) Achieve the greatest reduction in sulfate PM and sulfur dioxide emissions from nonroad, locomotive and marine diesel engines as early as practicable;

3) Provide for a smooth transition of the nonroad diesel fuel pool to 15 ppm sulfur;

4) Ensure that 15 ppm sulfur diesel fuel is produced and distributed widely for use in all 2011 and later model year nonroad engines;

5) Enable the efficient distribution of all diesel fuels; and

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195 Fuel Quality Regulations for Highway Diesel Fuel Sold in 1993 and Later Calendar Years, Final Rule, 55 FR 34120, August 21, 1990

196 Control of Air Pollution from New Motor Vehicles: Heavy-duty Engine and Vehicle Standards and Highway Diesel Sulfur Control Requirements; Final Rule, 66 FR 5002, January 18, 2001

6) Ensure that the program's requirements are enforceable and verifiable.

As described below, we believe the proposed fuel program achieves these principles.

The remainder of this section is organized as follows:

A) The fuel standards being proposed today,
B) The design and structure of the fuel program,
C) Special hardship provisions being proposed for small refiners and refiners facing particularly difficult circumstances,
D) Special provisions being proposed for fuel sold in the State of Alaska and U.S. Territories,
E) How today's proposed program would affect state diesel fuel control programs,
F) The technological feasibility of the production and distribution of 500 ppm and 15 ppm sulfur nonroad, locomotive and marine diesel fuel,
G) The impact of the program on other fuel properties and specialty fuels, and
H) The need for some refiners to obtain air permits for their desulfurization equipment.

Analyses supporting the design of these provisions can be found in Chapter IV and V of the Draft RIA for today's action. Section VIII of this preamble provides a discussion of the compliance and enforcement provisions affecting diesel fuel and additional explanation of various elements of the proposed program.

A. Proposed Nonroad, Locomotive and Marine Diesel Fuel Quality Standards

The following paragraphs describe the requirements, standards, and deadlines that apply to refiners and importers of nonroad, locomotive and marine (NRLM) diesel fuel and the options available to all refiners.

1. What Fuel Is Covered by this Proposal?

Today's proposed standards cover all the diesel fuel that is used in mobile applications but is not already covered by the previous standards for highway diesel fuel. For the purposes of this preamble, this fuel is defined primarily by the type of engine which it is used to power, land-based nonroad, locomotive, and marine diesel engines. These fuels typically include:

1) Any number 1 and 2 distillate fuels used in or intended to be used in land-based nonroad, locomotive or marine diesel engines and
2) Any number 1 distillate fuel (e.g., kerosene) added to such number 2 diesel fuel, e.g., to improve its cold flow properties.

The proposed program would reduce the sulfur in all diesel fuel likely used in mobile off-highway equipment and achieve very significant short and long-term environmental benefits. States, not the Agency, have responsibility for any fuel sulfur specifications for heating oil, so this fuel would not be covered by this proposal. However, we do propose a number of provisions, as described below, that would ensure that heating oil would not be used in nonroad, locomotive, or marine applications.

This proposal would not apply to:

1) Number 1 distillate fuels used to power jet aircraft (e.g., jet fuel, JP-8, JP-4),
2) Number 1 or number 2 distillate fuels used for other purposes, such as to power stationary diesel engines or for heating, and
3) Number 4 and 6 fuels (e.g., bunker or residual fuels, IFO Heavy Fuel Oil Grades 30 and higher, ASTM DMB and DMC fuels).

Primary examples of fuels under 1) would be those meeting ASTM D975 or D396 specifications for grades number 1-D and number 2-D or ASTM DMX and DMA specifications, if used in the engines mentioned above.

As in the recent highway diesel rule, in those cases where the same batch of kerosene is distributed for two purposes (e.g., as kerosene to be used for heating and to improve the cold flow of number 2 nonroad diesel fuel), that batch of fuel would have to meet the standards being proposed today for nonroad diesel fuel. However, an alternative compliance approach would be to produce and distribute two distinct kerosene fuels. In our example above, one batch would meet the proposed sulfur standards and could be blended into number 2 NRLM diesel fuel. The other batch would only have to meet any applicable specifications for heating fuel.

2. Standards and Deadlines for Refiners, Importers, and Fuel Distributors

Today's proposed fuel program consists of a two-step program to reduce the sulfur concentration of nonroad diesel fuel. By doing so, the program would allow the refining industry to smoothly transition the sulfur concentration from its current uncontrolled levels down to the very stringent 15 ppm level. By beginning with an initial step down to 500 ppm, we can start to achieve significant emission reductions and associated health benefits from the current fleet of equipment as soon as possible. While we considered and are seeking comment on a one-step approach of going directly to 15 ppm in 2008, as discussed in section VI, we believe that the advantages of the proposed two-step approach outweigh the advantages of a single step.

The specific proposed deadlines for meeting the 500 and 15 ppm sulfur standards would not apply to refineries covered by special hardship provisions for small refiners. In addition, a different schedule might apply for any refineries that might be approved under the proposed general hardship provisions. All of these hardship provisions are described below in Section

a. The First Step to 500 ppm

Under today's proposal NRLM diesel fuel produced by refiners or imported into the U.S. would be required to meet a 500 ppm sulfur standard beginning June 1, 2007. Refiners and importers could comply by either producing such fuel at or below 500 ppm, or could comply by obtaining credits as discussed in section B.4 below.

We believe that the proposed level of 500 ppm is appropriate for several reasons. This 500 ppm level is consistent with current highway diesel fuel, a grade which may remain for highway purposes until 2010. As such, adopting the same 500 ppm level for NRLM helps to avoid any issues and costs associated with more grades of fuel in the distribution system during this initial step of the program. The reduction to 500 ppm is also significant environmentally. The 500 ppm level achieves approximately 90 percent of the sulfate PM and SO2 benefits otherwise achievable by going all the way to 15 ppm. Yet, the costs would be roughly half that associated with full control down to 15 ppm. Because this first step is only to 500 ppm, it also allows for a short lead time for implementation, enabling the environmental benefits to begin accruing as soon as possible. After careful analysis of feasibility as discussed in section IV.G.5, we believe that the proposed start date of June 1, 2007 is the earliest that the 500 ppm step could take effect.

This first step down to 500 ppm is being proposed to achieve the public health and welfare benefits from reduced emissions in the current fleet of engines, and not to enable emission control technology on new nonroad diesel engines. Since the sulfate PM and SO2 benefits accrue as the fuel is desulfurized to any degree, mixing in the distribution system during the transition to 500 ppm would not reduce this benefit or cause any adverse consequences. Mixing in the distribution system would also not reduce the engine performance and durability benefits from the reduction in sulfur. As a result, unlike for the 15 ppm step discussed below, we are not proposing any required schedule for the turnover of dyed NRLM diesel fuel in the distribution system to 500 ppm, but rather would let that occur naturally.[197]

b. The Second Step to 15 ppm

In order to enable the high efficiency exhaust emission control technology to begin to be applied to nonroad engines beginning with the 2011 model year, we are proposing that all

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[197] Furthermore, as discussed in subsection B, we propose that high sulfur nonroad diesel fuel which is produced after June 1, 2007 due to the small refiner and fuel ABT provisions could be commingled with 500 ppm nonroad diesel fuel after it has been dyed to the IRS specifications. Thus, at some points in the distribution system, nonroad fuel higher than the 500 ppm standard would remain until it is precluded from production beginning June 1, 2010.

nonroad diesel fuel produced or imported after June 1, 2010 would have to meet a 15 ppm sulfur cap. We are proposing that diesel fuel used for locomotive and marine diesel engines could continue to the meet the 500 ppm cap first applicable in 2007.

In order to allow for a smooth and orderly transition of diesel fuel in the distribution system to 15 ppm, we are proposing that parties downstream of the refineries be allowed a small amount of additional time to turnover their tanks to 15 ppm. We are proposing that at the terminal level, nonroad diesel fuel would be required to meet the 15 ppm sulfur standard beginning July 15, 2010. At bulk plants, wholesale purchaser-consumers, and any retail stations carrying nonroad diesel, this fuel would have to meet the 15 ppm sulfur standard by September 1, 2010.[198] The proposed transition schedule for compliance with the 15 ppm standard at refineries, terminals, and secondary distributors are the same as those allowed under the recently promulgated highway diesel fuel program.

As with the 500 ppm standard, refiners and importers could comply with this standard by either physically producing 15 ppm fuel or by obtaining sulfur credits, as described below.

We are seriously considering and seeking comment on bringing the sulfur level of locomotive and marine diesel fuel to 15 ppm as early as June 1, 2010 along with nonroad diesel fuel. As discussed in more detail in section VI and in chapter 12.1 of the draft RIA, there are several advantages associated with this alternative. First, it would provide important sulfate PM and SO2 emission reductions and the estimated benefits from these reductions would outweigh the costs by a considerable margin. Second, it would simplify the fuel distribution system and the design of the fuel program proposed today causing actual prices for locomotive and marine fuel may be relatively unaffected compared to the prices under today's proposal. Third, it would help reduce the potential opportunity for misfueling of 2007 and later model year highway vehicles and 2011 and later model year nonroad equipment with higher sulfur fuel. Finally, it would allow refiners to coordinate plans to reduce the sulfur content of all of their nonroad diesel fuel at one time.

However, discussions with refiners have suggested there are advantages to leaving locomotive and marine diesel fuel at 500 ppm, at least in the near-term and until we set more stringent standards for those engines. The locomotive and marine diesel fuel markets could provide a market for offspec product that is important for refiners, particularly during the transition to 15 ppm for highway and nonroad diesel fuel in 2010. Furthermore, waiting just a year or two beyond 2010 would address the critical near term needs during the transition. Second, waiting just another year or two beyond 2010 is also projected to allow virtually all

[198] A bulk plant is a secondary distributor of refined petroleum products. They typically receive fuel from terminals and distribute fuel in bulk by truck to end users. Consequently, while for highway fuel, bulk plants often serve the role of a fuel distributor, delivering fuel to retail stations, for nonroad fuel, they often serve the role of the retailer, delivering fuel directly to the end-user.

refiners to take advantage of the new lower cost technology.

In addition to seeking comment on whether to apply the 15 ppm standard to locomotive and marine diesel fuel in 2010, we also seek comment on other timing for doing so, and especially on how the Agency should coordinate a 15 ppm standard for locomotive and marine with the nonroad diesel fuel standard being proposed today. It is the Agency's intention to take action in the near future to set new emission standards for locomotive and marine engines that could require the use of high efficiency exhaust emission control technology, and thus, also require the use of 15 ppm sulfur diesel fuel. We anticipate that such engine standards would likely take effect in the 2011-13 timeframe, requiring 15 ppm locomotive and marine diesel fuel in the 2010-12 timeframe. We intend to publish an advanced notice of proposed rulemaking (ANPRM) for such a rule in the Spring of 2004 and complete action on a final rule by 2007.

c. Other Standard Provisions

We are proposing that the 500 ppm NRLM and 15 ppm nonoad standards would apply to the areas of Alaska served by the Federal Aid Highway System (FAHS). Rural areas, those outside the FAHS, would not be subject to either the 15 or 500 ppm standards. Market forces in these areas would be relied upon to provide 15 ppm diesel fuel for 2011 and later nonroad diesel engines used in these areas. This is consistent with the approach which is in the process of being developed by the State of Alaska for implementing the 2007 highway diesel fuel program. EPA can revisit this issue when it takes action on Alaska's plan for implementation of the highway sulfur requirements, allowing for coordination of the nonroad and highway fuel requirements. The specifics of our proposal for diesel fuel sold in Alaska are described in more detail in section IV.D.1. below. In addition, these proposed 500 and 15 ppm sulfur caps would not apply to fuel sold in three Pacific U.S. territories, as described in more detail in section IV.D.2. below.

The early credits and other special provisions create the probability that high sulfur NRLM diesel fuel would be produced and sold after June 1, 2007 and that 500 ppm nonroad diesel fuel would be produced and sold after June 1, 2010. In the latter case, the higher sulfur fuel would have to be kept segregated from the 15 ppm fuel because nonroad equipment owners and operators could not use 500 ppm diesel fuel in nonroad engines requiring 15 ppm fuel. Under the proposal, fuel distributors would be responsible for ensuring that statements on product transfer documents and fuel product labels are consistent with the corresponding fuel quality. The specific requirements for both fuel distributors and end-users are described in detail in Section VIII.

d. Cetane Index or Aromatics Standard

Currently, in addition to containing no more than 500 ppm sulfur, EPA requires that highway diesel fuel meet a minimum cetane index level of 40 or, as an alternative contain no more than 35 volume percent aromatics. We are proposing today to extend this cetane index/aromatics content specification to NRLM diesel fuel. Extension of these content specifications would reduce NOx and PM emissions from the current nonroad equipment fleet slightly, providing associated public health and welfare benefits.

Low diesel fuel cetane levels are associated with increases in NOx and PM emissions in current nonroad diesel engines. Thus, we expect that this cetane index specification would lead to a reduction in these emissions from the existing fleet. Because the vast majority of current NRLM diesel fuel already meets this specification, the NOx and PM emission reductions would be small. Also, the impact of cetane on NOx and PM emissions appears to be very weak or nonexistent for diesel engines equipped with EGR. Thus, the positive emission impact of this specification would likely decrease over time as these engines gradually dominate the in-use fleet.

ASTM already applies a cetane number specification of 40 to NRLM diesel fuel, which in general is more stringent than the similar 40 cetane index specification. Because of this, the vast majority of current NRLM diesel fuel already meets the EPA cetane index/aromatics specification for highway diesel fuel. Thus, the proposed requirement would have an actual impact only on a limited number of refiners and there would be little overall cost associated with producing fuel to meet the proposed cetane/aromatic requirement.

In addition, we expect that if all NRLM fuel met the cetane index or aromatics specification as proposed, refiners would benefit from the ability to fungibly distribute highway and NRLM diesel fuels of like sulfur content. For that fraction of fuel that today does not meet this specification, the proposed requirement would eliminate the need to separately distribute fuels of different cetane/aromatics specifications that would otherwise need to occur. Requiring NRLM diesel fuel to meet this cetane index specification would thus give fuel distributors certainty in being able to combine shipments of highway and NRLM diesel fuels. Overall, we believe that the economic benefits from more efficient fuel distribution would likely exceed the cost of refining the small volume of NRLM diesel fuel that might not currently meet the cetane index or aromatics content specification.

We request comment on the costs and benefits of our proposal to extend the cetane index specification applicable to highway diesel fuel to NRLM diesel fuel.

B. Program Design and Structure

In addition to the proposed levels of the standards and their timing, the program must be designed and structured carefully to achieve the overall principles of this proposed nonroad diesel fuel program. The health benefits and 15 ppm fuel availability needs of the highway diesel program must be maintained. This will only happen if the program is designed such that the amount of low sulfur fuel expected to be produced under that program is in fact produced. Likewise, the benefits of the low sulfur diesel program proposed today will only achieved if the program is designed such that the volume of diesel fuel consumed by NRLM engines is matched by the production and distribution of at least the same volume of diesel fuel produced to the appropriate low sulfur levels. At the same time, promoting the efficiency of the distribution system calls for fungible (mixed) distribution of physically similar products, and minimizing the need for segregation of products in the distribution system.

1. Background

Prior to the highway diesel fuel sulfur standard that took effect in 1993, most number 2 distillate fuel was produced to essentially the same specifications, shipped fungibly, and used interchangeably for highway diesel engines, nonroad diesel engines, locomotive and marine diesel engines and heating oil (e.g., furnaces and boilers) applications. Beginning in 1993, highway diesel fuel was required to meet a 500 ppm sulfur cap and be segregated from other distillate fuels as it left the refinery by the use of a visible level of dye solvent red 164 in all non-highway distillate.[199] At about the same time, the IRS similarly required non-highway diesel fuel to be dyed red (to a much higher concentration) prior to retail sale to distinguish it from highway diesel fuel for excise tax purposes (dyed non-highway fuel is exempt from this tax). This splitting up of the distillate pool necessitated costly changes in the distribution system to ship and store the now distinct products separately. In some parts of the country where the costs to segregate non-highway diesel fuel from highway diesel fuel could not be justified, both fuels have been produced to the highway specifications.[200]

When the 15 ppm highway diesel fuel standard takes effect in 2006, an additional segregation of the distillate pool is anticipated. Since up to 20% of the highway diesel fuel pool is allowed to remain at 500 ppm until 2010, in some portions of the country as many as three grades of distillate may be distributed; 15 ppm highway, 500 ppm highway, and high sulfur for all non-highway uses. In the highway final rule, EPA projected that if refiners take advantage of the flexibility to continue producing 20 percent of their highway fuel at 500 ppm, then the additional fuel segregation would cost entities in the distribution system as much as $1.05 billion.

In order to avoid unnecessarily adding more cost to the fuel distribution system, we chose to add to our environmental objectives for today’s proposal the objective of enabling the efficient

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[199] Non-highway distillate for the purposes of this proposal refers to all diesel fuel and distillate use for nonroad, locomotive, marine and heating oil purposes; in other words, all number 1 or number 2 distillate other than that used for highway purposes, and excluding jet fuels.

[200] Diesel fuel produced to highway specifications but used for non-highway purposes is referred to as “spill-over.” It leaves the refinery gate and is fungibly distributed as if it were highway diesel fuel, and is typically dyed at a point later in the distribution system. Once it is dyed it is no longer available for use in highway vehicles, and is not part of the supply of highway fuel. Based on the most recent EIA data, roughly 15 percent of highway fuel is spillover, representing nearly a third of non-highway consumption.

distribution of all diesel fuels. Accomplishing this principle while adding new fuel sulfur standards for NRLM diesel fuel, and without undermining the other guiding principles, presents a significant challenge.

2. Reliance on Segregation, Dyes, and Markers

a. Dye requirement for NRLM at the refinery gate

With the application of the proposed 500 ppm cap on NRLM diesel fuel in 2007, this fuel will have the same sulfur level as one of the future grades of highway diesel fuel. Nevertheless, absent a change to the existing highway diesel regulations, this 500 ppm grade of NRLM diesel fuel would have to be dyed and kept segregated from the existing grade of 500 ppm highway diesel fuel. Even though the sulfur levels would be the same, a new grade of diesel fuel (500 ppm NRLM) would have to be segregated throughout the entire distribution system. While this would continue the separation of the highway program from the non-highway program and ensure the benefits of the two programs, the costs of requiring this segregation throughout the entire distribution system could be quite substantial.[201] Given the magnitude of these potential distribution system costs, and the considerably lower costs of refining nonroad diesel fuel to 500 ppm (capital costs of slightly less than $0.6 billion, as discussed in section V) compared to these distribution system costs, the market would quickly optimize its choice of what fuels to distribute to what locations, just as it does today. Depending on the market response, in some cases more fuel would be produced to the 15 ppm highway standard than was anticipated by the highway program. In other cases more fuel would be produced to the 500 ppm NRLM standard than would be necessary to meet the goals of today's proposed program.

While this would be beneficial from an environmental standpoint, it would significantly increase refining costs. Furthermore, it is doubtful that the resulting increased stringency of the programs would be feasible in this timeframe for all refiners, particularly with respect to increased production of 15 ppm fuel in 2006 or 2007. Most highway diesel fuel refiners are already well into their planning process for meeting the highway diesel fuel sulfur standard. Modifying these plans to incorporate large additional volumes of 500 ppm NRLM diesel fuel by June 1, 2007 could be very difficult. Refiners that today only produce high sulfur non-highway diesel fuel would face an even larger challenge to start from scratch and produce 15 ppm fuel in this time frame.

For these reasons, we propose that the current requirement that non-highway distillate

[201] Under the highway program the potential exists to add a third grade of diesel fuel in an estimated 40% of the country, and we projected one-time tankage and distribution system costs of $1.05 billion to accomplish this. Using similar assumptions, to add a second 500 ppm grade nationwide would cost in excess of $2 billion. This assumes that the capability exists to add such new tankage.

fuels be dyed at the refinery gate be made voluntary effective June 1, 2006.[202] However, in its place we are proposing (as described in IV.B.3 below) an alternate means for refiners to differentiate their highway diesel fuel from NRLM diesel fuel. For those refiners for whom it is nevertheless feasible and cost effective to continue to dye and segregate their nonroad fuel, we propose that they continue to have this option.

Without some means of differentiating highway diesel fuel from NRLM diesel fuel, it would be impossible to maintain the benefits and program integrity of the 2006 highway diesel fuel program. Under the highway program a refiner must produce 15 and 500 ppm diesel fuel in at least a 4-to-1 ratio (80%/20%) from June 1, 2006 to December 31, 2009, at which time all highway diesel it produces must meet the 15 ppm standard. Pre-2007 model year highway vehicles are free to continue using 500 ppm fuel during this period as long as it is available. However, if a refiner produced all 500 ppm fuel, designating it as nonroad fuel, that refiner would have no obligation to produce any 15 ppm highway diesel fuel. Without some way of limiting the use of 500 ppm nonroad fuel in the highway market, much more 500 ppm fuel could, and likely would find its way into the highway market than would otherwise happen under the current highway program, displacing 15 ppm that would have otherwise been produced. This likely series of events would circumvent the 80/20 intent of the highway rule and sacrifice some of the resulting PM and SO2 emission benefits of that program. Perhaps more importantly, if this occurred to any significant degree, it could also undermine the integrity of the highway program by failing to ensure adequate availability of 15 ppm fuel nationwide for the vehicles that need it.

b. Segregate Heating Oil from NRLM Diesel Fuel

As described above, with today's proposal, we are proposing to cap the sulfur level of NRLM diesel fuel, while allowing heating oil to have its sulfur level remain uncontrolled; limited only by various state regulations. Thus, while NRLM is commonly distributed today with heating oil, after implementation of today's proposal, these two grades of fuel would have to be distributed separately. If 500 ppm NRLM could be distributed with 500 ppm highway diesel fuel (as discussed above), this segregation of NRLM fuel from heating oil would maintain the same number of fuel grades for the distribution system to carry (that is: 15 ppm highway, 500 ppm highway and NRLM, and heating oil).

If heating oil were the only high-sulfur fuel allowed to be produced and marketed and its segregation was required, an enforceable program would only need a prohibition of high sulfur NRLM in the distribution system and on the use of high sulfur fuel in any nonroad equipment, locomotive, or marine vessel after June 1, 2007. As occurred with the original 1993 highway

[202] The IRS requirement that non-highway fuel be dyed prior to sale to consumers to exempt it from excise taxes will still apply.

diesel rule, a sulfur test of the fuel in the distribution system or in any end user's tank would demonstrate whether the program was being implemented properly. However, as discussed in Section C below, we are also proposing that refiners in certain circumstances be allowed to continue to produce high sulfur NRLM fuel for some period after 2007 and 500 ppm nonroad fuel for some period after 2010 under the early fuel credit provisions and hardship provisions. Consequently, it should be permissible to use high sulfur diesel fuel in NRLM equipment during this period.[203] Given this, some additional method must be used to distinguish heating oil from nonroad diesel fuel to enforce its segregation in the distribution system. Otherwise, if a refiner produced heating oil, and this heating oil later made its way into nonroad equipment, for example because it was later combined with other high sulfur nonroad fuel in the distribution system, it would be indistinguishable from the lawful high sulfur NRLM. The resulting use of heating oil for NRLM equipment would circumvent the intent of the first step of today's proposed nonroad standards -- that PM and SO2 benefits be achieved by producing fuel to the NRLM diesel fuel standards in an amount that fully corresponded to the amount of fuel used in these engines.

3. Proposed Fuel Program Design and Structure

a. Program Beginning June 1, 2007

To avoid the costs associated with segregating 500 ppm NRLM diesel fuel from 500 ppm highway fuel, the existing requirement that NRLM diesel fuel be dyed leaving the refinery would need to be made voluntary. Under the provisions of the program described below, we propose that this change occur on June 1, 2006. As described above, this action would then require an additional measure to maintain the necessary level of national production of 15 ppm highway fuel and ensure the effectiveness of the highway program. Our proposed solution involves establishing and enforcing a baseline volume percentage of non-highway diesel fuel for each refinery. The baseline percentage of non-highway diesel fuel is used to identify what 500 ppm fuel is subject to the NRLM requirements and what 500 ppm fuel is subject to the highway requirements. As detailed below, we believe that in conjunction with a marker to prevent the use of heating oil in nonroad equipment, the program would effectively protect the benefits and integrity of the highway program and ensure that the benefits of the first step of NRLM diesel fuel to 500 ppm sulfur would be obtained. A discussion of this proposal follows, beginning with the introduction of a fuel marker for heating oil.

i. Use of A Marker to Differentiate Heating Oil from NRLM

One way of ensuring that high sulfur heating oil would remain segregated from NRLM diesel fuel and is not used in NRLM equipment would be to require that a dye or "marker" be

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[203] Only 15 ppm diesel fuel would be permitted for use in 2011 and later model year equipment.

added to heating oil to distinguish it from NRLM diesel fuel.[204] There is no differentiation today between fuel used for NRLM uses, and heating oil. Both are typically produced to the same sulfur specification today, and both are required to have the same red dye added prior to distribution and sale.[205] As a result, the dye or marker would have to be different from the current red dye requirement.

There are a number of types of dyes and markers. Visible dyes are most common, are inexpensive, and are easily detected. Invisible markers are beginning to see more use in branded fuels and are somewhat more expensive that visible markers. Such markers are detected either by the addition of a chemical reagent or by their fluorescence when subjected to near-infra-red or ultraviolet light. Some chemical-based detection methods are suitable for use in the field. Others must be conducted in the laboratory due to the complexity of the detection process or concerns regarding the toxicity of the reagents used to reveal the presence of the marker. Near-infra-red and ultra-violet flourescent markers can be easily detected in the field using a small device and brief training of the operator. There are also more exotic markers available such as based on immunoassay, and isotopic or molecular enhancement. Such markers typically need to be detected by laboratory analysis.

Using a second dye for segregation of heating oil based on visual identification appears to be problematic. Most dye colors that provide a strong visible trace in fuels are already in use for different fuel applications. More importantly, mixing two fuels containing different strong dyes can result in interference between the two dyes rendering identification of the presence of either dye difficult. Yet, the mixing of nonroad diesel fuel into heating oil for eventual sale as heating oil would be an acceptable and often an economically desirable practice. Furthermore, to avoid interfering with the IRS tax code, it would be advantageous to maintain the current red color. Based on these considerations, we believe that the use of a second dye to visibly segregate heating oil from NRLM is not practicable. We request comment on this assessment. Thus, the best approach to prevent the use heating oil as NRLM diesel fuel would appear to be to require the addition to heating oil of a marker that does not impart a significant color to diesel fuel. The marker would be required to be added at the refinery gate just as visible evidence of the red dye is required today, and fuel containing the marker would be segregated from highway and NRLM diesel fuel and would be prohibited from use in highway, nonroad, locomotive, or marine application.

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[204] A marker is an additive which is phosphorescent or has some other property which allows it to be easily detected, though not necessarily visible to the naked eye. A dye is intended to be visibly identified by the naked eye.

[205] Although there may be some exceptions were a refiner produces a unique grade of distillate fuel solely for heating oil purposes.

Based on the following discussion, we propose that the solvent yellow 124 marker be used beginning June 1, 2007 in heating oil. We further propose that it be added in a concentration of 6 milligrams per liter in order to ensure adequate detection in the distribution system even if diluted by a factor of 50. The modest costs associated with the use of a marker in heating oil are discussed in section V.A. of today's preamble.

Effective in August 2002, the European Union (EU) enacted a marker requirement for diesel fuel that is taxed at a lower rate (which applies in all of the EU member states).[206] The marker selected by the EU is N-ethyl-N-[2-[1-(2-methylpropoxy)ethoxyl]-4-phenylazo]-benzeneamine.[207] This compound is also referred to as solvent yellow 124 or the Euromarker. The treatment level required by the EU is the same as that proposed in today's rule. Despite its name, solvent yellow 124 does not impart a strong color to diesel fuel when used at the proposed concentration. Therefore, we do not expect that its use in diesel fuel that contains the IRS-specified red dye would interfere with the use of the red dye by IRS to identify non-taxed fuels. We request comment on this assessment.

The presence of the euromarker is identified using a chemical test. The current European test is inexpensive and easy to use. However, this test involves reagents that present some safety concerns and the small amount of fuel required in the test must be disposed of as hazardous waste. Nevertheless, we believe that such safety concerns are manageable and that small amount of waste generated can be handled along with other similar waste generated by the company conducting the test and that the associated effort/costs would be negligible. Therefore, we are proposing its use under today's proposed program. Specifically, we propose the PetroSpec DT 100C-I-S based method for use in detecting the presence and determining the concentration of solvent yellow 124.[208] This would be the method accepted by EPA for use by industry to establish affirmative defense to presumptive liability and would be used by EPA to establish violations with the marker requirements. We request comment on the need for a more robust method to support EPA enforcement actions such as an HPLC-based or other laboratory method.

Additional work is underway by the EC to mitigate the problems and improve the current test. We anticipate that this work would be completed early enough so that we could finalize the improved field test in the final rule which will follow this proposal. We request comment on the suitability of the PetroSpec based test for solvent yellow 124 and on the improved test under

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[206] The EU marker legislation, 2001/574/EC, document C(2001) 1728, was published in the European Council Official Journal, L203 28.072001.

[207] Opinion on Selection of a Community-wide Mineral Oils Marking System, ("Euromarker"), European Union Scientific Committee for Toxicity, Ecotoxicity and the Environment plenary meeting, September 28, 1999.

[208] Memorandum to the docket entitled "Use of the PetroSpec DT 100C-I-S Based Test Method for Use in Detecting the Presence and Determining the Concentration of Solvent Yellow 124 in Diesel Fuel"

development, as well as other potential test procedures.

Solvent yellow 124 is chemically similar to other additives used in gasoline and diesel fuel, and meets the requirements for registration by EPA as a fuel additive under 40 CFR 79. Thus, the risk to public health from its products of combustion would be comparable to that for other additives. Likewise, its products of combustion would not be anticipated to have an adverse impact on emission control devices, such as a catalytic converter. In addition, extensive evaluation and testing of the Euromarker was conducted by the EC. This included combustion testing which showed no detectable difference between the emissions from marked and unmarked fuel. Therefore, we do not expect that there would be concerns regarding the compatibility of the Euromarker in the US fuel distribution system or for use in motor vehicle engines and other equipment such as in residential furnaces. We request comment on this assessment.

Solvent yellow 124 is marketed by several manufactures and is in current wide-scale use in the European community. We anticipate that these manufactures would have sufficient lead-time to increase their production of solvent yellow 124 to supply the need for fuel marker that would result from today's proposal. We request comment on whether there are product licencing or other concerns regarding the manufacture of solvent yellow 124 for use under today's proposed rule.

We request comment on other potential markers that might be used to segregate heating oil from NRLM fuel. For example, the Clir-Code® marker system manufactured by ISOTAG Technologies Inc. includes a field test that employs a hand-held near infra-red detector. The use of this marker would obviate the need for the use of any reagent during field testing. We furthermore seek comment on whether more than one marker could be selected, but which could all be detected using the same detection method. In this manner refiners would not be dependent on a sole supplier for the marker. Additional discussion of the rationale for our selection of solvent yellow 124 and the feasibility of its use is contained in Chapter 5 of the Draft RIA.

Since marked heating oil would be a relatively small volume product in many parts of the country, we anticipate that it will not be carried everywhere as a separate fungible product. In places where it is not carried as a separate fungible grade we anticipate that most shipments of marked heating oil will be from refinery racks or other segregated shipments directly into end-user tankage. In these areas any distillate supplied from the fungible supply system for heating oil purposes will therefore likely be spillover from 500 ppm NRLM supply. Clearly, in those parts of the country with high demand for heating oil, particularly the Northeast and Pacific Northwest, we anticipate that marked heating oil will in fact be carried by the distribution system as a separate fungible product. To the extent this is the case, it is entirely possible that heating oil will no longer be produced to diesel fuel cetane or aromatic specifications, reducing production costs. The most difficult to desulfurize streams in a refinery are in fact those that are low in cetane and high in aromatics. Shifting these streams to a unique heating oil product can therefore reduce desulfurization costs, while still producing a high quality heating oil.[209]

ii. Non-highway Distillate Baseline Cap

As discussed above, with the proposed use of a marker to effectively distinguish uncontrolled heating oil from NRLM fuel, the NRLM standards proposed today can be enforced throughout the distribution system and at the end-user. However, in order to allow for the highway diesel fuel standards to continue to be enforced in the absence of a NRLM dye requirement, we are proposing that a non-highway distillate baseline percentage be established for each refinery and importer in the country. This non-highway baseline would be defined as the percentage of all number 2 distillate fuel that a refinery or importer produced/imported during the specified baseline period that was dyed for non-highway purposes.

We propose that if a refiner chooses to fungibly distribute its NRLM and highway fuels, then under the first step of the nonroad program (June 1, 2007 - June 1, 2010), any production up to its non-highway distillate baseline percentage would have to either meet the 500 ppm NRLM standard or be marked as heating oil. Any production above this baseline percentage would have to meet the requirements of the highway fuel program (i.e., 80 percent of this fuel would have to meet a 15 ppm sulfur cap).

We propose that a refiner, for each of its refineries, would need to choose either to continue to dye all of its NRLM fuel at the refinery gate or to apply the non-highway baseline percentage to all of its NRLM fuel. If a refinery's production could be split between these two options, the refiner could avoid the cap by dyeing additional volumes over its baseline. The result could be a diversion of 500 ppm fuel to the highway market while the dyed 500 ppm fuel served the nonroad market, and little or no production of 15 ppm highway diesel fuel. Given this, the choice of whether to dye all of their 500 ppm fuel at the refinery gate or comply with the non-highway distillate baseline would have to be made in advance. We propose that compliance with the baseline be determined on an annual basis. We therefore also propose that the decision of whether to dye their NRLM 500 ppm fuel or comply with the baseline could also be made on an annual basis.

An example will help to explain the use of the baseline. Assume the baseline non-highway percentage has been established as discussed below and is 40%. That means 40% of the total diesel fuel production in the baseline years was non-highway fuel, dyed at the refinery gate. If the refinery then produced a total of 100,000,000 gallons of diesel fuel in 2008, 40,000,000 gallons would be its applicable non-highway baseline. If it then produced and marked 10,000,000 gallons as heating oil, 30,000,000 gallons of the remaining diesel fuel (dyed or

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[209] The costs projected for this rule do not assume such shifts.

undyed) would be subject to the NRLM standard of 500 ppm, and all the remaining diesel fuel would be considered highway diesel fuel and would have to meet the applicable 80/20 requirements.

In essence, this approach allows a refinery's production of 500 ppm NRLM fuel and heating oil to remain flexible in response to market demand, while ensuring that the proportion of fuel they produce in the future to highway and non-highway requirements remains consistent with their historical baseline production. Since the non-highway baseline is set as a percentage of production, the actual volume needed for compliance with this baseline would rise and fall with the refinery's total production of number 2 distillate. In this way, it would provide refineries with flexibility similar to that under the 80/20 volume percentage provisions of the highway rule. If total production of number 2 distillate decreased, the absolute volume of diesel fuel which had to be produced to highway or NRLM specifications would decrease. If total production increased, the amount of diesel fuel subject to the 80/20 highway and the NRLM standards would also increase. A refiner wishing not to be limited to this non-highway distillate baseline percentage of production could elect to segregate and dye its NRLM diesel fuel at the refinery gate.

Like the current dye requirement, this approach would focus compliance at the refinery or point of importation. Once undyed 500 ppm (or 15 ppm) diesel fuel was produced or imported, it could be mixed and shipped fungibly and sold to either the highway or the NRLM diesel fuel market by anyone further down the distribution system. This would provide a significant degree of market flexibility to refiners and distributors and enable the efficient distribution of diesel fuel. Compliance with the non-highway baseline would be enforced at the refinery gate in the same manner as the current 2006 highway provisions. With the marker for heating oil, compliance with the 15 ppm and 500 ppm standards could also be enforced through to the end-user. But most importantly, this approach would maintain the health benefits and fuel availability needs of the highway diesel fuel program, because the overall volume of highway diesel fuel produced to the 15 ppm cap would be maintained.

iii. Setting the Non-highway Distillate Baseline

The purpose of the non-highway baseline is to identify a "historical' level of non-highway production occurring prior to implementation of the provisions of today's proposal for use as a baseline after such implementation. We propose to determine the non-highway baseline percentage for each refinery by averaging the volume of dyed number 2 distillate that it produced over the three year period from January 1, 2003 through December 31, 2005, and dividing that volume by the average of all number 2 distillate it produced over the same period (and then muliplied by 100). By using a multi-year average, variations that might otherwise occur from year to year in a refinery's production will get averaged out.

Selecting a baseline period prior to finalization of the final rule helps to prevent the possibility of entities inappropriately adjusting their operations solely for the purpose of modifying their baseline. At the same time, setting a baseline period as close to the implementation date as possible helps to capture the most recent changes in the industry's production patterns. The proposed period of January 1, 2003 through December 31, 2005 is split roughly equally between production prior to the final rule and production after the final rule to appropriately balance these competing objectives. One advantage of ending the baseline period on December 31, 2005 is that it allows the opportunity for refineries to generate credit for the early production of 500 ppm NRLM fuel after that date and at the same time avoid having to dye it at the refinery gate. The three year period serves to limit any potential actions to inappropriately adjust the baseline that a refinery might otherwise attempt. A refiner would have to dye and sell a greater fraction of its fuel to the non-highway market over an extended period of time to significantly modify its baseline. The potential financial loss associated with this, particularly if other refineries tried to do the same thing, would likely be prohibitive.

Each refinery and importer would have to report its non-highway baseline to EPA by February 28, 2006 along with the supporting information. EPA would then approve these baselines by June 1, 2006. We propose that any new (or shut down) refinery or importer not able to establish a baseline during this period would be assigned a non-highway baseline percentage reflecting the projected national average production of non-highway fuel in 2004. Based on data from the Department of Energy's Energy Information Agency (EIA) on the current production of low and high sulfur diesel fuel and heating oil and EIA and EPA projections of future fuel use, this national average non-highway baseline would be 29 percent (see Chapter 4 of the Draft RIA).

EPA requests comments on our proposal to use the January 1, 2003 through December 31, 2005 time period for calculation of each refinery's non-highway baseline percentage. We also request comment on any alternative time periods that could be used to accomplish the objectives discussed above.

iv. Fuel Credit Banking, and Trading Provisions for 2007

In order to provide some implementation flexibility at the start of the 500 ppm NRLM standard in 2007, today's proposal includes provisions for refiners and importers to generate early credits for production of 500 ppm NRLM fuel prior to June 1, 2007. These credits are tradeable and can be used to delay compliance with either the 500 ppm NRLM standard in 2007 or the 15 ppm nonroad standard in 2010. The proposed banking and trading provisions would allow an individual refinery to purchase credits and delay compliance. This would allow for a somewhat smoother transition at the start of the program, with some refineries complying early, others on time, and others a little later. Nevertheless, on average the overall benefits of the program would be obtained, and some environmental benefits could be achieved earlier than expected. Perhaps the most advantageous use of these credit provisions, however, might be for individual refineries to utilize available credits to permit the continued sale of otherwise off-spec product during the start up of the program when they are still adjusting their operations for consistent production to the new sulfur standards.

Credit Generation:

We propose that credits can be generated to allow for the use of high sulfur NRLM fuel after June 1, 2007 in two ways. First, we propose that a refinery or importer can generate credit for early production of NRLM diesel fuel to the 500 standard from June 1, 2006 through May 31, 2007. If the refiner chose not to dye its 500 ppm NRLM fuel at the refinery gate during this period, then credits would be calculated using the non-highway baseline. Second, we propose, in conjunction with the small refiner hardship provisions described below in subsection C, that small refiners could generate credits for any production of NRLM fuel to the 500 ppm standard from June 1, 2007 through May 31, 2010. These credits can be banked for future use, or traded to any other refinery or importer nationwide. In either case, these credits would be calculated according to the following formula:

High-Sulfur NRLM credits[210] = (15 ppm production volume + 500 ppm production volume) - (100% - non-highway baseline percentage) * total #2 distillate production

If the excess production was 15 ppm fuel instead of 500 ppm fuel, the refiner would of course still have the option of using it to generate 500 ppm credits under the existing highway diesel ABT provisions instead. Credit could not be earned under both programs.

Credit Use:

We propose that there would be two ways in which refiners could use high-sulfur NRLM credits. First, we propose that these credits could be used during the period from June 1, 2007 - May 31, 2010 to continue to produce high sulfur diesel fuel and sell it into the NRLM market. Any high sulfur NRLM fuel produced, however, would have to be dyed red at the refinery gate, kept segregated from other fuels in the distribution system and tracked through the use of unique codes on product transfer documents.

Only at the point in the distribution system where NRLM fuel has been dyed to IRS specifications for excise tax purposes (e.g., after a terminal or bulk plant) do we propose that high sulfur and 500 ppm sulfur NRLM fuels could be commingled. Such commingling will not diminish the PM and SO2 emission reductions or other benefits associated with the 500 ppm sulfur standard. However, in order to ensure that owners of nonroad equipment can be confident

[210] For the purposes of this proposal, the credits are labeled on the basis of their use in order to follow the convention used in the highway rule. A high-sulfur credit is generated through the production of 500 ppm fuel and allows the production of one gallon of high sulfur fuel.

in knowing whether the fuel being purchased meets the 500 ppm cap, the PTD and labels for any commingled fuel will have to indicate that the sulfur level exceeds 500 ppm. This is particularly a concern for some 2008 and later model year equipment that may need to run on 500 ppm or lower sulfur fuel in order to achieve the emission benefits in-use of the standards proposed today, as discussed in section III.

In most cases we anticipate that the distribution costs associated with segregating such a small volume product will prevent high-sulfur NRLM from being carried in the fungible distribution system. As a result, we anticipate that only those refineries that have their own segregated distribution system could continue to produce solely high sulfur NRLM fuel after June 1, 2007. Since there are few refineries set up to accomplish this, our expectation is that the most likely manner in which refiners will be able to use high-sulfur NRLM credits will be through sales of that portion of their fuel production that they sell directly from their on-site fuel rack or co-located terminal. Nevertheless, in order to have confidence that refiners are making the transition to 500 ppm for NRLM uses, we seek comment on whether caps on the use of credits would be necessary. In particular, we seek comment on placing a cap on the use of credits at 25 percent of its non-highway baseline (less marked heating oil) beginning June 1, 2008.

The second way in which we propose that refiners and importer could use high-sulfur NRLM credits is by banking them for use during the June 1, 2010 - May 31, 2012 period (as 500 ppm nonroad credits). During this period they could then continue producing 500 ppm fuel subject to the usage restrictions that apply during that period, as discussed in subsection B.3.b.ii below. This use of high-sulfur credits would provide a cost-effective environmental benefit, since credits generated from the reduction of sulfur levels from high sulfur to 500 ppm would be used to offset the much smaller increment of sulfur control from 500 ppm down to 15 ppm.

b. 2010

After June 1, 2010, the fuel standards situation is simplified considerably and the fuel program structure can therefore also be simplified. The need for the non-highway baseline disappears, since all highway and nonroad diesel fuel must meet the 15 ppm cap. Furthermore, since we propose that high sulfur diesel fuel no longer be permitted to be used in any NRLM equipment, the only high sulfur distillate remaining in the market should be heating oil. Heating oil would have to be kept segregated and preventing its use in NRLM equipment could be enforced on the basis of sulfur level, avoiding the need for a unique marker to be added to heating oil.

However, one new situation arises that needs to be addressed. After June 1, 2010, under today's proposal locomotive and marine diesel fuel would be allowed to remain at the 500 ppm level. In addition, assuming we allowed the continued production and use of 500 ppm nonroad diesel fuel through the small refiner hardship provisions discussed in subsection C and fuel credit provisions discussed below, 500 ppm nonoad fuel would continue to exist in the distribution system as late as May 31, 2014. If a refiner produced 500 ppm diesel fuel without the use of credits for the intended use in locomotive and marine applications, and this 500 ppm fuel later made its way into nonroad equipment, less 15 ppm nonroad fuel would be produced and the full benefits of the 15 ppm nonroad standard would not be achieved. If this happened to a large enough extent it could call into question the adequate supply of 15 ppm for nonroad purposes beginning in 2010. Thus, some method is needed to differentiate locomotive and marine 500 ppm fuel from nonroad 500 ppm fuel after June 1, 2010. Of course, the option being considered by the Agency to require locomotive and marine diesel fuel to also meet the 15 ppm standard beginning June 1, 2010 would resolve this situation as well.

i. A Marker to Differentiate Locomotive and Marine Diesel from Nonroad Diesel

Differentiating locomotive and marine diesel fuel from nonroad diesel fuel presents a very analogous situation, though perhaps on a smaller scale, to that described above for heating oil prior to June 1, 2010. As a result, we propose to use a marker to segregate locomotive and marine diesel fuel from 500 ppm nonroad diesel fuel beginning June 1, 2010. Since both fuels need to be dyed red for tax purposes prior to sale, for the same reasons discussed above with respect to heating oil, a marker that does not impart a stong would be required. Since use of the marker in heating oil is no longer required, we propose that the same marker used for heating oil from June 1, 2007 through May 31, 2010 be the marker used in locomotive and marine diesel fuel beginning June 1, 2010. We propose that the marker would be required to be added at the refinery gate just as visible evidence of the red dye is required today, and fuel containing the marker would be prohibited from use in any nonroad application.

Since this marked 500 ppm locomotive and marine diesel fuel would be a relatively small volume product, we anticipate that in most parts of the distribution system it would not be carried as a separate product in the fungible distribution system. Therefore we anticipate that most shipments of 500 ppm locomotive and marine fuel would be from refinery racks or other segregated shipments directly into end-user tankage. Any diesel fuel supplied off the fungible supply system for locomotive and marine uses would therefore likely be spillover from 15 ppm supply. For this reason, we also seek comment on whether the marker for locomotive and marine diesel fuel is necessary at all, or whether we could just limit supply of 500 ppm locomotive and marine diesel fuel to such segregated shipments, with refineries being liable to ensure and keep records demonstrating that 500 ppm fuel produced for locomotive and marine purposes was distributed solely for these purposes.

ii. Fuel Credit Banking, and Trading Provisions for 2010

For the same reasons described above for 2007, we are proposing similar implementation flexibility through the use of a fuel credit banking and trading program for 2010. We propose that refiners and importers be able to generate early credit for production of 15 ppm nonroad diesel fuel prior to June 1, 2010 which can be used or traded to delay compliance with the 15 ppm nonroad standard in 2010. As in 2007, while it is possible that a refinery could delay entirely compliance with the 15 ppm standard in 2010 through the use of credits, perhaps the most advantageous use of these credit provisions may be for the continued sale by individual refineries of otherwise off-spec product during the start up of the program when they are still adjusting their operations for consistent production to the new sulfur standards.

Credit Generation:

Under today's proposal, highway and nonroad fuels of like sulfur level would be allowed to be distributed fungibly, and as such would be indistinguishable. For example, prior to June 1, 2010 undyed 15 ppm would be distributed together whether or not it was later dyed for nonroad purposes. Consequently, we are proposing that credits for production of excess 15 ppm diesel fuel prior to June 1, 2010 up to a refinery's total highway requirement (100 percent minus the non-highway baseline) continue to be calculated based on excess production of 15 ppm diesel fuel under the provisions of 2007 highway diesel fuel program.[211] Any production of 15 ppm fuel greater than this amount (100% minus the non-highway baseline) beginning June 1, 2009 could be used to generate early nonroad credits.

An example will help to explain the use of these credits. Assume the baseline non-highway percentage has been established at 40% and the refinery produces a total of 100,000,000 gallons of diesel fuel in 2008. It's applicable non-highway baseline would be 40,000,000 gallons. If it then produced and marked 10,000,000 gallons of heating oil, 30,000,000 gallons of the remaining diesel fuel (dyed or undyed) would be subject to the NRLM standard of 500 ppm, and the remaining 60,000,000 gallons of diesel fuel would be considered highway diesel fuel and would have to meet the applicable 80/20 requirements. If the refiner instead produced only 20,000,000 gallons of fuel to the 500 ppm NRLM standard and produced 70,000,000 to the 15 ppm standard, then it would receive early credit for the 10,000,000 gallons excess 15 ppm NRLM fuel that it produced.

In addition to this source of credits, we propose that there be two other sources of credits to allow production of 500 ppm nonroad after June 1, 2010. First, as discussed in subsection B.3.a.iv above, high-sulfur NRLM credits generated prior to June 1, 2010 could be converted into 500 ppm nonroad credits and carried over for use beginning June 1, 2010. Second, we propose in conjunction with the small refiner hardship provisions described below in subsection C, that small refiners could get credit for any production of NRLM fuel to the 15 ppm standard

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[211] Under the highway program four gallons of excess 15 ppm diesel fuel produced or imported would generate one 500 ppm diesel fuel credit. This credit grants the refiner or importer the right to produce one additional gallon of undyed 500 ppm diesel fuel between June 1, 2006 and May 31, 2010. These credits can be used (or traded within the PADD in which they were generated) to produce or import less than 80% of its highway volume as 15 ppm fuel. This would continue under today's proposal.

from June 1, 2010 through May 31, 2012. These credits could be traded to any other refinery or importer nationwide.

Credit Use:

We propose that 500 ppm nonroad credits could be used on a gallon for gallon basis during the period from June 1, 2010 - May 31, 2012 to continue to produce 500 ppm nonroad diesel fuel. (Small refiners could continue to produce 500 ppm nonroad diesel until June 1, 2014.) Any 500 ppm nonroad fuel produced would have to be dyed red at the refinery gate, kept segregated from other fuels in the distribution system, and tracked through the use of unique codes on product transfer documents all the way through to the end-user. Refiners wishing to produce 500 ppm fuel and sell it as nonroad would have to get EPA approval in advance demonstrating how they will ensure such segregation.

Given the cost and burden associated with segregating 500 ppm nonroad diesel fuel as a separate product in the distribution system, we anticipate that the most likely manner in which refiners will be able to use 500 ppm nonroad credits will be through sales of that portion of their fuel production that they sell directly from their on-site fuel rack.

We request comment on all aspects of the proposed credit trading system.

c. 2014

Beginning June 1, 2014, after all small refiner and credit provisions have ended, both the 15 ppm nonroad standard and the 500 ppm locomotive and marine standard could be enforced based on sulfur level throughout the distribution system and at the end-user. There would no longer be any need for a baseline or any marker. Consequently, we are proposing that from June 1, 2014 on the different grades of fuel, 15 ppm, 500 ppm, and high-sulfur would merely have to be kept segregated in the distribution system.

4. Other Options Considered

In developing the proposed program structure described above, we also evaluated a number of other possible approaches aimed at accomplishing the same objectives. The alternatives discussed below are designed to allow for even greater fuel fungibility, for example, even for smaller volume products such as those produced through the use of credits. However, in so doing, they would also either place more restrictions on refinery operations, or raise significant enforcement and program integrity concerns. As a result, we are not proposing the following alternatives, but nevertheless wish to seek comment on them and ways to minimize or alleviate the concerns associated with them.

a. Highway Baseline and a NRLM baseline for 2007

The proposed program described above relies on a non-highway baseline to distinguish production of highway fuel from production of NRLM fuel, and a marker to distinguish production of heating oil from NRLM fuel. In lieu of using a marker for heating oil, another approach would be to use a second baseline aimed at the NRLM portion of non-highway diesel fuel. In this case a highway baseline would be established analogous to the baseline proposed above -100 percent minus the proposed non-highway baseline. The highway 80/20 standards would apply to this baseline and a second NRLM baseline would be established to which the 500 ppm NRLM standard would apply. Any remaining fuel produced would be uncontrolled (i.e., high sulfur). This approach would allow for greater fungibility of fuels with the same sulfur level. Not only could 500 ppm highway and 500 ppm NRLM fuel be distributed together, but high sulfur NRLM fuel produced through the credit and hardship provisions could be fungibly distributed with heating oil. As a result, this approach would allow for greater flexibility in using the fuel credit and hardship provisions. The disadvantage, however, is that refiners would face additional burden when shifting into the heating oil market. An explanation of this approach follows.

These baselines, as with the proposed non-highway baseline, are set on the basis of a percentage of production. Therefore, as a refinery's overall production of number 2 distillate rises and falls, the required volume of each grade of fuel will also rise and fall. Thus, the baselines are flexible enough to respond to changes in a refinery's market or situation. Furthermore, a nationwide credit trading program for 500 ppm NRLM fuel could be put in place, allowing refineries further flexibility to change production in response to consumer demand. To add additional flexibility we could allow for some deficit carry-over of NRLM credits. Finally, a refinery could always avoid compliance with the baselines entirely by dyeing or marking their fuel and ensuring that it is only used in appropriate end-uses.

i. Highway Baseline

The highway baseline would be very analogous to the non-highway baseline proposed above. It would be calculated in the same way, except that it would in essence be 100 percent minus the proposed NRLM baseline. Instead of being used as a cap on the amount of fuel subject to the NRLM 500 ppm standard, it would be used as a floor on the percentage of fuel to which the highway 80/20 provisions apply.

The requirement that NRLM fuel be dyed at the refinery gate would become voluntary. From June 1, 2007 through May 31, 2010 any volume of 500 ppm fuel not dyed at the refinery gate would have to meet the 80/20 highway provisions up to the refinery specific highway baseline percentage. The highway baseline percentage would be determined for each refinery by averaging the volume of undyed number 2 distillate that it produced over the three year period from January 1, 2003 through December 31, 2005, and dividing that volume by the average of all number 2 distillate it produced over the same period (and then muliplied by 100).

ii. Nonroad, Locomotive, and Marine Baseline

The NRLM baseline would dovetail with the highway baseline approach described above. Instead of requiring that all heating oil contain a marker, we would require that a baseline percentage of a refinery's or importer's current high-sulfur number 2 distillate production be deemed to be NRLM diesel fuel and thus, subject to today's proposed 500 ppm cap beginning June 1, 2007. The remaining portion would remain uncontrolled. In concert with the highway baseline, application of this baseline would mean that a refiner's baseline for NRLM diesel fuel would apply to the percentage of number 2 distillate fuel not included in the highway baseline (i.e., the proposed non-highway baseline).

In lieu of complying with the NRLM diesel fuel baseline percentage, a refinery or importer could reduce the volume of 500 ppm fuel they need to produce by adding the proposed marker and segregating their heating oil from any NRLM diesel fuel throughout the distribution system, including high sulfur NRLM diesel fuel (produced through the use of credits or by small refiners or refiners utilizing hardship provisions). The refinery would have to demonstrate that the fuel was segregated all the way through to the end-user and that the end-user used the fuel for legitimate heating oil purposes only. NRLM end-users would be prohibited from using any fuel with a marker.

Unlike the situation today where highway diesel fuel and other distillates are accounted for based upon their different sulfur levels and the presence of red dye, there is no easy way to measure a given refinery's production of NRLM diesel fuel as compared to their production of heating oil in order to establish an individual refinery baseline percentage. The two fuels currently are generally produced and shipped as a single fuel. We considered allowing refiners and importers to track their high sulfur fuel through the distribution system and estimate the volumes used as diesel fuel and heating oil to establish individual refinery baselines. However, given that most high sulfur diesel fuel and heating oil is shipped by fungible carriers, we do not believe that sufficient data exist to accurately determine which refiner's fuel was actually consumed in either use. Therefore, we have developed an approach to assign each refinery a percentage of their current high-sulfur distillate production based on the PADD they reside in to serve as their NRLM baseline (with PADDs 1 and 3 combined due to the large amount of high sulfur non-highway diesel fuel shipped from PADD 3 to PADD 1 today).

Under this alternative approach we would use the projected consumption of NRLM diesel fuel and heating oil to determine the relative consumption of these two fuels by PADD. The percentage represented by NRLM diesel fuel would then have to meet the proposed 500 ppm cap beginning June 1, 2007. The remainder would remain uncontrolled by EPA regulations and would only have to meet any applicable state sulfur standards for heating oil. If a refinery desired to only produce heating oil, then they could either purchase credits from other refineries that were only producing highway and NRLM fuels or segregate and mark their heating oil.

Using EIA estimated fuel consumption data of the year 2000, grown to 2008 using EPA NONROAD emission model growth rates for nonroad and EIA growth rates for other fuels the NRLM baseline percentages shown in Table IV-1 result.

TABLE IV-1 – NRLM DIESEL FUEL BASELINE PERCENTAGES

PADD	Percentage of Total High Sulfur Diesel Fuel and Heating Oil Production		
	Nonroad Only	Loco and Marine	Combined
1 and 3	26%	16%	42%
2	57%	27%	84%
4	67%	29%	96%
5 (excluding Alaska)	59%	18%	77%
Alaska	22%	28%	50%

One particular concern exists with respect to the ability of this NRLM baseline approach to allow refiners to easily respond to above average demand for heating oil in the event of an unusually cold winter. As today, any short-term, unexpected increases in demand will be made up from existing inventories of fuel. Today, if there are insufficient inventories of high sulfur fuel, 500 ppm inventories are tapped as well. The same situation will continue to occur in the future. As a result, the issue is not one of being able to supply the market with sufficient fuel to meet demand, but rather what quality of fuel must be produced to build inventories back up after high demand has brought them down. This could be addressed in a number of ways. First, in setting the NRLM baseline itself we could make sure it is not too high and allows for sufficient volumes of high sulfur heating oil to be produced even in the event of an unusually cold winter. Second, we could allow credits to flow across the country through a nationwide credit trading program. This would allow the production of high sulfur fuel to likewise flow across the country to the places experiencing higher than normal demand. Third, provisions could be made for deficit carry over of credits. If demand for high sulfur fuel is unusually high in one year, a refiner could increase production to respond to that demand as long as it is made up the following year.

Another concern raised by this baseline approach is the inability to accurately tailor it to each refinery's actual historical production of NRLM. This baseline approach does reflect the historical practice - refineries produced fungible high sulfur fuel for distribution as a common pool of fuel that was later treated as either NRLM or heating oil. However, it does not allow the refinery specific customization allowed under the proposal, where the specific non-highway percentage is determined for each refinery, and the actual volume of marked and dyed heating oil is subtracted. The lack of individual specificity for the NRLM baseline approach, however, avoids the need to add a marker to heating oil.

iii. Combined Impact of both baselines

The combined effect of these highway baseline and this NRLM baselines is shown in Table IV-2.

TABLE IV-2 – COMBINED IMPACT OF THE DIFFERENT BASELINES FOR JUNE 1, 2007 - MAY 31, 2010

Sulfur level	Percentage requirement (applied to total no. 2 distillate production
15 ppm	> or = 80% x (highway baseline) or;
	> or = 80% x All undyed diesel fuel (whichever is less)
15+500 ppm	>or= (highway baseline) + (NRLM baseline)(100%-highway baseline) or;
	= All fuel without a marker and segregated through to the end-user

An example will help to explain the use of these baselines. Assume a refinery in PADD 3 produces 100,000,000 gallons of number 2 distillate per year from 2003-5, 60 percent of which is undyed. Its highway baseline would thus be 60 percent of its total number 2 distillate. Its NRLM baseline, assigned by EPA from Table IV-1, would be 42 percent applied to the remaining 40 percent of total number 2 distillate, or 16.8 percent of total distillate. If the refinery then continues to produce a total of 100,000,000 gallons of diesel fuel in 2008, 60,000,000 gallons would be required to meet the highway 80/20 standards, i.e., 48,000,000 at 15 ppm and 12,000,000 at 500 ppm. An additional 16.8 percent, or 16,800,000 gallons would be required to meet the 500 ppm NRLM standard, for a total required 500 ppm production of 28,800,000 gallons. Its remaining 23,200,000 gallons of production could remain uncontrolled and could be sold as heating oil or high sulfur NRLM. If the refiner reduced this 23,200,000 gallons to 500 ppm it would then earn credits that could be sold to another refiner.

b. Locomotive and Marine Baseline for 2010

The proposed program described above relies on a marker to distinguish production of locomotive and marine diesel fuel from production of NRLM fuel after June 1, 2010. Just as in the alternative above, a baseline for locomotive and marine fuel could be used in lieu of a marker. The 2010 locomotive and marine baseline would be established by EPA and used in the same manner as described above for NRLM fuel in 2007. Possible locomotive and marine baselines are shown in Table IV-1. The advantage of this baseline approach over the proposed approach is that it allows for the fungibility of 500 ppm locomotive and marine fuel with 500 ppm nonroad fuel produced through the credit and hardship provisions. As a result, this approach would allow for greater flexibility in using the fuel credit and hardship provisions. The disadvantage, however, is that refiners wishing to produce locomotive and marine fuel in quantities larger than their baseline, would have to purchase credits from other refiners.

It may also be possible for each refiner and importer to track the use of its diesel fuel to determine what percentage was used by railroads and marine vessels. This information could then be used in lieu of the PADD average values shown in Table IV-1. This approach would have to be taken by every refinery and importer to avoid double counting. Any new refineries or importers however, would still be assigned a baseline from Table IV-1. Tracking fuel use in this instance could be feasible, since the number railroads and marine terminals is relatively small. We request comment on this alternative approach and details of how such an approach could be implemented.

c. Designate and Track Volumes in 2007

Another possible alternative would allow a refiner or importer to designate its fuel as highway diesel fuel or NRLM diesel fuel and use this refiner designation instead of baselines to differentiate highway fuel and NRLM fuel. A marker would still be used to segregate heating oil but the dye requirement for NRLM at the refinery gate would be removed. As with the baseline approach, undyed 500 ppm highway and 500 ppm NRLM could be fungibly distributed up until the point the dye is required for tax purposes.

These refiner designations would follow the fuels through the distribution system through to the end user. Under this "designate and track" approach, fuel distributors would be required to sell only those fuels which had designations consistent with the intended use of the fuel purchaser. This approach was recommended to us as a potential solution during discussions with various refiners.

This approach shifts the focus away from monitoring production at the refinery gate to monitoring the volumes of fuel handled by each party in the distribution system. Under the designation approach, refiners and importers would have complete flexibility to designate individual batches of diesel fuel or even portions of batches as either highway fuel or NRLM fuel. A pipeline could mix undeyd highway 500 ppm and NRLM diesel fuels and ship them fungibly as a single physical batch. However, two sets of records (e.g., product transfer documents (PTDs)) would be kept, one applicable to the highway fuel portion and one applicable to the NRLM fuel portion. Whenever all or a portion of the fungible batch was split off or sold, that portion would carry one of the two designations (highway or NRLM) and the sum of the volumes designated as either fuel would always be required to add up to the volumes designated in the original batch.[212] A combination of fungibly mixed batches would be handled similarly, with the total volumes of each designation equaling the sum of the volumes of each designation of the batches, respectively.

Each party in the distribution system beyond the refinery gate would be required to reconcile the volumes taken in and the volumes discharged, based on the designations of the diesel fuel. For example, assume that over a year a pipeline received a total of 100,000,000 gallons of undyed 500 ppm diesel fuel from various refineries, with 70% of what it received being designated by the refiners as highway and 30% designated as NRLM. Over the year the pipeline would also designate what it discharged at various terminals or other points as either highway or NRLM. The pipeline would have to ensure that over a years time it did not discharge more than 70% of the volume of this entire pool of diesel fuel as highway diesel fuel, to ensure that fuel designated as NRLM was not converted to highway use. It could not discharge more fuel as highway than it took in as highway, and it had to discharge at least as much diesel fuel designated as NRLM as it took in.

In order to maintain the integrity of the highway program, EPA would have to ensure that all NRLM designated fuel eventually was dyed and sold to one of these three markets. Otherwise, for example, refiners and importers could simply designate diesel fuel under the more lenient NRLM diesel fuel program while downstream in the distribution system the fuel is shifted to the highway diesel fuel market. This would reduce the volume of 15 ppm fuel produced and used, undermining the benefits and integrity of the highway program. Thus, under this designation approach, EPA would require that all parties handling undyed diesel fuel designated as NRLM must maintain records and submit reports demonstrating that the volume of undyed NRLM designated fuel that they dyed plus that transferred undyed to another fuel distributor equaled or exceeded the volume of undyed NRLM designated fuel that they received. We would also require that all parties handling dyed or undyed NRLM diesel fuel maintain records and submit reports demonstrating that the volume of NRLM designated fuel that they received was sold for use in nonroad, locomotive or marine diesel engines or transferred to another fuel distributor with the same designation. These requirements would be applied on an annual basis, providing fuel distributors with flexibility to shift fuel designated for one use to the other market and vice versa to address short term supply fluctuations of each fuel but still maintain overall program integrity.

While we seek comment on this designation concept, we are concerned that it does not appear to meet some of our key principles in designing the program. First, although it may work in theory, we are concerned about both the real-world enforceability of this approach and its

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[212] The only exception to this would be to recognize product gained or lost in the distribution system due to interface mixing (e.g., downgrade, transmix, etc.). To ensure program integrity, any downgrade to 500 ppm in the distribution system would have to be designated as NRLM diesel fuel.

impact on fuel distributors. Under the baseline approach described above, enforcement is focused on the roughly 100 refineries producing nonroad diesel fuel. This designation approach would add as many as 100 pipelines, 1000 terminals, and an undetermined number of bulk plants, and barge and rail distributors. Trying to ensure compliance by reviewing the thousands of documents and records generated on all the batches of fuel handled by each of these entities throughout the course of a year would be a difficult challenge. This challenge would be compounded by the fact that to determine whether inappropriate changes in designation occurred by a given entity, the records of each entity from which it received fuel and to which it sent fuel would also have to be compared. If any entity in the distribution system were unable to verify through their records that they distributed the same amount or more of diesel fuel as NRLM fuel as they took in with this designation, then they, not the refiners would be presumed liable for violating the provisions of the highway rule. Given the complexity of such a program and the sheer magnitude of the task, we have serious doubts that such a program could be reliably enforced in practice.

Second, we are also concerned that such an approach, even if enforceable, would not maintain the benefits and integrity of the highway program. Due primarily to limitations in the distribution system, nearly a third of all non-highway distillate today is produced to the highway specifications. While under the provisions of the highway rule this “spillover” from highway could be dyed at the refinery gate and avoid compliance with the 2006 highway standards, our expectation in developing the highway program was that the majority of the spillover today would continue into the future. Significantly changing the current distribution practices would be a costly endeavor. The sulfate PM and SO2 emission benefits in the highway rule, and the assumptions with respect to program cost and fuel availability were based on the assumption that 80% of this spillover volume would comply with the 15 ppm highway standard and would be available for highway use if needed. While the highway program does not ensure this and spillover could decline, it would not go to zero. By definition, under this designation approach, the spillover volume would be designated as NRLM fuel, or even heating oil, and therefore would no longer be subject to the highway program standards. The cost of segregation that previously existed would be gone. As a result, the benefits projected from this fuel volume under the highway rule would be lost entirely. Furthermore, with the reduced volume of 15 ppm fuel produced, we would be concerned whether sufficient 15 ppm fuel would still be available in all parts of the country for the vehicles that would need it. The enforcement concerns cited in the paragraph above only serve to heighten this concern.

A final concern is based on the economic incentives and rigidity in distribution institutionalized in such a system. There would be an incentive to designate fuel as NRLM at the refinery gate, as it would be subject to a less stringent standard than highway. At the same time, it is not clear that each refinery could accurately predict exactly what percentage of it’s fuel would be needed as highway and what percentage as NRLM. The precise allocation of diesel fuel as highway or NRLM often occurs downstream of the refinery, and the existence of spillover is in part a reflection of this. Given the incentive to designate the fuel as NRLM, and the inability at the time of production to precisely predict eventual usage as highway or NRLM, there is a risk of overestimation and overproduction of NRLM. This leads to either a shortage of highway fuel or a pressure to redesignate NRLM as highway fuel. However under the designation and track approach, volumes of NRLM can not later be redesignated as highway except on a short term basis. Overall, the total volume of NRLM produced is supposed to end up dyed as NRLM, and not used as highway. This structure appears to create the potential to inhibit the production and distribution of highway diesel fuel, or if there is not adequate enforcement to lead to distribution of NRLM as highway fuel.

EPA requests comments on the practical viability of this approach. In addition to the issues noted above, we specifically request comments on the following:

1) What would be the impacts of this approach on fuel distributors?
2) How might these record keeping requirements be combined with those already required by the U.S. Internal Revenue Service?
3) How might the required reports be automated in a common, digital format?
4) How would the record keeping requirements work for pipelines and certain terminals that handle fuel without taking ownership and that do not control the decision to dye certain diesel fuel prior to sale?
5) How might the IRS records for refiners, importers and distributors be used as an independent check on the volumes of undyed diesel fuel handled which are eventually dyed and which are sold undyed?
6) Could the industry utilize independent auditors to simplify EPA's enforcement oversight?
7) What changes could be made to the program to recover the benefits of the highway program (avoid loss of the spillover volume)?

C. Hardship Provisions for Qualifying Refiners

1. Hardship Provisions for Qualifying Small Refiners

In developing our proposed nonroad diesel sulfur program, we evaluated the need and the ability of refiners to meet the 500 and 15 ppm standards as expeditiously as possible. We believe it is feasible and necessary for the vast majority of the program to be implemented in the proposed time frame to achieve the air quality benefits as soon as possible. Based on information available from small refiners and others, we believe that refineries owned by small businesses generally face unique hardship circumstances, compared to larger refiners. Thus, as discussed below, we are proposing several special provisions for refiners that qualify as "small refiners" to reduce the disproportionate burden that nonroad diesel sulfur requirements would have on these refiners.

a. Qualifying Small Refiners

EPA is proposing several special provisions that would be available to companies approved as small refiners. The primary reason for these provisions is that small refiners generally lack the resources available to large companies that help the large companies (including those large companies that own small-capacity refineries) to raise capital for investing in desulfurization equipment, such as shifting of internal funds, securing of financing, or selling of assets. Small refiners are also likely to have more difficulty in competing for engineering resources and completing construction of the needed desulfurization equipment in time to meet the standards proposed today.

Since our analysis showed that small refiners are more likely to face hardship circumstances than larger refiners, we are proposing temporary provisions that would provide refineries owned by small businesses additional time to meet the sulfur standards. This approach would allow the program to begin as early as possible, avoiding the need to delay the overall program in order to address the ability of small refiners to comply.

i. The "SBREFA" Process

As explained in the discussion of our compliance with the Regulatory Flexibility Act in Section X.C and in the Initial Regulatory Flexibility Analysis in Chapter 11 of the Draft RIA, we considered the impacts of the proposed regulations on small businesses. Most of our analysis of small business impacts conducted for this rulemaking was performed as a part of the work of the Small Business Advocacy Review (SBAR) Panel convened by EPA, pursuant to the Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA). The final report of the Panel is available in the docket for this proposed rule.

Through the SBREFA process, the Panel provided information and recommendations regarding:

- The significance of the economic impact of the proposed rule on small entities;

- Any significant alternatives to the proposed rule that were evaluated to consider whether they would ensure that the objectives of the proposal would be accomplished while minimizing the economic impact of the proposed rule on small entities;

- The projected reporting, recordkeeping, and other compliance requirements of the proposed rule; and,

- Other relevant federal rules that may duplicate, overlap, or conflict with the proposed rule.

In addition to our participation in the SBREFA process, we conducted our own outreach, fact-finding, and analysis of the potential impacts of our regulations on small businesses. Based on these discussions and analyses, the Panel concluded that small refiners in general would likely experience a significant and disproportionate financial hardship in reaching the objectives of the proposed nonroad diesel fuel sulfur program.

One indication of this disproportionate hardship for small refiners is the relatively high cost per gallon of producing nonroad diesel fuel under the proposed program. Refinery modeling of refineries owned by refiners likely to qualify as small refiners, and of non-small refineries, indicates significantly higher refining costs for small refiners. Specifically, we project that without special provisions, refining costs for small refiners on average would be about 5.5 cents per gallon compared to about 4.0 cents per gallon for non-small refiners.

The Panel also noted that the burden imposed on the small refiners by the proposed sulfur standards may vary from refiner to refiner. Thus, the Panel recommended more than one type of flexibility so that most if not all small refiners could benefit.

ii. Rationale for Special Small Refiner Provisons

Generally, we structured these proposed provisions to address small refiner hardship while expeditiously achieving air quality benefits and ensuring that the availability of 15 ppm nonroad diesel fuel would coincide with the introduction of 2011 model year nonroad diesel engines and equipment. The following paragraphs review the reasons we believe the proposed special provisions for small refiners are necessary and appropriate.

First, the proposed compliance schedule for the nonroad diesel program, combined with flexibility for small refiners, would achieve the air quality benefits of the program as soon as possible, while helping to ensure that small refiners will have adequate time to raise capital for new or upgraded fuel desulfurization equipment. Most small refiners have limited additional sources of income beyond refinery earnings for financing and typically do not have the financial backing that larger and generally more integrated companies have. Therefore, they can benefit from additional time to accumulate capital internally or to secure capital financing from lenders.

Second, we recognize that while the sulfur levels in today's proposed program can be achieved using conventional refining technologies, new technologies are also being developed that may reduce the capital and/or operational costs of sulfur removal. Thus, we believe that allowing small refiners some additional time for newer technologies to be proven out by other refiners would have the added benefit of reducing the risks faced by small refiners. The added time would likely allow for lower costs of these improvements in desulfurization technology (e.g., better catalyst technology or lower-pressure hydrotreater technology). This would help to offset the disproportionate financial burden facing small refiners.

Third, providing small refiners more time to comply would increase the availability of engineering and construction resources. Most refiners would need to install additional processing equipment to meet the nonroad diesel sulfur requirements. We anticipate that there may be significant competition for technology services, engineering resources, and construction management and labor. In addition, vendors will be more likely to contract their services with the larger refiners first, as their projects will offer larger profits for the vendors. Temporarily delaying compliance for small refiners would spread out the demand for these resources and probably reduce any cost premiums caused by limited supply.

We discuss below the provisions we are proposing to minimize the degree of hardship for small refiners. We believe these provisions would enable us to go forward with the 500 ppm sulfur standard for NRLM diesel fuel in 2007 and the 15 ppm sulfur standard for nonroad diesel fuel in 2010 for the rest of the industry. Without small refiner flexibility, EPA would have to consider delaying the overall program until the disproportionate burden of the program on many small refiners were diminished, also delaying the air quality benefits of the overall program. By providing temporary relief to small refiners, we are able to adopt a program that expeditiously reduces nonroad diesel sulfur levels in a feasible manner for the industry as a whole.

iii. Limited Impact of Small Refiner Options on Program Emissions Benefits

Small refiners that choose to make use of the proposed delayed nonroad diesel sulfur requirements would also delay the emission reductions that they would otherwise have achieved. However, we believe that the overall impact of these postponed emission reductions would be small, for several reasons.

First, small refiners represent only a fraction of national nonroad diesel production. Today, refiners that we expect would qualify as small refiners represent only about 6 percent of all high-sulfur diesel production. Second, the proposed delayed compliance provisions described below would affect only engines without new emission controls. During the first (500 ppm) step, the new controls would not yet be required, but small refiner nonroad fuel could be well above 500 ppm. During the second (15 ppm) step, equipment with the new controls would be entering the market, but 500 ppm small refiner fuel would be restricted only to older engines without the new controls. Thus, there would be some loss of sulfate PM control in engines without new controls that operated on higher sulfur small refiner fuel, but no effect on the major emission reductions that the proposed new engine standards would achieve starting in 2011. Finally, because small nonroad diesel refiners are generally dispersed geographically across the country, the limited loss of sulfate PM control would also be dispersed.

One proposed small refiner option discussed below would allow a modest (20%) relaxation in the gasoline sulfur interim small refiner standards for small refiners that take the step of producing all nonroad fuel at 15 ppm by June 1, 2006. To the extent that small refiners elected this option, a small loss of emission control from Tier 2 gasoline vehicles that used the fuel could occur. We believe that such a loss of control would be very small. A very few small refiners would be in a position to use this provision. Further, the relatively small production of gasoline with slightly higher sulfur levels should have no measurable impact on the emission of new Tier 2 vehicles, even if the likely "blending down" of sulfur levels as this fuel mixed with lower sulfur fuel during distribution were not to occur. This provision would also maintain the maximum 450 ppm gasoline sulfur per-gallon cap standard in all cases, providing a reasonable sulfur ceiling for any small refiners making use of this provision.

b. How Do We Define Small Refiners?

The following definition of small refiner for the proposed nonroad diesel program is basically the same as our small refiner definitions in the Tier 2/Gasoline Sulfur and Highway Diesel rules. We define a refiner that demonstrates that it meets both of the following criteria as a "small refiner" for purposes of this rule:

- No more than 1,500 employees corporate-wide, based on the average number of employees for all pay periods from January 1, 2002 to January 1, 2003.

- A corporate crude oil capacity less than or equal to 155,000 barrels per calendar day (bpcd) for 2002.

As with the earlier fuel sulfur programs, the dates for the employee count and for calculation of the crude capacity represent the latest complete years prior to the issuing of the proposed rule.

In determining the total number of employees and crude oil capacity, a refiner must include the number of employees and crude oil capacity of any subsidiary companies, any parent company and subsidiaries of the parent company, and any joint venture partners. We define a subsidiary of a company to mean any subsidiary in which the company has a 50 percent or greater ownership interest. However, we are proposing that a refiner be eligible for small refiner status if it is owned and controlled by an Alaska Regional or Village Corporation organized under the Alaska Native Claims Settlement Act (43 U.S.C. 1626), regardless of number of employees and crude oil capacity. Such an exclusion would be consistent with our desire to grant relief from regulatory burden to that part of the industry that can least afford compliance, and would also be consistent with the definition of "small business" under the Small Business Administration rules at (xx CFR 121.103(b)). We believe that very few refiners, probably only one, would qualify under this provision. Similarly, we are proposing to incorporate this exclusion into the small refiner provisions of the highway diesel and gasoline sulfur rules, which did not address this issue.

As with the earlier fuel sulfur rules, we are proposing that a refiner that restarts a refinery in the future may be eligible for small refiner status. Thus, a refiner restarting a refinery that was shut down or non-operational between January 1, 2002 and January 1, 2003 could apply for small refiner status. In such cases, we would judge eligibility under the employment and crude oil capacity criteria based on the most recent 12 consecutive months unless data provided by the refiner indicates that another period of time is more appropriate. Companies with refineries built after January 1, 2002 would not eligible for the small refiner hardship provisions.

If a refiner with approved small refiner status later exceeds the small refiner criteria for either employee count or crude capacity through merger or acquisition, we propose that its refineries must forfeit their small refiner status and begin complying with the applicable non-small refiner standards within 18 months of the event that caused the refiner to exceed the small refiner criteria. For example, if a small refiner purchased another refinery on September 1 of 2008 and that purchase caused the refiner to exceed either the employee or corporate crude oil capacity thresholds for small refiner status, then that refiner would forego its small refiner status and begin complying with the 500 ppm standard by March 1, 2010 (and the 15 ppm standard by June 1, 2010) at all its refineries.

If a refiner with approved small refiner status were later to exceed the 1,500 employee threshold or the corporate crude oil capacity of 155,000 bpcd without merger or acquisition, we propose that it would keep its small refiner status. This would avoid stifling normal company growth and is subject to our finding that the company did not apply for and receive the small refiner status in bad faith.

Several refiners have raised to EPA the concern that a large refiner (i.e., non-small refiner) that acquires a small refinery should have some "grace period" of additional lead time to remain at the small refiner standards. These refiners have claimed that, without such additional lead time, they would not be able to put in place the capital improvements necessary to comply with the base fuel program (i.e., the non-small refiner standards), and thus would not be able to comply with the base program standards upon acquisition of the new refinery. These refiners further claim that the lack of such a provision is a significant disincentive to purchasing a small refinery and, as a result, some small refineries may be forced to shut down if they cannot attract potential buyers. While this issue primarily has been raised thus far in the context of the gasoline sulfur program, it has relevance to the nonroad program as well.

In light of these expressed concerns, we are seeking comments on whether the nonroad diesel program should provide a limited period of lead time for a new, large refiner owner of a former, approved small refinery to remain at the small refiner standards. For example, we believe that 18 months generally should be a sufficient amount of time for the new large refiner owner to complete any necessary construction to meet the non-small refiner standards. Under this scenario, if the acquired (formerly small) refinery did not already meet the base nonroad, marine and locomotive diesel standards of 500 ppm (by June 1, 2007) or nonroad diesel standard of 15 ppm (by June 1, 2010), the refiner would have up to 18 months from the time the acquisition was completed to make the capital upgrades needed to meet the base program (non-small refiner) standards. During this 18 months, the nonroad diesel sulfur level that existed at the former small refinery at the time of purchase could be maintained by the new owner. All existing provisions and restrictions applying to small refiners would also remain in place during this time period, including that refinery's volume limitation on the amount of nonroad diesel that can be produced at the small refiner standards.

The appropriate length of lead time may be dependent on several case-by-case factors, such as the former small refinery's existing nonroad diesel sulfur level, the extent of equipment modifications necessary to meet the base program sulfur standards, whether the small refiner had already received any necessary permits, etc. We seek comment on what the appropriate amount of lead time should be for a new large refiner owner to remain at the small refiner standards for such a newly acquired small refinery. We also seek comment on whether EPA should allow a new refiner owner to apply on a case-by-case basis for additional time if a refiner believed that 18 months was insufficient time for it to complete the capital upgrades needed to meet the base program standards, based on specific technical challenges facing that refiner. Finally, we seek comment on whether there are any measures that could be taken between the selling (small) refinery and potential (large refiner) buyer to ensure compliance with the base program standards could be achieved upon acquisition, thus avoiding the need for this additional lead time provision.

c. What Options Are Available for Small Refiners?

We propose several provisions intended to reduce the disproportionate burdens on small refiners discussed above as well as to encourage their early compliance whenever possible. As described below, these proposed small refiner provisions consist of additional time for compliance and, for small refiners that choose to comply earlier than required, the option of either generating diesel sulfur credits or receiving a limited relaxation of gasoline sulfur requirements.

i. Delays in Nonroad Fuel Sulfur Standards for Small Refiners

We propose that small refiners be allowed to postpone reducing sulfur in nonroad diesel fuel as well as in locomotive and marine fuel until June 1, 2010. As described earlier, we are proposing that all refiners producing nonroad diesel fuel be provided significant lead time for making the capital and operational investments to produce 15 ppm fuel, including about 3 years before any requirements would become effective and 3 additional years before 15 ppm was required (June 1, 2007 through May 31, 2010, when 500 ppm fuel could be produced). While this leadtime would be useful for small and non-small refiners alike, we believe that in general small refiners would still face disproportionate challenges, and the proposed delay in the first step of control for small refiners would help mitigate these challenges.

Then, beginning June 1, 2010, when the second step of the proposed base program would require 15 ppm fuel for other refiners for nonroad fuel, we propose that small refiners be required to meet a 500 ppm sulfur standard for NRLM diesel fuel. We propose that this interim standard be effective for four years (until June 1, 2014), after which small refiners would meet the 15 ppm sulfur standard for nonroad fuel. (As for other refiners, the standard for locomotive and marine diesel fuel would remain at 500 ppm.) Since new engines with sulfur sensitive emission controls would begin to become widespread during this time, small refiners would need to segregate the 500 ppm fuel and supply it only for use in pre-2010 nonroad equipment or in locomotives or marine engines. Section VIII below discusses the requirements for product transfer documents (PTDs) associated with the production of 500 ppm nonroad fuel by small refiners during this period.

The following figure illustrates the proposed small refiner nonroad diesel standards as compared to the standards proposed in the base nonroad diesel program. (For simplicity, the proposed locomotive and marine diesel standards for small and non-small refiners described above do not appear in the table.)

FIGURE IV-3 – PROPOSED SMALL REFINER NONROAD DIESEL SULFUR STANDARDS, PPM [a]

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015+
Non-Small Refiners	--	500	500	500	15	15	15	15	15	15
Small Refiners	**--**	**--**	**--**	**--**	**500**	**500**	**500**	**500**	**15**	**15**

[a] New standards would take effect in June of the applicable year.

We also request comment on a slightly different compliance schedule that would require small refiners to produce 15 ppm nonroad diesel fuel beginning June 1, 2013, one year earlier than proposed above. Such a schedule would align the end of the interim small refiner provisions with the end of the proposed phase-in for nonroad engines and equipment and eliminate higher sulfur nonroad fuel from the distribution system by the time all new engines required 15 ppm fuel.

This proposed delayed compliance schedule for small refiners is intended to compensate for the relatively high compliance burdens on these refiners. It is not intended as an opportunity for those refiners to greatly expand their production of uncontrolled diesel fuel (2007-2010) or 500 ppm sulfur fuel (2010-2014). To help ensure that any significant expansion of refining capacity that a small refiner might undertake in the future would be accompanied by an expansion of desulfurization capacity, we are proposing that small refiners choosing to produce higher sulfur fuel limit that production to baseline volume levels.

Specifically, during the first (500 ppm) step of the nonroad diesel program, a small refiner could produce uncontrolled nonroad diesel fuel up to the proposed non-highway baseline for that refiner less any marked heating oil they produce (refer to sub-section B for an explanation of this baseline). Any fuel produced over their non-highway baseline would be subject to the 500 ppm standard applying to other refiners. Similarly, from June 1, 2010 through May 31, 2014, a small refiner could produce nonroad diesel fuel at 500 ppm up to the non-highway baseline less any volume of heating oil and marked locomotive and marine diesel fuel they produce. Fuel produced in excess of this volume would be subject to the 15 ppm standard.

As with the highway diesel program, we propose that all refiners producing nonroad diesel fuel be required to provide EPA with basic data on their progress toward compliance in the years leading up to the 500 ppm and 15 ppm requirements. Because the compliance requirements for small refiners are somewhat different than for other refiners, we are proposing slightly different pre-compliance reporting for small refiners. We discuss the pre-compliance reporting requirements Section VIII below.

ii. Options to Encourage Earlier Compliance by Small Refiners

Some small refiners have indicated that they might find it necessary to produce fuel meeting the nonroad diesel sulfur standards earlier than they would be required to under the small refiner program described above, for a variety of reasons. Some small refiners could find that their distribution systems limit the number of grades of diesel fuel that will be carried. Others might find it economically advantageous to make 500 ppm or 15 ppm fuel earlier so as not to lose market share. At least one small refiner has indicated that it could decide to desulfurize its NR pool at the same time as it desulfurized its highway diesel fuel, in June of 2006 (due to limitations in the their distribution system and to take advantage of economies of scale). Given these situations, we propose that small refiners be able to choose between two mutually exclusive options to provide incentives for early compliance, as described below.

The first proposed option is to make the proposed nonroad diesel sulfur credit banking, and trading program discussed earlier in this section fully applicable to small refiners. A small refiner could generate NRLM diesel sulfur credits for production of 500 ppm NRLM diesel fuel prior to June 1, 2010, and for production of 15 ppm nonroad fuel from June 1, 2010 through May 31, 2012. The specifics of the credit program are described above in subsection B.3, including how they would be applicable to small refiners. Thus, generating and selling credits could provide funds to defray the costs of early nonroad compliance.

The proposed second option would apply to a small refiner that produced all of its NRLM diesel production at 15 ppm by June 1, 2006 and elected not to use the provision described above to earn NRLM sulfur credits for this early compliance. (As for other refiners, locomotive and marine fuel sulfur would not be controlled in 2006 and could meet the 500 ppm standard beginning June 1, 2007.) Such a refiner could receive a modest revision in its small refiner gasoline sulfur interim sulfur standards, starting January 1, 2004. Specifically, the applicable small refiner annual average and per-gallon cap gasoline standards would be revised upward by

20 percent for the duration of the small refiner gasoline sulfur interim program (i.e., through either 2007 or 2010, depending on whether the refiner had extended its participation in the gasoline sulfur interim program by complying with the highway diesel standard at the beginning of that program (June, 2006, as provided in 40 CFR 80.552(c))). However, in no case could the per-gallon cap exceed 450 ppm, the highest level allowed under the gasoline sulfur program.

We believe it is very important to link any such temporary relaxation of a small refiner gasoline sulfur interim sulfur standards with environmental benefit of early desulfurization of a significant volume of nonroad diesel fuel. Thus, we propose that a small refiner wishing to use this option produce a minimum volume of nonroad diesel fuel at 15 ppm by June 1, 2006. Each participating small refiner would need to produce a volume of 15 ppm fuel that was at least 85% of the average total volume of nonroad diesel fuel that it produced in calendar years 2001 and 2002. If the refiner began to produce gasoline in 2004 at the higher interim standard of this provision but then either failed to meet the 15 ppm standard for its nonroad fuel or failed to meet the 85% minimum volume requirement, the original small refiner interim gasoline sulfur standard applicable to that refiner would be reinstated. In addition, the refiner would need to compensate for the higher gasoline levels that it had enjoyed by purchasing gasoline sulfur credits or producing gasoline at lower than required sulfur levels. These compensation provisions are discussed further in Section VIII below.

Under this option, a small refiner could in effect shift some funds from its gasoline sulfur program to accelerate desulfurization of nonroad diesel fuel. Given the environmental benefit that would result from the production of 15 ppm fuel earlier than necessary, and the small potential loss of emission reduction under the gasoline sulfur program from fuel produced by the very few small refiners that we believe would qualify under this second option, we believe the environmental impact of this option would be neutral or positive.

d. How Do Refiners Apply for Small Refiner Status?

We proposed that an application of a refiner for small refiner status be submitted to EPA by June 1, 2005 and include the following information:

- The name and address of each location at which any employee of the company, including any parent companies or subsidiaries,[213] worked during the 12 months preceding January 1, 2003;

- The average number of employees at each location, based on the number of employees for each of the company's pay periods for the 12 months preceding January 1, 2003;

[213] "Subsidiary" here covers entities of which the parent company has 50 percent or greater ownership.

- The type of business activities carried out at each location; and

- The total crude oil refining capacity of the corporation. We define total capacity as the sum of all individual refinery capacities for multiple-refinery companies, including any and all subsidiaries, as reported to the Energy Information Administration (EIA) for 2002, or in the case of a foreign refiner, a comparable reputable source, such as professional publication or trade journal[214]. Refiners do not need to include crude oil capacity used in 2002 through a lease agreement with another refiner in which it has no ownership interest.

The crude oil capacity information reported to the EIA or comparable reputable source is presumed to be correct. However, in cases where a company disputes this information, we propose to allow 60 days after the company submits its application for small refiner status for that company to petition us with detailed data it believes shows that the EIA or other source's data was in error. We would consider this data in making a final determination about the refiner's crude oil capacity.

2. General Hardship Provisions

a. Temporary Waivers from Nonroad Diesel Sulfur Requirements in Extreme Unforseen Circumstances

We are proposing a provision which, at our discretion, would permit any domestic or foreign refiner to seek a temporary waiver from the nonroad, locomotive, or marine diesel sulfur standards under certain rare circumstances. This waiver provision is similar to provisions in the reformulated gasoline (RFG), low sulfur gasoline, and highway diesel sulfur regulations. It is intended to provide refiners short-term relief in unanticipated circumstances–such as a refinery fire or a natural disaster–that cannot be reasonably foreseen now or in the near future.

Under this provision, a refiner may seek permission to distribute nonroad, locomotive, or marine diesel fuel that does not meet the applicable 500 or 15 ppm sulfur standards for a brief time period. An approved waiver of this type could, for example, allow a refiner to produce and distribute diesel fuel with higher than allowed sulfur levels, so long as the other conditions described below were met. Such a request would be based on the refiner's inability to produce complying nonroad, locomotive or marine diesel fuel because of extreme and unusual circumstances outside the refiner's control that could not have been avoided through the exercise of due diligence. The request would also need to show that other avenues for mitigating the problem, such as purchase of credits toward compliance under the proposed credit provisions, had been pursued and yet were insufficient. As with other types of relief established in this rule,

[214] We will evaluate each foreign refiner's documentation of crude oil capacity on an individual basis.

this type of temporary waiver would have to be designed to prevent fuel exceeding the 15 ppm standard from being used in 2011 and later nonroad engines.

The conditions for obtaining a nonroad diesel waiver are similar to those in the RFG, Tier 2 gasoline sulfur, and highway diesel regulations. These conditions are necessary and appropriate to ensure that any waivers that are granted are limited in scope, and that refiners do not gain economic benefits from a waiver. Therefore, refiners seeking a waiver must show that the waiver is in the public interest, that the refiner was not able to avoid the nonconformity, that it would make up the air quality detriment associated with the waiver, that it would make up any economic benefit from the waiver, and that it would meet the applicable diesel sulfur standards as expeditiously as possible.

b. Temporary Waivers Based on Extreme Hardship Circumstances

In addition to the provision for short-term relief in extreme unforseen circumstances, we are proposing a provision for relief based on extreme hardship circumstances that is very similar to those established in the gasoline sulfur and highway diesel sulfur programs. Under the gasoline sulfur program, we granted waivers to four refiners. Each waiver was designed for the specific situation of that refiner. (Under the highway diesel program, we have received two applications on which action by EPA is still pending).

As in the earlier rules, we have considered whether any refiners would face particular difficulty in complying with the standards in the lead time provided. As described earlier in this section, we concluded that in general small refiners would experience more difficulty in complying with the standards on time because they have less ability to raise the capital necessary for refinery investments, face proportionately higher costs because of poorer economies of scale, and are less able to successfully compete for limited engineering and construction resources. However, it is possible that other refiners that are not small refiners would also face particular difficulty in complying with the sulfur standards on time. Therefore, we are including in this proposed rule a provision which allows us, at our discretion, to grant temporary waivers from the proposed nonroad diesel sulfur standards based on a showing of extreme hardship circumstances.

The extreme hardship provision allows any domestic or foreign refiner to request a waiver from the sulfur standards based on a showing of unusual circumstances that result in extreme hardship and significantly affect a refiner's ability to comply with either the 500 ppm or 15 ppm sulfur diesel standards by either June 1, 2007 or June 1, 2010, respectively. EPA would evaluate each application on a case-by-case basis, considering the factors described below. If EPA approved a hardship application, we could provide refiners with provisions similar to those for small refiners (e.g., we may provide an allowance for producing high sulfur fuel during the period the 500 ppm cap is in effect, or produce 500 ppm fuel (for sale only for use in pre-2011 nonroad engines) for a period of time after June 1, 2010.) In such an approval, we might impose appropriate conditions to assure the refiner is making its best effort and to minimize any loss of emission control. As with other relief provisions established in this rule, any waiver under this provision would be designed to prevent fuel exceeding the 15 ppm standard from being used in 2011 and later nonroad engines.

Providing short-term relief to those refiners that need additional time because they face hardship circumstances facilitates adoption of an overall program that reduces NRLM diesel fuel sulfur to 500 ppm beginning in 2007, and nonroad diesel fuel sulfur to 15 ppm in 2010, for the majority of the industry. However, we do not intend for this waiver provision to encourage refiners to delay planning and investments they would otherwise make. We do not expect to grant temporary waivers that apply to more than approximately one percent of the national NRLM diesel fuel pool in any given year.

The regulatory language for today's action includes a complete list of the information that must be included in a refiner's application for an extreme hardship waiver. If a refiner fails to provide all the information, as specified in the regulations, as part of its hardship application, we can deem the application void. The following are some examples of the types of information that must be contained in an application:

- The crude oil refining capacity and fuel sulfur level(s) of each diesel fuel product at each of the refiner's refineries.
- Technical plan for capital equipment and operating changes to achieve future diesel fuel sulfur levels.
- The anticipated timing for the overall project the refiner is proposing and key milestones to ultimately produce 100 percent of NRLM diesel fuel at 500 ppm sulfur and 100 percent of its nonroad diesel fuel at 15 ppm sulfur.
- The refiner's capital requirements for each step of the proposed projects.
- Detailed plans for financing the project and financial statements demonstrating the nature of and degree of financial hardship and how the requested relief would mitigate this hardship. This would include a description of the overall financial situation of the company and its plans to secure financing for the desulfurization project (e.g., internal cash flow, bank loans, issuing of bonds, sale of assets, or sale of stock).
- Description of the market area for the refiner's diesel fuel products.
- A plan demonstrating how they would achieve the standards as quickly as possible, including a timetable for obtaining the necessary capital, contracting for engineering and construction resources, obtaining any necessary permits, and beginning and completing construction.

We would consider several factors in our evaluation of the hardship waiver applications. Such factors would include whether a refinery's configuration is unique or atypical; the proportion of nonroad diesel fuel production relative to other refinery products; whether the refiner, its parent company, and its subsidiaries are faced with severe economic limitations (for example, a demonstrated inability to raise necessary capital or an unfavorable bond rating); steps the refiner has taken to attempt to comply with the standards, including efforts to obtain credits towards compliance. In addition, we would consider the total crude oil capacity of the refinery and its parent or subsidiary corporations, if any, in assessing the degree of hardship and the refiner's role in the diesel market. Finally, we would consider where the diesel fuel would be sold in evaluating the environmental impacts of granting a waiver.

This extreme hardship provision is intended to address unusual circumstances that should be apparent now or would emerge in the near future. Thus, refiners seeking additional time under this provision would have to apply for relief by June 1, 2005. (We request comment on this date and whether a separate date would be appropriate for the second (15 ppm) step of the nonroad diesel program.) We would review and act on applications and, if a waiver is granted, would specify a detailed desulfurization schedule under the waiver. Typically, because of EPA's comprehensive evaluation both financial and technical information, action on hardship applications can take six or more months.

D. Should Any Individual States or Territories Be Excluded From This Rule?

1. Alaska

We propose that low sulfur diesel fuel standards proposed today (500 ppm cap for NRLM diesel fuel beginning June 1, 2007 and a 15 ppm cap for the nonroad portion beginning June 1, 2010) apply to the portion of Alaska served by the Federal Aid Highway System. However, we propose that Alaska's rural areas be excluded from these proposed fuel standards. The engine standards proposed today would apply to all nonroad engines throughout Alaska. Consequently, even in rural Alaska we would still require 2011 and later model year nonroad diesel engines and equipment to be fueled with 15 ppm diesel fuel. The rationale supporting this proposal follows.

a. How Was Alaska Treated Under the Highway Diesel Standards?

Unlike the rest of the nation, Alaska is currently exempt from the 500 ppm sulfur standard for highway diesel fuel and dye requirements for diesel fuel not meeting this standard. Since the beginning of the 500 ppm highway diesel fuel program, we have granted Alaska exemptions from meeting the sulfur standard and dye requirements because of its unique geographical, meteorological, air quality, and economic factors.[215]

On December 12, 1995, Alaska submitted a petition for a permanent exemption for all areas of the state served by the Federal Aid Highway System, that is, those areas covered only by the temporary exemption. While considering that petition, we started work on a nationwide rule

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[215] Copies of information regarding Alaska's petition for exemption, subsequent requests by Alaska, public comments received, and actions by EPA are available in public docket A–96–26.

to consider more stringent highway diesel fuel requirements, particularly for the sulfur content. In the subsequent January 18, 2001 highway diesel sulfur rule (66 FR 5002) the highway engine emission standards were applied fully in Alaska, but because of factors unique to Alaska, we provided the State with: 1) an extension of the current exemption from the 500 ppm sulfur highway diesel fuel standard until the effective date of the new 15 ppm sulfur highway diesel fuel standard in 2006, 2) an opportunity to request an alternative implementation plan for the 15 ppm sulfur diesel fuel program, and 3) a permanent exemption from the diesel fuel dye requirement.

In response to the flexibility we provided in our January 18, 2001 highway rule, Alaska informed us that areas served by the Federal Aid Highway System (i.e., communities on the connected road system or served by the Alaska State ferry system) will follow the nationwide requirements. Diesel fuel produced by refineries in for use in areas of Alaska served by the Federal Aid Highway System will therefore be required to meet the final rule requirements for production of 80% of their highway diesel fuel to the 15 ppm standard, with the remainder allowed to be produced to the 500 ppm standard. For the rural parts of the State, that not served by the Federal Aid Highway System, they informed us that they will submit by mid-2003 the details for an alternative implementation approach.[216] Preliminary discussions with the State indicate this plan may recommend not applying the 15 ppm or 500 ppm standards to this part of the State. Rather, 15 ppm fuel would be provided on demand as 2007 or later model year diesel highway vehicles enter the fleet in these remote areas. Since the vehicle turnover rate in the rural villages is typically very low, and many of the replacement vehicles are typically pre-owned vehicles (i.e., not new vehicles), some villages may not obtain their first 2007 or later model year diesel highway vehicle until long after 2010, possible after 2020.

b. What Nonroad Standards Do We Propose for Urban Areas of Alaska?

Since Alaska is currently exempt from the 500 ppm sulfur highway standard, we also considered exempting Alaska from the 500 ppm step of today's proposed fuel standards. However, despite the exemption, officials from the State of Alaska have informed us that 500 ppm highway diesel fuel is nevertheless being marketed in many parts of Alaska. Market forces have been bringing the prices down for 500 ppm fuel such that it is now becoming competitive with higher sulfur, uncontrolled diesel fuel. Consequently, assuming this trend continues, requiring that NRLM diesel fuel be produced to 500 ppm beginning June 1, 2007 would not appear to be unduly burdensome and for this reason, we propose that this standard apply.

At the same time, our expectation is that in order to comply with the highway program described above, may result in the transition of some or all of the highway diesel fuel distribution

[216] Letter and attached document to Jeffrey Holmstead of EPA from Michele Brown of the Alaska Department of Environmental Conservation, dated April 1, 2002. The communities on the connected road system or served by the Alaska State ferry system are listed in the attached document.

system beginning in 2006 to 15 ppm. It could prove very challenging for the distribution system in some of the areas to segregate a 500 ppm grade of fuel for NRLM purposes from a 15 ppm grade for highway and an uncontrolled grade for other purposes. We believe economics would determine whether the distribution system would handle the new grade of fuel or substitute 15 ppm sulfur diesel fuel for nonroad applications. Thus, in the 2007 to 2010 time frame, the nonroad market in some urban areas might be supplied with 500 ppm sulfur diesel, and in other areas might be supplied with 15 ppm sulfur diesel.

Regardless of what takes place prior to 2010, however, we anticipate that 15 ppm diesel fuel will be made available in Alaska by this time frame. The 2007 and later model year fleet will be growing, demanding more and more supply of 15 ppm diesel fuel. Adding nonroad volume to this would not appear to create any undue burden. Thus, we also propose that the 15 ppm standard for nonroad diesel fuel would apply in Alaska, along with the rest of the Nation beginning June 1, 2010. We seek comment on whether the 500 ppm NRLM diesel standard should apply to urban Alaska beginning June 1, 2007 and whether the 15 ppm nonroad standard should apply beginning June 1, 2010..

c. What Do We Propose for Rural Areas of Alaska?

Rural Alaska represents a rather unique situation. In the rural areas, the state estimates that the heating oil uses represent approximately 95% of all distillate consumption (about 50% for heating and 45% for electricity generation). Highway vehicles account for about 1 percent, and marine engines about 4 percent.[217] Consequently, except for marine engines, nonroad engines and equipment consume a negligible amount of diesel fuel in the rural areas. The fuel storage infrastructure in the villages generally consists of a limited number of small community storage tanks. The fuel must last during the entire winter season when fuel deliveries may not be possible. There is currently only one distillate fuel that is delivered and stored for all distillate purposes in the villages, including home heating, power generation, vehicles, and nonroad engines and equipment. Modifications to permit the segregation of small amounts of low sulfur distillate fuel for highway and/or nonroad use or switching to low sulfur fuel for all purposes would be an economic hardship for the villages.

Furthermore, as discussed above, for areas not served by the Federal Aid Highway System, the State of Alaska is considering not applying the 15 ppm and 500 ppm highway standards. Rather, the 15 ppm fuel would be required of, and provided based on demand to 2007 and later model year vehicles that must be operated on 15 ppm fuel as they enter the fleet. If this highway plan is finalized and EPA subsequently incorporates it into the regulations, today's proposed nonroad low-sulfur diesel fuel program, without similar provisions, would require low-sulfur diesel fuel (500 ppm sulfur) solely for the nonroad market in rural areas beginning June 1,

[217] Email from the Alaska Department of Environmental Conservation, dated July 2, 2002

2007 and 15 ppm beginning June 1, 2010. Since the demand for new nonroad engines and equipment with aftertreatment (2011 and later) is expected to be nonexistent or very low in the early years in rural Alaska, we believe the best approach is to propose no low sulfur requirements for rural Alaska at this time. EPA can revisit this when it receives and takes action on Alaska's highway implementation plan. This will allow for coordination between the highway and nonroad fuel requirements. As proposed, this would allow rural Alaska to limit the volume of 15 ppm sulfur diesel fuel to that which is sufficient to meet the demand from the small number of new nonroad diesel engines and equipment that would be certified to the Tier 4 nonroad standards proposed today beginning with the 2011 model year.

Our goal in proposing this approach is to allow rural Alaska to transition to the low sulfur fuel program in a manner that minimizes costs while still ensuring that the 2011 and later nonroad engines and equipment with aftertreatment receive the low sulfur fuel they need. Similar to the flexibility being considered under the highway low-sulfur program, the flexibility offered by the proposed nonroad low-sulfur program would likely result in a delay of some sulfate emission reduction benefits in the rural areas of Alaska. The sulfate emissions of nonroad engines and equipment in Alaska would remain at current levels for as long as high-sulfur diesel fuel is used.

2. American Samoa, Guam, and the Commonwealth of Northern Mariana Islands

a. What Provisions Apply in American Samoa, Guam, and the Commonwealth of Northern Mariana Islands?

We are proposing to exclude American Samoa, Guam and the Commonwealth of the Northern Mariana Islands from the proposed nonroad diesel fuel sulfur requirement of 500 ppm sulfur in 2007 and 15 ppm in 2010 and the proposed nonroad vehicle, engine and equipment emissions standards to be effective in 2011, and other requirements associated with those emission standards. The territories will continue to have access to new nonroad diesel engine and equipment using 2010 technologies, at least as long as manufacturers choose to market those technologies. We will not allow the emissions control technology in the territories to backslide from those available in 2010. If, in the future, manufacturers choose to market only nonroad diesel engines and equipment with 2011 and later emission control technologies, we believe the market will determine if and when the territories will make the investment needed to obtain and distribute the low sulfur diesel fuel necessary to support these technologies.

We are also proposing to require all nonroad diesel vehicles, engines and equipment for these territories be certified and labeled to the applicable requirements - either to the 2010 model year standards and associated requirements under this proposed exclusion, or to the 2011 and later standards and associated requirements applicable for the model year of production under the nationwide requirements of this proposal - and warranted, as otherwise required under the Clean Air Act and EPA regulations. Special recall and warranty considerations due to the use of excluded high sulfur fuel are the same as those for Alaska during its exemption and transition periods for highway diesel fuel and for these territories for highway diesel fuel (see 66 FR 5086, 5088, January 18, 2001).

To protect against this exclusion being used to circumvent the emission requirements applicable to the rest of the United States (i.e., continental United States, Alaska, Hawaii, Puerto Rico and the U.S. Virgin Islands) after 2010 by routing exempted (pre-2011 technology) vehicles and engines through one of these territories, we are restricting the importation of nonroad vehicles, engines and equipment from these territories into the rest of the United States. After the 2010 model year, nonroad diesel vehicles, engines and equipment certified under this exclusion to meet the 2010 model year emission standards for sale in American Samoa, Guam and the Commonwealth of the Northern Mariana Islands will not be permitted entry into the rest of the United States.

b. Why Are We Treating These Territories Uniquely?

Like Alaska, these territories are currently exempt from the 500 ppm sulfur standard for highway diesel fuel. Unlike Alaska and the rest of the nation, they are also exempt from the new highway diesel fuel standard effective in 2006 and the new highway vehicle and engine emission standards effective beginning in 2007 (see 66 FR 5088, January 18, 2001).

Section 325 of the CAA provides that upon request of Guam, American Samoa, the Virgin Islands, or the Commonwealth of the Northern Mariana Islands, we may exempt any person or source, or class of persons or sources, in that territory from any requirement of the CAA, with some specific exceptions. The requested exemption could be granted if we determine that compliance with such requirement is not feasible or is unreasonable due to unique geographical, meteorological, or economic factors of the territory, or other local factors as we consider significant. Prior to the effective date of the current highway diesel sulfur standard of 500 ppm, the territories of American Samoa, Guam and the Commonwealth of Northern Mariana Islands petitioned us for an exemption under section 325 of the CAA from the sulfur requirement under section 211(i) of the CAA and associated regulations at 40 CFR 80.29. We subsequently granted the petitions[218]. We recently determined that the 2007 heavy-duty emission standards and 2006 diesel fuel sulfur standard of our January 18, 2001 highway rule (66 FR 5088) would not apply to these territories.

Compliance with today's proposal would result in major economic burden. All three of these territories lack internal petroleum supplies and refining capabilities and rely on long distance imports. Given their remote location from Hawaii and the U.S. mainland, most

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[218] See 57 FR 32010, July 20, 1992 for American Samoa; 57 FR 32010, July 30, 1992 for Guam; and 59 FR 26129, May 19, 1994 for CNMI.

petroleum products are imported from East rim nations, particularly Singapore. Although Australia, the Philippines, and certain other Asian countries have or will soon require low sulfur diesel fuel, their sulfur limit is 500 ppm, not the new 15 ppm sulfur limit established for highway diesel fuel by the January 18, 2001 highway rule or today's proposal for nonroad diesel fuel beginning in 2010 for the United States. Compliance with new 15 ppm sulfur requirements for highway diesel fuel beginning in 2006 and the proposed 15 ppm sulfur requirements for nonroad diesel fuel beginning in 2010 (or the proposed 500 ppm sulfur requirements for NRLM diesel fuel beginning 2007) would require construction of separate storage and handling facilities for a unique grade of diesel fuel for highway and nonroad purposes, or use of 15 ppm diesel fuel for all purposes to avoid segregation. Either of these alternatives would require importation of 500 and 15 ppm sulfur diesel fuel from Hawaii or the U.S. mainland, and would significantly add to the already high cost of diesel fuel in these territories, which rely heavily on United States support for their economies. At the same time, it is not clear that the environmental benefits in these areas would warrant this cost. Therefore, we are not proposing to apply the fuel and engine standards to these territories, but seek comment on this.

E. How Are State Diesel Fuel Programs Affected by the Sulfur Diesel Program?

Section 211(c)(4)(A) of the CAA prohibits states (and political subdivisions of states) from prescribing or attempting to enforce, for purposes of motor vehicle emission control, "any control or prohibition respecting any characteristic or component of a fuel or fuel additive in a motor vehicle or motor vehicle engine," if EPA has prescribed "a control or prohibition applicable to such characteristic or component of the fuel or fuel additive" under section 211(c)(1). This prohibition applies to all states except California, as explained in section 211(c)(4)(B). This express preemption provision in section 211(c)(4)(A) applies only to controls or prohibitions respecting any characteristics or components of fuels or fuel additives for motor vehicles or motor vehicle engines, that is, highway vehicles, and not to controls or prohibitions respecting any characteristics or components of fuels or fuel additives for nonroad engines or nonroad vehicles.[219]

Section 211(c)(4)(A) specifically mentions only controls respecting characteristics or components of fuel or fuel additives in a "motor vehicle or motor vehicle engine," adopted "for purposes of motor vehicle emissions control," and the definitions of motor vehicle and nonroad engines and vehicles in CAA section 216 are mutually exclusive. This is in contrast to section 211(a) and (b), which specifically mention application to fuels or fuel additives used in nonroad

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[219] See letter from Carl Edlund, Director, Multimedia Planning and Permitting Division, U.S. Environmental Protection Agency, Region VI, to Jeffrey Saitas, Executive Director, Texas Natural Resources Conservation Commission, dated September 25, 2000, providing comments on proposed revisions to the Texas State Implementation Plan for the control of ozone, specifically the Post 99 Rate of Progress Plan and Attainment Demonstration for the Houston/Galveston area. This letter noted that preemption under section 211(c)(4) did not apply to controls on nonroad diesel fuel.

engines or nonroad vehicles, and with section 211(c)(1) which refers to fuel used in motor vehicles or engines or nonroad engines or vehicles.

Thus, today's proposal would not preempt state controls or prohibitions respecting characteristics or components of fuel or fuel additives used in nonroad engines or nonroad vehicles under the provisions of section 211(c)(4)(A). At the same time, a state control that regulates both highway fuel and nonroad fuel is preempted to the extent the state control respects a characteristic or component of highway fuel regulated by EPA under section 211(c)(1).

A court could consider whether a state control for fuels or fuel additives used in nonroad engines or nonroad vehicles is implicitly preempted under the Supremacy Clause of the U.S. Constitution. Courts have determined that a state law is preempted by federal law where the state requirement actually conflicts with federal law by preventing compliance with the federal requirement, or by standing as an obstacle to accomplishment of Congressional objectives. A court could thus consider whether a given state standard for sulfur in nonroad, locomotive or marine diesel fuel is preempted if it places such significant cost and investment burdens on refiners that refiners cannot meet both state and federal requirements in time, or if the state control would otherwise meet the criteria for conflict preemption.

F. Technological Feasibility of the 500 and 15 ppm sulfur Diesel Fuel Program

This section begins with a description of the nonroad, locomotive and marine diesel fuel market and how these fuels differ from current highway diesel fuel, whose sulfur content is already controlled to no more than 500 ppm sulfur. This section then summarizes our assessment of the feasibility of refining and distributing NRLM diesel fuel with a sulfur content of no more than 500 ppm and, for nonroad fuel only, 15 ppm. Based on this evaluation, we believe it is technologically feasible for refiners and distributors to meet both sulfur standards in the lead time provided. We are only summarizing our analysis here and we refer the reader to the Draft RIA for more details.

1. What is the Nonroad, Locomotive and Marine Diesel Fuel Market Today

Nonroad, locomotive and marine diesel fuel comprise part of what is generally called the number 2 distillate fuel market. Other fuels in this market are highway diesel fuel and heating oil which is used in furnaces and boilers as well as in stationary diesel engines to generate power (power generation fuel). Nonroad diesel fuel comprises about 15% of all number 2 distillate fuel, while locomotive and marine diesel fuel comprise about 9% of all number 2 distillate fuel (see Draft RIA).

ASTM defines three number 2 distillate fuels: 1) low sulfur No. 2-D (which includes the 500 ppm sulfur cap that EPA requires be met by fuel used in highway diesel vehicles), 2) high sulfur No. 2-D, and 3) No. 2 fuel oil.[220] Low sulfur No. 2-D fuel must contain no more than 500 ppm sulfur, have a minimum cetane number of 40, and have a minimum cetane index limit of 40 (or a maximum aromatic content of 35 volume percent). This fuel meets EPA's requirements for current highway diesel vehicle fuel. Both high sulfur No. 2-D and No. 2 fuel oil must contain no more than 5000 ppm sulfur.[221] The ASTM standards for high sulfur No. 2-D fuel also include a minimum cetane number specification of 40. Practically, since most No. 2 fuel oil (commonly referred to as heating oil) meets the minimum cetane number specification, pipelines which ship fuel fungibly need only carry one high sulfur number 2 distillate fuel which meets both sets of specifications. Nonroad, locomotive and marine engines can be and are fueled with both low and high sulfur No. 2-D fuels.

Eighty percent of highway diesel fuel, which comprises about 57% of all number 2 distillate fuel, will be capped at 15 ppm sulfur starting in 2006. However, because of limitations in the fuel distribution system and other factors, about one-third of non-highway, No. 2 distillate currently meets the 500 ppm highway diesel fuel cap. Thus, about 69 percent of number 2 distillate pool currently meets the 500 ppm sulfur cap, not just the 57 percent used in highway vehicles. The result is that about one-third of the 24% of the distillate market comprised by NRLM diesel fuel currently meets a 500 ppm specification and is also expected to meet the future highway diesel fuel requirements even without this proposed rule. Thus, while strictly speaking, this proposed rule would apply to all NRLM diesel fuel, the rule should only materially affect about two-thirds of all NRLM diesel fuel, or 16% of today's distillate market. EPA is not considering any national sulfur standards applicable to home heating fuel or power generation fuel at this time.

2. How Do Nonroad, Locomotive and Marine Diesel Fuel Differ from Highway Diesel Fuel?

Refiners blend together a variety of distillate blendstocks to produce both highway and non-highway diesel fuels. These distillate blendstocks always include straight run material contained in crude oil, plus often light cycle oil from a fluidized catalytic cracker, light coker gas oil from a coker and hydrocrackate from a hydrocracker. The actual mix of these blendstocks in highway and non-highway diesel fuel at refineries producing both fuels can differ. However, in general, significant quantities of all of these blendstocks find their way into both low sulfur and high sulfur diesel fuel today. A survey of distillate fuel quality conducted by API and NPRA in 1996 indicated the following feedstock composition for low sulfur diesel fuel and high sulfur diesel fuel and heating oil.

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[220] "Standard Specification for Diesel Fuel Oils," ASTM D 975-98b and "Standard Specification for Fuel Oils," ASTM D 396-98.

[221] Some states, particularly those in the Northeast, limit the sulfur content of No. 2 fuel oil to 2000-3000 ppm.

TABLE IV-3 – COMPOSITION OF LOW SULFUR DIESEL FUEL AND HIGH SULFUR DIESEL FUEL AND HEATING OIL: 1996 U.S. NON-CALIFORNIA AVERAGE OF SURVEYED REFINERS (VOLUME PERCENT)

Feedstocks	Low Sulfur Diesel Fuel	High Sulfur Diesel Fuel and Heating Oil [a]
Hydrotreated		
Straight Run Material	52	18
Light Cycle Oil	20	11
Light Coker Gas Oil	8	5
Hydrocrackate	4	9
Non-Hydrotreated		
Straight Run Material	12	45
Light Cycle Oil	3	11
Light Coker Gas Oil	1	1

[a] High sulfur diesel fuel refers to high sulfur number 2 distilate

The primary difference between low and high sulfur number 2 distillate fuels today is the fact that a greater volume percentage of low sulfur fuel feedstocks have been hydrotreated to meet the 500 ppm sulfur cap applicable to highway diesel fuel. As shown in the table above, high sulfur distillate fuels may contain significant amounts of hydrotreated material, but the final sulfur level of the blend is usually well above 500 ppm and currently averages 3400 ppm (see Draft RIA). Hydrotreating today typically involves combining diesel fuel with hydrogen and a catalyst under pressures of 400-1200 pounds per square inch and temperatures of roughly 600 degrees Fahrenheit. In general, the existence of the 500 ppm sulfur cap gives refiners an incentive to use low sulfur blendstocks, such as hydrocrackate and straight run in their low sulfur diesel fuel. However, some high sulfur blendstocks, such as light cycle oil and light gas coker oil, require hydrotreating to remove other undesirable compounds, such as olefins and metals. Once hydrotreated, they are suitable for use in low sulfur diesel fuel. Also, some light cycle oils and light gas coker oils contain so much sulfur and olefins and has such a low cetane number that they are unsuitable for direct blending into even high sulfur diesel fuel, since most high sulfur diesel fuel meets the ASTM sulfur cap of 5000 ppm and cetane number minimum of 40.[222] If material must be hydrotreated in order to blend into a high sulfur fuel, it is often easier to hydrotreat this material further to meet a 500 ppm cap and blend straight run material directly into the high sulfur diesel pool. Thus, there is no bright line separating the blendstocks used to produce low and high sulfur diesel fuel today.

3. What Technology Would Refiners Use to Meet the Proposed 500 ppm Sulfur Cap?

Refiners currently hydrotreat some or all of their distillate blendstocks to meet the 500 ppm sulfur cap applicable to highway diesel fuel. Refiners would be able to meet the proposed 500 ppm sulfur cap for NRLM diesel fuel using this same technology. As will be discussed further in the next section, several alternative desulfurization technologies are being developed. However, these alternative technologies promise the greatest cost savings at very low sulfur levels, such as 15 ppm. Also, their ongoing development makes it unlikely that they would be selected by most refiners as early as 2007. Finally, the use of conventional hydrotreating technology to meet a 500 ppm standard can readily be combined later with these alternative technologies to meet the subsequent 15 ppm standard in 2010. Thus, we expect that the vast majority of refiners would use conventional hydrotreating to meet the 500 ppm standard in 2007 applicable to NRLM diesel fuel.

Refiners would also likely need to install or modify several existing ancillary units related to sulfur removal (e.g., hydrogen production and purification, sulfur recovery, amine scrubbing and sour water scrubbing facilities). All of these units currently exist at the vast majority of refineries, but may have to be expanded or enlarged.

4. Has Technology to Meet a 500 ppm Cap Been Commercially Demonstrated?

As mentioned above, conventional diesel desulfurization technologies have been available and in use for many years. U.S. refiners have nearly ten years of experience with this technology in producing diesel fuel with less than 500 ppm sulfur for highway use. Thus, the technology to produce 500 ppm NRLM diesel fuel has clearly been demonstrated and optimized over the last decade.

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[222] Non-highway diesel fuel often meets even more stringent sulfur standards of 2000-3000 ppm in some states, particularly those in the Northeast. These states have limited the sulfur content of home heating oil to these levels. To ease fuel distribution, refiners and distributors sell the same fuel into the home heating fuel and non-highway diesel fuel markets.

5. Availability of Leadtime to Meet the 2007 500 ppm Sulfur Cap

If we promulgate today's proposal one year from today, this would provide refiners and importers with approximately 38 months before they would have to begin complying with the 500 ppm cap for NRLM diesel fuel on June 1, 2007. Our leadtime analysis, which is presented in the DRIA, projects that 27-39 months are typically needed to design and construct a diesel fuel hydrotreater.[223] Thus, the leadtime available for the 500 ppm cap in mid-2007 should be sufficient for all but a few refiners.

Easing the task is the fact that we project that essentially all refiners would use conventional hydrotreating to comply with the 500 ppm NRLM diesel fuel cap. This technology has been used extensively for more than 10 years and its capabilities to process a wide range of diesel fuel blendstocks are well understood. Thus, the time necessary to optimize this technology for a specific refiner's situation should be relatively short.

While conventional hydrotreating would likely be used to meet the 500 ppm cap in 2007, most refiners would have to plan to be able process this fuel further to meet the 15 ppm nonroad diesel fuel cap in 2010. Even those refiners planning on producing 500 ppm locomotive and marine diesel fuel starting in 2010 would likely have to plan for the potential that this fuel could be controlled to 15 ppm sulfur at some time in the future. Thus, the conventional hydrotreater built in 2007 would have to be able to be compatible with the technology eventually chosen to produce 15 ppm fuel in 2010. This could affect the hydrotreater's design pressure, physical location and layout and peripherals, such as hydrogen supply and utilities. However, we project that 34 out of the 42 refineries which we project would produce this fuel also produce highway diesel fuel. Thus, over 80 percent of the refiners likely to produce 500 ppm NRLM fuel in 2007 are already well into their planning for meeting the 15 ppm highway diesel fuel standard, effective June 1, 2006. It is likely that these refiners have already chemically characterized their high sulfur diesel fuel blendstocks, as well as their highway diesel fuel, for potential desulfurization. They will also have already assessed the various technologies for producing 15 ppm diesel fuel and have a good idea of what technology they might use to meet the 15 ppm nonroad diesel fuel cap starting in 2010. Those refiners which only produce high sulfur distillate fuel today would still be able to take advantage of the significant experience that technology vendors have obtained in helping refiners of highway diesel fuel plan for producing 15 ppm diesel fuel in 2006.

Also, of the 34 refineries producing highway diesel fuel today, we project that three will likely build a new hydrotreater to produce 15 ppm highway diesel fuel in 2006. This would allow them to produce 500 ppm NRLM diesel fuel using their existing highway diesel fuel hydrotreater. Another 10 of these 34 refineries produce relatively small volumes of high sulfur

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[223] "Highway Diesel Progress Review," USEPA, EPA420-R-02-016, June 2002.

distillate compared to highway diesel fuel today. Thus, we project that they should be able to produce 500 ppm NRLM fuel from their high sulfur distillate with minor modification to their existing hydrotreater.

Refiners may also need some time to assess what diesel fuel and heating oil markets they plan on participating in come 2010. While heating oil may not be widely distributed in PADDs 2, 3 and 4, refiners in PADDs 1 and 3 would still be able to produce heating oil for the Northeast fuel market. Likewise, heating oil may still be distributed in the Pacific Northwest. Under today's proposal, locomotive and marine diesel fuel would remain at 500 ppm for some time. Thus, many refiners would require some time to decide what market to participate in after 2010. This strategic planning should be able to coincide with refiners' evaluation of 15 ppm technologies and not add to the overall lead time required.

In all, we project that the task of producing 500 ppm NRLM fuel in 2007 would be less difficult than the task refiners faced with the implementation of the 500 ppm highway diesel fuel cap in 1993. Refiners had just over three years of leadtime for the highway diesel fuel cap, as is the case here and this proved sufficient.

6. What Technology Would Refiners Use to Meet the Proposed 15 ppm Sulfur Cap for Nonroad Diesel Fuel?

We project that refiners would be able to use a variety of desulfurization technologies to meet the proposed 15 ppm sulfur cap for nonroad fuel. One approach would be to use an extension of conventional hydrotreating technology. As mentioned above, we expect that refiners would utilize hydrotreating to meet the proposed 500 ppm standard. We expect that refiners would design this hydrotreater to facilitate the addition of a second reactor or hydrotreating stage to further desulfurize their distillate blendstocks from 500 ppm to 15 ppm. Refiners might also shift to the use of an improved catalyst even in the first reactor (i.e., that producing roughly 500 ppm sulfur product), as well as add equipment to further purify the hydrogen used.

This is the same technology which EPA projected would be used by most refiners to meet the 15 ppm sulfur cap for highway diesel fuel. EPA just recently reviewed the progress being made by refining technology vendors and refiners in meeting the 2006 highway diesel sulfur cap.[224] All evidence available confirms EPA's projection that conventional hydrotreating will be capable of producing diesel fuel containing less than 10 ppm sulfur. Refiners should have an added advantage in meeting a 15 ppm sulfur cap for nonroad fuel over that for highway fuel. They would be able to design their hydrotreater from the ground up, while most refiners producing 15 ppm diesel fuel for highway use will be trying to utilize their existing 500 ppm

[224] "Highway Diesel Progress Review," EPA, June 2002, EPA420-R-02-016.

hydrotreaters, which may not be designed to be revamped to produce 15 ppm fuel in the most efficient manner.

Based on our review of the limited catalyst performance data in the published literature and the one set of confidential data submitted, we believe that the projections of the more optimistic vendors are the most accurate for the 2010 timeframe given this additional leadtime. For example, the confidential commercial data indicated that five ppm sulfur levels could be achieved with two-stage hydrotreating at moderate hydrogen pressure despite the presence of a significant amount of light cycle oil (LCO). The key factor was the inclusion of a hydrogenation catalyst in the second stage, which saturated many of the poly-nuclear, aromatic rings in the diesel fuel, allowing the removal of sulfur from the most sterically hindered compounds. In addition, refiners that are able to defer production of 15 ppm highway diesel fuel through the purchase of credits, as well as refiners producing 15 ppm nonroad in 2010, would have the added benefit of being able to observe the operation of those hydrotreating units starting up in 2006. This should allow these refiners to be able to select from the best technologies which are employed in the highway program.

In addition, a number of alternative technologies are presently being developed which could produce 15 ppm fuel at lower cost. ConocoPhillips, for example, has developed a version of their S-Zorb technology for diesel fuel desulfurization. This technology utilizes a catalytic adsorbent to remove the sulfur atom from hydrocarbon molecules. It then sends the sulfur-laden catalyst to a separate reactor, where the sulfur is removed and the catalyst is restored. Unipure has developed a process which selectively oxidizes the sulfur contained in diesel fuel. This process has the advantage that the sulfur containing compounds which are most difficult to desulfurize via hydrotreating are quite easily desulfurized via oxidation. Finally, Linde has developed a method which greatly improves the concentration of hydrogen on hydrotreating catalysts. This process promises to greatly reduce the reactor volume necessary to produce 15 ppm diesel fuel.

These three new technologies are at various stages of development. This is discussed in more detail in the next section. Due to the projected ability of these technologies to reduce the cost of meeting a 15 ppm sulfur cap and the leadtime available between now and 2010, we project that 80% of the new volume of 15 ppm nonroad diesel fuel would be produced using one of these three advanced technologies.

7. Has Technology to Meet a 15 ppm Cap Been Commercially Demonstrated?

EPA just completed a review of refiners' progress in preparing to produce 15 ppm highway diesel fuel.[225] The information we obtained during that review confirm the projections

[225] *Ibid*.

we made in the HD 2007 program – refiners are technically capable of producing 15 ppm sulfur diesel fuel using extensions of conventional technology and, in fact, they are moving forward with their plans to comply with the program. Thus, we believe there are no technological hurdles to producing 15 ppm diesel fuel.

The European Union has also determined that diesel fuel can be desulfurized to meet a sulfur cap in the range of 10-15 ppm. Europe has established a 10 ppm sulfur cap on highway diesel fuel, effective in 2009, with plans underway for a 10 ppm sulfur cap for nonroad diesel fuel soon thereafter. As with our standards, Europe's 10 ppm cap applies throughout the distribution system. However, fuel tends to be transported much shorter distances in Europe. Therefore, we believe that both the 10 and 15 ppm sulfur caps will require refiners to meet the same 7-8 ppm sulfur target at the refinery gate. Given this, the European standard will require the same technology as that required in the U.S. Most European diesel fuel must meet a higher cetane number specification than U.S. diesel fuel, which causes it to be predominantly comprised of straight run material. This material is easier to desulfurize to sub-15 ppm levels using conventional hydtrotreating technology. In some European countries, nonroad diesel fuel is the same as heating oil and contains significant amounts of cracked material. Thus, on average, it should be easier for European refiners to meet a 10 ppm sulfur cap with their highway diesel fuel than in the U.S. As the 10 ppm cap is extended to nonroad diesel fuel, the stringency of the European standard will be much closer to that of a 15 ppm cap here in the U.S.

We also met with a number of diesel fuel refiners to learn about their plans to produce 15 ppm highway diesel fuel by the June 2006 program compliance date. Since the 15 ppm diesel fuel sulfur standard was established based on the use of extensions of conventional diesel desulfurization technologies, diesel fuel refineries are well positioned to make firm plans for implementation by 2006. Our review has found that this is exactly what refiners are doing. We are very encouraged by the actions some refiners have already taken in terms of announcing specific plans for low sulfur diesel fuel production. It may still be early in the process, but virtually all refiners are already in the stage of planning their approach for compliance. Thus, the refining industry is where we anticipated it would be at this point in time. Moreover, some refining companies are ahead of schedule and will be capable of producing significant quantities of 15 ppm sulfur diesel fuel as early as next year. Thus, we expect that the capability of conventional hydrotreating to produce 15 ppm diesel fuel in refinery-scale quantities will be demonstrated in the U.S. by the end of 2003.

Phillips Petroleum is currently in the process of designing and constructing a commercial sized S-Zorb unit to produce sub-15 ppm diesel fuel at their Sweeney, Texas refinery. This plant is scheduled to begin commercial operation in 2004. This would provide refiners with roughly 3 years of operating data before they would have to decide which technology to use to meet the 15 ppm nonroad sulfur cap in 2010. This should be enough operating experience for most refiners to have sufficient confidence in this advanced process to include it in their options for 2010 compliance. Based on information received from Phillips Petroleum, we estimate that this technology could reduce the cost of meeting the 15 ppm cap for many refiners by 25 percent.

Linde has also developed a new approach for improving the contact between hydrogen, diesel fuel and conventional desulfurization catalysts. Linde projects that their Iso-Therming process could reduce the hydrotreater volume required to achieve sub-15 ppm sulfur levels by roughly a factor of 2. Linde has already built a commercial-sized demonstration unit at a refinery in New Mexico and has been operating the equipment since September 2002. Thus, refiners would have 4-5 years of operating data available on this process before they would have to decide which technology to use to meet the 15 ppm nonroad sulfur cap in 2010. This should be ample operating experience for essentially all refiners to include this process in their options for 2010. Based on information received from Linde, we estimate that this technology could reduce the cost of meeting the 15 ppm cap for many refiners by 40 percent.

Finally, Unipure Corporation is developing a desulfurization process which oxidizes the sulfur atom in diesel fuel molecules, facilitating its removal. This process operates at low temperatures and ambient pressure, so it avoids the need for costly, thick walled, pressure vessels and compressors. It also consumes no hydrogen. Thus, it could be particularly advantageous for refiners who lack an inexpensive supply of hydrogen (e.g., isolated or smaller refineries who cannot construct a world scale hydrogen plant based on inexpensive natural gas). However, the oxidant is very powerful, so specialized, oxidation resistant materials are needed. Unipure has demonstrated its process at the pilot plant level, but has yet to build a commercial sized demonstration unit. However, time still remains for this to be done before refiners need to make final decisions for their 2010 compliance plans. Thus, while more uncertain than the other two advanced processes, the Unipure oxidation process could be selected by a number of refiners to meet the 2010 15 ppm cap. Based on inputs from Unipure, we estimate that their process could reduce the cost of meeting the 15 ppm cap for roughly one-fourth of all refineries by 25-35 percent.

The savings associated with each technology varies with the size, location and complexity of the refinery. However, on average the Linde process appears to have the potential reduce the cost of desulfurizing 500 ppm diesel fuel to 15 ppm by 35-40 percent. The savings associated with the Phillips and Unipure processes appear to be more refinery specific. For about 25 refineries, the Phillips process appears to have the potential to reduce these desulfurization costs by 20-40 percent. The primary advantage of the Unipure process is its lower capital costs. For about 30 refineries, the Unipure process appears to have the potential to reduce the capital investment related to produce 15 ppm fuel from 500 ppm diesel fuel by an average of 40 percent.

8. Availability of Leadtime to Meet the 2010 15 ppm Sulfur Cap

If we promulgate today’s proposal one year from today, this would provide refiners and importers with more than six years before they would have to begin complying with the 15 ppm cap for nonroad diesel fuel on June 1, 2010. Our leadtime analysis, which is presented in the

DRIA, projects that 30-39 months are typically needed to design and construct a diesel fuel hydrotreater.[226] Thus, refiners would have about 3 years before they would have to begin detailed design and construction. This would allow them time to observe the performance of the hydrotreaters being used to produce 15 ppm highway diesel fuel for at least one year. While not a full catalyst cycle, any unusual degradation in catalyst performance over time should be apparent within the first year. Thus, we project that the 2010 start date would allow refiners to be quite certain that the designs they select in mid-2007 will perform adequately in 2010.

In addition, we expect that most of the advanced technologies will be demonstrated on a commercial scale by the end of 2004. Thus, refiners would have at least two and a half years to observe the performance of these technologies before having to select a technology to meet the 2010 15 ppm cap. This should be more than adequate to fully access the costs and capabilities of these technologies for all but the most cautious refiners.

9. Feasibility of Distributing Nonroad, Locomotive and Marine Diesel Fuels that Meet the Proposed Sulfur Standards

There are two considerations with respect to the feasibility of distributing non-highway diesel fuels meeting the proposed sulfur standards. The first pertains to whether sulfur contamination can be adequately managed throughout the distribution system so that fuel delivered to the end-user does not exceed the specified maximum sulfur concentration. The second pertains to the physical limitations of the system to accommodate any additional segregation of product grades.

a. Limiting Sulfur Contamination

With respect to limiting sulfur contamination during distribution, the physical hardware and distribution practices for non-highway diesel fuel do not differ significantly from those for highway diesel fuel. Therefore, we do not anticipate any new issues with respect to limiting sulfur contamination during the distribution of non-highway fuel that would not have already been accounted for in distributing highway diesel fuel. Highway diesel fuel has been required to meet a 500 ppm sulfur standard since 1993. Thus, we expect that limiting contamination during the distribution of 500 ppm non-highway diesel engine fuel can be readily accomplished by industry.

In the highway diesel rule, EPA acknowledged that meeting a 15 ppm sulfur specification would pose a substantial new challenge to the distribution system. Refiners, pipelines and terminals would have to pay careful attention to and eliminate any potential sources of contamination in the system (e.g., tank bottoms, deal legs in pipelines, leaking valves,

[226] "Highway Diesel Progress Review," USEPA, EPA420-R-02-016, June 2002.

interface cuts, etc.) In addition, bulk plant operators and delivery truck operators would have to carefully observe recommended industry practices to limit contamination, including things as simple as cleaning out transfer hoses, proper sequencing of fuel deliveries, and parking on a level surface. Due to the need to prepare for compliance with the highway diesel program, we anticipate that issues related to limiting sulfur contamination during the distribution of 15 ppm nonroad diesel fuel will be resolved well in advance of the proposed 2010 implementation date for nonroad fuel. We are not aware of any additional issues that might be raised unique to nonroad fuel. If anything we anticipate limiting contamination will become easier as batch sizes are allowed to increase and potential sources of contamination decrease. We request comment on whether there are unique considerations regarding the transition to a 15 ppm standard for nonroad diesel fuel and what actions we should take beyond those that are already underway in preparation for the 15 ppm highway diesel program.

b. Potential Need for Additional Product Segregation

As discussed in sub-section B, we have designed today's proposed program in such a way as to minimize the need for additional product segregation and the associated feasibility and cost issues associated with it. Today's proposal would allow for 500 ppm highway and 500 ppm NRLM diesel fuel in 2007 and 15 ppm highway and 15 ppm NRLM diesel fuel in 2010 to be fungibly distributed up until the point where NRLM fuel must be dyed for IRS excise tax purposes. Heating oil would be required to be segregated as a separate pool beginning in 2007 through the use of a new marker, and locomotive and marine fuel by use of the same marker beginning in 2010. With this program design, we believe we have eliminated any potential feasibility issues associated with the need for product segregation. This is not to say that steps will not have to be taken. We have identified only a single instance where it seems likely that the adoption of today's proposal would result entities in the distribution system choosing to add new tankage due to new product segregation. Bulk plants in areas of the country where heating oil is expected to remain in the market will face the decision of adding tankage to distribute both heating oil and 500 ppm NRLM fuel. In all other cases we anticipate segments of the distribution system will choose to avoid any fuel segregation costs by limiting the range of products they choose to carry, just as they do today. Regardless, however, the costs and impacts of these choices are small. We request comment on this assessment. A more detailed explanation of this assessment can be found in Chapter 5.6 of the draft RIA.

G. What Are the Potential Impacts of the 15 ppm sulfur Diesel Program on Lubricity and Other Fuel Properties?

1. What Is Lubricity and Why Might it Be a Concern?

Engine manufacturers depend on diesel fuel lubricity properties to lubricate and protect moving parts within fuel pumps and injection systems for reliable performance. Unit injector systems and in-line pumps, commonly used in diesel engines, are actuated by cams lubricated with crankcase oil, and have minimal sensitivity to fuel lubricity. However, rotary and distributor type pumps, commonly used in light and medium-duty diesel engines, are completely fuel lubricated, resulting in high sensitivity to fuel lubricity. The types of fuel pumps and injection systems used in nonroad diesel engines are the same as those used in highway diesel vehicles. Consequently, nonroad and highway diesel engines share the same need for adequate fuel lubricity to maintain fuel pump and injection system durability.

Diesel fuel lubricity concerns were first highlighted during the implementation of the federal 500 ppm sulfur highway diesel program and the state of California's diesel program circa 1993. The diesel fuel requirements in the state of California differed from the federal requirements by substantially restricting the aromatics content of diesel fuel. Reducing the aromatics content of diesel fuel requires more severe hydrotreating than reducing the sulfur content to meet a 500 ppm standard.[227] Consequently, concerns regarding diesel fuel lubricity have primarily been associated with California diesel fuel and some California refiners treat their diesel fuel with a lubricity additive as needed. Outside of California, hydrotreating to meet the current 500 ppm sulfur specification seldom results in a sufficient reduction of lubricity to require the use of a lubricity additive. Therefore, we anticipate only a marginal increase in the use of lubricity additives in NRLM diesel fuel meeting the proposed 500 ppm sulfur standard for 2007.[228] Today's proposal would require diesel fuel used in nonroad engines to meet a 15 ppm sulfur standard in 2010. Based on the following discussion, we believe that the increase in the use of lubricity additives in 15 ppm nonroad diesel fuel would be the same as that estimated for 15 ppm highway diesel fuel.

The state of California currently requires the same standards for diesel fuel used in nonroad equipment as in highway equipment. Outside of California, highway diesel fuel is often used in nonroad equipment when logistical constraints or market influences in the fuel distribution system limit the availability of high sulfur fuel. Thus, nonroad equipment has been using federal 500 ppm sulfur diesel fuel and California diesel fuel, some of which may have been treated with lubricity additives, for nearly a decade. During this time, there has been no indication that the level of diesel lubricity needed for fuel used in nonroad engines differs substantially from the level needed for fuel used in highway diesel engines.

Blending small amounts of lubricity-enhancing additives increases the lubricity of poor-lubricity fuels to acceptable levels. These additives are available in today's market, are effective,

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[227] Chevron Products Diesel Fuel Technical Review provides a discussion of the impacts on fuel lubricity of current diesel fuel compositional requirements in California versus the rest of the nation. http://www.chevron.com/prodserv/fuels/bulletin/diesel/l2%5F7%5F2%5Frf.htm

[228] The cost from the increased use of lubricity additives in 500 ppm NRLM diesel fuel in 2007 and in 15 ppm nonroad diesel fuel in 2010 is discussed in section V of today's preamble.

and are in widespread use around the world. Considerable research remains to be performed to better understand which fuel components are most responsible for lubricity. Consequently, it is unclear whether and to what degree the proposed sulfur standards for non-highway diesel engine fuel will impact fuel lubricity. Nevertheless, there is evidence that the typical process used to remove sulfur from diesel fuel -- hydrotreating – can impact lubricity depending on the severity of the treatment process and characteristics of the crude. We expect that hydrotreating will be the predominant process used to reduce the sulfur content of non-highway diesel engine fuel to meet the 500 ppm sulfur standard during the first step of the proposed program. The highway diesel program projected that hydrotreating would be the process most frequently used to meet the 15 ppm sulfur standard for highway diesel fuel. The 2010 implementation date for the proposed 15 ppm standard for nonroad diesel fuel would allow the use of new technologies to remove sulfur from fuel.[229] These new technologies have less of a tendency to affect other fuel properties than does hydrotreating.

Based on our comparison of the blendstocks and processes used to manufacture non-highway diesel fuels, we believe that the potential decrease in the lubricity of these fuels from hydrotreating that might result from the proposed sulfur standards should be substantially the same as that experienced in desulfurizing highway diesel fuel.[230] To provide a conservative, high cost estimate, we assumed that the potential impact on fuel lubricity from the use of the new desulfurization processes would be the same as that experienced when hydrotreating diesel fuel to meet a 15 ppm sulfur standard. We request comment on the potential impact of these new desulfurization technologies on lubricity (as well as other fuel properties) that might help us to improve our estimate of the potential impacts of today's proposal on fuel properties other than sulfur. Given that the requirements for fuel lubricity in highway and non-highway engines are the same, and the potential decrease in lubricity from desulfurization of non-highway diesel engine would be no greater than that experienced in desulfurizing highway diesel fuel, we estimate that the potential need for lubricity additives in non-highway diesel engine fuel under today's proposal would be the same as that for highway diesel fuel meeting the same sulfur standard.

2. Today's Action on Lubricity: a Voluntary Approach

In the United States, there is no government or industry standard for diesel fuel lubricity. Therefore, specifications for lubricity are determined by the market. Since the beginning of the 500 ppm sulfur highway diesel program in 1993, refiners, engine manufacturers, engine component manufacturers, and the military have been working with the American Society for

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[229] See section IV.F for a discussion of which desulfurization processes we expect will be used to meet the 15 ppm standard for nonroad diesel fuel.

[230] See Chapter 5 of the RIA for a discussion of the potential impacts on fuel lubricity of today's proposal.

Testing and Materials (ASTM) to develop protocols and standards for diesel fuel lubricity in its D-975 specifications for diesel fuel. ASTM is working towards a single lubricity specification that would be applicable to all diesel fuel used in any type of engine. Although ASTM has not yet adopted specific protocols and standards, refiners that supply the US market have been treating diesel fuel with lubricity additives on a batch to batch basis, when poor lubricity fuel is expected. Other examples include Sweden, Canada, and the U.S. military. The military has found that the traditional corrosion inhibitor additives used in its fuels have been highly effective in reducing fuel system component wear. Since 1991, the use of lubricity additives in Sweden's 10 ppm sulfur Class I fuel and 50 ppm sulfur Class II fuel has resulted in acceptable equipment durability.[231] Since 1997, Canada has required that its 500 ppm sulfur diesel fuel not meeting a minimum lubricity be treated with lubricity additives.

The potential need for lubricity additives in diesel fuel meeting a 15 ppm sulfur specification was evaluated during the development of EPA's highway diesel rule. In response to the proposed highway diesel rule, all comments submitted regarding lubricity either stated or implied that the proposed sulfur standard of 15 ppm would likely cause the refined fuel to have lubricity characteristics that would be inadequate to protect fuel injection equipment, and that mitigation measures such as lubricity additives would be necessary. However, the commenters suggested varied approaches for addressing lubricity. For example, some suggested that we need to establish a lubricity requirement by regulation while others suggested that the current voluntary, market based system would be adequate. The Department of Defense recommended that we encourage the industry (ASTM) to adopt lubricity protocols and standards before the 2006 implementation date of the 15 ppm sulfur standard for highway diesel fuel.

The final highway diesel rule did not establish a lubricity standard for highway diesel fuel. We believe the issues related to the need for diesel lubricity in fuel used in non-highway diesel engines are not substantially different from the those related to the need for diesel lubricity for highway engines. Consequently, we are proposing the same industry-based voluntary approach to ensuring adequate lubricity in non-highway diesel fuels that we finalized for highway diesel fuel. We believe the best approach is to allow the market to address the lubricity issue in the most economical manner, while avoiding an additional regulatory scheme. A voluntary approach should provide adequate customer protection from engine failures due to low lubricity, while providing the maximum flexibility for the industry. This approach would be a continuation of current industry practices for diesel fuel produced to meet the current federal and California 500 ppm sulfur highway diesel fuel specifications, and benefits from the considerable experience gained since 1993. It would also include any new specifications and test procedures that we expect would be adopted by the American Society for Testing and Materials (ASTM) regarding lubricity of NRLM diesel fuel quality. We do not believe that an EPA regulation for

[231] Letter from L. Erlandsson, MTC AB, to Michael P. Walsh, dated October 16, 2000. EPA air docket A-99-06, docket item IV-G-42.

lubricity is appropriate for several reasons.

Regardless, this is an issue that will be resolved to meet the demands of the highway diesel market, and whatever resolution is reached for highway diesel fuel could be applied to non-highway diesel engine fuel with sufficient advance notice. We request comment on what actions EPA should take to ensure adequate lubricity of non-highway diesel engine fuel beyond those already underway for highway diesel fuel.

3. What Other Impact Would Today's Actions Have on the Performance of Diesel and Other Fuels?

We do not expect that today's proposed fuel program would have any negative impacts on the performance of the diesel fuels being directly regulated today (i.e., NRLM) or other fuels. Beginning with diesel fuels, there were some problems with leaks from fuel pump O-ring seals made of a certain material (Nitrile) after the introduction of 500 ppm sulfur diesel fuel in the United States in 1993. The leakage from the Nitrile seals was determined to be due to low aromatics levels in some 500 ppm sulfur fuel; 15 ppm sulfur levels were not the issue at that time. In the process of lowering the sulfur content of some fuel, some of the aromatics had also been removed. Normally, the aromatics in the fuel penetrate the Nitrile material and cause it to swell, thereby providing a seal with the throttle shaft. When low-aromatics fuel is used after conventional fuel has been used, the aromatics already in the swelled O-ring would leach out into the low-aromatics fuel. Subsequently, the Nitrile O-ring would shrink and pull away, thus causing leaks, or the stress on the O-ring during the leaching process would cause it to crack and leak. Not all 500 ppm sulfur fuels caused this problem, because the amount and type of aromatics varied. Fuel pumps using a different material for the seals, Viton, did not experience leakage. However, these issues have since been addressed by equipment manufacturers who switched to materials that are compatible with low aromatic fuels.

We believe that no additional problems would occur with a change of diesel fuel from 500 to 15 ppm sulfur. The primary reason for this conclusion is that no problems are occurring with the use of current California diesel fuel. California diesel fuel must meet a specific standard for aromatics, and many fuels only contain as little as 10 volume percent aromatics. Desulfurizing diesel fuel to meet the nationwide, nonroad 15 ppm cap should not reduce aromatics to this low of a level, if aromatic levels are significantly reduced at all. Thus, current California diesel fuel should present a more significant challenge for engine seals than the future federal 15 ppm diesel fuel. The same cannot be said for specific types of ultra-low sulfur diesel fuel components, such as those made using the Fischer-Tropsch process. These blendstocks contain essentially no sulfur, nor aromatics. However, use of such blendstocks would not be required by today's proposal and the impact of their use would be the responsibility of the fuel producer, consistent with the situation today.

We expect that today's proposal would have no negative impacts on other fuels, such as jet fuel or heating oil. We do expect that the sulfur levels of heating oil would decrease because of today's proposal. Beginning in mid-2007, we expect that controlling NRLM diesel fuel to 500 ppm would lead many pipelines to discontinue carrying high sulfur heating oil. In areas, served by these pipelines, heating oil users would likely switch to 500 ppm diesel fuel. This would reduce emissions of sulfur dioxide and sulfate PM from furnaces and boilers fueled with heating oil. The primary exception to this would likely be the Northeast and some areas of the Pacific Northwest, where a distinct higher sulfur heating oil would still be distributed as a separate fuel. Also, we expect that some high sulfur distillate fuel would be created during distribution from the mixing of low sulfur diesel fuels and higher sulfur fuels, such as jet fuel in the pipeline interface. Such high sulfur material would likely be sold by the terminal as high sulfur heating oil.

H. Refinery Air Permitting

Prior to making diesel desulfurization changes, some refineries may be required to obtain a preconstruction permit, under the New Source Review (NSR) program, from the applicable state/local air pollution control agency. [232] We believe that today's proposed program provides sufficient lead time for refiners to obtain any necessary NSR permits well in advance of the compliance date.

Given that today's diesel sulfur program would provide roughly three years of lead time before the 500 ppm standard would take effect, we believe refiners would have time to obtain any necessary preconstruction permits. Nevertheless, we believe it is reasonable to continue our efforts under the Tier 2 and highway diesel fuel programs, to help states in facilitating the issuance of permits under the NRLM diesel sulfur program. For example, the guidance on Best Available Control Technology (BACT) and Lowest Achievable Emission Rate (LAER) control technology that was developed for the gasoline sulfur program should have application for diesel desulfurization (highway and NRLM) projects as well. Similarly, we believe the concept of EPA permit teams for gasoline sulfur projects could readily be extended to permits related to diesel projects as well. These teams, as needed, would track the overall progress of permit issuance and would be available to assist state/local permitting authorities, refineries and the public upon request to resolve site-specific permitting questions. In addition, these teams will be available, as necessary, to assist in resolving case specific issues to ensure timely issuance of permits. Finally, to facilitate the processing of permits, we encourage refineries to begin discussions with permitting agencies and to submit permit applications as early as possible.

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[232] Hydrotreating diesel fuel involves the use of process heaters, which have the potential to emit pollutants associated with combustion, such as NOx, PM, CO and SO2. In addition, reconfiguring refinery processes to add desulfurization equipment could increase fugitive VOC emissions. The emissions increases associated with diesel desulfurization would vary widely from refinery to refinery, depending on many source-specific factors, such as crude oil supply, refinery configuration, type of desulfurization technology, amount of diesel fuel produced, and type of fuel used to fire the process heaters.

V. Economic Impacts

In this section, we present the projected cost impacts and cost effectiveness of the proposed nonroad Tier 4 emission standards and low-sulfur fuel requirement. We also present a benefit-cost analysis and an economic impact analysis. 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, equipment and fuel that would be affected by the standards.

The results detailed below show that this rule would be highly beneficial to society, with net present value benefits through 2030 of $520 billion, compared to a net present value of social cost of only $18 billion. The impact of these costs on society should be minimal, with the prices of goods and services produced using equipment and fuel affected by the proposal being expected to increase less than 0.01 percent.

Further information on these and other aspects of the economic impacts of our proposal are summarized in the following sections and 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. Refining and Distribution Costs

As described above, the fuel-related requirements associated with this proposed rule would be implemented in two steps. Nonroad, locomotive and marine diesel fuel would be subject to a 500 ppm sulfur cap beginning June 1, 2007, while nonroad diesel fuel would be subject to a 15 ppm sulfur cap beginning June 1, 2010. Meeting these standards would generally require refiners adding hydrotreating equipment and possibly new or expanded hydrogen and sulfur plants in their refineries for desulfurizing their nonroad diesel fuel and dispensing of the removed sulfur. Using information provided by vendors of desulfurization equipment and through discussions with distributors of nonroad diesel fuel, we estimated the desulfurization and associated distribution and additive cost for complying with this two step desulfurization program. Except for the costs presented at the end of this section, the costs below reflect a fully phased in fuels program without the proposed small refiner exemption. All costs are in 2002 dollars. We request comment on the cost estimates presented below and the methodologies used to develop them. You can refer to the Draft RIA for details.

The cost to provide nonroad, locomotive and marine diesel fuel under today's proposed fuel program is summarized in Table V-1 below. The costs shown (and all of the costs described in the rest of this section) only apply to the roughly 65 percent of current nonroad, locomotive and marine diesel fuel that contains more than 500 ppm sulfur (hereafter referred to as the affected volume). We project that the other 35 percent of this fuel is actually fuel certified to the highway diesel fuel standards, which are more stringent than those being proposed today. Thus, today's proposed fuel program would not affect this fuel and no additional costs would be incurred by refiners or distributors. The costs and benefits of desulfurizing this highway fuel which spills over into the non-highway markets was already included in EPA's 2007 highway diesel fuel rule.

Table V-1 Increased Cost of Providing Nonroad, Locomotive and Marine Diesel Fuel (cent per gallon of affected fuel)

	Refining	Distribution	Total
Step One - 500 ppm NRLM diesel fuel	2.2	0.3	2.5
Step Two - 15 ppm Nonroad diesel fuel	4.4	0.4	4.8
Step Two - 500 ppm Locomotive and Marine diesel fuel	2.2	0.2	2.4

The majority of the fuel-related cost of the proposal is refining-related, with only 15-25 percent of the costs being distribution-related. These costs include required capital investments amortized at 7 percent per annum before taxes. The derivation of these costs is discussed in more detail below and in the Draft RIA. We request comment on the estimated cost of meeting the 15 ppm and 500 ppm sulfur caps.

We also project that the increased cost of refining and distributing 15 ppm and 500 ppm fuel would be substantially offset by reductions in maintenance costs. These savings would apply to all diesel engines in the field, not just new engines. Refer to Section V. B for a more complete discussion on the projected maintenance savings associated with lower sulfur fuels.

1. Refining Costs

Our process for estimating the refining costs associated with the proposed fuel program consisted of four steps. One, we estimated the volume of 500 and 15 ppm nonroad, locomotive and marine diesel fuel which had to be produced in each PADD in each phase of the program. This step utilized diesel fuel and heating oil use estimates from the Energy Information Administration, shipments of diesel fuel between PADDs, projected downgrades of 15 and 500 ppm fuel during distribution small refiner provisions, etc. Two, we estimated the cost for each refinery to desulfurize its high sulfur fuel to 500 and 15 ppm. This was based on their historical production volume of high sulfur diesel fuel and estimates of the composition of this fuel (straight run, light cycle oil, etc.). We also considered whether these refineries would be modifying or building hydrotreating capacity in order to meet the 15 ppm highway cap. Three, we estimated which refineries would find it difficult to market all of their current high sulfur diesel fuel as heating oil, due to their location relative to major pipelines and the size of the heating oil market in their area. Those not located in major heating oil markets and not connected to pipelines serving these areas were projected to have to meet the 500 ppm cap in 2007. Four, we determined the additional refineries which would produce 500 ppm and 15 ppm fuel to satisfy demand during each phase of the fuel program. Refineries projected to have the lowest compliance costs in each PADD were projected to produce the lower sulfur fuels until demand was met. PADD 3 refineries were allowed to ship low sulfur fuel to the Northeast, but other inter-PADD transfers were not allowed.

With the onset of a 2007 500 ppm sulfur cap for nonroad, locomotive and marine diesel fuel, we project that the market for high sulfur diesel fuel and heating oil would become so small that high sulfur fuel would no longer be shipped through common carrier pipelines in most areas. The prime exception to this would be the Northeast, where the heating oil market is very large. Thus, refiners located in the Northeast and those along the major pipelines serving the Northeast, namely the Colonial and Plantation pipelines, could continue to produce high sulfur heating oil. Other refineries would shift the production of high sulfur diesel fuel and heating oil to the 500 ppm NRLM market. The second exception would be refiners granted special provisions due to the small size of their business (i.e., SBREFA refiners) or economic hardship, as discussed in Section IV above. The high sulfur distillate production levels of these refineries is small enough that they can sell into more local nonroad, locomotive and marine markets or the heating oil market without using pipelines and so they could continue to produce high sulfur distillate.

Based on refinery non-highway distillate production data from the Energy Information Administration (EIA) and on the outuput from our refinery cost model, we project that 42 out of the 105 refineries currently producing some high sulfur distillate would desulfurize their high sulfur diesel fuel in response to the proposed 500 ppm standard in 2007. As explained in Section IV, we project that these refiners would use conventional hydrotreating technology to meet this standard. Of these 42 refineries, we project that only 32 would have to build new hydrotreaters to meet the 500 ppm sulfur cap. We project that three refineries would be able to meet the 500 ppm cap with their hydrotreater which is currently being used to produce highway diesel fuel. These refineries are projected to build a new hydrotreater to produce 15 ppm highway diesel fuel in 2006, so their existing highway fuel hydrotreater could process their current high sulfur diesel fuel. The remaining 10 refineries currently produce relatively small amounts of high sulfur diesel fuel compared to their highway diesel fuel production. We project that these refiners would be able to economically revamp their existing highway hydrotreater to process their non-highway diesel fuel.

We project that the capital cost involved to meet the 2007 500 ppm sulfur cap would be $600 million, or $9.7 million per refinery building a new hydrotreater. The bulk of this capital would be invested in 2007 ($500 million), with the remainder being invested in 2010.[233] Operating costs would be about $3 million per year for the average refinery. We request comment on the number of refiners who would need to build new equipment to meet the 500 ppm sulfur cap, the capital cost for this new equipment and the cost of operating this equipment.

Starting in mid-2010, we project that 25 refineries would add or revamp equipment to meet the 15 ppm cap on nonroad diesel fuel. An additional 12 refineries would do so in 2014. We project that 80 percent of the nonroad volume would be desulfurized by advanced technologies, while the remaining 20 percent would be desulfurized by conventional hydrotreaters. Since the bulk of the hydrotreating capacity being used to meet the 2007 500 ppm standard would have just been built in 2007, we expect that it would have been designed to facilitate further processing to 15 ppm sulfur and the added 15 ppm facilities would be revamps. However, a few refiners who used their existing highway diesel fuel hydrotreaters to meet the proposed 500 ppm cap in 2007 would likely have to construct new equipment in 2010 or 2014 to meet the 15 ppm cap on nonroad diesel fuel.

The total capital cost of new equipment and revamps related to the proposed 2010 sulfur standard would be $640 million, or $17 million per refinery adding or revamping equipment. Total operating costs would be about $5 million per year for the average refinery. The total refining cost, including the amortized cost of capital, would be 4.4 cents per gallon of new 15 ppm nonroad fuel. This cost is relative to the cost of producing high sulfur fuel today, and includes the cost of meeting the 500 ppm standard beginning in 2007. We request comment on the number of refiners who would need to build new equipment to meet the 15 ppm sulfur cap, the capital cost for this new equipment and the cost of operating this equipment. The average cost of continuing to meet the 500 ppm standard for locomotive and marine fuel would continue at 2.2 cents per gallon.

Our projection that 80 percent of refineries would utilize some form of advanced technology to meet the proposed 15 ppm nonroad fuel sulfur cap is based on the fact that this 15 ppm cap would follow the production of 15 ppm highway diesel fuel by four years. Several firms are expending significant research and development resources to bring such advanced technologies to the market for the highway diesel fuel program. We developed cost estimates for two such technologies: Linde Iso-Therming and Phillips S-Zorb. The development of cost estimates for these two advanced technologies, as well as conventional hydrotreating, is described in detail in the Draft RIA. We request comment on the potential viability and cost savings associated with advanced desulfurization technologies, particularly in the 2010 timeframe.

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[233] Some refineries would be able to delay production of 500 ppm NRLM fuel until 2010 due to the proposed small refiner provisions. Likewise, some refineries would be able to delay production of 15 ppm nonroad diesel fuel until 2014.

The above costs reflect national averages for the fully phased in program for each control step. Some refiners would face lower costs while others would face higher costs. Excluding refiners because they are able to take advantage of the proposed small refiner provisions, the average refining costs by refining region are shown in the table below. Combined costs are shown for PADDs[234] 1 and 3 because of the large volume of diesel fuel which is shipped from PADD 3 to PADD 1.

Table V-2 Average Refining Costs by Region (cents per gallon)		
	2007 500 ppm Cap	2010 15 ppm Cap
PADDs 1 and 3	1.4	2.6
PADD 2	2.9	5.7
PADD 4	4.0	8.5
PADD 5	2.6	5.4

We request comment on the range of estimated refining costs for the various regions for both the proposed 500 and 15 ppm sulfur caps.

2. Cost of Lubricity Additives

We expect that the need for lubricity additives that would result of the proposed 500 ppm sulfur standard for off-highway diesel engine fuel would be similar to that for highway diesel fuel meeting the current 500 ppm sulfur cap standard.[235] Industry experience indicates that the vast majority of highway diesel fuel meeting the current 500 ppm sulfur cap does not need lubricity additives. Therefore, we expect that the great majority of off-highway diesel engine fuel meeting the proposed 500 ppm sulfur standard would also not need lubricity additives. For 500 ppm diesel fuel that is treated with lubricity additives, our information indicates that the cost is approximately 0.02 cent per gallon. Given that the majority of off-highway diesel engine fuel meeting a 500 ppm sulfur standard would not need lubricity additives, we believe that 0.01 cent per gallon represents a conservatively high estimate of the cost of lubricity additives for affected volume of nonroad, locomotive and marine diesel fuel. Starting in 2010, this 0.01 cent per gallon cost would apply only to affected volumes of locomotive and marine diesel fuel.

We project that nonroad diesel fuel would require a full treatment rate of lubricity

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[234] Petroleum Administrative Districts for Defense.

[235] Please refer to section IV.**?** In today's preamble for additional discussion regarding our projections of the potential impact on fuel lubricity of today's proposed rule.

additive starting in 2010 when this fuel must meet the proposed 15 ppm sulfur cap. Consistent with our projection for 15 ppm highway diesel fuel, this is projected to cost 0.2 cent per gallon. See the Draft RIA for more details on the issue of lubricity additives.

3. Distribution Costs

Today's proposed fuel program is projected to impact distribution costs in three ways. One, we project that more diesel fuel would have to be distributed under the proposal than without it. This is due to the fact that some of the desulfurization processes reduce the fuel's volumetric energy density during processing. Total energy is not lost during processing, as the total volume of fuel is increased. However, a greater volume of fuel must be consumed in the engine to produce the same amount of power. We assumed that the current 10 cent per gallon cost of distributing diesel fuel would stay constant (i.e., a 1 percent increase in the amount of fuel distributed would increase total distribution costs by 1 percent).

We project that desulfurizing diesel fuel to 500 ppm would reduce volumetric energy content by 0.7 percent. This would increase the cost of distributing fuel by 0.07 cent per gallon. We project that desulfurizing diesel fuel to 15 ppm would reduce volumetric energy content by an additional 0.35 percent. This would increase the cost of distributing fuel by an additional 0.04 cent per gallon, or a total cost of 0.11 cent per gallon volumetric energy content.

Two, while today's proposal minimizes the segregation of similar fuels, some additional segregation of products in the distribution system would still be required. The proposed allowance that highway and off-highway diesel engine fuel meeting the same sulfur specification can be shipped fungibly until it leaves the terminal obviates the need for additional storage tankage in this segment of the distribution system.[236] Today's proposal would also allow 500 ppm off-highway diesel engine fuel to be mixed with high-sulfur diesel fuel once the fuels are dyed to meet IRS requirements. This provision would ease the last part of the distribution of high-sulfur NRLM diesel fuel.

However, we expect that the implementation of the proposed 500 ppm standard for NRLM diesel fuel in 2007 would compel approximately 10 percent of the 10,000 bulk plants in the U.S. to install a second diesel storage tank to handle this 500 ppm nonroad fuel. These bulk plants currently handle only high-sulfur fuel and hence would need a second tank to continue their current practice of selling fuel into the heating oil market in the winter and into the nonroad market in the summer.[237] We believe that some of these bulk plants would convert their existing

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[236] Including the refinery, pipeline, marine tanker, and barge segments of the distribution system.

[237] See section IV.E.9. of today's proposal and Chapter 5 of the RIA for additional discussion of the potential impacts of the proposed sulfur standards on the distribution system.

diesel tank to 500 ppm fuel in order to avoid the expense of installing an additional tank. However, to provide a conservatively high estimate we assumed that all 1,000 of these bulk plants would install a second tank in order to handle both 500 ppm NRLM diesel fuel and heating oil. The cost of an additional storage tank at a bulk plant is estimated at $90,000 and the cost of de-manifolding their delivery truck at $10,000.[238] If all 1,000 bulk plants were to install a new tank, the total one-time capitol cost would be $100,000,000. Amortizing the capital costs over 20 years, results in a estimated cost for tankage at such bulk plants of 0.1 cent per gallon of affected off-highway diesel engine fuel supplied. Although the impact on the overall cost of the proposed program is small, the cost to those bulk plant operators who need to put in a separate storage tank may represent a substantial investment. Thus, as discussed in Section IV, we believe many of these bulk plants could make other arrangements to continue servicing both heating oil and NRLM markets.

Due to the end of the highway program temporary compliance option (TCO) in 2010 and the disappearance of high-sulfur diesel fuel from much of the fuel distribution system due to the implementation of today's proposed rule, we expect that storage tanks at many bulk plants which were previously devoted to 500 ppm TCO highway fuel and high-sulfur fuel would become available for dyed 15 ppm nonroad diesel service. Based on this assessment, we do not expect that a significant number of bulk plants would need to install an additional storage tank in order to provide dyed and undyed 15 ppm diesel fuel to their customers beginning in 2010 (the proposed implementation date for the 15 ppm nonroad standard) .[239] There could be additional costs related to the need for new tankage in some areas not already carrying 500 ppm fuel under the temporary compliance option of the highway diesel program and which continue to carry high sulfur fuel. Therefore, we estimate that the potential additional tankage costs beyond those described above for bulk plants that previously carried only high-sulfur diesel fuel would be minimal. Thus, we estimate that the total cost of additional storage tanks that would result from the adoption of today's proposal would be 0.1 cent per gallon of affected off-highway diesel engine fuel supplied.

Three, the proposed requirement that high sulfur heating oil be marked between 2007 and 2010 and that locomotive and marine diesel fuel be marked from 2010 until 2014 would increase the cost of distributing these fuel slightly. Based on input from marker manufacturers, we estimate that marking these fuels would cost 0.2 cent per gallon. There should be no capital cost associated with this requirement, as we are proposing to remove the current requirement that refiners dye all high sulfur distillate at the refinery. The current dyeing equipment should work equally well for the marker. Because heating oil is being marked to prevent its use in NRLM engines, we have spread the cost for this marker over NRLM diesel fuel. Thus, from a regulatory

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[238] This estimated cost includes the addition of a separate delivery system on the tank truck.

[239] See section IV of today's preamble for additional discussion of our rational for this conclusion.

point of view, the heating oil marker would increase the cost of NRLM diesel fuel between 2007 and 2010 by 0.16 cent per gallon. We attribute the cost of marking 500 ppm locomotive and marine diesel fuel directly to this fuel, so the marker cost is simply 0.2 cent per gallon between 2010 and 2014.

We do not project any additional downgrade of 15 ppm diesel fuel would result from today's proposed fuel program. In our analysis of the 15 ppm highway fuel program, we also projected additional distribution costs due to the need to downgrade more volume of highway diesel fuel to a lower value product. This is a consequence of the large difference between the sulfur content of 15 ppm fuel and other distillate products, like high sulfur diesel fuel, heating oil and jet fuel.[240] We do not project that these costs would increase with this proposed rule for three reasons. First, 15 ppm highway diesel fuel will already be being distributed in all major pipeline and terminal networks. Thus, we expect that 15 ppm nonroad fuel would be added to batches of 15 ppm already being distributed. In this situation, the total interface volume needing to be downgraded would not increase. At the same time, we are not projecting that interface volume would decrease, as high sulfur fuels, such as jet fuel, would still be in the system.

Thus, overall, we estimate that the total additional distribution costs would be 0.3 cent per gallon of nonroad, locomotive and marine fuel during the first step of the proposed program (from 2007 through 2010). We project that distribution costs would increase to 0.4 cent gallon for 500 ppm locomotive and marine diesel fuel from 2010 to 2014, but decrease to 0.2 cent per gallon thereafter. Finally, we project that distribution costs would increase to 0.2 cent gallon for 15 ppm nonroad diesel fuel.

4. How EPA's Projected Costs Compare to Other Available Estimates

We used two different methods for evaluating how well our cost estimates reflect the true costs for complying with the two step nonroad fuel program. The first method compared our costs with the incremental market price of diesel fuel meeting a 15 or 500 ppm standard. The second method compared our cost estimate to that from an engineering analysis analogous to the one we performed.

Beginning with market prices, highway diesel fuel meeting a 500 ppm sulfur cap has been marketed in the U.S. for almost ten years. Over the five year period from 1995 - 1999, its national average price has exceeded that of high sulfur diesel fuel by about 2.4 cent per gallon. While fuel prices are a often a function of market forces which might not reflect the cost of producing the fuel, the comparison of the price difference over a fairly long period such as 5

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[240] Off-highway diesel fuel sulfur content is currently unregulated and is approximately 3,500 ppm on average. The maximum allowed sulfur content of heating oil is 5,000 ppm. The maximum allowed sulfur content of kerosene (and jet fuel) is 3,000 ppm.

years would tend to reduce the effect of the market on the prices and more closely reflect the cost of complying with the 500 ppm cap standard. Thus, we feel that this is a sound basis for evaluating our cost estimate. This price difference is essentially the same as our estimated cost for refining and distributing 500 ppm non-highway diesel fuel, thus the price difference for producing and distributing 500 ppm highway fuel corroborates our cost analysis.

Only a very limited amount of diesel fuel meeting a 15 ppm sulfur cap is marketed today. This fuel is designed to be used in vehicle fleets which have been retrofitted with particulate traps. The fuel is produced in very limited quantities using equipment designed to meet the current EPA and California highway diesel fuel standards. It is also much more costly to distribute due to its extremely low volume. Thus, the current market prices for 15 ppm diesel fuel in the U.S. are not at all representative of what might be expected in 2010 under the proposed standard. A greater volume, though still not large quantities, of 10 ppm sulfur diesel fuel is currently being sold in Europe. The great majority of this fuel is the so-called Swedish diesel fuel, which is essentially a number one diesel fuel with very low aromatic content. The low aromatic specification significantly affects the cost of producing this fuel. Also, this fuel is generally produced using equipment not originally designed to produce 10-15 ppm sulfur fuel. Thus, as in the U.S., the prices paid for this fuel are not representative of what would occur in the U.S. in 2010. Therefore, we did not attempt to use fuels sold today which have sulfur levels similar to the standards we are proposing to evaluate our cost estimate for complying with the 15 ppm cap standard.

Regarding engineering studies, the Engine Manufactures Association (EMA) commissioned a study by Mathpro to estimate the cost of controlling the sulfur content of highway and nonroad diesel fuel to levels consistent with both 500 ppm and 15 ppm cap standards.[241] Mathpro used a higher rate of return on new capital so we adjusted their per-gallon costs to reflect our own amortization methodology. Also, the Mathpro study was completed in 1999 so we adjusted their costs for inflation to year 2002 dollars. After these two adjustments, Mathpro's cost to desulfurize the high sulfur non-highway pool to 500 ppm is 2.5 cents per gallon, while that for a 15 ppm cap is 5.8 cents per gallon.[242] The 500 ppm cost estimate for compares quite favorably with our own estimate of 2.2 cents per gallon cost. One reason for our somewhat lower estimate for complying with the 500 ppm standard is that our refinery-specific analysis has only the lowest cost refineries complying as many more expensive refineries can continue to produce heating oil. It is likely that the refineries which our analysis show would comply are more optimized for desulfurizating diesel fuel than the average refinery used by Mathpro. This reason applies even more for 15 ppm cap standard as fewer, more optimized

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[241] Hirshfeld, David, MathPro, Inc., "Refining economics of diesel fuel sulfur standards," performed for the Engine Manufactuers Association, October 5, 1999.

[242] The Mathpro costs cited reflect their case where current diesel fuel hydrotreaters are revamped with a new reactor in series, which is the most consistent with our technology projection.

refineries need to comply to produce nonroad diesel fuel which complies with a 15 ppm sulfur cap standard . Furthermore, we considered the use of advanced desulfurization technologies for complying with the 15 ppm standard, while Mathpro did not. Since the Mathpro study was performed in 1999, cost estimates were not available for either of the two technologies which we included. The adjustment of the Mathpro costs and the comparison with our own cost estimates are discussed in detail in the Draft RIA. We request comment on the degree that the results of the Mathpro study for EMA and the comparison with real-world prices support our own cost estimates.

5. Supply of Nonroad, Locomotive and Marine Diesel Fuel

EPA has developed the proposed fuel program to minimize its impact on the supply of distillate fuel. For example: we have proposed to transition the fuel sulfur level down to 15 ppm in two steps, providing an estimated 6 years of leadtime for the final step; we are proposing to provide flexibility to refiners through the availability of fuel credit, banking, and trading provisions; and we have provided hardship provisions for qualifying refiners. In order to evaluate the effect of this proposal on supply, EPA evaluated four possible cases: 1) whether today's proposed standards could cause refiners to remove certain blendstocks from the fuel pool, 2) whether the proposed standards could require chemical processing which loses fuel in the process, 3) whether the cost of meeting the proposed standards could lead some refiners to leave that market, and 4) whether the cost of meeting the proposed standards could lead some refiners to stop operations altogether (i.e., shut down). In all cases, as discussed below, we have concluded that the answer is no. Therefore, we believe that the proposed fuel program would result in adequate supply of nonroad, locomotive, and marine diesel fuels.

In the first case, there should be no long term reduction in the amount of material derived from crude oil available for blending into diesel fuel or heating oil as a result of today's proposal. Technology exists to desulfurize any commercial diesel fuel to less than 10 ppm sulfur. This technology is just now being proven on a commercial scale with a range of no. 2 diesel fuel blendstocks, as a number of refiners are producing 15 ppm fuel for diesel fleets which have been retro-fitted with PM traps or for pipeline testing. Therefore, there is no technical necessity to remove certain blendstocks from the diesel fuel pool. It costs more to process certain blendstocks, such as light cycle oil, than others. Therefore, there may be economic incentives to move certain blendstocks out of the diesel fuel market to reduce compliance costs. However, that is an economic issue, not a technical issue and will be addressed below.

In the second case, the impact of the proposed rule on the total output of liquid fuel from refineries would be negligible. Conventional desulfurization processes do not reduce the energy content of the input material. However, the form of the material is affected slightly. With conventional hydrotreating, about 98 percent of the diesel fuel fed to a hydrotreater producing 15 ppm sulfur product leaves as diesel fuel. Of the 2 percent loss, three-fourths, or about 1.5 percent leaves the unit as naphtha (i.e., gasoline feedstock). The remainder is split evenly between liquified petroleum gas (LPG) and refinery fuel gas. Both naphtha and LPG have higher valuable uses as liquid fuels. Naphtha can be used to produce gasoline. Refiners can adjust the relative amounts of gasoline and diesel fuel which they produce, especially to this small degree. This additional naphtha can displace other gasoline blendstocks, which can then be shifted to the diesel fuel pool. LPG, on the other hand, is primarily used in heating, where it competes with heating oil. Thus, additional LPG can be used to displace gasoline and heating oil, which in turn can be shifted to the diesel fuel pool. Thus, there should be little or no direct impact of desulfurization on refinery fuel production. The shift from diesel fuel to fuel gas is very small (0.25 percent) and this fuel gas can be used to reduce consumption of natural gas within the refinery. These figures apply to the full effect of the proposed standards (i.e., the reduction in sulfur content from 3400 ppm to 15 ppm). For the first step of the proposed fuel program and that portion of the diesel fuel pool which would remain at the 500 ppm level indefinitely, the impacts would only be about 40 percent of those described above.

The use of advanced desulfurization technologies would further reduce these impacts. These technologies are projected to be used in the second step of reducing 500 ppm diesel fuel to 15 ppm sulfur. We project that the Linde process would reduce the above losses for the second step by 55 percent, while the Phillips SZorb process would have no loss in diesel fuel production.

In the third case, while the cost of meeting the proposed standards might cause some individual refiners to consider reducing their production of NRLM fuel or leave the market entirely, we do not believe that across the entire industry such a shift is possible or likely. As mentioned above, all diesel fuels and heating oil are essentially identical both chemically and physically, except for sulfur level. Thus, if a refiner could shift his high sulfur distillate material from the nonroad, locomotive and marine diesel fuel markets to the heating oil market starting in mid-2007, it would avoid the need to invest in new desulfurization equipment. Likewise, starting in mid-2010, a refiner could focus his 500 ppm diesel fuel in the locomotive and marine diesel fuel markets or shift this material to the heating oil market. The problem would be a potential oversupply of heating oil starting in 2007 and locomotive and marine diesel fuel and heating oil starting in 2010. An oversupply could lead to a substantial drop in market price, significantly increasing the cost of leaving the nonroad, locomotive and marine diesel fuel markets. Or, it may be necessary to export the higher sulfur fuel in order to sell it. This could entail transportation costs and overseas prices no higher than existed in the U.S. before the oversupply.

We addressed this same issue during the development of 2007 highway diesel fuel program. There the issue was whether refiners would shift some or all of their current highway diesel fuel production to either domestic or overseas markets for high sulfur diesel fuel or heating oil in order to avoid investing to meet the 15 ppm cap for highway diesel fuel. With the support of a study by Muse, Stancil, we concluded that refiners would face greater economic loss in trying to avoid meeting the 15 ppm highway diesel fuel cap than they would by complying at current production levels even if the market did not allow them to recover their capital investment.

We believe that the same conclusion applies to today's proposed fuel program for six reasons. One, the alternative markets for high sulfur diesel fuel and heating oil would be even more limited after the proposed sulfur caps on nonroad, locomotive and marine diesel fuel than they will be in 2006, as half of the current U.S. market for high sulfur, no. 2 distillate would disappear. We expect that high sulfur heating oil would not even by carried by common carrier pipelines except those serving the Northeast. Therefore, refiners' sale of high sulfur distillate may be limited to markets serviceable by truck. Two, the desulfurization technology to meet a 500 ppm cap has been commercially demonstrated for over a decade. The desulfurization technology to meet a 15 ppm cap will have been commercially demonstrated in mid-2006, a full four years prior to the implementation of the 15 ppm cap on nonroad diesel fuel. Three, the volume of fuel affected by the 15 ppm nonroad diesel fuel standard would be only one-seventh of that affected by the highway diesel fuel program. This dramatically reduces the required capital investment. Four, both Europe and Japan are implementing sulfur caps for highway and nonroad diesel fuel in the range of 10-15 ppm, eliminating these markets as a sink for high sulfur diesel fuel. Five, refineries outside of the U.S. and Europe are operating at a lower percentage of their capacity than U.S. refineries. Thus, U.S. refineries would not be able to obtain attractive prices for high sulfur diesel fuel overseas. Finally, refinery profit margins were much higher during the last part of 2000 and most of 2001 than over the past ten years, indicating a potential long-term improvement in profitability. Margins decreased again during most in 2002, but recovered during the last few months of that year and in early 2003.

In the fourth and final case, we evaluated whether the cost of the program could cause some refineries to cease operations completely. We do not believe that this would occur. One reason is that we have included a provision in the proposed regulations for adjustments to the sulfur caps for refiners facing unusual financial hardship. Another reason is that nonroad, locomotive and marine diesel fuel is usually the third or fourth most important product produced by the refinery from a financial perspective. A total shutdown would mean losing all the revenue and profit from these other products. Gasoline is usually the most important product, followed by highway diesel fuel and jet fuel. A few refineries do not produce either gasoline or highway diesel fuel, so jet fuel and high sulfur diesel fuel and heating oil are their most important products. The few refiners in this category likely face the biggest financial challenge in meeting today's proposed requirements. However, those refiners would also presumably be in the best position to apply for special hardship provisions, presuming that they do not have readily available source of investment capital. The additional time afforded by these provisions should allow the refiner to generate sufficient cash flow to invest in the required desulfurization equipment. Investment here could also provide them the opportunity to expand into more profitable (e.g., highway diesel) markets.

Therefore, consistent with our findings made during the 2007 highway diesel rule, we do not expect this proposed rule to cause any supply shortages of nonroad, locomotive and marine diesel fuel. The reader is referred to the DRIA for a more detailed discussion of the potential supply impact of this proposed rule.

6. Fuel Prices

We developed three projections for the potential impact of the proposed fuel program on fuel prices. This is due to the fact that fuel pricing is affected by a number of factors, most of which are outside the scope of this regulation. This makes the projection of fuel prices very difficult and highly uncertain. The range of potential price increases are shown in Table V-3.

Table V-3 Range of Possible Total Diesel Fuel Price Increases (cents per gallon) *

	Lower Limit	Mid-Point	Maximum
2007 500 ppm Sulfur Cap: Nonroad, Locomotive and Marine Diesel Fuel			
PADDs 1 and 3	0.9	1.5	3.4
PADD 2	2.3	3.0	4.8
PADD 4	1.7	4.1	5.8
PADD 5	1.0	2.8	4.3
2010 15 ppm Sulfur Cap: Nonroad Diesel Fuel			
PADDs 1 and 3	1.8	3.0	5.4
PADD 2	2.9	6.1	7.4
PADD 4	3.0	8.9	9.3
PADD 5	1.7	5.9	8.4

* At the current wholesale price of approximately $1.00 per gallon, these values also represent the percentage increase in diesel fuel price.

The lower end of the range assumes that prices within a PADD increased to reflect the highest operating cost increase faced by any refiner in that PADD. In this case, this refiner with the highest operating cost would not recover any of his invested capital, but all other refiners would recover some or all of their investment. In this case, the price of nonroad, locomotive and marine diesel fuel would increase in 2007 by 1-2 cents per gallon, depending on the area of the country. In 2010, the price of nonroad diesel fuel would increase a total of 2-3 cents per gallon. Locomotive and marine diesel fuel prices would continue to increase by 1-2 cents per gallon.

The mid-range estimate of price impacts assumes that prices within a PADD increase by the average refining and distribution cost within that PADD, including full recovery of capital (at 7 percent per annum before taxes). Lower cost refiners would recover more than their capital investment, while those with higher than average costs recover less. Under this assumption, the price of nonroad, locomotive and marine diesel fuel would increase in 2007 by 2-4 cents per gallon, depending on the area of the country. In 2010, the price of nonroad diesel fuel would increase a total of 3-9 cents per gallon. Locomotive and marine diesel fuel prices would continue to increase by 2-4 cents per gallon.

The upper end estimate of price impacts assumes that prices within a PADD increase by the maximum total refining and distribution cost of any refinery within that PADD, including full recovery of capital (at 7 percent per annum before taxes). All other refiners would recover more than their capital investment. Under this assumption, the price of nonroad, locomotive and marine diesel fuel would increase in 2007 by 3-6 cents per gallon, depending on the area of the country. In 2010, the price of nonroad diesel fuel would increase a total of 5-9 cents per gallon. Locomotive and marine diesel fuel prices would continue to increase by 3-6 cents per gallon.

B. Cost Savings to the Existing Fleet from the Use of Low Sulfur Fuel

We estimate that reducing fuel sulfur to 500 ppm would reduce engine wear and oil degradation to the existing nonroad diesel equipment fleet and that a further reduction to 15 ppm sulfur would result in even greater reductions. This reduction in wear and oil degradation would provide a dollar savings to users of nonroad equipment. The cost savings would also be realized by the owners of future nonroad engines that are subject to the standards in today's proposal. As discussed below, these maintenance savings have been conservatively estimated to be greater than 3 cents per gallon for the use of 15 ppm sulfur fuel when compared to the use of today's unregulated nonroad diesel fuel.

The draft RIA has catalogued a variety of benefits from the low-sulfur diesel fuel. These benefits are summarized in Table V.B-1.

Table V.B-1
Engine Components Potentially Affected by Lower Sulfur Levels in Diesel Fuel

Affected Components	Effect of Lower Sulfur	Potential Impact on Engine System
Piston Rings	Reduced corrosion wear	Extended engine life and less frequent rebuilds
Cylinder Liners	Reduced corrosion wear	Extended engine life and less frequent rebuilds
Oil Quality	Reduced deposits, reduced acid build-up, and less need for alkaline additives	Reduce wear on piston ring and cylinder liner and less frequent oil changes
Exhaust System (tailpipe)	Reduced corrosion wear	Less frequent part replacement
Exhaust Gas Recirculation System	Reduced corrosion wear	Less frequent part replacement

The monetary value of these benefits over the life of the equipment will depend upon the length of time that the equipment operates on low-sulfur diesel fuel and the degree to which engine and equipment manufacturers specify new maintenance practices and the degree to which equipment operators change engine maintenance patterns to take advantage of these benefits. For equipment near the end of its life in the 2008 time frame, the benefits will be quite small. However, for equipment produced in the years immediately preceding the introduction of 500 ppm sulfur fuel, the savings would be substantial. Additional savings would be realized in 2010 when the 15 ppm sulfur fuel would be introduced

We estimate the single largest savings would be the impact of lower sulfur fuel on oil change intervals. The draft RIA presents our analysis for the oil change interval extension which would be realized by the introduction of 500 ppm sulfur fuel in 2007, as well as the additional oil extension which would be realized with the introduction of 15 ppm sulfur nonroad diesel fuel in 2010. As explained in the draft RIA, these estimates are based on our analysis of publically available information from nonroad engine manufacturers. Due to the wide range of diesel fuel sulfur which today's nonroad engines may see around the world, engine manufacturers specify different oil change intervals as a function of diesel sulfur levels. We have used this data as the basis for our analysis. Taken together, when compared to today's relatively high nonroad diesel fuel sulfur levels, we estimate the use of 15 ppm sulfur fuel will enable an oil change interval extension of 35 percent from today's products.

We present here a fuel cost savings attributed to the oil change interval extension in terms of a cents per gallon operating cost. We estimate that an oil change interval extension of 31 percent, as would be enabled by the use of 500 ppm sulfur fuel in 2007, results in a fuel operating costs savings of 3.0 cents per gallon for the nonroad fleet. We project an additional cost savings of 0.3 cents per gallon for the oil change interval extension which would be enabled by the use of 15 ppm sulfur beginning in 2010. Thus, for the nonroad fleet as a whole, beginning in 2010 nonroad equipment users can realize an operating cost savings of 3.3 cents per gallon compared to today's engine. For a typical 100 horsepower nonroad engine this represents a net present value lifetime savings of more than $500.

These savings will occur without additional new cost to the equipment owner beyond the incremental cost of the low-sulfur diesel fuel, although these savings are dependent on changes to existing maintenance schedules. Such changes seem likely given the magnitude of the savings. We have not estimated the value of the savings from the other benefits listed in Table V.B-1, and therefore we believe the 3.3 cents per gallon savings is conservative as it only accounts for the impact of low sulfur fuel on oil change intervals.

C. Engine and Equipment Cost Impacts

The following sections briefly discuss the various engine and equipment cost elements considered for today's proposal and present the total costs we have estimated; the reader is referred to the draft RIA for a complete discussion. Estimated engine and equipment 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 today's proposed standards. The wide size variation (e.g., <4 horsepower engines through >2500 horsepower engines) and the broad application variation (e.g., lawn equipment through large mining trucks) that exists in the nonroad industry makes it difficult to present here an estimated cost for every possible engine and/or piece of equipment. Nonetheless, for illustrative purposes, we present some example per engine/equipment cost impacts throughout this discussion. This analysis is presented in detail in Chapter 6 of the draft RIA.

It is important to note that the costs presented here do not reflect any savings that are expected to occur because of the engine ABT program and the equipment manufacturer transition program, both of which are discussed in section VII. As discussed in the draft RIA, these optional programs have the potential to provide significant savings for both engine and equipment manufacturers. We request comment on the cost estimates presented here, and the underlying analysis presented in Chapter 6 of the draft RIA.

1. Engine Cost Impacts

Estimated engine costs are broken into fixed costs (for research and development, retooling, and certification), variable costs (for new hardware and assembly time), and life-cycle operating costs. Total operating costs include the estimated incremental cost for low-sulfur diesel fuel, any expected increases in maintenance costs associated with new emission control devices, any costs associated with increased fuel consumption, and any decreases in operating cost (i.e., maintenance savings) expected due to low-sulfur fuel. Cost estimates presented here represent an expected incremental cost of engines in the model year of their introduction. Costs in subsequent years would be reduced by several factors, as described below. All engine and equipment costs are presented in 2001 dollars.

a. Engine Fixed Costs

i. Engine and Emission Control Device R&D

The technologies described in Section III represent those technologies we believe will be used to comply with the proposed Tier 4 emission standards. These technologies are part of an ongoing research and development effort geared toward compliance with the 2007 heavy-duty diesel highway emission standards. The engine manufacturers making R&D expenditures toward compliance with highway emission standards will have to undergo some additional R&D effort to transfer emission control technologies to engines they wish to sell into the nonroad market. These R&D efforts will allow engine manufacturers to develop and optimize these new technologies for maximum emission-control effectiveness with minimum negative impacts on engine performance, durability, and fuel consumption. Many nonroad engine manufacturers are not part of the ongoing R&D effort toward compliance with highway emissions standards because they do not sell engines into the highway market. These manufacturers are expected to benefit from the R&D work that has already occurred and will continue through the coming years through their contact with highway manufacturers, emission control device manufacturers, and the independent engine research laboratories conducting relevant R&D.

Several technologies are projected for complying with the proposed Tier 4 emission standards. We are projecting that NOx adsorbers and catalyzed diesel particulate filters (CDPFs) would be the most likely technologies applied by industry to meet our proposed emissions standards for >75 horsepower engines. The fact that these technologies are being developed for implementation in the highway market prior to the implementation dates in today's proposal, and the fact that engine manufacturers would have several years before implementation of the proposed Tier 4 standards, ensures that the technologies used to comply with the nonroad standards would undergo significant development before reaching production. This ongoing development could lead to reduced costs in three ways. First, we expect research will lead to enhanced effectiveness for individual technologies, allowing manufacturers to use simpler packages of emission control technologies than we would predict given the current state of development. Similarly, we anticipate that the continuing effort to improve the emission control technologies will include innovations that allow lower-cost production. Finally, we believe that manufacturers would focus research efforts on any drawbacks, such as fuel economy impacts or maintenance costs, in an effort to minimize or overcome any potential negative effects.

We anticipate that, in order to meet the proposed standards, industry would introduce a combination of primary technology upgrades. Achieving very low NOx emissions would require basic research on NOx emission control technologies and improvements in engine management to take advantage of the exhaust emission control system capabilities. The manufacturers are expected to take a systems approach to the problem of optimizing the engine and exhaust emission control system to realize the best overall performance. Since most research to date with exhaust emission control technologies for nonroad applications has focused on retrofit programs, there remains room for significant improvements by taking such a systems approach. The NOx adsorber technology in particular is expected to benefit from re-optimization of the engine management system to better match the NOx adsorber's performance characteristics. The majority of the dollars we have estimated for research is expected to be spent on developing this synergy between the engine and NOx exhaust emission control systems. Therefore, for engines requiring both a CDPF and a NOx adsorber (i.e., >75 horsepower), we have attributed two-thirds of the R&D expenditures to NOx control, and one-third to PM control.

In the 2007 HD highway rule, we estimated that each engine manufacturer would expend $35 million for R&D to redesign their engines and apply catalyzed diesel particulate filters (CDPF) and NOx adsorbers. For their nonroad R&D efforts on engines requiring CDPFs and NOx adsorbers (i.e., >75 horsepower), engine manufacturers selling into the highway market would incur some level of R&D effort but not at the level incurred for the highway rule. In many cases, the engines used by highway manufacturers in nonroad products are based on the same engine platform as those used in highway products. However, horsepower and torque characteristics are often different so some effort will have to be expended to accommodate those differences. While we know the R&D required would not be zero, we believe it would be closer to zero than to the levels expected for the highway rule. Therefore, for these manufacturers, we have estimated that they would incur an R&D expense 10 percent of that incurred for the highway rule, or $3.5 million. This $3.5 million R&D expense would allow for the transfer of R&D knowledge from their highway experience to their nonroad engine product line. Two-thirds of this R&D is attributed to NOx control and one-third to PM control.

For those manufacturers that sell engines only into the nonroad market, and where those engines require a CDPF and a NOx adsorber, we believe that they will incur an R&D expense nearing that incurred by highway manufacturers for the highway rule, although not at the level incurred by highway manufacturers for the highway rule. Nonroad manufacturers would be able to learn from the R&D efforts already underway for both the highway rule and for the Tier 2 light-duty highway rule (65 FR 6698). This learning could be done via seminars, conferences, and contact with highway manufacturers, emission control device manufacturers, and the independent engine research laboratories conducting relevant R&D. Therefore, we have estimated an expenditure of 70 percent of that spent by highway manufacturers in their highway efforts. This lower number – $24.5 million versus $35 million in the highway rule – reflects the learning that would be done by nonroad manfacturers from the many other stakeholders in the diesel industry. Two-thirds of this R&D is attributed to NOx control and one-third to PM control.

For those engine manufacturers selling engines that would require CDPF-only R&D (i.e., 25 to 75 horsepower engines in 2013), we have estimated that the R&D they would incur would be roughly one-third that incurred by manufacturers conducting CDPF/NOx adsorber R&D. We believe this is a good estimate because CDPF technology is further along in its development than is NOx adsorber technology and, therefore, a 50/50 split would not be appropriate. Using this estimate, the R&D incurred by manufacturers selling any engines into both the highway and the nonroad markets would be $1.2 million, and the R&D for manufacturers selling engines into only the nonroad market would be roughly $8 million. All of this R&D is attributed to PM control.

For those engine manufacturers selling engines that would require DOC-only or some engine-out modification R&D (i.e., <75 horsepower engines in 2008), we have estimated that the R&D they would incur would be roughly one-half the amount estimated for their CDPF-only R&D. Using this estimate, the R&D incurred by manufacturers selling any engines into both the highway and nonroad markets would be roughly $600,000, and the R&D for manufacturers selling engines into only the nonroad market would be roughly $4 million. All of this R&D is attributed to PM control.

Some manufacturers of engines produce engines to specifications developed by other manufacturers. Such joint venture manufacturers do not conduct engine-related R&D but simply manufacture an engine designed and developed by another manufacturer. For such manufacturers, we have assumed no R&D expenditures given that we believe they will conduct no R&D themselves and will rely on their joint venture partner. This is true unless the parent company has no engine sales in the horsepower categories covered by the partner company. Under such a situation, we have accounted for the necessary R&D by attributing it to the parent company. We have also estimated that some manufacturers will choose not to invest in R&D for the US nonroad market due to low volume sales that cannot justify the expense. More detail on these assumptions and the number of manufacturers assumed not to expend R&D is presented in Chapter 6 of the draft RIA. We welcome comments and supporting documentation.

We have assumed that all R&D expenditures occur over a five year span preceding the first year any emission control device is introduced into the market. Where a phase-in exists (e.g., for NOx standards on >75 horsepower engines), expenditures are assumed to occur over the five year span preceding the first year NOx adsorbers would be introduced, and then to continue during the phase-in years; the expenditures would be incurred in a manner consistent with the phase-in of the standard. All R&D expenditures are then recovered by the engine manufacturer over an identical time span following the introduction of the technology. We assume a seven percent rate of return for all R&D. We have also attributed a portion of these R&D expenditures to engine sales outside the US because we believe US sales should not bear the full brunt of the R&D that will serve engines sold in countries with similar levels of emission control. We have estimated the portion of the R&D attributable to the US by comparing US GDP to the GDP of countries expected to have similar levels of emission control. Of these countries, the US GDP constitutes 42% of the total GDP and, therefore, we have attributed this amount to US sales.

Using this methodology, we have estimated the total R&D expenditures associated with today's proposed standards at $196 million.

ii. Engine-Related Tooling Costs

Once engines are ready for production, new tooling will be required to accommodate the assembly of the new engines. In the 2007 highway rule, we estimated approximately $1.6 million per engine line for tooling costs associated with CDPF/NOx adsorber systems. For the proposed nonroad Tier 4 standards, we have estimated that nonroad-only manufacturers would incur the same $1.6 million per engine line requiring a CDPF/NOx adsorber system and that these costs would be split evenly between NOx control and PM control. For those systems requiring only a CDPF, we have estimated one-half that amount, or $800,000 per engine line. For those systems requiring only a DOC or some engine-out modifications, we have applied a one-half factor again, or $400,000 per engine line. Tooling costs for CDPF-only and for DOC engines are attributed solely to PM control.

For those manufacturers selling into both the highway and nonroad markets, we have estimated one-half the baseline tooling cost, or $800,000, for those engine lines requiring a CDPF/NOx adsorber system. We believe this is reasonable since many nonroad engines are produced on the same engine line with their highway counterparts. For such lines, we believe very little to no tooling costs would be incurred. For engine lines without a highway counterpart, something approaching the $1.6 million tooling cost would be applicable. For this analysis, we have assumed a 50/50 split of engine product lines for highway manufacturers and, therefore, a 50 percent factor applied to the $1.6 million baseline. These tooling costs would be split evenly between NOx control and PM control. For engine lines <75 horsepower, we have used the same tooling costs as the nonroad-only manufacturers because these engines tend not to have a highway counterpart. Therefore, for those engine lines requiring only a CDPF (i.e., those between 25 and 75 horsepower), we have estimated a tooling cost of $800,000. Similarly, the tooling costs for DOC and/or engine-out engine lines has been estimated to be $400,000. Tooling costs for CDPF-only and for DOC engines are attributed solely to PM control.

We expect engines in the 25 to 50 horsepower range to apply EGR systems to meet the proposed NOx standards for 2013. For these engines, we have included an additional tooling cost of $40,000 per engine line, consistent with the EGR-related tooling cost estimated for 50-100 horsepower engines in our Tier 2/3 rulemaking. This tooling cost is applied equally to all engine lines in that horsepower range regardless of the markets into which the manufacturer sells. We have applied this tooling cost equally because engines in this horsepower range do not tend to have highway counterparts. Tooling costs for EGR systems are attributed solely to NOx control.

We have applied all the above tooling costs to all manufacturers that appear to actually make engines. We have not eliminated joint venture manufacturers because these manufacturers would still need to invest in tooling to make the engines even if they do not conduct any R&D. We have assumed that all tooling costs are incurred one year in advance of the new standard and are recovered over a five year period following implementation of the new standard; all tooling costs include a seven percent discount rate to reflect the time value of money. As done for R&D costs, we have attributed a portion of the tooling costs to US sales and a portion to sales in other countries expected to have similar levels of emission control. More information is contained in Chapter 6 of the draft RIA and we request comment on how we have applied our tooling cost estimates and to whom we have applied them.

Using this methodology, we estimate the total tooling expenditures associated with today's proposed standards at $67 million.

iii. Engine Certification Costs

Manufacturers will incur more than the normal level of certification costs during the first few years of implementation because so many engines will need to be certified to the new emission standards. We have estimated engine certification costs at $60,000 per new engine certification to cover testing and administrative costs. To this, we have added the certification fee of $2,156 per new engine family. We have applied these certification costs to only the US sold engines because the certification conducted for US sales is not presumed to fulfill the certification requirements of other countries. Applying these costs to each of the 665 engine families as they are certified to a new emissions standard results in total costs of $64 million expended during implementation of today's proposed standards. These costs are attributed to NOx and PM control consistent with the phase-in of the new emissions standards – where new NOx and PM standards are introduced together, the certification costs are split evenly; where only a new PM standard is introduced, the certification costs are attributed to PM only; where a NOx phase-in becomes 100% in a year after full implementation of a PM standard, the certification costs are attributed to NOx only. All certification costs are assumed to occur one year prior to the new emission standard and are then recovered over a five year period following compliance with the new standard; all certification costs include a seven percent discount rate to reflect the time value of money.

b. Engine Variable Costs

i. NOx Adsorber System Costs

The NOx adsorber system that we are anticipating would be applied for Tier 4 would be the same as that used for highway applications. In order for the NOx adsorber to function properly, a systems approach that includes a reductant metering system and control of engine A/F ratio is also necessary. Many of the new air handling and electronic system technologies developed in order to meet the Tier 2/3 nonroad engine standards can be applied to accomplish the NOx adsorber control functions as well. Some additional hardware for exhaust NOx or O_2 sensing and for fuel metering will likely be required. The cost estimates include a DOC for clean-up of hydrocarbon emissions that occur during NOx adsorber regeneration events. We have also assumed that warranty costs would increase due to the application of this new hardware. Chapter 6 of the draft RIA contains the details for how we estimated costs associated with the new NOx control technologies required to meet the proposed Tier 4 emission standards. These costs are estimated to increase engine costs by roughly $660 in the near-term for a 150 horsepower engine, and $2010 in the near-term for a 500 horsepower engine. In the long-term, we estimate these costs to be $540 and $1620 for the 150 horsepower and 500 horsepower engines, respectively.[243]

ii. Catalyzed Diesel Particulate Filter Costs

Catalyzed diesel particulate filters are experiencing increasing retrofit use in much of North America as low-sulfur diesel fuel becomes more readily available. These technologies are proving to be robust in their non-optimized retrofit applications requiring no modification to engine or vehicle control functions. We therefore anticipate that catalyzed diesel particulate filters can be integrated with new highway diesel engines with only a minimal amount of engine development. In fact, one engine manufacturer has introduced a diesel school bus equipped with a catalyzed diesel particulate filter and certified to the 2007 heavy-duty highway PM standard of 0.01 g/bhp-hr. However, nonroad applications are expected to present challenges beyond those of highway applications. For this reason, we anticipate that some additional hardware beyond the diesel particulate filter itself may be required to ensure that CDPF regeneration occurs. For some engines this may be new fuel control strategies that force regeneration under some circumstances, while in other engines it might involve an exhaust system fuel injector to inject fuel upstream of the CDPF to provide necessary heat for regeneration under some operating conditions. We estimate that the CDPF systems will add $750 to engine costs in the near-team for a 150 horsepower engine with $320 of that being the regeneration system, and $2660 in the near-term for a 500 horsepower engine with $370 of that being the regeneration system. In the long-term, we estimate these CDPF system costs to be $570 and $2030 for the 150 horsepower and the 500 horsepower engines, respectively.

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[243] We have estimated costs for all engines in all horsepower ranges, and these estimates are presented in detail in the draft RIA. Throughout this discussion of engine and equipment costs, we present costs for a 150 and a 500 horsepower engine for illustrative purposes.

iii. Closed-Crankcase Ventilation System Costs

We are proposing to eliminate the exemption that allows turbo-charged nonroad diesel engines to vent crankcase gases directly to the environment. Such engines are said to have an open crankcase system. We project that this requirement to close the crankcase on turbo-charged engines would force manufacturers to rely on engineered closed crankcase ventilation systems that filter oil from the blow-by gases prior to routing them into either the engine intake or the exhaust system upstream of the CDPF. We have estimated the initial cost of these systems to be roughly $30 for low horsepower engines and up to $120 or more for very high horsepower engines. These costs are incurred only by turbo-charged engines.

iv. Variable Costs for Engines Below 75 Horsepower

Today's proposal includes standards for engines <25 horsepower that begin in 2008, and two sets of standards for 25 to 75 horsepower engines – one set that begins in 2008 and another that begins in 2013. The 2008 standards for all engines <75 horsepower are of similar stringency and are expected to result in similar technologies. The 2013 standards for 25 to 75 horsepower engines are considerably more stringent than the 2008 standards and are expected to force the addition of a CDPF along with some other engine hardware to enable the proper functioning of that new technology. More detail on the mix of technologies expected for all engines <75 horsepower is presented in section III.

As discussed in section III, we expect manufacturers to comply with the 2008 standards through either engine improvements or through the addition of a DOC. From a cost perspective, we have projected that engines would comply by either adding a DOC or by making some engine modifications resulting in engine-out emission reductions. Presumably, the manufacturer would choose the least costly approach that provided the necessary reduction. To be conservative, we have projected that manufacturers would employ the more costly approach. Therefore, we have assumed that, beginning in 2008, all engines below 75 horsepower add a DOC. We have estimated this added hardware to result in an increased engine cost of $130 in the near-term and $125 in the long-term for a 30 horsepower engine.

We have also projected that some engines in the 25 to 75 horsepower range would have to upgrade their fuel systems to accommodate the CDPF. We have estimated the incremental costs for these fuel systems at roughly $700 in the 25-50 horsepower range, and around $400 in the 50-75 horsepower range. This difference reflects a different base fuel system, with the smaller engines assumed to have mechanical fuel systems and the larger engines assumed to already be electrical. The electrical systems will incur lower costs because they already have the control unit and electronic fuel pump. Also, we have assumed these fuel changes would occur for only direct injection (DI) engines; indirect injection engines (IDI) are assumed to remain IDI, but to add a regeneration system to ensure CDPF regeneration. These regeneration systems are estimated to cost approximately $320 in the near-term and $240 in the long-term for a 30 horsepower engine.

We have also projected that some engines in the 25-50 horsepower range would add EGR to comply with their new NOx standard. We have estimated that this would add $110 in the near-term and $80 in the long-term to the cost of a 30 horsepower engine.

We believe there are factors that would cause variable hardware costs to decrease over time, making it appropriate to distinguish between near-term and long-term costs. Research in the costs of manufacturing has consistently shown that as manufacturers gain experience in production, they are able to apply innovations to simplify machining and assembly operations, use lower cost materials, and reduce the number or complexity of component parts.[244] Our analysis, as described in more detail in the draft RIA, incorporates the effects of this learning curve by projecting that the variable costs of producing the low-emitting engines decreases by 20 percent starting with the third year of production. For this analysis, we have assumed a baseline that represents such learning already having occurred once due to the 2007 highway rule (i.e., a 20 percent reduction in emission control device costs is reflected in our near-term costs). We have then applied a single learning step from that point in this analysis. We invite comment on this methodology to account for the learning curve phenomenon and also request comment on whether learning is likely to reduce costs even further in this industry (e.g., should a second learning step be applied to our near-term costs?). Additionally, manufacturers are expected to apply ongoing research to make emission controls more effective and to have lower operating costs over time. However, because of the uncertainty involved in forecasting the results of this research, we conservatively have not accounted for it in this analysis.

c. Engine Operating Costs

We are projecting that a variety of new technologies will be introduced to enable nonroad engines to meet the proposed Tier 4 emissions standards. Primary among these are advanced emission control technologies and low-sulfur diesel fuel. The technology enabling benefits of low-sulfur diesel fuel are described in Section III, and the incremental cost for low-sulfur fuel is described in Section V.A. The new emission control technologies are themselves expected to introduce additional operating costs in the form of increased fuel consumption and increased maintenance demands. Operating costs are estimated in the draft RIA over the life of the engine and are expressed in terms of cents/gallon of fuel consumed. In section V.C.3, we present these lifetime operating costs as a net present value (NPV) in 2001 dollars for several example pieces of equipment.

Total operating cost estimates include the following elements: the change in maintenance

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[244] "Learning Curves in Manufacturing," Linda Argote and Dennis Epple, *Science,* February 23, 1990, Vol. 247, pp. 920-924.

costs associated with applying new emission controls to the engines; the change in maintenance costs associated with low sulfur fuel such as extended oil change intervals; the change in fuel costs associated with the incrementally higher costs for low sulfur fuel, and the change in fuel costs due to any fuel consumption impacts associated with applying new emission controls to the engines. This latter cost is attributed to the CDPF and its need for periodic regeneration which we estimate may result in a one percent fuel consumption increase. Maintenance costs associated with the new emission controls on the engines are expected to increase since these devices represent new hardware and, therefore, new maintenance demands. For CDPF maintenance, we have used a maintenance interval of 3,000 hours for smaller engines and 4,500 hours for larger engines and a cost of $65 through $260 for each maintenance event. For CCV systems, we have used a maintenance interval of 675 hours for all engines and a cost per maintenance event of $8 to $48 for small to large engines. Offsetting these maintenance cost increases would be a savings due to an expected increase in oil change intervals because low sulfur fuel would be far less corrosive than is current nonroad diesel fuel. Less corrosion would mean a slower acidification rate (i.e., less degradation) of the engine lubricating oil and, therefore, more operating hours between needed oil changes. As discussed in Section V.B, the use of 15 ppm sulfur fuel can extend oil change intervals by as much as 35 percent for both new and existing nonroad engines and equipment. We have used a 35 percent increase in oil change interval along with costs per oil change of $70 through $400 to arrive at estimated savings associated with increased oil change intervals.

These operating costs are expressed as a cent/gallon cost (or savings). As a result, operating costs are directly proportional to the amount of fuel consumed by the engine. We have estimated these operating costs, inclusive of fuel-related costs, to be 3.4 cents/gallon for a 150 horsepower engine and 4.2 cents/gallon for a 500 horsepower engine. More detail on operating costs can be found in Chapter 6 of the draft RIA.

The existing fleet will also benefit from lower maintenance costs due to the use of low sulfur diesel fuel. The operating costs for the existing fleet are discussed in Section V.B.

2. Equipment Cost Impacts

In addition to the costs directly associated with engines that incorporate new emission controls to meet new standards, we expect cost increases due to the need to redesign the nonroad equipment in which these engines are used. Such redesigns would probably be necessary due to the expected addition of new emission control systems, but could also occur if the engine has a different shape or heat rejection rate, or is no longer made available in the configuration previously used. Based on their past experiences, equipment manufacturers have told EPA that a major concern with a new standard is their ability to redesign a large number of applications in a short period of time. Therefore, we have provided equipment manufacturers transition flexibility provisions to help them avoid business disruptions resulting from the changes associated with new emission standards. These flexibility provisions are presented in detail in section III.E.4.

In assessing the economic impact of the new emission standards, EPA has made a best estimate of the modifications to equipment that relate to packaging (installing engines in equipment engine compartments). The incremental costs for new equipment would be comprised of fixed costs (for redesign to accommodate new emission control devices) and variable costs (for new or modified equipment hardware and for labor to install new emission control devices). Note that the fixed costs do not include certification costs, as did the engine fixed costs, because equipment is not certified to emission standards. We have attributed all changes in operating costs (e.g., additional maintenance) to the cost estimates for engines. Included in section V.C.3 is a discussion of several example pieces of equipment (e.g., skid/steer loader, dozer, etc.) and the costs we have estimated for these specific example pieces of equipment Full details of our equipment cost analysis can be found in Chapter 6 of the draft RIA. All costs are presented in 2001 dollars.

a. Equipment Fixed Costs

The most significant changes anticipated for equipment redesign are changes to the engine compartment to accommodate the physical changes to engines, especially for those engines that add PM traps and NOx adsorbers. The costs for engine development and the emission control devices are included as costs to the engines, as described above. What remains to be quantified for equipment manufacturers is the effort to make space for the larger engine system and to integrate the engine with emission control devices into the overall functioning of the equipment. We have allocated extensive engineering time for this effort.

For this analysis, we have tried to estimate the amount of engineering time and money that would be needed to redesign a piece of nonroad equipment to accommodate an aftertreatment equipped engine. Several factors influence the decision of resource allocation within a company’s product line making it difficult to estimate redesign costs for our analysis that are representative of every manufacturer. These factors include, but are not limited to: the resources available to redesign equipment versus other demands within the company; the sensitivity of the piece of equipment’s sales volume to price; the sales volume of one application relative to another application within a manufacturer’s product line; the time required for a redesign; and, the job for which the equipment is designed (e.g., a generator set would be expected to require less redesign effort than an agricultural tractor due in part to the latter’s need for a propulsion system).

The dollar values we have used are based on engine power and whether an application is non-motive (e.g., a generator set) or motive (e.g., a skid steer loader). The designs we have considered to be non-motive are those that lack a propulsion system. In addition, the proposed emission standards for engines rated under 25 horsepower and the proposed 2008 standards for 25-75 horsepower engines are projected to require no significant equipment redesign beyond that done to accommodate Tier 2. We expect that these engines would comply with today’s proposed standards through either engine modifications to reduce engine-out emissions or through the addition of a DOC. We have projected that engine modifications would not affect the outer dimensions of the engine and that a DOC would replace the existing muffler. Therefore, either approach taken by the engine manufacturer should have minimal to no impact on the equipment design. Nonetheless, we have conservatively estimated their redesign costs at $50,000 per model.

A number of equipment manufacturers have shared detailed information with us regarding the investments made for Nonroad Tier 2 equipment redesign efforts, as well as redesign estimates for significant changes such as installing a new engine design. These estimates range from approximately $50,000 for some lower powered equipment models to well over $1 million dollars for high horsepower equipment with very challenging design constraints. For today's proposed standards, we have estimated that equipment redesign costs would range from $50,000 per model for 25 horsepower equipment up to $750,000 per model for 300 horsepower equipment and above. We have attributed only a portion of the equipment redesign costs to US sales in a manner consistent with that taken for engine R&D costs and engine tooling costs. In addition, we expect manufacturers to incur some fixed costs to update service and operation manuals to address the maintenance demands of new emission control technologies and the new oil service intervals which we estimate to be between $2,500 and $10,000 per equipment model.

These equipment fixed costs (redesign and manual updates) were then allocated appropriately to each new model to arrive at a total equipment fixed cost of $698 million. We have assumed that these costs would be recovered over a ten year period at a seven percent interest rate.

b. Equipment Variable Costs

Equipment variable cost estimates are based on costs for additional sheet metal to shroud the new aftertreatment devices, the brackets and bolts required to secure the aftertreatment devices and shroud within the equipment, and the labor required to install the new aftertreatment devices and shroud. For engines >75 horsepower – those expected to incorporate CDPF and NOx adsorber technology – the size of the shroud is based on the size of the aftertreatment devices giving consideration to the ability to eliminate the muffler when adding the DOC which is part of the NOx adsorber technology.

For equipment of 150 horsepower and 500 horsepower, respectively, we have estimated the costs to be $55 to $135. More detail regarding equipment variable costs is presented in Chapter 6 of the draft RIA.

3. Overall Engine and Equipment Cost Impacts

To better illustrate the engine and equipment cost impacts we are estimating for today's proposed standards, we have chosen several example pieces of equipment and presented the estimated costs for them. Using these examples, we can calculate the costs for a specific piece of equipment in several horsepower ranges and better illustrate the cost impacts of today's proposed standards. These costs along with information about each example piece of equipment are shown in Table V.C-1. Costs presented are near-term and long-term costs for the final standards to which each piece of equipment would comply. Long-term costs are only variable costs and, therefore, represent costs after all fixed costs have been recovered. Included in the table are estimated prices for each piece of equipment to provide some perspective on how our estimated control costs relate to existing equipment prices.

Table V.C-1
Near-Term and Long-Term Costs for Several Example Pieces of Equipment[a]
($2001, for the final emission standards to which the equipment must comply)

	GenSet	Skid/Steer Loader	Backhoe	Ag Tractor	Dozer	Off-Highway Truck
Horsepower	9 hp	33 hp	76 hp	250 hp	503 hp	1000 hp
Engine & Equipment Cost Long-Term (Near-Term)	$100 ($150)	$1,050 ($1,240)	$970 ($1,360)	$1,710 ($2,820)	$3,670 ($5,820)	$6,910 ($10,360)
Estimated Price when New[b]	$3,500	$15,500	$50,000	$130,000	$575,000	$700,000
Incremental Operating Costs[c]	-$90	$30	$400	$1,430	$5,410	$13,780
Baseline Operating Costs (Fuel & Oil only)[c]	$1,230	$3,840	$12,320	$37,710	$125,030	$290,010

a. Near-term costs include both variable costs and fixed costs; long-term costs include only variable costs and represent those costs that remain following recovery of all fixed costs.
b. Zuimdie Guerra Memo to docket.
c. Present value of lifetime costs.

More detail and discussion regarding what these costs and prices mean from an economic impact perspective can be found in section V.E.

D. Annual Costs and Cost Per Ton

One tool that can be used to assess the value of today's proposed standards for nonroad fuel and engines is the 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.

We have calculated the cost per ton of our proposed program based on the net present value of all costs incurred and all emission reductions generated over a 30 year time window following implementation of the program. This approach captures all of the costs and emissions reductions from our proposed program including those costs incurred and emissions reductions generated by the existing fleet. The baseline (i.e., the point of comparison) for this evaluation is the existing set of engine standards (i.e., the Tier 2/Tier 3 program). The 30-year time window chosen 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 proposed standards.

As discussed in section IV, today's proposal contains two separate fuel programs. We are proposing a 500 ppm sulfur cap on nonroad, locomotive, and marine fuels beginning in 2007. This fuel program, the first step in our two step fuel program, provides significant air quality benefits through reduced SO_2 and PM emissions from both new and existing nonroad, locomotive, and marine engines. In sections V.D.1 and 2, we summarize the cost for this program as if it remained in place for 30 years, even though it would be supplanted by the second step of our fuel program in 2010. We also provide an analysis of the cost per ton for the SO_2 reductions that would be realized by the 500 ppm fuel program for the same 30 year time window. In this way, the cost per ton of the SO_2 reductions realized by the 500 ppm fuel program can be compared to other available means to control SO_2 emissions. The significant PM reductions are not accounted for in the relative cost per ton estimate, but are accounted for in our inventory analysis presented in section II and in the benefits analysis presented later in this section. Additional detail regarding all of the estimates presented here are available in the draft RIA.

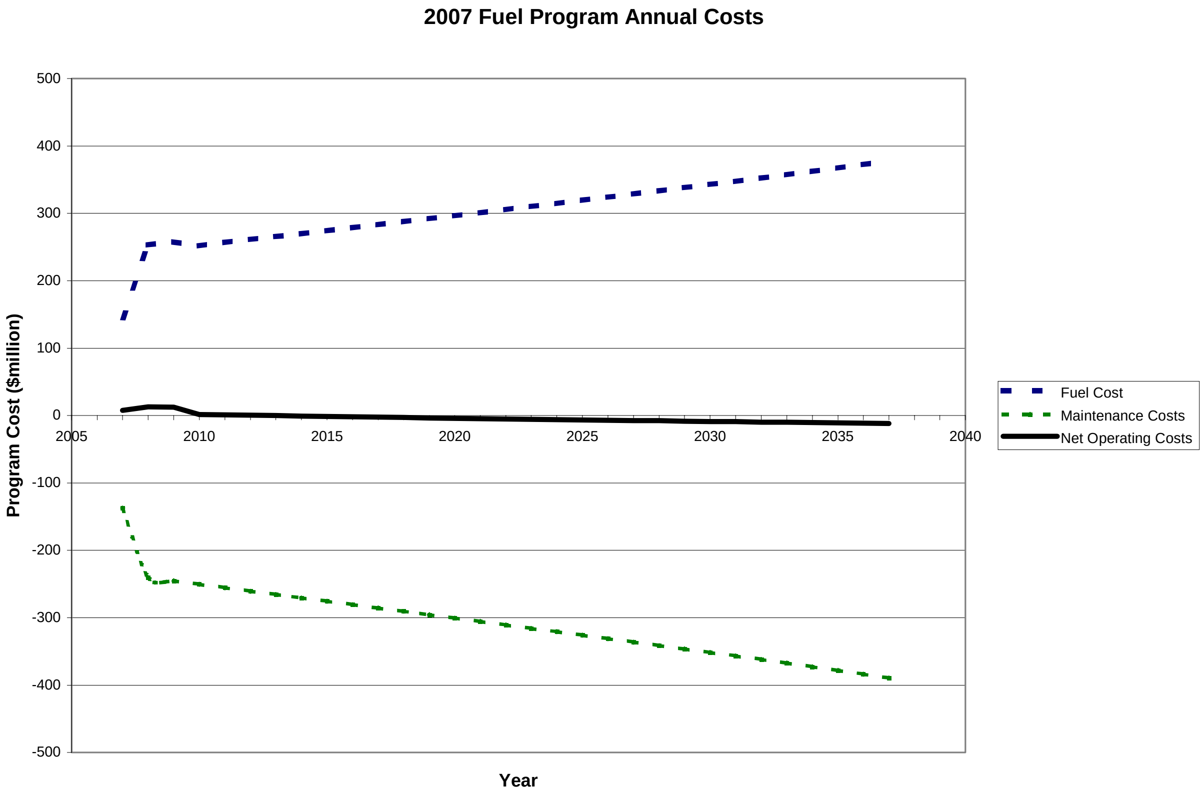
We are also proposing a second step in the fuel program that would cap nonroad fuel sulfur levels at 15 ppm beginning in 2010. This fuel program enables the introduction of advanced emission control technologies including CDPFs and NOx adsorbers. The combination of the two-step fuel program and the new diesel engine standards represents the total Tier 4 program for nonroad diesel engines and fuel proposed today. In sections V.D.3 and 4, we present our estimate of the annual and total costs for this complete program beginning in 2007 and continuing for 30 years. Also included is an estimate of the cost per ton of emissions reductions realized by this program for NMHC+NOx, PM, and SO_2.

1. Annual Costs for the 2007 Fuel Program

Costs for the proposed 2007 fuel program (i.e., the reduction to a 500 ppm sulfur cap) were presented in section V.A. Having this fuel would result in maintenance savings associated with increased oil change intervals for both the new and the existing fleet of nonroad, locomotive, and marine engines. These maintenance savings were discussed in section V.B. There are no engine and equipment costs associated with the 2007 fuel program. Figure V.D-1 shows the annual costs associated with the 2007 fuel program.

As can be seen in Figure V.D-1, the costs of the program range from $250 million in 2008 to $370 million in 2037. These control costs are offset by the maintenance savings that range from $240 million in 2008 to $380 million in 2037. As a result, the net cost of the program in each year is essentially zero, ranging from $13 million in the early years to negative $11 million in 2037. The shift from positive to negative net costs are the result of a decrease in fuel cost in 2010; this decreased fuel cost is the result of the lower distribution costs once high sulfur nonroad fuel is eliminated from the distribution system. The net present value of the costs and savings associated with the proposed 2007 fuel program during the years 2007 to 2036 is estimated at -$38 million.

Figure V.D-1



2. Cost Per Ton for the 2007 Fuel Program

The 2007 fuel program would result in large reductions of both SO_2 and PM emissions. Roughly 98 percent of fuel sulfur is converted to SO_2 in the engine with the remaining two percent being exhausted as sulfate PM. Because the majority of the emissions reductions associated with this program would be SO_2, we have attributed all the control costs to SO_2 in calculating the cost per ton associated with this program. However, we have modeled both the SO_2 and PM reductions so that our air quality analysis and benefits analysis fully account for them.

As noted above, we have calculated both costs and emission reductions of the 2007 fuel program as if it were to remain in place indefinitely. Figure V.D-1 shows the costs in each year of the program, the net present value of which are estimated at -$38 million. We have estimated the 30 year net present value of the SO_2 emission reductions at 5.2 million tons.

Table V.D-1 shows the cost per ton of emissions reduced as a result of the proposed 2007 fuel program. The cost per ton numbers include costs and emission reductions that would occur from both the new and the existing fleet (i.e., those pieces of nonroad equipment that were sold into the market prior to the proposed emission standards) of nonroad, locomotive, and marine engines.

Table V.D-1
2007 Fuel Program
Summary of Aggregate Cost per Ton and Long-Term Annual Cost Per Ton
($2001)

Pollutant	Aggregate 2004-2036 Discounted Lifetime Cost per ton	Long-Term Cost per Ton in 2036
SO_2	($10)	($30)

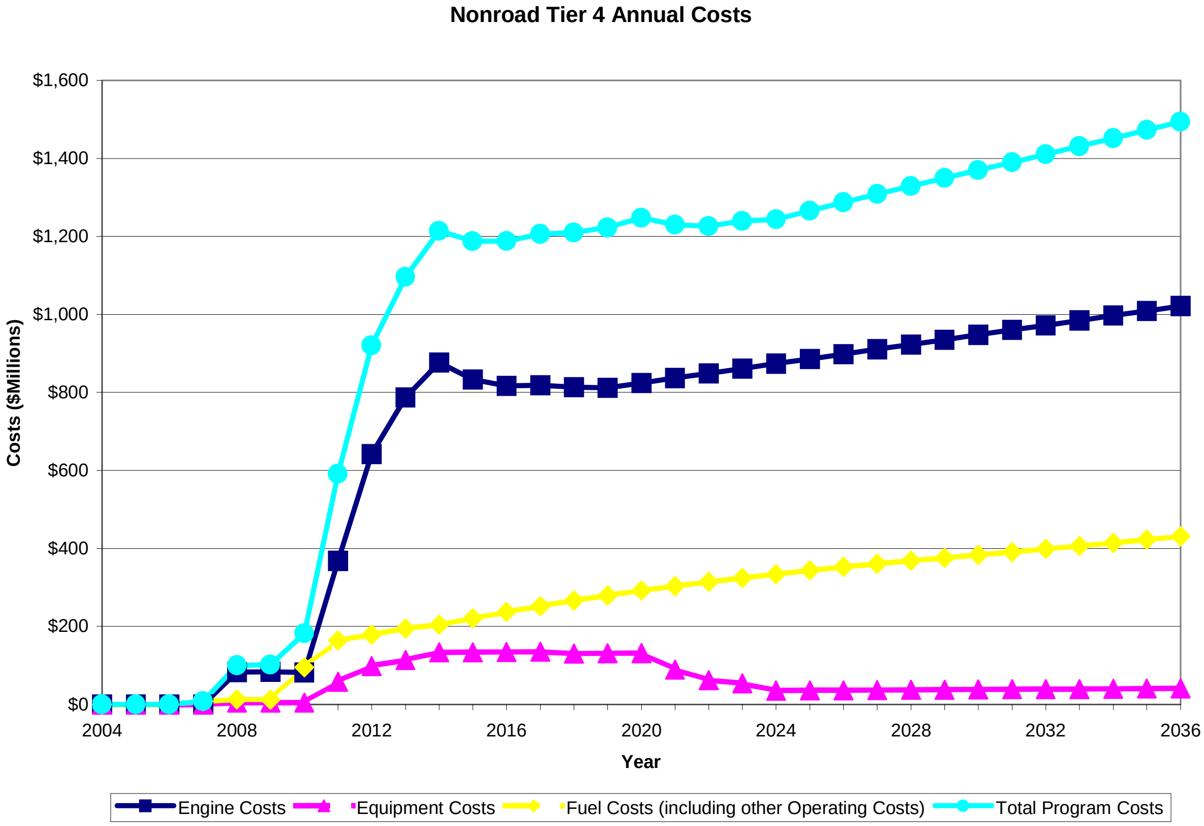
We also considered the cost per ton of the 2007 fuel program without taking credit for the expected maintenance savings associated with low sulfur fuel. Without the maintenance savings, the cost per ton of SO_2 reduced would be $1,000 per ton for each year of the program. More detail on how the costs and cost per ton numbers associated with the 2007 fuel program were calculated can be found in the draft RIA.

3. Annual Costs for the Total Program

The costs of today's proposed engine and fuel program include costs associated with both steps in the fuel program – the reduction to 500 ppm sulfur in 2007 and the reduction to 15 ppm sulfur in 2010. Also included are costs for the 2008 engine standards for <75 horsepower engines, and costs for the engine standards proposed for >75 horsepower engines. Also included are all maintenance costs and savings realized by both the existing fleet (nonroad, locomotive, and marine) and the new fleet of engines complying with the proposed standards.

Figure V.D-2 presents these results. All capital costs for fuel production and engine and equipment fixed costs have been amortized. The figure shows that total annual costs are estimated to be $200 million in the first year the new engine standards apply, increasing to a peak of $1.6 billion in 2036 as increasing numbers of engines become subject to the new standards and an ever increasing amount of fuel is consumed. The costs increase with time due to engine sales growth and as more low sulfur fuel is consumed. The present value of the annualized costs over the period from 2004 to 2036 would be $18.8 billion.

Figure V.D-2



4. Cost per Ton of Emissions Reduced for the Total Program

We have calculated the cost per ton of emissions reduced associated with today's proposed engine and fuel program. We have done this using the net present value of the annualized costs of the program through 2036 and the net present value of the annual emission reductions through 2036. We have also calculated the cost per ton of emissions in the year 2034 using the annual costs and emission reductions in that year alone. This number represents the long-term cost per ton of emissions reduced after all fixed costs of the program have been recovered by industry leaving only the variable costs of control. The cost per ton numbers include costs and emission reductions that would occur from the existing fleet (i.e., those pieces of nonroad equipment that were sold into the market prior to the proposed emission standards). These results are shown in Table V.D-2.

Table V.D-2
Total Proposed Program
Summary of Aggregate Cost per Ton
and Long-Term Annual Cost Per Ton ($2001)

Pollutant	Aggregate 2004-2036 Discounted Lifetime Cost per ton	Long-Term Cost per Ton in 2034
NOx+NMHC	$810	$530
PM	$8,200	$6,400
SO_2	$140	$160

5. Comparison With Other Means of Reducing Emissions

In comparison with other mobile source control programs, we believe that today's proposed programs represent a cost effective strategy for generating substantial NOx+NMHC, PM, and SO2 reductions. This can be seen by comparing the 2007 fuel program (i.e., a sulfur cap of 500 ppm) cost per ton and the total program cost per ton with a number of mobile source standards that EPA has adopted in the past. Table V.D-3 summarizes the cost per ton of several past EPA actions for NOx+NMHC. Table V.D-4 summarizes the cost per ton of several past EPA actions for PM.

Table V.D-3
Cost Per Ton of Previous
Mobile Source Programs for NOx + NMHC

Program	*$/ton*
Tier 2 Nonroad Diesel	630
Tier 3 Nonroad Diesel	430
Tier 2 vehicle/gasoline sulfur	1,410 - 2,370
2007 Highway HD	2,260
2004 Highway HD	220 - 430
Off-highway diesel engine	450 - 710
Tier 1 vehicle	2,160 - 2,930
NLEV	2030
Marine SI engines	1,230 - 1,940
On-board diagnostics	2,430
Marine CI engines	30 - 190

Note: Costs adjusted to 2001 dollars using the Producer Price Index for Total Manufacturing Industries.

Table V.D-4
Cost Per Ton of Previous
Mobile Source Programs for PM

Program	*$/ton*
Tier 1/Tier 2 Nonroad Diesel	2,410
2007 Highway HD	14,280
Marine CI engines	5,480 -4,070
1996 urban bus	12,870 - 20,590
Urban bus retrofit/rebuild	31,740
1994 highway HD diesel	21,930 - 25,670

Note: Costs adjusted to 2001 dollars using the Producer Price Index for Total Manufacturing Industries.

To compare the cost per ton of SO_2 emissions reduced, we looked at the cost per ton for future EGU controls. The SO_2 cost per ton results of today's proposed program presented in Table V.D-2 compare very favorably with the programs shown in Table V.D-5.

Table V.D-5
Cost Per Ton of SO_2 from Future EGU
Emission Controls

Program	$/ton
Future EGU Emission Control	$1250* in 2010

*2001 dollars

E. Do the Benefits Outweigh the Costs of the Standards?

Our analysis of the health and welfare benefits to be expected from this proposal are presented in this section. Briefly, the analysis projects major benefits throughout the period from initial implementation of the rule through 2030, the last year analyzed. As described below, thousands of deaths and other serious health effects would be prevented, yielding a net present value in 2004 of those benefits we could monetize of approximately $520 billion dollars. These benefits exceed the net present value of the social cost of the proposal ($14 billion) by a factor of nearly 40 to one.***[Note: Visibility benefits will be provided very soon and will be added to this total benefit estimate]***

1. What were the results of the benefit-cost analysis?

Table V.E-1 presents the primary estimate of reduced incidence of PM-related health effects for the years 2020 and 2030. In interpreting the results, it is important to keep in mind the limited set of effects we are able to monetize. Specifically, the table lists the PM-related benefits associated with the reduction of several health effects.[245] In 2030, we estimate that there will be 9,600 fewer fatalities per year associated with fine PM, and the rule will result in about 5,700 fewer cases of chronic bronchitis, 4,500 fewer hospitalizations (for respiratory and cardiovascular disease combined), and result in significant reductions in days of restricted activity due to respiratory illness (with an estimated 6 million fewer cases). We also estimate substantial health improvements for children from reduced upper and lower respiratory illness,

[245] Based upon recent preliminary findings by the Health Effects Institute, the concentration-response functions used to estimate reductions in hospital admissions may over- or underestimate the true concentration-response relationship. See Letter from Dan Greenberg, President, Health Effects Institute, May 30, 2002, attached to letter from Dr. Hopke, dated August 8, 2002. Docket A-2000-01, Document IV-A-145.

acute bronchitis, and asthma attacks.[246]

Table V.E-2 presents the total monetized benefits for the years 2020 and 2030. This table also indicates with a "B" those additional health and environmental effects which we were unable to quantify or monetize. These effects are additive to estimate of total benefits, and EPA believes there is considerable value to the public of the benefits that could not be monetized. A full listing of the benefit categories that could not be quantified or monetized in our estimate are provided in Table V.E-5.

In summary, EPA's primary estimate of the benefits of the rule are approximately $79 + B billion in 2030. In 2020, total monetized benefits are approximately $42 + B billion. 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 account for over 90 percent of total benefits.

[246] Our estimate incorporates significant reductions of 150,000 fewer cases of lower respiratory symptoms in children ages 7 to 14 each year, 110,000 fewer cases of upper respiratory symptoms (similar to cold symptoms) in asthmatic children each year, and 14,000 fewer cases of acute bronchitis in children ages 8 to 12 each year. In addition, we estimate that this rule will reduce almost 6,000 emergency room visits for asthma attacks in children each year from reduced exposure to particles. Additional incidents would be avoided from reduced ozone exposures. Asthma is the most prevalent chronic disease among children and currently affects over seven percent of children under 18 years of age.

Table V.E-1
Reductions in Incidence of PM-related Adverse Health Effects Associated with the Proposed Nonroad Diesel Engine and Fuel Standards

Endpoint	Avoided Incidence[A] (cases/year)	
	2020	2030
Premature mortality[B] - Base estimate: Long-term exposure (adults, 30 and over)	5,200	9,600
Chronic bronchitis (adults, 26 and over)	3,600	5,700
Non-fatal myocardial infarctions (adults, 18 and older)	9,200	16,000
Hospital admissions – Respiratory (adults, 20 and older)[C]	2,400	4,500
Hospital admissions – Cardiovascular (adults, 20 and older)[D]	1,900	3,800
Emergency Room Visits for Asthma (18 and younger)	3,600	5,700
Acute bronchitis (children, 8-12)	8,300	14,000
Lower respiratory symptoms (children, 7-14)	92,000	150,000
Upper respiratory symptoms (asthmatic children, 9-11)	77,000	110,000
Work loss days (adults, 18-65)	650,000	960,000
Minor restricted activity days (adults, age 18-65)	3,800,000	5,700,000

[A] Incidences are rounded to two significant digits.
[B] Premature mortality associated with ozone is not separately included in this analysis
[C] Respiratory hospital admissions for PM includes admissions for COPD, pneumonia, and asthma.
[D] Cardiovascular hospital admissions for PM includes total cardiovascular and subcategories for ischemic heart disease, dysrhythmias, and heart failure.

Table V.E-2
EPA Primary Estimate of the Annual Quantified and Monetized Benefits Associated with Improved PM Air Quality Resulting from the Proposed Nonroad Diesel Engine and Fuel Standards

Endpoint	Monetary Benefits[A,B] (millions 2000$, Adjusted for Income Growth)	
	2020	2030
Premature mortality[C] Long-term exposure, (adults, 30 and over)	$39,000	$74,000
Chronic bronchitis (WTP valuation; adults, 26 and over)	$1,600	$2,600
Non-fatal myocardial infarctions	$750	$1,300
Hospital Admissions from Respiratory Causes	$37	$73
Hospital Admissions from Cardiovascular Causes	$42	$82
Emergency Room Visits for Asthma	$1	$2
Acute bronchitis (children, 8-12)	$3	$5
Lower respiratory symptoms (children, 7-14)	$2	$3
Upper respiratory symptoms (asthmatic children, 9-11)	$2	$3
Work loss days (adults, 18-65)	$89	$130
Minor restricted activity days (adults, age 18-65)	$210	$320
Recreational visibility (86 Class I Areas)		
Total Monetized Benefits[H]	$42,000 + B	$79,000 + B

[A] Monetary benefits are rounded to two significant digits.
[B] Monetary benefits are adjusted to account for growth in real GDP per capita between 1990 and the analysis year (2020 or 2030).
[C] Valuation assumes the 5 year distributed lag structure described earlier. Results reflect the use of two different discount rates; a 3% rate which is recommended by EPA's Guidelines for Preparing Economic Analyses (US EPA, 2000a), and 7% which is recommended by OMB Circular A-94 (OMB, 1992).
[D] Respiratory hospital admissions for PM includes admissions for COPD, pneumonia, and asthma.
[E] Cardiovascular hospital admissions for PM includes total cardiovascular and subcategories for ischemic heart disease, dysrhythmias, and heart failure.
[G] **B** represents the monetary value of the unmonetized health and welfare benefits. A detailed listing of unquantified PM, ozone, CO, and NMHC related health effects is provided in Table V.E-5.

The estimated social cost (measured as changes in consumer and producer surplus) in 2030 to implement the final rule from Table V.F-2 is $1.2 billion (2000$). Thus, the net benefit (social benefits minus social costs) of the program at full implementation is approximately $77 + B billion. In 2020, partial implementation of the program yields net benefits of $40 + B billion. Therefore, implementation of the final rule is expected to provide society with a net gain in social welfare based on economic efficiency criteria. Table V.E-3 presents a summary of the benefits, costs, and net benefits of the proposed rule. Figure V-E.1 displays the stream of benefits, costs, and net benefits of the Nonroad Land-based Diesel Vehicle Rule from 2007 to 2030. In addition, Table V-E.4 presents the net present value of the stream of benefits, costs, and net benefits associated with the rule for this 23 year period (using a three percent discount rate). The total net present value of the stream of net benefits (benefits minus costs) is $510 billion.

Table V.E-3
Summary of Benefits, Costs, and Net Benefits of the Proposed Nonroad Diesel Engine and Fuel Standards

	2020[A] (Billions of 2000 dollars)	2030 [A] (Billions of 2000 dollars)
Social Costs[B]	$1.1	$1.2
Social Benefits[B, C, D]:		
CO, VOC, Air Toxic-related benefits	Not monetized	Not monetized
Ozone-related benefits	Not monetized	Not monetized
PM-related Welfare benefits	Not monetized	Not monetized
PM-related Health benefits	$42 + B	$79 + B
Net Benefits (Benefits-Costs)[C, D]	$40 + B	$77 + B

[A] All costs and benefits are rounded to two significant digits.
[B] Note that costs are the total costs of reducing all pollutants, including CO, VOCs and air toxics, as well as NOx and PM. Benefits in this table are associated only with PM, NOx and SO2 reductions.
[C] Not all possible benefits or disbenefits are quantified and monetized in this analysis. Potential benefit categories that have not been quantified and monetized are listed in Table V.E-5. B is the sum of all unquantified benefits and disbenefits.
[D] Monetized benefits are presented using two different discount rates. Results calculated using 3 percent discount rate are recommended by EPA's *Guidelines for Preparing Economic Analyses* (U.S. EPA, 2000a). Results calculated using 7 percent discount rate are recommended by OMB Circular A-94 (OMB, 1992).

Figure V.E-1
Stream of Benefits, Costs, and Net Benefits of the Proposed Nonroad Diesel Engine and Fuel Standards

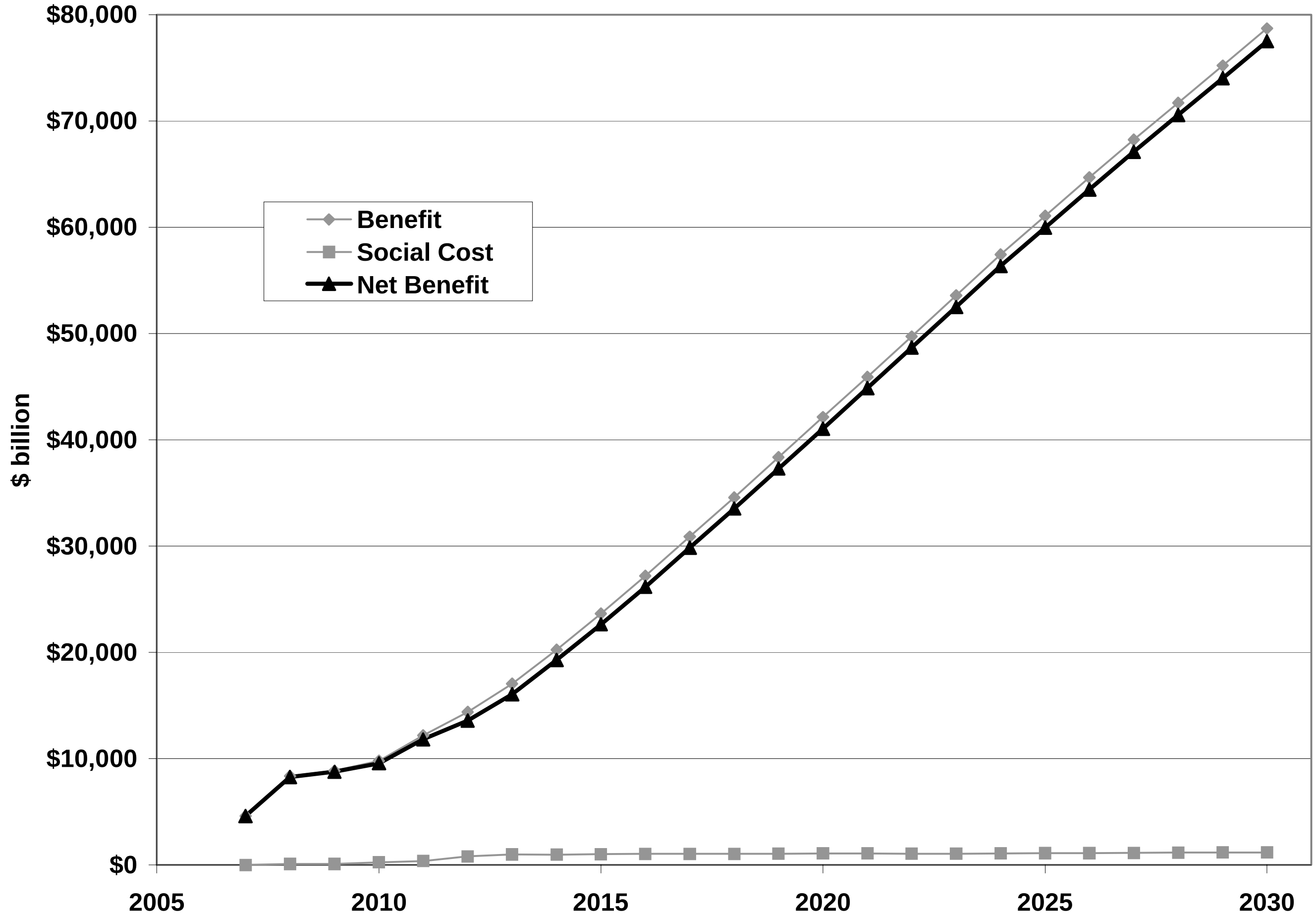


Table V.E-4
Net Present Value in 2004 of the Stream of Benefits, Costs, and Net Benefits for the Proposed Nonroad Diesel Engine and Fuel Standards
(Billions of 2000$)

Social Costs	**$14**
Social Benefits	**$520**
Net Benefits	**$510**

2. What was our overall approach to the benefit-cost analysis?

The basic question we sought to answer in the benefit-cost analysis was, ``What are the net yearly economic benefits to society of the reduction in mobile source emissions likely to be achieved by this proposed rulemaking?" In designing an analysis to address this question, we selected two future years for analysis (2020 and 2030) that are representative of the stream of benefits and costs at partial and full-implementation of the program.

To quantify benefits, we evaluated PM-related health effects (including directly emitted PM, SO2, and NOx contributions to fine particulate matter). Our approach requires the estimation of changes in air quality expected from the rule and then estimating the resulting impact on health. In order to characterize the benefits of today's action, given the constraints on time and resources available for the analysis, we adopted a benefits transfer technique that relies on air quality and benefits modeling for a preliminary control option for nonroad diesel engines and fuels. Results from the modeled preliminary control option in 2020 and 2030 are then scaled and transferred to the emission reductions expected from the proposed rule. We also transferred modeled results by using scaling factors associated with time to examine the stream of benefits in years other than 2020 and 2030.

More specifically, our health benefits assessment is conducted in two phases. Due to the time requirements for running the sophisticated emissions and air quality models needed to obtain estimates of the benefits expected to result from implementation of the rule, it is often necessary to select an example set of emission reductions to use for the purposes of emissions and air quality modeling. In phase one, we evaluate the PM and ozone related health effects associated with a modeled preliminary control option that was a close approximation of the proposed standards in the years 2020 and 2030. Using information from the modeled preliminary control option on the changes in ambient concentrations of PM and ozone, we then conduct a health assessment to estimate the number of reduced incidences of illnesses, hospitalizations, and premature fatalities associated with this scenario and estimate the total economic value of these health benefits. The standards we are proposing in this rulemaking, however, are slightly different in the amount of emission reductions expected to be achieved in 2020 and 2030 relative to the modeled scenario. Thus, in phase two of the analysis we apportion the results of the phase one analysis to the underlying NOx, SO2, and PM emission reductions and scale the apportioned benefits to reflect differences in emissions reductions between the modeled preliminary control option and the proposed standards. The sum of the scaled benefits for the PM, SO2, and NOx emission reductions provide us with the total benefits of the rule.

The benefit estimates derived from the modeled preliminary control option in phase one of our analysis uses an analytical structure and sequence similar to that used in the benefits analyses for the Heavy Duty Engine/Diesel Fuel final rule and in the "section 812 studies" to estimate the total benefits and costs of the full Clean Air Act.[247] We used many of the same models and assumptions used in the Heavy Duty Engine/Diesel Fuel analysis as well as other Regulatory Impact Analyses (RIAs) prepared by the Office of Air and Radiation. By adopting the major design elements, models, and assumptions developed for the section 812 studies and other RIAs, we have largely relied on methods which have already received extensive review by the independent Science Advisory Board (SAB), by the public, and by other federal agencies. The benefits transfer method used in phase two of the analysis is similar to that used to estimate benefits in the recent analysis of the Nonroad Large Spark-Ignition Engines and Recreational Engines standards (67 FR 68241, November 8, 2002). A similar method has also been used in recent benefits analyses for the proposed Industrial Boilers and Process Heaters NESHAP and the Reciprocating Internal Combustion Engines NESHAP.

On September 26, 2002, the National Academy of Sciences (NAS) released a report on its review of the Agency's methodology for analyzing the health benefits of measures taken to reduce air pollution. The report focused on EPA's approach for estimating the health benefits of regulations designed to reduce concentrations of airborne particulate matter (PM).

In its report, the NAS said that EPA has generally used a reasonable framework for analyzing the health benefits of PM-control measures. It recommended, however, that the Agency take a number of steps to improve its benefits analysis. In particular, the NAS stated that the Agency should:

- include benefits estimates for a range of regulatory options;
- estimate benefits for intervals, such as every five years, rather than a single year;
- clearly state the projected baseline statistics used in estimating health benefits, including those for air emissions, air quality, and health outcomes;
- examine whether implementation of proposed regulations might cause unintended

[247] The section 812 studies include: (1) US EPA, Report to Congress: The Benefits and Costs of the Clean Air Act, 1970 to 1990, October 1997 (also known as the ``Section 812 Retrospective Report"); and (2) the first in the ongoing series of prospective studies estimating the total costs and benefits of the Clean Air Act (see EPA report number: EPA-410-R-99-001, November 1999). See Docket A-99-06, Document II-A-21.

impacts on human health or the environment;
- when appropriate, use data from non-U.S. studies to broaden age ranges to which current estimates apply and to include more types of relevant health outcomes;
- begin to move the assessment of uncertainties from its ancillary analyses into its Base analyses by conducting probabilistic, multiple-source uncertainty analyses. This assessment should be based on available data and expert judgment.

Although the NAS made a number of recommendations for improvement in EPA's approach, it found that the studies selected by EPA for use in its benefits analysis were generally reasonable choices. In particular, the NAS agreed with EPA's decision to use cohort studies to derive benefits estimates. It also concluded that the Agency's selection of the American Cancer Society (ACS) study for the evaluation of PM-related premature mortality was reasonable, although it noted the publication of new cohort studies that should be evaluated by the Agency.

EPA has addressed many of the NAS comments in our analysis of the proposed rule. We provide benefits estimates for each year over the rule implementation period for a wide range of regulatory alternatives, in addition to our proposed emission control program. We use the estimated time path of benefits and costs to calculate the net present value of benefits of the rule. In the RIA, we provide baseline statistics for air emissions, air quality, population, and health outcomes. We have examined how our benefits estimates might be impacted by expanding the age ranges to which epidemiological studies are applied, and we have added several new health endpoints, including non-fatal heart attacks, which are supported by both U.S. studies and studies conducted in Europe. We have also improved the documentation of our methods and provided additional details about model assumptions.

Several of the NAS recommendations addressed the issue of uncertainty and how the Agency can better analyze and communicate the uncertainties associated with its benefits assessments. In particular, the Committee expressed concern about the Agency's reliance on a single value from its analysis and suggested that EPA develop a probabilistic approach for analyzing the health benefits of proposed regulatory actions. The Agency agrees with this suggestion and is working to develop such an approach for use in future rulemakings. EPA plans to hold a meeting of its Science Advisory Board (SAB) in early Summer 2003 to review its plans for addressing uncertainty in its analyses. Our likely approach will incorporate short-term elements intended to provide interim methods in time for the final Nonroad rule to address uncertainty in important analytical parameters such as the concentration-response relationship for PM-related premature mortality. Our approach will also include longer-term elements intended to provide scientifically sound, peer-reviewed characterizations of the uncertainty surrounding a broader set of analytical parameters and assumptions, including but not limited to emissions and air quality modeling, demographic projections, population health status, concentration-response functions, and valuation estimates.

3. 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. Deficiencies in 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. While these general uncertainties in the underlying scientific and economics literatures, which can cause the valuations to be higher or lower, are discussed in detail in the Regulatory Support Document and its supporting documents and references, the key uncertainties which have a bearing on the results of the benefit-cost analysis of this final rule include the following:

- The exclusion of potentially significant benefit categories (such as health and ecological benefits of reduction in CO, VOCs, air toxics, and ozone);
- Errors in measurement and projection for variables such as population growth;
- Uncertainties in the estimation of future year emissions inventories and air quality;
- Uncertainties associated with the scaling of the results of the modeled benefits analysis to the proposed standards, especially regarding the assumption of similarity in geographic distribution between emissions and human populations and years of analysis;
- Variability in the estimated relationships of health and welfare effects to changes in pollutant concentrations;
- Uncertainties in exposure estimation;
- Uncertainties associated with the effect of potential future actions to limit emissions.

Despite these uncertainties, we believe the benefit-cost analysis provides a reasonable indication of the expected economic benefits of the proposed rulemaking in future years under a set of assumptions.

One significant limitation to the benefit transfer method applied in this analysis is the inability to scale ozone-related benefits. Because ozone is a homogeneous gaseous pollutant, it is not possible to apportion ozone benefits to the precursor emissions of NOx and VOC. Coupled with the potential for NOx reductions to either increase or decrease ambient ozone levels, this prevents us from scaling the benefits associated with a particular combination of VOC and NOx emissions reductions to another. Because of our inability to scale ozone benefits, we do not include ozone benefits as part of the monetized benefits of the proposed standards. For the most part, ozone benefits contribute substantially less to the monetized benefits than do benefits from PM, thus their omission will not materially affect the conclusions of the benefits analysis. Although we expect economic benefits to exist, we were unable to quantify or to value specific changes in ozone, CO or air toxics because we did not perform additional air quality modeling.

There are also a number of health and environmental effects which we were unable to quantify or monetize. A full appreciation of the overall economic consequences of the proposed rule requires consideration of all benefits and costs expected to result from the new standards, not just those benefits and costs which could be expressed here in dollar terms. A complete listing of the benefit categories that could not be quantified or monetized in our estimate are provided in Table V.E-5. These effects are denoted by “B” in Table V.E-3 above, and are additive to the estimates of benefits.

Table V.E-5
Additional, Non-monetized Benefits of the Proposed Nonroad Diesel Engine and Fuel Standards

Pollutant	Unquantified Effects
Ozone Health	Premature mortality[a] Increased airway responsiveness to stimuli Inflammation in the lung Chronic respiratory damage Premature aging of the lungs Acute inflammation and respiratory cell damage Increased susceptibility to respiratory infection Non-asthma respiratory emergency room visits Increased school absence rates
Ozone Welfare	Decreased yields for commercial forests (for example, Western US) Decreased yields for fruits and vegetables Decreased yields for non-commercial crops Damage to urban ornamental plants Impacts on recreational demand from damaged forest aesthetics Damage to ecosystem functions
PM Health	Infant mortality Low birth weight Changes in pulmonary function Chronic respiratory diseases other than chronic bronchitis Morphological changes Altered host defense mechanisms Cancer Non-asthma respiratory emergency room visits
PM Welfare	Visibility in many Class I areas Residential and recreational visibility in non-Class I areas Soiling and materials damage Damage to ecosystem functions
Nitrogen and Sulfate Deposition Welfare	Impacts of acidic sulfate and nitrate deposition on commercial forests Impacts of acidic deposition to commercial freshwater fishing Impacts of acidic deposition to recreation in terrestrial ecosystems Reduced existence values for currently healthy ecosystems Impacts of nitrogen deposition on commercial fishing, agriculture, and forests Impacts of nitrogen deposition on recreation in estuarine ecosystems

Pollutant	Unquantified Effects
CO Health	Premature mortality[a] Behavioral effects
HC Health[b]	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 Welfare	Direct toxic effects to animals Bioaccumulation in the food chain Damage to ecosystem function

[a] Premature mortality associated with ozone and carbon monoxide is not separately included in this analysis. In this analysis, we assume that the ACS/Krewski, et al. C-R function for premature mortality captures both PM mortality benefits and any mortality benefits associated with other air pollutants. A copy of Krewski, et a., can be found in Docket A-99-06, Document No. IV-G-75.
[b] Many of the key hydrocarbons related to this rule are also hazardous air pollutants listed in the Clean Air Act.

F. Economic Impact Analysis

An Economic Impact Analysis (EIA) was prepared for this proposal to estimate the economic impacts of this proposal on producers and consumers of nonroad engines and equipment and related industries.[248] The analysis uses the Nonroad Diesel Economic Impact Model (NDEIM) developed for this analysis to estimate market-level changes in price and outputs for affected engine, equipment, fuel, and application markets as well as the social costs and their distribution across economic sectors affected by the program. This section presents the results of this economic impact analysis. A detailed description of the NDEIM, the model inputs, and a sensitivity analysis can be found in Chapter 10 of the Draft Regulatory Impact Analysis prepared for this proposal.

248 *Title of report*. Docket No. A-xxx-xxx, Document No. IV-A-XXX.

1. What is an Economic Impact Analysis?

Regulatory agencies conduct economic impact analyses of potential regulatory actions to inform decision makers about the effects of a proposed regulation on society's current and future well-being. In addition to informing decision makers within the Agency, economic impact analyses are conducted to meet the statutory and administrative requirements imposed by Congress and the Executive office. The Clean Air Act requires an economic impact analysis under Section 317, while Executive Order 12866–Regulatory Planning and Review requires Executive Branch agencies to perform benefit-costs analysis of all rules it deems to be "significant" (typically over $100 million annual social costs) and submit these analysis to OMB for review. This economic impact analysis estimates the potential market impacts of the proposed rule's compliance costs and provides the associated social costs and its distribution across stakeholders for comparison with social benefits.

2. What is EPA's Economic Analysis Approach for this Proposal?

The underlying objective of an EIA is to evaluate the effect of a proposed regulation on the welfare of affected stakeholders and society in general. The engineering estimate of compliance costs presented in the preceding discussion represents an estimate of the resources required to comply with the proposed rule. However, the engineering cost analysis does not explore how the companies that produce nonroad diesel engines, equipment, or fuel may change their production behavior in response to the costs of complying with the standards. It also does not explore how the consumers that use the affected products may change their purchasing decisions. For example, the construction industry may reduce purchases if the prices of nonroad diesel equipment increases, thereby reducing the volume of equipment sold (or market demand) for such equipment. Alternatively, the construction industry may pass along these additional costs to the consumers of their final goods and services by increasing prices, which would dampen the potential impacts on the purchases of nonroad diesel equipment.

This EIA evaluates how producers and consumers are expected to respond to the regulatory costs associated with the proposed emission control program. This analysis uses a multi-market partial equilibrium model to track changes in price and quantity for over 50 linked product markets. Direct costs are borne by engine manufacturers, equipment manufacturers, and petroleum refineries. Nonroad diesel equipment users (e.g., farmers, construction and manufacturing companies) and consumers of their products and services are indirectly affected through changes in prices. The model estimates behavioral responses that lead to new equilibrium price and quantity for each individual market, based on the engineering cost estimates prepared for this proposal. These changes in market prices and quantities are used to estimate the total social cost of the regulation as well as the distribution of costs across stakeholders.

The Nonroad Diesel Economic Impact Model developed for this analysis uses a multi-market partial equilibrium approach, employs an intermediate run time frame, and assumes perfect competition in the market sectors. It is a computer model comprised of a series of spreadsheet modules that define the baseline characteristics of the supply and demand for the relevant markets and the relationships between them. A detailed description of the model methodology, inputs, and parameters is provided in Chapter 10 of the draft RIA prepared for this proposal. The model methodology is firmly rooted in applied microeconomic theory and was developed following the *OAQPS Economic Analysis Resource Document* (EPA, 1999). Based on the market linkages specified in the market, the model is shocked by applying the engineering compliance cost estimates to the appropriate market suppliers, and then solved using an iterative auctioneer approach by "calling out" new prices until a new equilibrium is reached in all markets simultaneously. The data sources and supply and demand elasticities used in the analysis are described in the draft Regulatory Impact Analysis for this proposal

The estimated engine and equipment market impacts are based solely on the expected increase in variable costs associated with the proposed standards. Fixed costs are not included in the market analysis reported in Table V.F-1 because they are primarily R&D costs associated with design and engineering changes, and firms in the affected industries currently allocate funds for these costs. Therefore, fixed costs are not likely to affect the prices of engines or equipment. However, because fixed R&D costs represent opportunity costs, they are included in the welfare impact estimates reported in Table V.F-2 as unavoidable costs that reduce producer surplus. In other words, engine manufacturers budget for research and development programs and include these charges in their long-run strategies. In the absence of new standards, these resources would be focused on design changes to increase customer satisfaction. Engine manufacturers are expected to redirect these resources toward compliance with the standards, instead of adding additional resources to research and development programs. We include a sensitivity analysis in Chapter 10 of the draft RIA for this proposal that includes the fixed costs in the economic impact analysis, and request comment as to which approach is more appropriate.

In addition to the variable and fixed costs described above, there are two additional costs components that are included in the total social cost estimates of the propose regulation but that are not explicitly included in the analysis. These are operating savings (costs) and fuel marker costs. Operating savings (costs) refers to changes in operating costs are expected to be realized by diesel equipment users, for both existing and new equipment, as a result of the reduced sulfur content of nonroad diesel fuel. These include operating savings (cost reductions) due to fewer oil changes and operating cost increases due to decrease equipment fuel efficiency. Fuel marker costs refers to costs associated with marking high sulfur diesel fuel in the locomotive, marine, and heating oil markets between 2007 and 2014. Marker costs are not include in the market analysis because locomotive, marine, and heating oil markets are not explicitly modeled in NDEIM. These costs are not included in the analysis but instead are listed as a separate category in the social cost results in Table V.F-2. We also include a sensitivity analysis in Chapter 10 of the draft RIA for this proposal that includes the operating savings (cost reductions) in the economic impact analysis, as part of the application market costs. We request comment on how best to incorporate these costs in the analysis.

Also, consistent with the engine and equipment cost discussion in Section V.C. of this preamble, this EIA does not include any cost savings associated with the proposed equipment transition flexibility program or the proposed nonroad engine ABT program. As a result, the results of this EIA can be viewed as somewhat conservative.

3. What Are the Results of this analysis?

The economic analysis consists of two parts: a market analysis and welfare analysis. The market analysis looks at expected changes in prices and quantities for directly and indirectly affected market commodities. The welfare analysis looks at economic impacts in terms of annual and present value changes in social costs. For this proposed rule, the social costs are computed as the sum of market surplus offset by operating cost savings. Market surplus is equal to the aggregate change in consumer and producer surplus based on the estimated market impacts associated with the proposed rule. Operating cost savings are associated with the decreased sulfur content of diesel fuel. These include maintenance savings (cost reductions) and changes in fuel efficiency. Increased maintenance costs may also be incurred for some technologies. Operating costs are not included in the market analysis but are instead listed as a separate category in the social cost results tables.

Because compliance costs vary over time, results are presented for three years: 2013, 2020, and 2030. 2013 corresponds to the year of highest annualized costs, while 2020 and 2030 correspond to years analyzed in our benefits analysis. We expect the nonroad equipment fleet to fully turnover by the year 2030 so that it corresponds to the year when the full benefits of the proposed rule are realized. Detailed results for other years are included Chapter 10 of the draft RIA for this proposal

a. Expected Market Impacts

The market impacts of this rule suggest that the overall economic impact of the proposed emission control program on society is expected be minimal. According to this analysis, the prices of goods and services produced using equipment and fuel affected by the proposal are expected to increase less than 0.01 percent. The estimated price increases and quantity reductions for engines and equipment vary depending on compliance costs. In general, we would expect for price increases to be higher (lower) as a result of a high (low) relative level of compliance costs to market price. We would also expect the change in price to be highest when compliance costs are highest.

The estimated market impacts for 2013, 2020, and 2030 are presented in Table V.F-1. Consistent with the compliance cost inputs, the estimated price and quantity changes are largest in 2013 and stabilize by 2020. From 2020 to 2030 the overall cost of the regulation increases as the population of engines increases over time. However, the relative impact represented by the percentage change in market price and quantity remains unchanged during this period because compliance costs per unit are approximately constant after 2020.

The market-level impacts presented in this table represent production-weighted averages of more the individual market-level impact estimates generated by the model, i.e.,

- 7 diesel engine markets by size (horsepower),
- 42 equipment markets by major engine application and size,
- 3 application markets for final products and services, and
- 8 nonroad diesel fuel markets by region (PADD) and sulfur content.

For example, the model includes seven individual engine markets are reflecting the different horsepower size categories. The 15 percent price change for engines shown in Table 10-2 for 2013 is an average price change across all engine markets weighted by the number of production units. Similarly, equipment impacts presented in Table 10-2 are weighted averages of 42 equipment-application markets, such as small (< 25hp) agricultural equipment and large (>600hp) industrial equipment. The individual market-level impacts are presented in Chapter 10 of the draft RIA for this proposal.

Engine Market Results: Most of the variable costs associated with the proposed rule are passed along in the form of higher prices. The average price increase in 2013 for engines is estimated to be about 15 percent. This percentage is expected to decrease to about 12 percent by 2020 and beyond. This expected price increase varies by engine size because compliance cost are a larger share of total production costs for smaller engines. In 2013, the year of greatest compliance costs overall, the largest expected price increase is for engines between 26 and 50 hp: 28 percent or $827; the average price for an engine in this category is about $3,000. However, this price increase is expected to drop to 21 percent, or about $636, by 2015. The smallest expected price increase for is for engines in the 175-600 and greater than 600 hp categories. These engines are expected to see price increases of about 3 percent. For engines in the 175-600 hp category, the expected increase is about $1,500 for engines that cost on average about $40,000. For engines in the greater than 600 hp category, the expected price increase is about $4,300 for engines that cost on average about $130,000.

These increases in engines prices are not expected to disrupt sales. The estimated change in market quantity is small because as compliance costs as passes long the supply chain they become a smaller share of total production costs. In other words, firms that use these engines and equipment will continue to purchase them even at the higher cost because the increase in costs will not have a large impact on their total production costs. Diesel equipment is only one factor of production for their output of agricultural, construction, or manufactured goods. The average decrease in the quantity of all engines produced as a result of the regulation is estimated to be to about one hundredth of 1 percent. This decrease ranges from 0.009 percent for engines less than 25 hp to 0.014 percent for engines greater than 176 hp.

Equipment Market Results: Estimated price changes for the equipment markets reflect both the direct costs of the proposed standards on equipment production and the indirect cost through increased engine prices. In 2013, the average price increase for nonroad diesel equipment is estimated to be about 3 percent for all years. The range of estimated price increases across equipment types parallels the share of engine costs relative to total equipment price, so the estimated percentage price increase among equipment types also varies. For example, the market price for agricultural equipment between 26 and 50 hp is estimated to increase about 6 percent, or $XXX for equipment with an average cost of $XXX. However, the market price for agricultural equipment greater than 100 hp is estimated to increase less than 0.5 percent, or $XXXX for equipment with an average cost of $XXX. The largest expected price increase for equipment is $XXX, or X%, for TYPE OF EQUIPMENT. The smallest expected price increase for equipment is $XXX, or X%, for TYPE OF EQUIPMENT. The price changes for the equipment are less than that for the engines because the engine is only one input in the production of equipment. **[need to expand on this explanation]**

The output reduction for nonroad diesel equipment is estimated to be very small and to average about one hundredth of 1 percent. This decrease ranges from 0.006 percent for general manufacturing equipment to 0.018 for construction equipment.

Table 10-2. Summary of Market Impacts ($2001)

	Year 2013					Year 2020					Year 2030				
	Engineering Cost	Change in Price ($10[6])		Change in Quantity[a]		Engineering Cost	Change in Price ($10[6])		Change in Quantity[a]		Engineering Cost	Change in Price ($10[6])		Change in Quantity[a]	
Market	Per Unit	Absolute	Percent	Absolute[b]	Percent	Per Unit	Absolute	Percent	Absolute[b]	Percent	Per Unit	Absolute	Percent	Absolute[b]	Percent
Engines	$969.99	$757.1	14.6	–68	–0.0124	$840.36	$712.9	12.3	–76	–0.0122	$0.04	$703.5	12.3	–88	–0.0121
Equipment	$840.36	$837.5	5.2	–116	–0.0139	$803.93	$801.1	4.5	–129	–0.0136	$794.87	$792.1	4.5	–150	–0.0135
Application Markets		NA	0.01		–0.0106			0.01		–0.0105			0.01		–0.0104
No. 2 Distillate Nonroad	$0.03672	$0.03612	3.9	–1,513,907	–0.0130	$0.03672	$0.03613	3.9	–1,673,968	–0.0128	$0.03672	$0.03613	3.9	–1,933,757	–0.0127

[a] Units are in gallons.
[b] Total decrease in engine production is equal to the decrease in equipment production due to the one-to-one relationship between engines and equipment. However, because not all engines are sold on the open market (some are used internally by integrated engine/equipment manufacturers), the market change in engines is less than the market change in equipment.
[c] Absolute changes in price and quantity are not provided for the application markets because these values were normalized for the analysis; see text.

Application Market Results: The estimated price increase associated with the proposed standards in all three of the application markets is very small and averages about one hundredth of 1 percent for all years. The estimated price increase ranges from 0.06 percent in the agricultural application market to less than 0.01 percent in the manufacturing application market. The percentage change in output is also estimated to be very small and averages about one hundredth of 1 percent. This reduction ranges from less than 0.01 percent decrease in manufacturing to a roughly 0.02 percent decrease in construction. **[provide additional explanation]**

Absolute changes in price and quantity are not provided for the application markets in Table 10-1 because normalized commodity values are used in the market model. Because of the great heterogeneity of manufactured or agriculture products, a normalized commodity ($1 unit) is used in the application markets. This has no impact on the estimated percentage change impacts but makes interpretation of the absolute changes less informative.

Fuel Markets Results: The estimated average price increase for nonroad diesel fuel is about 4 percent for 15 ppm fuel in all years. The estimated price increase ranges from 3 percent in the East Coast region (PADD 1&3) to 9 percent in the mountain region (PADD 4). The average national output decrease is estimated to be about one hundredth of 1 percent and is relatively constant across the four regional fuel markets.

b. Expected Welfare Impacts

Social cost impact estimates are presented in Table V.F-2. A time series of social costs from 2007 through 2030 is presented in Chapter 10 of the draft RIA for this proposal. As described above, the total social cost of the regulation is the sum of the changes in producer and consumer surplus estimated by the model plus engine maintenance savings (negative costs) resulting from using fuel with a lower sulfur content. Engineering costs are projected to peak in 2013 and then decline slightly as fixed R&D and capital costs are depreciated. Total social costs in 2013 are $1,081 million ($2001). Our analysis estimates that approximately 90 percent of the social costs will be born by producers and consumers in the application markets, indicating that the majority of the costs are expected to be passed on in the form of higher prices. Equipment manufactures are expected to bear about 7 percent of the social costs. Engine manufacture and diesel fuel refineries are expected to bear the remaining 2 percent and 1 percent, respectively. **[Note: these are still draft numbers and will change when we have the final costs of the program]**

In 2030 the total social costs are projected to be $1,230 million ($2001). The increase is due to the projected annual growth of 3.3 percent in the engine and equipment populations. As in the earlier years, producers and consumers in the application markets are expected to bear the large majority of the costs, approximately 99 percent. This is consistent with economic theory where in the long run all costs are passed on to the consumers of goods and services.

The present value of total social costs through 2030 is estimated to be $14,843 million ($2001). This present value is calculated using a social discount rate of 3 percent from 2002 to 2030. We also performed an analysis using an alternative 7 percent social discount rates. Using that discount rate, the present value of the social costs through 2030 is estimated to be $XXXXX million ($2001).

Table V.F-2
Summary of Social Costs Estimates: Primary Program ($million)[a,b]

Market	Year 2013 Estimates			Year 2020 Estimates			Year 2030 Estimates			Net Present Value Estimates[b]		
	Market Surplus	Fuel Maintenance	Total[c]	Market Surplus	Fuel Maintenance	Total[c]	Market Surplus	Fuel Maintenance	Total[c]	Market Surplus	Fuel Maintenance	Total[c]
Engines, Total	$26		$26	$1		$1	$0		$0	$183		$183
Equipment, Total	$86		$86	$70		$70	$5		$5	$660		$660
Agricultural	$26		$26	$20		$21	$2		$2	$201		$201
Construction	$36		$36	$31		$31	$2		$2	$272		$272
Industrial	$24		$24	$19		$19	$1		$1	$188		$188
Application Mrkt Total	$1,119		$1,119	$1,229		$1,229	$1,420		$1,420	$16,754		$16,755
Agriculture	$310	($35)	$276	$338	($39)	$299	$390	($45)	$345	$4,530	($630)	$3,901
Construction	$408	($59)	$349	$459	($66)	$392	$529	($77)	$452	$6,152	($1,073)	$5,079
Manufacturing	$401	($66)	$334	$433	($75)	$358	$501	($87)	$415	$6,072	($1,206)	$4,867
NR Distillate Total	$10		$10	$11		$11	$13		$13	$154		$154
PADD I&III	$5		$5	$5		$5	$6		$6	$75		$75
PADD II	$4		$4	$4		$4	$5		$5	$55		$55
PADD IV	$1		$1	$1		$1	$1		$1	$13		$13
PADD V	$1		$1	$1		$1	$1		$1	$11		$11
Total	$1,241	($160)	$1,081	$1,312	($180)	$1,132	$1,438	($209)	$1,230	$17,752	($2,909)	$14,843

[a] Figures are in 2001 dollars. ( ) represents a negative cost (social gain).
[b] Net present values are calculated using a social discount rate of 3 percent over the 2002–2030 time period.
[c] Figures in this column do not include human health and environmental benefits of the regulations.

VI. Alternative Program Options

Our proposed emission control program consists of a two-step program to reduce the sulfur content of nonroad diesel fuel in conjunction with the proposed Tier 4 engine standards. As we developed this proposal, we evaluated a number of alternative options with regard to the scope, level, and timing of the standards to ensure that we were looking at the full range of possible control options. This section presents a summary of our analysis of ten alternative control scenarios. A complete discussion of all the alternatives, their feasibility, and their inventory, benefits, and cost impacts can be found in Chapter 12 of the draft Regulatory Impact Analysis for this proposal.

While we are interested in comments on all of the alternatives presented, we are especially interested in comments on two alternative scenarios which EPA believes merit further consideration in developing the final rule: a program in which sulfur levels are required to be reduced to 15 ppm in essentially a single step, and a variation on the proposed two-step fuel control program, in which the second step of sulfur control to 15 ppm in 2010 would apply to locomotive and marine diesel fuel in addition to nonroad diesel fuel. This section describes these two options in greater detail; additional information can be found in Chapter 12 of the draft Regulatory Impact Analysis for this proposal.

A. Summary of Alternatives

Although a great number of alternative control options are conceivable, not all of them are reasonable or feasible. Table IV-1 contains a summary of the alternatives we considered and the expected emission reductions, costs, and monetized benefits associated with them in comparison to the proposal. These alternatives cover a broad range of possible approaches and serve to provide insight into the many other program design alternatives not expressly evaluated further.

Table VI-1
Summary of Alternative Program Options
(Incremental to the Proposal)

PROPOSAL	• 500 PPM in 2007 for NR, loco/marine • 15 ppm in 2010 NR only	• >25 hp: PM AT introduced 2011-2013 • >75 hp: NOx AT introduced and phased-in 2011-2014 • <25 hp: PM stds in 2008 • 25-75 hp: PM stds in 2008 (optional for 50-75 hp)	Relative to baseline: 1,079,700 PM 4,808,200 SO2 5,434,000 NOx	$15.2	$520[b]
Option	Fuel Standards	Engine Standards	Estimated Relative Inventory Impacts[c] (NPV cumulative tons thru 2030; 3%)	Estimated Cost Impacts - $Billion (NPV thru 2030; 3%)	Estimated Benefits Stream - $Billion[e] (NPV thru 2030; 3%)
1-Step Fuel Options					
1	• 15 ppm in 2008 for NR only • 500 ppm in 2008 for loco/marine	• < 25 hp: PM stds only in 2009 • 25-75 hp: PM AT stds and EGR or equivalent NOx technology in 2013; no NOx AT • >75 hp: PM AT stds phasing in beginning in 2009; NOx AT phasing in beginning in 2011	15,500 PM -123,400 SO2 10,500 NOx+HC	$1.6[d]	$3[b]
1a	• 15 ppm in 2008 for NR, loco/marine	• PM AT introduced in 2009-10 • NOx AT introduced in 2011-12	138,900 PM -61,000 SO2 1,788,500 NOx+HC	a	$59
1b	• 15 ppm in 2006 for NR, loco/marine	Same as 1a	a		
2-Step Fuel Options					
2a	Same as proposal except – • 500 ppm in 2006 for NR, loco/marine	Same as proposal	17,800 PM 221,000 SO2 0 NOx+HC	a	$7[b]

Option	Fuel Standards	Engine Standards	Estimated Relative Inventory Impacts[c] (NPV cumulative tons thru 2030; 3%)	Estimated Cost Impacts - $Billion (NPV thru 2030; 3%)	Estimated Benefits Stream - $Billion[e] (NPV thru 2030; 3%)
2b	Same as proposal except – • 15 ppm in 2009 for NR	Same as proposal except – • Move PM AT up 1 year for all engines > 25 hp (phase in starts 2010)	55,500 PM 16,500 SO2 38,900 NOx+HC	$1.0[d]	$16[b]
2c	Same as proposal except – • 15 ppm in 2009 for NR	Same as proposal except – • Move PM AT up 1 year for all engines 175-750 hp (phase in starts 2010)	19,800 PM 16,400 SO2 16,000 NOx+HC	$0.7[d]	$6[b]
2d	• Same as proposal	Same as proposal except – • Phase-in NOx AT for 25-75hp beginning in 2013	0 PM 0 SO2 729,200 NOx+HC	a	$9[b]
Other Options					
3	• Same as proposal	Same as proposal except – • Mining equipment over 750 hp left at Tier 2	-26,400 PM -200 SO2 -729,400 NOx+HC	-$0.5	-$16[b]
4	Same as proposal except – • loco/marine fuel to 15 ppm in 2010	Same as proposal	8,500 PM 106,300 SO2 0 NOx+HC	$1.4	$5[b]

[a]Qualitative analysis only due to the option being impractical due to infeasibility or other significant concerns. See the draft RIA for a detailed discussion
[b]By benefits transfer method
[c]Cumulative impacts through 2030, relative to the proposed program. Positive values mean that the Option produces greater emission reductions from baseline than the proposed program.
[d]Cost estimates do not include the costs due to potential for limited product offerings and market disruptions in the engine/equipment and/or fuel markets. See Section V of this preamble and the draft FIA for a detailed discussion.
[e]Benefits do not include CO, VOC, air toxics, ozone, and PM welfare benefits. See Section V.F of this preamble and the draft RIA for additional discussion.

B. Introduction of 15 ppm Sulfur Fuel in One Step

EPA carefully evaluated and is seeking comment on an alternative regulatory approach. Instead of the proposed two-step for fuel control, this alternative would require that the nonroad fuel sulfur level be reduced to 15ppm beginning June 1, 2008. This alternative would have the advantage of enabling high efficiency exhaust emission control technology to begin to be applied to nonroad engines as early as the 2009 model year. It also would have several disadvantages which have prompted us not to propose it. The disadvantages in comparison to the proposal include shorter lead-time for engine and equipment manufacturers and refiners, leading to increased costs and potential market disruptions. In this section, we describe this alternative in greater detail and discuss potential engine and fuel impacts. We also present our estimated emission and benefit impacts. Two other one-step fuel options which are variations of the alternative discussed in this section, options 1a and 1b in Table VI01, are presented in Chapter 12 of the draft RIA for this proposal.

1. Description of the One-Step Alternative

While numerous engine standards and phase-in schedules are possible, we considered the standards shown in Tables VI-2 and VI-3 as being the most stringent one-step program feasible considering cost, lead-time, and other factors. These standards are similar to those in our proposed option, the difference being the phase-in dates for the PM standards and the level of the standards for engines in the 25-75 hp category.

Table VI-2
PM Standards for 1-Step Fuel Scenario (g/bhp-hr)

<table>
<tr><th rowspan="2">Engine Power</th><th colspan="6">Model Year</th></tr>
<tr><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th></tr>
<tr><td>hp <25</td><td>0.30</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>25 ≤ hp < 75</td><td></td><td></td><td></td><td></td><td>0.02</td><td></td></tr>
<tr><td rowspan="2">75 ≤ hp < 175</td><td rowspan="2"></td><td colspan="3">0.01</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>50%[a]</td><td>50%[a]</td><td>100%[a]</td></tr>
<tr><td rowspan="2">175 ≤ hp < 750</td><td colspan="3">0.01</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>50%[a]</td><td>50%[a]</td><td>100%[a]</td></tr>
<tr><td>hp ≥ 750</td><td></td><td></td><td colspan="4">0.01</td></tr>
</table>

			50%[a]	50%[a]	50%[a]	100%[a]

[a] Percentages are the model year sales required to comply with the indicated standard.

Table VI-3
NOx and NMHC Standards for 1-Step Fuel Scenario (g/bhp-hr)

Engine Power	Model Year			
	2011	2012	2013	2014
25 ≤ hp < 75			3.5 [a] NMHC+NOx	
75 ≤ hp < 175		0.30 NOx 0.14 NMHC		
		50% [b]	50% [b]	100% [b]
175 ≤ hp < 750	0.30 NOx 0.14 NMHC			
	50% [b]	50% [b]	50% [b]	100% [b]
hp ≥ 750	0.30 NOx 0.14 NMHC			
	50% [b]	50% [b]	50% [b]	100% [b]

[a] A 3.5 NMHC + NOx standard would apply to the 25-50 hp engines. Engines greater than 50hp are already subject to this standard in 2008 under the existing Tier 3 program.
[b] Percentages are the model year sales required to comply with the indicated standards.

2. Engine Emission Impacts

The main advantage associated with this one-step approach is pulling ahead the long-term PM engine standards. By making 15 ppm sulfur fuel widely available by late 2008, we could accelerate the long-term PM engine standards, leading to the introduction of precious metal catalyzed PM traps as early as 2009, two years earlier than possible under the two-step sulfur reduction approach. This was a concern expressed by some stakeholders as we developed our rule: that a two-step approach leads to later than desired introduction of high-efficiency exhaust emissions controls on nonroad diesels because this cannot happen until the 15 ppm fuel standard goes into effect. As shown in Table VI-1, there would be additional public health benefits associated with this one-step approach. However, in comparison to the proposal, the additional benefits are relatively small, less than one percent or about $3 billion more than the proposed program.[249]

Even though 15 ppm fuel would be available beginning June 1, 2008 under this one-step approach, we do not believe it would be feasible to propose an aggressive turnover of new engines to trap-equipped versions in 2009. Nor would it be possible to introduce NOx controls any earlier than we are already proposing, model year 2011. The reasons are the need to coordinate the proposed standards with Tier 3 standards, and with the heavy duty highway diesel standards. The coordination of Tier 4 standards with Tier 3 standards and with the development of emissions control technology for highway diesel engines is of critical importance to successful implementation of the Tier 4 standards. Even those manufacturers who do not make highway engines are expected to gain substantially from the highway PM and NOx control development work, provided they can plan for standards set at a similar level of stringency and timed in a way to allow for the orderly migration of highway engine technology to nonroad applications.

Thus, although the application of high-efficiency exhaust PM emission controls to nonroad diesels would be enabled with the introduction of 15 ppm sulfur nonroad fuel in 2008 under a one-step program, we believe that to require the application of PM controls across the wide spectrum of nonroad engines shortly thereafter would raise serious feasibility concerns that could only be resolved, if at all, through a very large additional R&D effort undertaken roughly in parallel with the similarly large highway R&D effort, a duplication of effort we wish to avoid for reasons discussed in Section III. Nonroad engine designers would need to accomplish much of this development well before the diesel experience begins to accumulate in earnest in 2007, in order to be ready for a 2009 first introduction date, since waiting until 2007 before initiating 2009 model year design work would risk the possibility of product failures, limited product availability and major market disruptions. At the same time, for those engine manufacturers who participate in both the highway and nonroad diesel engine markets, trying to do too much simultaneously (i.e., attempting to have concurrent engine product developments for highway and nonroad) could result in the possibility of product failures, limited product availability and major disruptions for the highway market as well. Thus, in balancing their costs and burden, many manufacturers may be forced to choose which products to have available for 2009, and which products they delay for release. Manufacturers would also incur large additional costs to redesign hundreds of engine models and thousand of machine types to meet Tier 4 standards only one to three years after Tier 3 standards take effect in 2006-2008. These cost impacts are reflected in Table VI-1 and their derivation is explained in chapter 12 of the draft RIA. This extra expenditure could only be modestly mitigated by phasing in the standards, since a crash

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[249] A variation on this one-step approach would be to also require the sulfur content of locomotive and marine fuel to meet the 15 ppm standard in 2008. The decision of whether or not to require the sulfur content of locomotive and marine fuel to also be reduced to 15 ppm, however, is not unique to the one step approach, and, as discussed below is an alternative also being evaluated under our proposed 2-step program. Were we to require locomotive and marine diesel fuel to also meet the 15 ppm standard in 2008 under a one-step approach, there would be additional inventory reductions of about **XXX** tons of PM and **XXX** tons of SO2.

R&D effort with limited benefit from highway experience would still be necessary.

Moreover, with respect to NOx, it would be impractical or simply infeasible to pull the standards ahead on the same schedule. This is because EPA's highway diesel program allows manufacturers to phase in NOx technology over 2007-2010. As a result, we do not expect that the high-efficiency NOx control technology could reasonably be applied to nonroad engines any earlier under a one-step program than under a two-step program (i.e., beginning in 2011).

In summary, this option would lead us to apply PM and NOx standards in two different model years, or else forgo any opportunity to apply PM traps in 2009. Redesigning engines and emission controls for early PM control and then again a couple of years later for NOx control, on top of shortened Tier 3 stability periods, would likely add substantial costs to the program. As manufacturers attempt to avoid these costs and optimize their development they may simply have to restrict product offerings for some period, leading to price spikes and shortages due to lack of product availability. Having the NOx and PM standards phase in simultaneously under our proposed approach avoids cost and design stability issues for both engine and equipment manufacturers. In addition, the longer leadtime for the engine standards under our proposed program will allow greater economic efficiencies for engine manufacturers as they transfer highway emission reduction technology to nonroad engines.

3. Fuel Impacts

In addition to the challenges associated with pulling ahead the PM standards described above, there are also some concerns regarding the practicality of an early 15 ppm fuel sulfur standard. A one-step approach may result in several economic inefficiencies that may increase the cost of the program. For example, refiners will have little opportunity to take advantage of the newer technologies currently being developed to desulfurize down to 15 ppm. As described in Section IV and V, refiners will only begin to be able to take advantage of these new technologies in 2008. By 2010, the ability to incorporate them into their refinery modifications is expected to double. If refiners have to take steps to reduce the sulfur content of nonroad fuel earlier, they will likely have to use more expensive current technology. The cost impacts of this decision will persist, since the choice of technology is a long term decision. If a refiner is forced by the effective date of the standards to employ a more expensive technology, that choice will affect that refiner's output indefinitely, since the cost of upgrading to the new technologies will be prohibitive. As presented in Section 5.2 of the Draft RIA, we estimate that the costs of achieving a 15 ppm standard in 2008 is approximately 0.4 c/gal greater than for the proposal. While difficult to quantify there are also considerable advantages to allowing refiners some operating time in producing 15 ppm diesel fuel for the highway program prior to requiring them to solidify their designs for producing nonroad diesel fuel to 15 ppm. The primary advantage is that the design of desulfurization equipment used to produce 15 ppm nonroad diesel fuel can reflect the operating experience of the equipment used to produce 15 ppm highway diesel fuel starting in 2006. This extra time would also provide current refiners of high sulfur diesel fuel with highly confident estimates of the cost of producing 15 ppm diesel fuel, reducing uncertainty and increasing their likelihood of investing to produce this fuel. With a start date of June 1, 2008 refiners would have to solidify their designs and start construction prior to getting any data on the performance of their highway technology. This would increase the cost of producing 15 ppm nonroad diesel fuel for the life of the new desulfurization equipment, as well as potentially delaying some refiners' decision to invest in new desulfurization equipment due to uncertainties in cost, performance, etc.

4. Emission and Benefit Impacts

We used the nonroad model to estimate the emission inventory impacts associated with this one-step option (as well as the other options listed in Table VI-1). As for all the alternatives, we then used a method, termed the benefits transfer method, to estimate the monetized benefits of the alternative.[250] The results are shown in Table VI-1. As is evidenced by the values in Table VI-1, the one-step alternative would achieve slightly greater PM and NOx emission reductions through 2030 than the proposed 2-step program, with 15,500 and 10,500 additional tons reduced, respectively (or about 1 percent and less than 1 percent, respectively). Unlike in the proposed 2-step, however, there would be no SO2 emission reductions in 2007 due to the delay in fuel sulfur control, although 2009 and later emission are slightly greater due primarily to the earlier introduction of PM filters. Nevertheless, the SO2 benefits of the one-step program are slightly than the proposed 2-step program in the long run, by about 123,400 tons (about 2.5 percent) through 2030.

After careful consideration of these matters, we have decided to propose the two-step approach in today's notice. While the incremental benefits of the one-step program outweigh the potential increase in cost, the incremental cost per ton (about $102,000 per ton of PM reduced; see Table 12.5-1 in the draft RIA) is higher than that for the two-step option (about $8,200; see Table V.D-2, above). This is higher than PM reductions that could be achieved from other possible emission control programs. For example, additional PM emission controls for locomotives or commercial marine diesel engines are expected to provide PM benefits at a much lower cost per ton. Thus, we do not believe that the small incremental benefits are sufficient to outweigh the added cost and especially the unquantified risk to the smooth implementation of the entire Tier 4 nonroad program caused by the significantly shortened lead-time and stability. There are also concerns about the potential negative impacts this option may have on the 2007 highway program, including the implications of the overlap of implementation schedules (see above and Chapter 12 of the draft RIA). Nevertheless, we believe that the one-step approach is a regulatory alternative worth considering. In addition to seeking comment on our proposed

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[250] The results that were obtained for alternative 1a were extrapolated based on the emission inventory changes to the proposed program and the other alternatives by assuming the air quality changes between the alternative and the actual case run were small enough to allow for such extrapolation. An explanation of the benefits transfer method is contained in Chapter 9 of the draft RIA.

program, we also seek comment on the relative merits and shortcomings of a one-step approach to regulating nonroad diesel fuel and the associated schedule for implementing the engine standards.

C. Applying 15 ppm Requirement to Locomotive and Marine Fuel

To enable the high efficiency exhaust emission control technology to begin to be applied to nonroad engines beginning with the 2011 model year, we are proposing that all nonroad diesel fuel produced or imported after June 1, 2010 would have to meet a 15 ppm sulfur cap. Although locomotive and marine diesel engines are similar in size to some of the diesel engines covered in this proposal, there are many differences (e.g., duty cycles, exhaust system design configurations, size, and rebuild and maintenance practices) that have caused us to treat them separately in past EPA programs.[251] Because of these differences, we are not proposing new engine standards today for these engine categories. Since we are not proposing more stringent emission standards, we are also not proposing that the second step of sulfur control to 15 ppm in 2010 be applied to locomotive and marine fuel. Instead, we are proposing to set a sulfur fuel content standard of 500 ppm for fuel used in locomotive and marine diesel applications. This fuel standard is expected to provide considerable sulfate PM benefits even without establishing more stringent emission standards for these engines. We estimate that, cumulatively through 2030, reducing the sulfur content of locomotive and marine diesel fuel would eliminate about 102,000 tons of sulfate PM (net present value, based on a 3 percent discount rate).

As discussed in section IV, we are nevertheless seriously considering the option of extending the 15 ppm standard to locomotive and marine fuel as early as June 1, 2010, thereby including them in the second step of the proposed two-step program. There are several advantages associated with this alternative. First, as reflected in Table VI-1, it would provide important additional sulfate PM and SO2 emission reductions and the estimated benefits from these reductions would outweigh the costs by a considerable margin. Second, it would simplify the fuel distribution system and the design of the fuel program proposed today since a marker would not be required for locomotive and marine diesel fuel. Furthermore, the prices for locomotive and marine diesel fuel may be virtually unaffected. Under the proposal, we expect that a certain amount of marine fuel will be ultra-low sulfur fuel regardless of the standard due to limitations in the production and distribution of unique fuel grades. Where 500 ppm fuel is available, the possible suppliers of fuel will likely be more constrained, limiting competition and allowing prices to approach that of 15 ppm fuel. If we were to bring locomotive and marine fuel to 15 ppm, the pool of possible suppliers could expand beyond those today, since highway diesel fuel will also be at the same standard. Third, it would help reduce the potential opportunity for

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[251] Locomotives, in fact, are treated separately from other nonroad engines and vehicles in the Clean Air Act, which contains provisions regarding them in section 213(a)(5). Less than 50 hp marine engines were included in the 1998 final rule for nonroad diesel engines, albeit with some special provisions to deal with marine-specific engine characteristics and operating cycles.

misfueling of 2007 and later model year highway vehicles and 2011 and later model year nonroad equipment with higher sulfur fuel. Finally, it would allow refiners to coordinate plans to reduce the sulfur content of all of their nonroad diesel fuel at one time. While in many cases this may not be a significant advantage, it may be a more important consideration here since it is probably not a question of whether locomotive and marine fuel must meet a 15 ppm cap, but merely when. As discussed in section IV, it is the Agency's intention to take action in the near future to set new emission standards for locomotive and marine engines that could require the use of high efficiency exhaust emission control technology, and thus, also require the use of 15 ppm sulfur diesel fuel.[252] We anticipate that such engine standards would likely take effect in the 2011-13 timeframe, requiring 15 ppm locomotive and marine diesel fuel in the 2010-12 timeframe. We intend to publish an advance notice of proposed rulemaking for such standards by the Spring of 2004 and finalize those standards by 2007.

However, discussions with refiners have suggested there are significant advantages to leaving locomotive and marine diesel fuel at 500 ppm, at least in the near-term and until we set more stringent standards for those engines. First, the locomotive and marine diesel fuel markets could provide an important market for off-specification product that is important for refiners, particularly during the transition to 15 ppm for highway and nonroad diesel fuel in 2010. Waiting just a year or two beyond 2010 would address the critical near-term needs during the transition. Second, waiting just another year or two beyond 2010 is also projected to allow virtually all refiners to take advantage of the new lower cost technology. Finally, while the monetized benefits of controlling the sulfur level of locomotive and marine diesel fuel from 500 ppm down to 15 ppm outweigh the costs (even in the absence of new engine emission standards), the cost per ton for the incremental sulfate PM and SO2 emission reductions are $55,000 and $8,800, respectively. These costs are rather high in comparison to those of other possible control programs.

After careful consideration of these matters, we have decided not to propose to apply the second step of sulfur control of 15 ppm to locomotive and marine diesel fuel at this time. Nevertheless, for the reasons described above, we are carefully weighing whether it would be appropriate to do so. Therefore, we seek comment on this alternative and the various advantages, disadvantages, and implications of it.

D. Other Alternatives

We also analyzed eight other basic alternatives, as shown in Table VI-1. Some of these focus on control options more stringent than our proposal while others reflect modified engine requirements that result in less stringent control. Each of these options, while having possible

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[252] EPA established the most recent new standards for locomotives and marine diesel engines (including those under 50 hp) in separate actions (63 FR 18977, April 16, 1998 and 67 FR 68241, November 8, 2002).

merit in some areas, raises what we believe are significant concerns in terms of feasibility, cost, or other relevant factors. These concerns are addressed in more detail in Chapter 12 of the draft RIA. Hence, we did not include these options as part of our proposal for nonroad fuel and engine controls. We are interested in comment on these alternatives, especially information regarding their feasibility, costs, and other relevant concerns.

VII. Requirements for Engine and Equipment Manufacturers

This section describes the regulatory changes proposed for the engine and equipment compliance program. The most obvious change is that proposed regulations for Tier 4 engines have been written in plain language, in accordance with existing guidelines.[253] They are structured to contain the provisions that are specific to nonroad CI engines in a new part 1039, and to apply the general provisions of existing parts 1065 and 1068. The proposed plain language regulations, however, are not intended to significantly change the compliance program, except as specifically noted in today's notice. As proposed, these plain language regulations would only apply for Tier 4 engines. The changes from the existing nonroad program are described below along with other notable aspects of the compliance program.

A. Averaging, Banking, and Trading

1. Are we proposing to keep the ABT program for nonroad diesel engines?

EPA has included averaging, banking, and trading (ABT) programs in most mobile source emission control programs adopted in recent years. Our existing regulations for nonroad diesel engines include an ABT program (§89.201 through §89.212). We are proposing to retain the basic structure of the existing nonroad diesel ABT program with today’s notice, though we are proposing a number of changes to accommodate implementation of the proposed emission standards. Behind these changes is the recognition that the proposed standards represent a major technological transfer challenge to the industry. The proposed program is intended to enhance the ability of engine manufacturers to meet the stringent standards proposed today. The proposed program also will prevent production of very high-emitting engines and unnecessary delay of the transition to the new exhaust emission control technology.

We view the proposed ABT program as an important element in setting emission standards that are appropriate under section 213 with regard to technological feasibility, lead time, and cost. The ABT program helps to ensure that the stringent standards we are proposing are appropriate under section 213(a) given the wide breadth and variety of engines covered by the standards. For example, if there are engine families that will be particularly costly or have a particularly hard time coming into compliance with the standard, this flexibility allows the manufacturer to adjust the compliance schedule accordingly, without special delays or exceptions having to be written into the rule. Emission-credit programs also create an incentive (for example, to generate credits in early years to create compliance flexibility for later engines) for the early introduction of new technology, which allows certain engine families to act as trailblazers for new technology. This can help provide valuable information to manufacturers on

[253] 63 FR 31883, June 10 , 1998

the technology before they apply the technology throughout their product line. This early introduction of clean technology improves the feasibility of achieving the standards and can provide valuable information for use in other regultory programs that may benefit from similar technologies. Early introduction of such engines also secures earlier emission benefits.

In an effort to make information on the ABT program more available to the public, we intend to issue periodic reports summarizing use of the proposed ABT program by engine manufacturers. The information contained the periodic reports would be based on the information submitted to us by engine manufacturers, and summarized in a way that protects the confidentiality of individual engine manufacturers. We believe this information will also be helpful to engine manufacturers by giving them a better indication of the availability of credits. Again, our periodic reports would not contain any confidential information submitted by individual engine manufacturers, such as sales figures. Also, the information would be presented in a format that would not allow such confidential information to be determined from the reports.

2. What are the provisions of the proposed ABT program?

The following section describes the changes proposed to the existing ABT program. In addition to those areas specifically highlighted, we are soliciting comments on all aspects of the proposed ABT changes, including comments on the need for and benefit of these changes to manufacturers in meeting the proposed emission standards.

The ABT program has three main components. Averaging means the exchange of emission credits between engine families within a given engine manufacturer’s product line. Averaging allows a manufacturer to certify one or more engine families at levels above the applicable emission standard (but below a set upper limit). However, the increased emissions must be offset by one or more engine families within that manufacturer’s product line that are certified below the same emission standard, such that the average emissions from all the manufacturer's engine families, weighted by engine power, regulatory useful life, and production volume, are at or below the level of the emission standard. (The inclusion of engine power, useful life, and production volume in the averaging calculations is designed to reflect differences in the in-use emissions from the engines.) Averaging results are calculated for each specific model year. The mechanism by which this is accomplished is certification of the engine family to a "family emission limit" (FEL) set by the manufacturer, which may be above or below the standard. An FEL that is established above the standard may not exceed an upper limit specified in the ABT regulations. Once an engine family is certified to an FEL, that FEL becomes the enforceable emissions limit for all the engines in that family for purposes of compliance testing. Averaging is allowed only between engine families in the same averaging set, as defined in the regulations.

Banking means the retention of emission credits by the engine manufacturer for use in future model year averaging or trading. Trading means the exchange of emission credits between nonroad diesel engine manufacturers which can then be used for averaging purposes, banked for future use, or traded to another engine manufacturer.

The existing ABT program for nonroad diesel engines covers NMHC+NOx emissions as well as PM emissions. With today's notice we are proposing to make the ABT program available for the proposed NOx standards and proposed PM standards. (For engines less than 75 horsepower where we are proposing combined NMHC+NOx standards, the ABT program would continue to be available for the proposed NMHC+NOx standards as well as the proposed PM standards.) ABT would not be available for the proposed NMHC standards for engines above 75 horsepower or for the proposed CO standards for any engines, as explained further below.

As noted earlier, the existing ABT program for nonroad diesel engines includes FEL caps; limits on how high the emissions from credit-using engine families can be. No engine family may be certified above these FEL caps. These limits provide the manufacturers compliance flexibility while protecting against the introduction of unnecessarily high-emitting engines. When we propose new standards, we typically propose new FEL caps for the new standards. In the past, we have generally set the FEL caps at the emission levels allowed by the previous standard, unless there was some specific reason to do otherwise. We are proposing to do otherwise here because the proposed standard levels in today's notice are so much lower than the current standards levels, especially the Tier 4 standards for engines above 75 horsepower. The transfer to new technology is feasible and appropriate. Thus, to ensure that the ABT provisions are not used to continue producing old-technology high-emitting engines under the new program, the proposed FEL caps would not, in general, be set at the previous standards. An exception is for the proposed NMHC+NOx standard for engines between 25 and 50 horsepower effective in model year 2013, where we are proposing to use the previously applicable NMHC+NOx standard for the FEL cap since the gap between the previous and proposed standards is approximately 40 percent (rather than 90 percent for engines above 75 horsepower).

For engines above 75 horsepower certified during the phase-in period, there would be two separate sets of engines with different FEL caps. For engines certified to the existing NMHC+NOx standards during the phase-in, the FEL cap would necessarily continue to be the existing FEL caps as adopted in the October 1998 rule. For engines certified to the proposed Tier 4 NOx standard during the phase-in, the FEL cap would be 3.3 g/bhp-hr for engines between 75 and 100 horsepower, 2.8 g/bhp-hr for engines between 100 and 750 horsepower, and 4.6 g/bhp-hr for engines above 750 horsepower. These proposed NOx FEL caps represent an estimate of the NOx emission level that is expected under the combined NMHC+NOx standards that apply with the existing previous tier standards. Beginning in model year 2014 when the proposed Tier 4 NOx standard for engines above 75 horsepower take full effect, we are proposing a NOx FEL cap of 0.60 g/bhp-hr for all engines above 75 horsepower. Given the fact that the proposed Tier 4 NOx standard is approximately a 90 percent reduction from the existing standards for engines above 75 horsepower, we do not believe the previous standard would be appropriate as the FEL cap once the Tier 4 standards are fully phased-in. We believe that the proposed NOx FEL caps will ensure that manufacturers fully adopt NOx aftertreament technology across all of their engine designs but will also allow for some meaningful use of averaging during the phase-in period. (As described below, we are also proposing additional restrictions on the use of banked NOx credits during the phase-in period to prevent a significant delay in implementation of NOx aftertreatment technologies during the phase-in.) Once the Tier 4 standards are fully phased-in, we believe it would not be appropriate to have FEL caps that allow some engines to indefinitely have emissions nearly ten times the level of the proposed standard. When compared to the proposed 0.30 g/bhp-hr NOx standard, the proposed NOx FEL cap of 0.60 g/bhp-hr (effective when the Tier 4 standards are fully phased-in) is consistent with FEL caps set in previous rulemakings.

For the transitional PM standards being proposed for engines between 25 and 75 horsepower effective in model year 2008 and for the Tier 4 PM standards for engines below 25 horsepower, we are proposing the previously applicable PM standards for the FEL caps since the gap between the previous and proposed standards is approximately 50 percent (rather than in excess of 90 percent for engines above 75 horsepower). For the proposed Tier 4 PM standard effective in model year 2013 for engines between 25 and 75 horsepower, we are proposing a PM FEL cap of 0.04 g/bhp-hr, and for the proposed Tier 4 PM standard effective in model year 2014 for engines between 75 and 750 horsepower, we are proposing a PM FEL cap of 0.03 g/bhp-hr. Given the fact that the proposed Tier 4 PM standards for engines above 25 horsepower are less than 10 percent of the previous standards, we do not believe the previous standards would be appropriate as FEL caps once the Tier 4 standards take effect. We believe that the proposed PM FEL caps will ensure that manufacturers fully adopt PM aftertreament technology across all of their engine designs, yet will still provide substantial flexibility in meeting the standards.

For the proposed Tier 4 PM standards for engines above 750 horsepower there is a phase-in period during model years 2011 through 2013. During the phase-in period, there would be two separate sets of engines with different FEL caps. For engines certified to the existing Tier 2 PM standard, the FEL cap would continue to be the existing PM FEL cap adopted in the October 1998 rule. For engines certified to the proposed Tier 4 PM standard during the phase-in, the FEL cap would be 0.15 g/bhp-hr (the PM standard for the previous tier). Beginning in model year 2014, when the proposed Tier 4 PM standard for engines above 750 horsepower takes full effect, consistent with the proposed caps for lower horsepower categories, we are proposing a PM FEL cap of 0.03 g/bhp-hr. We believe that the proposed PM FEL caps for engines above 750 horsepower will ensure that manufacturers fully adopt PM aftertreament technology across all of their engine designs once the standard is fully phased-in while allowing for some meaningful use of averaging during the phase-in period.

Table ___ contains the proposed FEL caps and the effective model year for the FEL caps. We request comment on the need for and the levels of these proposed FEL caps.

Table ____
Proposed FEL Caps for the Proposed Tier 4 Standards in the ABT Program

Power Category	Effective Model Years	NOx FEL (g/bhp-hr)	PM FEL (g/bhp-hr)
hp <25 (kW <19)	2008+	–[a]	0.60
25 ≤ hp < 50 (19 ≤ kW < 37)	2008-2012[b]	–[a]	0.45
25 ≤ hp < 50 (19 ≤ kW < 37)	2013+[c]	5.6[d]	0.04
50 ≤ hp < 75 (37 ≤ kW < 56)	2008-2012	–[a]	0.30
50 ≤ hp < 75 (37 ≤ kW < 56)	2013+	–[a]	0.04
75 ≤ hp < 175 (56 ≤ kW <130)	2012-2013	3.3 (for hp < 100) 2.8 (for hp ≥ 100)	0.03
75 ≤ hp < 175 (56 ≤ kW <130)	2014+	0.6	0.03
175 ≤ hp ≤ 750 (130 ≤ kW ≤ 560)	2011-2013	2.8	0.03
175 ≤ hp ≤ 750 (130 ≤ kW ≤ 560)	2014+	0.6	0.03
hp > 750 (kW >560)	2011-2013	4.6	0.15
hp > 750 (kW >560)	2014+	0.6	0.03

a - The existing NMHC+NOx FEL cap applies (see CFR Title 40, section 89.112(d)).
b - The proposed FEL caps do not apply if the manufacturer elects to comply with the optional standards. The existing FEL caps continue to apply.
c - FEL caps apply in model year 2012 if the manufacturer elects to comply with the optional standards.
d - This is a combined NMHC+NOx FEL cap.

Under the proposed Tier 4 program, for engines above 75 horsepower there will be two different groups of engines during the phase-in period. In one group, engines would certify to the applicable Tier 3 NOx+NMHC standard (or Tier 2 standard for engines above 750 horsepower), and would be subject to the ABT restrictions and allowances previously established for those tiers. In the other group, engines would certify to the 0.30 g/bhp-hr NOx standard, and would be subject to the restrictions and allowances in today's proposed program. While engines in each group are certified to different standards, we are proposing to allow manufacturers to transfer credits across these two groups of engines, with some restrictions. As proposed, manufacturers could use credits generated during the phase-out of engines subject to the Tier 3 NMHC+NOx standard (or Tier 2 NMHC+NOx standard for engines above 750 horsepower) to average with engines subject to the 0.30 g/bhp-hr NOx standard, but these credits will be subject to a 20 percent discount. In other words, each gram of NMHC+NOx credits from the phase-out engines would be worth 0.8 grams of NOx credits in the new ABT program. The ability to average credits between the two groups of engines will give manufacturers a greater opportunity to gain experience with the low-NOx technologies before they are required to meet the final Tier 4 standards across their full production.

The 20 percent discount factor is being proposed for two main reasons. First, the discounting addresses the fact that NMHC reductions can provide substantial NOx+NMHC credits, which are then treated as though they were NOx credits. For example, a 2010 model year engine (between 175 and 750 horsepower) emitting at 2.7 g/bhp-hr NOx and 0.3 g/bhp-hr NMHC meets the 3.0 g/bhp-hr NOx+NMHC standard in that year, but gains no credits. In 2011, that engine, equipped with a PM trap to meet the new PM standard, will have very low NMHC emissions because of the trap, an emission reduction already accounted for in our assessment of the air quality benefit of this program. As a result, without substantially redesigning the engine to reduce NOx or NMHC, the manufacturer could garner a windfall of nearly 0.3 g/bhp-hr of NOx+NMHC credit for each of these engines produced. (Engines designed at lower NOx levels than this in 2010 can gain even more credits.) Allowing these NMHC-derived credits to be used undiscounted to offset NOx emissions on the phase-in engines in 2011 (for which each 0.1 g/bhp-hr of margin can make a huge difference in facilitating the design of engines to meet the 0.30 g/bhp-hr NOx standard) would be inappropriate. Second, the discounting would work toward providing a net environmental benefit from the ABT program, such that the more that manufacturers use banked and averaged credits, the greater the potential emission reductions overall.

While we are proposing to allow manufacturers to average emissions between the two groups of engines during the phase-in period, we are also proposing a restriction on the use of banked NMHC+NOx credits generated from diesel engines certified to the earlier tier standards. We are proposing an upper bound on the number of engines for which a manufacturer could use such banked credits during any one model year. The proposed upper limit is ten percent of the manufacturer's annual U.S.-directed production of nonroad diesel engines, and would apply only for engines certified to NOx FELs higher than 0.60 g/bhp-hr. We believe this limit is necessary because the transfer to the new technology is feasible and appropriate and this limit will prevent manufacturers from building up credits from engines designed to the relatively much less stringent Tier 3 standards (or Tier 2 standards for engines above 750 horsepower), and thus delaying their compliance with the new standards by using a large number of banked credits into the first year of the phase-in (or longer). This kind of delay would be contrary to the goals of the phase-in, which is designed to facilitate the transition to high-efficiency NOx technologies when 15 ppm sulfur fuel becomes widely available.

Some foreign engine manufacturers have commented that it is difficult for them to accurately predict the number of engines that eventually end up in the U.S., especially when they sell to a number of different equipment manufacturers who may import equipment. This would make it difficult for the engine manufacturer to ensure they are complying with the proposed NOx phase-in requirements for engines above 75 horsepower and the proposed PM phase-in requirements for engines above 750 horsepower. Therefore, we are proposing to allow engine manufacturers to demonstrate compliance with the NOx phase in requirements for engines above 75 horsepower and the PM phase in requirements for engines above 750 horsepower by certifying "split" engine families (i.e., an engine family that is split into two subfamilies, one that uses credits and one that generates credits). In order to facilitate compliance with the proposed standards, we are proposing that this option be available to all engine manufacturers (i.e., both foreign and domestic manufacturers). Manufacturers would be allowed to certify engine families with FELs no higher than the levels specified in Table ___. The maximum NOx FEL values specified in Table ___ were set at the level which would result in NOx ABT credits from engines above the Tier 4 standards offsetting ABT credits from engines below the previously applicable NMHC+NOx standards, including the 20% discount for using NMHC+NOx credits on Tier 4 engines. Manufacturers certifying split engine families would exclude those engines from end of the year NOx ABT calculations. Manufacturers certifying split engine families would also exclude those engines from the calculations demonstrating compliance with the 50% phase-in as well. The maximum PM FEL value for engines above 750 horsepower was set at the level halfway between the Tier 2 and proposed Tier 4 PM standard for engines above 750 horsepower.

Table ___
Maximum FEL for Engine Families Certified as "Split" Engine Families

Power Category	Pollutant	Maximum FEL, g/bhp-hr
75 ≤ hp > 175 (56 ≤ kW < 130)	NOx	1.7
175 ≤ hp ≤ 750 (130 ≤ kW < 560)	NOx	1.5
hp > 750 (kW > 560)	NOx	2.3
hp > 750 (kW > 560)	PM	0.08

We are proposing one additional restriction on the use of credits under the ABT program. For the proposed Tier 4 standards we are proposing that manufacturers may only use credits generated from other Tier 4 engines or engines certified to the previous tier of standards (i.e., Tier 2 for engines below 50 horsepower, Tier 3 for engines between 50 and 750 horsepower, and Tier 2 engines above 750 horsepower). We currently have a similar provision that prohibits the use of Tier 1 credits to demonstrate Tier 3 compliance, and given the levels of the final Tier 4 standards being proposed today, we believe it is appropriate to apply a similar restriction. Otherwise, we would be concerned about the possibility that credits from engines certified to relatively high standards could be used to significantly delay the implementation of the final Tier 4 program and its benefits.

Effective with the Tier 4 standards, we are not proposing the restriction which prohibits manufacturers from averaging across the 25 horsepower threshold. Beginning with the Tier 4 standards, engine manufacturers will be allowed to use credits generated on Tier 4 engines without a restriction on the horsepower of either the engine generating or the engine using credits.

Effective with the Tier 4 standards, we are not proposing the restriction which prohibits manufacturers from trading credits generated on indirect fuel injection engines greater than 25 horsepower. The restriction was originally adopted because of concerns over the ability of manufacturers to generate significant credits from existing technology engines. (See 63 FR at 56977.) Based on the current certification levels of such engines, we do not believe there is the potential for manufacturers to generate significant credits from their currently certified indirect injection engines against the proposed Tier 4 standards. Therefore, effective with implementation of the Tier 4 standards, we are not proposing to restrict the trading of credits generated on indirect injection engines to other manufacturers effective with the implementation of the Tier 4 standards.

We are not proposing to apply a specific discount factor to Tier 3 PM credits used to demonstrate compliance with the Tier 4 standards. PM credits generated under the Tier 3 standards are based on testing performed over a steady-state test cycle. Under the proposed Tier 4 standards, the test cycle is being changed to a transient test. Because in-use PM emissions from Tier 3 engines will vary depending on the type of application in which the engine is used (some having higher in-use PM emissions, some having lower in-use PM emissions), the relative "value" of the Tier 3 PM credits in the Tier 4 timeframe will differ. Instead of requiring manufacturers to gather information to estimate the level of in-use PM emissions compared to the PM level of the steady-state test, we believe allowing manufacturers to bring Tier 3 PM credits directly into the Tier 4 time frame without any adjustment because it likely discounts their value for use in the Tier 4 timeframe (since the initial baseline being reduced is probably higher than measured in the Tier 2 test procedure).

3. Should we expand the nonroad ABT program to include credits from retrofit nonroad engines?

We are considering expanding the ABT program to allow NOx and PM credits to be generated through retrofitting in-use nonroad diesel engines so that the engines meet more stringent emissions levels than required. We request comment on whether such a program would be feasible and appropriate for the Tier 4 nonroad standards, and on how such a program might be structured.

This concept is based on an economic theory that there may be opportunities for control of nonroad diesel engine emissions that are more cost effective than the last increment of new nonroad diesel engine control under the Tier 4 program. If manufacturers could obtain credits from these other nonroad diesel engine sources and apply them to Tier 4 nonroad engines, the overall cost of the programs could be lowered. If we adopted such a program, we would need to ensure it provides a cost effective net environmental benefit, in the form of greater overall PM and NOx reductions than would otherwise occur. Any such program must also ensure that credits are surplus, verifiable, quantifiable, and enforceable.

We are considering an approach for credit generation based on the use of advanced exhaust emission control technology/engine system combinations that would provide significant emissions reductions. To accomplish this, simple changes that are easily accidently circumvented or intentionally defeated would not be eligible to generate credits, and essentially, only changes involving introduction of post combustion emissions control technology would be eligible. We would structure the program such that engine recalibration as the sole mechanism to reduce emissions would not be eligible for retrofit credits. Also, for purposes of a nonroad retrofit ABT program, in order to generate credits, the manufacturer of the nonroad retrofit engine system would agree that the retrofit engine would be considered a new nonroad engine, subject to enforceable standards and the normal certification and compliance requirements would apply. We have outlined in a memorandum to the docket, our ideas for meeting these objectives, including possible ways to structure the program.[254] This memorandum describes potential procedures for credit generation, credit use, and a number of compliance, implementation, and enforcement measures.

We recognize that expanding the ABT program in this way would introduce new issues and complexities to the nonroad Tier 4 program, and that there are several ways to structure the program. We are seeking comment on whether such an expansion of the ABT program is feasible and appropriate, as well as on the details of how a program could be structured. We have considered and described a possible framework for nonroad retrofit credits in an effort to help commenters provide input. The level of detail provided below and in the memorandum to the docket does not indicate that we have made any decisions on whether nonroad retrofit credits are appropriate for the ABT program or about how the program should function. We invite comment not only on the provisions described below and in the memorandum to the docket, but also on alternative approaches that commenters believe would lead to a better overall program.

We are also seeking comment on the timing of a retrofit credits approach. We believe that if such a program were adopted, credit generation could start in 2004, at the earliest, and request comment on ending the program in the 2015 time frame. We view this as primarily a transitional program which could be most useful in the early years of the nonroad program. Ending the program in 2015 may also ease concerns about long-term impact of such a program on the environment.

We encourage commenters to carefully address all aspects of a nonroad retrofit credits program including its usefulness, feasibility, compliance and enforcement measures, environmental benefits, and potential cost savings. We specifically request comment on the potential for such a program to provide additional emissions reductions than would otherwise be obtained and request comment on the potential impacts such provisions would have on emissions reductions associated with the proposed nonroad standards. We are also interested in comments on practical issues and details regarding how the program would operate and be enforced.

a. What would be the environmental impact of allowing ABT nonroad retrofit credits?

We would structure any nonroad credit ABT program in a way that provides greater overall emissions reductions over the life of the group of nonroad engines involved. These

[254] Memorandum to the Docket, Chris Lieske and Joseph McDonald, EPA, {DATE}, Additional Information on Nonroad Retrofit Engine ABT Credit Concepts, Docket A-2001-28.

additional overall reductions would be achieved by applying a discount of 30 percent to ABT retrofit credits that are used to meet nonroad standards. The result of applying a discount would be that each ABT retrofit credit generated would translate to less than one nonroad engine credit available for consumption in the nonroad program. For example, a discount of 30 percent would reduce the consumable credits by 30 percent. The discount would provide greater overall net emissions reductions from the use of an ABT retrofit program, and the amount of this environmental benefit would increase with increased use of the program. Also, applying a discount would be consistent with past Agency actions (see additional discussion in the memorandum to the docket noted above).

A discount would be an essential element of the nonroad retrofit credit provisions, since one of our objectives if we promulgated such an expanded ABT program would be to create greater net emission reductions. The absence of a discount would result in no net environmental impact, as the generation of credits would lead to emissions reductions which would be offset by the increase in emissions when the credits were used. A discount would also serve to mitigate the potential for net environmental detriments due to uncertainties in credit calculation and use.

We request comment on whether a discount of 30 percent would be appropriate given the expectation that the discount will generate cost-effective emissions reductions that would otherwise not occur, as well as the more prevalent uncertainties associated with trading credits between nonroad retrofits and new nonroad engines.

b. How would EPA ensure compliance with retrofit emissions standards?

If this program were adopted, we would expect to require the retrofit manufacturer to specify all emissions related maintenance and to list the type of fuel used to certify its retrofit-engine system and whether a particular fuel sulfur level is necessary to meet the standard and to maintain emissions compliance of the retrofit-engine system in-use. If such a fuel is necessary to maintain emissions compliance in-use, EPA would also consider the fuel to be "critical emission related scheduled maintenance" under a retrofit engine program. As a result of such classification, the manufacturer would be required to demonstrate that proper fueling will be performed in-use. Such a demonstration would include a showing that the required fuel is available to, and would be used by, the ultimate consumer or fleet operator receiving the retrofitted engines. Such retrofitted engines would also have to be labeled appropriately to reflect the new engine family and may also require labeling for the type of fuel to be used. In general, we would require the manufacturer to submit a plan for implementing all relevant aspects of the retrofit to ensure proper installation and emissions compliance throughout the useful life period A full discussion of compliance issues and possible compliance provisions, such as recall, in-use testing, useful life, and warranty is provided in the memorandum to the docket, noted above. We request comment on these approaches for ensuring in-use compliance with possible nonroad retrofit emissions standards and requirements.

c. What is the legal authority for a nonroad ABT retrofit program?

Allowing use by new nonroad engines of credits generated by retrofit of in-use nonroad engines is justified legally as an aspect of EPA's standard setting authority. As we envision a program, a retrofit nonroad engine would be considered to be a new nonroad engine when the manufacturer opts into a voluntary retrofit program (if established). Upon opt-in, this new engine would be subject to enforceable standards under CAA section 213, somewhat similar to opting in to the voluntary Blue Sky series standards. Thus, the generation of credits by nonroad retrofits and their use by new engines subject to Tier 4 would be similar to conventional ABT. Put another way, the generation of credits by retrofitting in-use non-road engines and their subsequent use by new nonroad engines subject to the Tier 4 standards is an averaging program involving emission credits generated by one type of new nonroad engine and used by other new nonroad engines, similar to conventional ABT programs. With a nonroad retrofit credit program, and the emissions reductions associated with it, the overall emission reductions from Tier 4 nonroad engines and nonroad retrofit engines, taken together, would be the greatest achievable considering cost, noise, safety and energy factors, and would also be appropriate after considering those same factors. See also NRDC v. Thomas, 805 F. 2d 410, 425 (D.C. Cir. 1986)(averaging provisions upheld against challenge that they are inconsistent with NCP provisions). Husqvarna AB v. EPA, 254 F. 3d 195, 202 (D.C. Cir 2001) (averaging, banking, and trading provisions cited as an element supporting EPA's selection of lead time under section 213 (b)). At the same time, we also note that the proposed standards are the greatest achievable (taking all statutory factors into account) and appropriate independent of the nonroad retrofit program, as explained elsewhere in this preamble. [255]

B. Transition Provisions for Equipment Manufacturers

1. Why are we proposing transition provisions for equipment manufacturers?

As EPA developed the 1998 Tier 2/3 standards for nonroad diesel engines, we determined that provisions were needed to avoid unnecessary hardship for equipment manufacturers. The specific concern is the amount of work required and the resulting time needed for equipment manufacturers to incorporate all of the necessary equipment redesigns into their applications in order to accommodate engines that have been redesigned to meet the new emission standards. We therefore, adopted a set of provisions for equipment manufacturers to provide them with reasonable leadtime for the transition process to the newly adopted standards. The program consisted of four major elements: (1) a percent-of-production allowance, (2) a small-volume

[255] There is one minor exception to this analysis. Retrofits involving use of new nonroad engines as replacement engines in older nonroad equipment would be justified primarily as an aspect of EPA's lead time authority under section 213(d). This is because credits would not be generated from an engine certifying to a more stringent standard, so that the credit is effectively generated by equipment rather than by an engine, i.e. something other than a new non-road engine.

allowance, (3) availability of hardship relief, and (4) continuance of the allowance to use up existing inventories of engines. See 63 FR 56977-56978, (Oct. 23, 1998).

Given the level of the proposed Tier 4 standards, we believe that there will be engine design changes comparable in magnitude to those involved during the transition to Tier 2/3. We thus believe that at least some equipment manufacturers will face comparable challenges during the transition to the Tier 4 standards. This is confirmed by comments to EPA by a number of the equipment Small Entity Representatives during the SBREFA process, which indicated that the Tier 2/3 transition provisions were proving beneficial in providing adequate leadtime and urging EPA to adopt comparable provisions in a Tier 4 rule. See Report of the Small Business Advocacy Review Panel, section 8.4.1 (Dec. 23, 2002). Therefore, with a few exceptions described in more detail below, we are proposing to adopt transition provisions for Tier 4 in this notice that are similar to those adopted with the previous Tier 2/3 rulemaking. The following section describes the proposed transition provisions available to equipment manufacturers. (Section VII.C. of today's notice describes all of the proposed provisions that would be available specifically for small businesses.)

Our experience to date with the transition provisions for the Tier 2/3 standards above 50 horsepower is limited. In the one power category where manufacturers have been required to submit information on the number of engines using the allowances (engines between 300 and 600 horsepower), approximately 20 percent of the engines in the category are relying on the allowances in the first year that the Tier 2 standards apply. (For the power categories below 50 horsepower, manufacturers are reporting that there are very few engines using allowances. However, given the level of the Tier 1 standards, we would not expect there to have been much need for equipment redesign to handle Tier 1 engines.) While this information is useful, we do not believe there is enough information available to determine if the level of the existing allowances should be revised for the Tier 4 proposal. For this reason, we are primarily relying on the provisions of the Tier 2/3 equipment manufacturer transition provisions for the Tier 4 proposal. However, as described in more detail below, we are proposing to add notification, reporting, and labeling requirements to the Tier 4 proposal, which are not required in the existing transition provisions for equipment manufacturers. We believe these additional proposed provisions are necessary for EPA to gain a better understanding of the extent to which these provisions will be used and to ensure compliance with the Tier 4 transition provisions.

As under the existing provisions, equipment manufacturers would not be obligated to use any of these provisions, but all equipment manufacturers would be eligible to do so. Also, as under the existing program, we are proposing that all entities under the control of a common entity, and that meet the definition in the regulations of a nonroad vehicle or nonroad equipment manufacturer contained in the regulations, would have to be considered together for the purposes of applying exemption allowances. This would not only provide certain benefits for the purpose of pooling exemptions, but would also preclude the abuse of the small-volume allowances that would exist if companies could treat each operating unit as a separate equipment manufacturer.

We are also requesting comment on provisions dealing specifically with foreign equipment manufacturers and the special concerns raised by the use of the transition provisions for equipment imported into the U.S.

2. What transition provisions are we proposing for equipment manufacturers?

a. Percent-of-Production Allowance

Under the proposed percent-of-production allowance, each equipment manufacturer may install engines not certified to the proposed Tier 4 emission standards in a limited percentage of machines produced for the U.S. market. These engines would instead have to be certified to the standards that would apply in the absence of the Tier 4 standards (i.e., Tier 2 for engines below 50 horsepower, Tier 3 for engines between 50 and 750 horsepower[256], and Tier 2 for engines above 750 horsepower). This percentage would apply separately to each of the proposed Tier 4 power categories (engines below 25 horsepower, engine between 25 and 75 horsepower, engines between 75 and 175 horsepower, engines between 175 and 750 horsepower, and engines above 750 horsepower) and is expressed as a cumulative percentage of 80 percent over the seven years beginning when the Tier 4 standards first apply in a category. No exemptions would be allowed after the seventh year. For example, an equipment manufacturer could install engines certified to the Tier 3 standards in 40 percent of its entire 2011 production of nonroad equipment that use engines rated between 175 and 750 horsepower, 30 percent of its entire 2012 production in this horsepower category, and 10 percent of its entire 2013 production in this horsepower category. (During the transitional period for the Tier 4 standards, the fifty percent of engines that would be allowed to certify to the previous tier NOx standard but meet the Tier 4 PM standard would be considered as Tier 4-compliant engines for the purpose of the equipment manufacturer transition provisions.) If the same manufacturer were to produce equipment using engines rated above 750 horsepower, a separate cumulative percentage allowance of 80 percent would apply to these machines during the seven years beginning in 2011. This proposed percent-of-production allowance is almost identical to the percent-of-production allowance adopted in the October 1998 final rule, the difference being, as explained earlier, that we are proposing to have fewer power categories associated with the proposed Tier 4 standards.

The proposed 80 percent exemption allowance, were it to be used to its maximum extent by all equipment manufacturers, would bring about the introduction of cleaner engines several months later than would have occurred if the new standards were to be implemented on their effective dates. However, the equipment manufacturer flexibility program has been integrated with the standard-setting process from the initial development of this proposal, and as such we believe it is a key factor in assuring that there is sufficient lead time to initiate the Tier 4

[256] For engines between 50 and 75 horsepower, the proposed Tier 4 NMHC+NOx standard is the same as the existing Tier 3 NMHC+NOx standard.

standards according to the proposed schedule.[257]

Machines that use engines built before the effective date of the proposed Tier 4 standards would not be included in an equipment manufacturer's percent of production calculations under this allowance. Machines that use engines certified to the previous tier of standards under our Small Business provisions (as described in Section VII.C. of today's proposal) would not be included in an equipment manufacturer's percent of production calculations under this allowance. All engines certified to the Tier 4 standards, including those engines that produce emissions at higher levels than the standards, but for which an engine manufacturer uses ABT credits to demonstrate compliance, would count as Tier 4 complying engines and would not be included in an equipment manufacturer's percent of production calculations. As noted earlier, engines that meet the proposed Tier 4 PM standards but are allowed to meet the Tier 3 NMHC+NOx standards during the phase-in period would also count as Tier 4 complying engines and would not be included in an equipment manufacturer's percent of production calculations. All engines used under the percent-of-production allowance would have to certify to the standards that would be in effect in the absence of the Tier 4 standards (i.e., the Tier 3 standards for engines between 50 and 750 horsepower and the Tier 2 standards for engines below 50 horsepower and above 750 horsepower).

The choice of a cumulative percent allowance of 80 percent is based on our best estimate of the degree of reasonable leadtime needed by equipment manufacturers. We believe the 80 percent allowance responds to the need for flexibility identified by equipment manufacturers, while ensuring a significant level of emission reductions in the early years of the proposed program.

We are also proposing to allow manufacturers to start using a limited number of the new Tier 4 flexibilities once the seven-year period for the existing Tier 2/Tier 3 program expires (and so continue producing engines meeting Tier 1 or Tier 2 standards). In this way, a manufacturer could potentially continue exempting the most difficult applications once the seven-year period of the current Tier 2/3 flexibility provisions is finished. (Under the existing transition program for equipment manufacturers, any unused allowances expire after the seven year period. We are not changing this provision with today's proposal.) However, opting to start using Tier 4 allowances once the seven-year period from the current Tier 2/Tier 3 program expires would

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257 For emissions modeling purposes, we have assumed that manufacturers take full advantage of the existing allowances under the transition program for equipment manufacturers. This assumption is based on limited data provided to us by engine manufacturers, noted earlier, which shows that approximately 20 percent of the engines in the 300-600 horsepower category are relying on the allowances in the first year that the Tier 2 standards apply. In modeling the Tier 4 program, because the program will not take effect for many years and it is not possible to accurately forecast use of the proposed transition program for equipment manufacturers, we have assumed that all engines will meet the Tier 4 standards in the timeframe proposed. As discussed in Section V.C., this is consistent with our cost analysis, which assumes no use of the proposed transition program for equipment manufacturers.

reduce the available percent of production exemptions available from the Tier 4 standards. We are proposing that equipment manufacturers may use up to a total of 10 percent of their Tier 4 allowances prior to the effective date for the proposed Tier 4 standards. (The early use of Tier 4 allowances would be allowed in each power category based on the five Tier 4 power categories). This percentage of equipment utilizing the early Tier 4 allowances would be subtracted from the proposed Tier 4 allowance of 80 percent for the appropriate power category, resulting in fewer allowances once the Tier 4 standards take effect. (If an equipment manufacturer used the maximum amount of early Tier 4 allowances of 10 percent, then the manufacturer would have a cumulative total of 70 percent remaining when the Tier 4 standards take effect.) We are also requesting comment on requiring equipment manufacturers to take a two-for-one loss of Tier 4 allowances for each allowance used prior to the Tier 4 effective date. This would reduce the number of overall engines that could be exempted under the Tier 4 allowance program and result in greater environmental benefits than would be realized if manufacturers used all of the Tier 4 allowances in the Tier 4 timeframe.

We view this proposed provision on early use of Tier 4 allowances as providing reasonable leadtime for introducing Tier 4 engines, since it should result in earlier introduction of Tier 4-compliant engines (assuming that the 80% allowance would otherwise be utilized) with resulting net environmental benefit (notwithstanding longer utilization of earlier Tier engines, due to the stringency of the Tier 4 standards) and should do so at net reduction in cost by providing cost savings for the engines that have used the Tier 4 allowances early. As discussed above, once the Tier 4 implementation model year begins, engines which use the transition provision allowances must be certified to the standards that would apply in the absence of the Tier 4 standards.

b. Small-Volume Allowance

The percent-of-production approach described above may provide little benefit to small businesses focused on a small number of equipment models. Therefore we are proposing to allow equipment manufacturers to exceed the percent-of-production allowances described above during the same seven year period, provided they limit the number of exempted engines used in each power category to 700 total over the seven years, and to 200 in any one year. In addition, manufacturers making use of this provision must limit exempted engines to a single engine family in each Tier 4 power category.

As with the proposed percent-of-production allowance, machines that use engines built before the effective date of the proposed Tier 4 standards would not be included in an equipment manufacturer's count of engines under the small-volume allowance. Similarly, machines that use engines certified to the previous tier of standards under our Small Business provisions (as described in Section VII.C. of today's proposal) would not be included in an equipment manufacturer's count of engines under the small-volume allowance. All engines certified to the Tier 4 standards, including those that produce emissions at higher levels than the standards but for which an engine manufacturer uses ABT credits to demonstrate compliance, would be considered as Tier 4 complying engines and would not be included in an equipment manufacturer's count of engines under the small-volume allowance. Engines that meet the proposed Tier 4 PM standards but are allowed to meet the Tier 3 NMHC+NOx standards during the phase-in period would also be considered as Tier 4 complying engines and would not be included in an equipment manufacturer's count of engines under the small-volume allowance. All engines used under the small-volume allowance would have to certify to the standards that would be in effect in the absence of the Tier 4 standards (i.e., the Tier 3 standards for engines between 50 and 750 horsepower and the Tier 2 standards for engines below 50 horsepower and above 750 horsepower).

In discussions regarding the current small-volume allowance, some manufacturers expressed the desire to be able to exempt engines from more than one engine family, but still fall under the number of exempted engine limit. (Under the current rules, although equipment manufacturers are allowed to exempt up to 700 units over seven years, they must all use the same engine family. In many cases, a manufacturer's largest sales volume model does not even sell 700 units over seven years. As a result, the maximum number of units a manufacturer can exempt under the small-volume allowance is less than the 700 unit limit.) We are concerned, however, that allowing manufacturers to exempt engines in more than one family, but retaining the current 700-unit allowance, could lead to significantly higher numbers of engines being exempted from the Tier 4 program.

Using data of equipment sales by equipment manufacturers that qualify as small businesses under Small Business Administration (SBA) guidelines, we have analyzed the effects of a small-volume allowance program that would set an exempted engine allowance lower than 700 units over seven years but allow manufacturers to exempt engines from more than one engine family. Based on sales information for small businesses, we believe we could revise the small-volume allowance program to include lower caps and allow manufacturers to exempt more than one engine family while still keeping the total number of engines eligible for the allowance at roughly the same overall level as the 700-unit program described above.[258] Such a program would in general provide sufficient leadtime for equipment manufacturers, allowing them to temporarily exempt greater numbers of equipment models from the proposed Tier 4 standards, but, as noted above, keeping the total number of engines eligible for the allowance at roughly the same overall level as the existing program would allow (and so not allow more leadtime than necessary). Based on our analysis, the small-volume allowance program could be revised to allow equipment manufacturers to exempt 525 machines over seven years (with a maximum of 150 in any given year) for each of the three power categories below 175 horsepower, and 350 machines over seven years (with a maximum of 100 in any given year) for the two power

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[258] "Analysis of Small Volume Equipment Manufacturer Flexibilities," EPA memo from Phil Carlson to Docket A-2001-28, _____ 2003 (Document II-B-__).

categories above 175 horsepower. Concurrent with the revised caps, manufacturers would be allowed to exempt engines from more than one engine family under the small-volume allowance program.

We request comment on adopting a small-volume allowance program with the lower caps noted above that allows manufacturers to exempt more than one engine family in each power category. We specifically request comment on allowing equipment manufacturers to choose between the two small-volume allowance programs described above. Alternatively, we request comment on whether we should replace the current program (which allows 700 units over seven years with a one engine family restriction), with this revised small-volume allowance program (which would allow fewer units over seven years but without the single engine family restriction). Our analysis of small businesses noted above did show that there were a very limited number of companies that could potentially get fewer total allowances under a revised program with the lower caps compared to the existing program. (i.e., a company that sells an equipment model that utilizes one engine family whose sales over a seven year period are above the revised limits noted above but less than 700). Allowing an equipment manufacturer to choose between the two programs, would help to ensure that manufacturers are able to retain the current level of flexibility they have under the current program.

Because we are proposing fewer power categories for the Tier 4 standards, the proposed equipment flexibility program is designed to reflect those changes. Therefore, under the proposed small-volume allowance, the specified unit allowances will apply separately to each of the five power categories being proposed for the Tier 4 standards.

As noted earlier, we are also proposing to allow manufacturers to start using a limited number of the new Tier 4 flexibilities once the seven-year period for the existing Tier 2/Tier 3 program expires (and so continue producing engines meeting Tier 1 or Tier 2 standards). Under the proposed small-volume allowance, any engines used by the manufacturer prior to Tier 4 would be subtracted from the proposed 700 unit allowance (for the appropriate Tier 4 power category), resulting in fewer allowances once the Tier 4 standards take effect. We are proposing to limit the number of Tier 4 allowances that can be used prior to the effective dates of the Tier 4 standards to a total of 100 units in each of the Tier 4 power categories. We are taking comment on requiring equipment manufacturers to take a two-for-one loss of Tier 4 allowances for each allowance used prior to the Tier 4 effective date. As explained above, we view this proposal as providing reasonable leadtime for introduction of Tier 4 engines by providing the possibility of earlier introduction of such engines with a net cost savings.

c. Hardship Relief Provision

We are proposing to extend the availability of the “hardship relief provision” with the Tier 4 transition provisions for equipment manufacturers. Under the proposal, an equipment manufacturer that does not make its own engines could obtain limited additional relief by providing evidence that, despite its best efforts, it cannot meet the implementation dates, even with the proposed equipment flexibility program provisions outlined above. Such a situation might occur if an engine supplier without a major business interest in the equipment manufacturer were to change or drop an engine model very late in the implementation process. As with other equipment manufacturer transition provisions, the equipment Small Entity Representatives indicated that the availability this allowance was useful to them in the transition to the Tier 2/3 standards, and they urged that it be continued in any Tier 4 rule. Report of the Small Business Advocacy Panel, section 8.4.1.

Applications for hardship relief would have to be made in writing, and would need to be submitted before the earliest date of noncompliance. The application would also have to include evidence that failure to comply was not the fault of the equipment manufacturer (such as a supply contract broken by the engine supplier), and would need to include evidence that serious economic hardship to the company would result if relief is not granted. We would work with the applicant to ensure that all other remedies available under the flexibility provisions were exhausted before granting additional relief, if appropriate, and would limit the period of relief to no more than one year. Applications for hardship relief generally will only be accepted during the first year after the effective date of an applicable new emission standard.

The Agency expects this provision would be rarely used. This expectation has been supported by our initial experience with the Tier 2 standards in which only one equipment manufacturer has applied under the hardship relief provisions. Requests for hardship relief would be evaluated by EPA on a case-by-case basis, and may require, as a condition of granting the applications, that the equipment manufacturer agree (in writing) to some appropriate measure to recover the lost environmental benefit.

d. Existing Inventory Allowance

The current program for nonroad diesel engines includes a provision for equipment manufacturers to continue to use engines built prior to the effective date of new standards, until the older engine inventories are depleted. It also prohibits stockpiling of previous tier engines. We are proposing to extend these provisions as manufacturers transition to the standards contained in today's proposal. We are also proposing to extend the existing provision that provides an exception to the applicable compliance regulations for the sale of replacement engines. In proposing to extend this provision, we are requiring that engines built to replace certified engines be identical in all material respects to an engine of a previously certified configuration that is of the same or later model year as the engine being replaced. The term "identical in all material respects" would allow for minor differences that would not reasonably be expected to affect emissions.

3. What are the recordkeeping, notification, reporting, and labeling requirements associated with the equipment manufacturer transition provisions?

a. Recordkeeping

We are proposing to extend the recordkeeping requirements from the current equipment manufacturer transition program. Under the proposed requirements, engine manufacturers would be allowed to continue to build and sell previous tier engines needed to meet the market demand created by the equipment manufacturer flexibility program, provided they receive written assurance from the engine purchasers that such engines are being procured for this purpose.

Equipment manufacturers choosing to take advantage of the proposed Tier 4 allowances would be required to: (1) keep records of the production of all pieces of equipment excepted under the allowance provisions for at least five full years after the final year in which allowances are available for each power category; (2) include in such records the serial and model numbers and dates of production of equipment and installed engines, and the rated power of each engine, (3) calculate annually the number and percentage of equipment made under these transition provisions to verify compliance that the allowances have not been exceeded in each power category; and (4) make these records available to EPA upon request.

b. Notification

We are also proposing some new notification requirements for equipment manufacturers with the Tier 4 program. Under today's proposal, equipment manufacturers wishing to participate in the Tier 4 transition provisions, would be required to notify EPA prior to their use of the Tier 4 transition provisions. Equipment manufacturers would be required to submit their notification prior to the first calendar year in which they intend to use the transition provisions. We believe that prior notification will not be a significant burden to the equipment manufacturer, but will greatly enhance our ability to ensure compliance. Indeed, EPA believes that in order for an equipment manufacturer to properly use either of the allowances provided, it would already have the information required in the notification. Thus we are not requiring additional planning or information gathering beyond that which the equipment manufacturer must already be doing in order to ensure its compliance with the regulations. Under the proposed notification requirements, each equipment manufacturer would be required to notify EPA in writing and provide the following information:

(1) the nonroad equipment manufacturer's name, address, and contact person's name;
(2) the allowance program that the nonroad equipment manufacturer intends to use by power category;
(3) the calendar years in which the nonroad equipment manufacturer intends to use the exception;
(4) an estimation of the number of engines to be exempted under the transition provisions

by power category;

(5) the name and address of the engine manufacturer from whom the equipment manufacturer intends to obtain exempted engines; and

(6) identification of the equipment manufacturer's prior use of Tier 2/3 transition provisions.

c. Reporting

As with the current program, engine manufacturers who participate in the proposed Tier 4 program would be required to annually submit information on the number of such engines produced and to whom the engines are provided, in order to help us monitor compliance with the program and prevent abuse of the program.

We are proposing new reporting requirement for equipment manufacturers participating in the Tier 4 equipment manufacturer transition provisions. Under today's proposal, equipment manufacturers participating in the program would be required to submit an annual written report to EPA that calculates its annual number of exempted engines and the percent of production for that year under the transition provisions. Each report would include a cumulative calculation for all years the equipment manufacturer has used the transition provisions for each of the proposed Tier 4 power categories.

d. Labeling

Engine manufacturers are currently required to label their certified engines with a label that contains a variety of information. Under today's proposal, we are proposing that engine manufacturers would be required to identify on the engine label if the engine is exempted under the Tier 4 transition program. In addition, equipment manufacturers would be required to apply a label to the engine or piece of equipment that identifies the equipment as using an engine produced under the Tier 4 transition program for equipment manufacturers. These proposed labeling requirements would allow EPA to easily identify the engines and equipment manufacturers using these exceptions and to monitor compliance with the transition provisions.

4. What are the proposed requirements associated with use of transition provisions for equipment produced by foreign manufacturers?

Under the current regulations, importers are treated as equipment manufacturers and are each allowed the full allowance under the transition provisions. Therefore, under the current provisions, importers of equipment from a foreign equipment manufacturer could as a group import more excepted equipment from that foreign manufacturer than 80% of that manufacturer's production for the US market or more than the small volume allowances identified in the transition provisions. Therefore, the current regulation creates a potentially significant disparity between the treatment of foreign and domestic equipment manufacturers.

EPA did not intend this outcome, and does not believe it is needed to provide reasonable leadtime to foreign equipment manufacturers.

Under today's proposal, only the nonroad equipment manufacturer that installs an engine as part of its manufacturing or assembling process would qualify for the allowances or other relief provided under the Tier 4 transition provisions. Foreign equipment manufacturers who comply with the compliance related provisions discussed below would receive the same allowances and other transition provisions as domestic manufacturers. Foreign equipment manufacturers who do not comply with the compliance related provisions discussed below would not receive allowances. Importers that do not install engines as part of the equipment's manufacturing or assembling process would not receive any allowances or other transition relief directly, but could import exempt equipment if it is covered by an allowance or transition provisions associated with a foreign equipment manufacturer. This would allow transition allowances and other provisions to be used by foreign equipment manufacturers in the same way as domestic equipment manufacturers, while avoiding the potential for use by importers of unnecessary allowances under the current regulations.

All foreign nonroad equipment manufacturers wishing to use the transition provisions would have to comply with all requirements of the regulation discussed above including: notification, recordkeeping, reporting and labeling. Along with the equipment manufacturer's notification, it would have to comply with various compliance related provisions similar to those adopted in several fuel regulations, relating to foreign refiners.[259] The foreign equipment manufacturer would have to:

1) Provide EPA with full, complete and immediate access to conduct inspections and audits;
2) Name an agent for service of process located in the District of Columbia; and
3) Agree that the forum for any enforcement action related to these provisions would be governed by the Clean Air Act and submitting to the substantive and procedural laws of the United States.

In addition to the foreign equipment manufacturer requirements discussed above, EPA also proposes to require importers of exempted equipment from a complying foreign equipment manufacturer to comply with certain provisions. EPA believes these importer provisions are essential to EPA's ability to monitor compliance with the transition provisions. EPA proposes that the regulations would require each importer to notify EPA prior to each calendar year that the importer intends to import exempted equipment from a complying foreign equipment manufacturer under the transition provisions. The importer's notification would need to include

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[259] See, for example, 40 CFR § 80.410, concerning provisions for foreign refiners with individual gasoline sulfur baselines.

the following information:

1) the name and address of importer (and any parent company);
2) the name and address of the manufacturers of the exempted equipment and engines the importer expects to import;
3) number of exempted equipment the importer expects to import for each year broken down by power category; and
4) the importer's use of the transition provisions in prior years (number of flexibility engines imported in a particular year, under what power category, and the names of the equipment and engine manufacturers).

In addition, EPA is proposing that any importer electing to import to the United States exempted equipment from a complying for equipment manufacturer would have to submit annual reports to EPA. The annual report would include the number of exempted equipment the importer actually imported to the United States in the previous calendar year; and the identification of the equipment manufacturers and engine manufacturers whose exempted equipment/engines were imported.

C. Engine and Equipment Small Business Provisions (SBREFA)

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. Since EPA believes that the proposed rule may have a significant economic impact on small businesses, we intend to prepare a regulatory flexibility analysis as part of this rulemaking, and have prepared an initial regulatory flexibility analysis (IRFA) pursuant to section 603 of the RFA which is part of the record for today's proposal.

Under section 609(b) of the RFA, a Small Business Advocacy Review Panel (SBAR Panel or Panel) is required to be convened prior to publication of an IRFA that an agency may be required to prepare under the RFA. Section 609(b) directs the Panel to, through outreach with small entity representatives (SERs), report on the comments of the SERs and make findings on issues related to identified elements of an IRFA under section 603 of the RFA (see Section X.C of this preamble for more discussion on the elements of an IRFA). The purpose of the Panel is to gather information to identify potential impacts on small businesses and to develop options to mitigate these concerns. At the completion of the SBAR Panel process, the Panel is required to prepare a Final Panel Report. This report includes background information on the proposed rule being developed, information on the types of small entities that would be subject to the proposed rule, a description of efforts made to obtain the advice and recommendations of representatives of those small entities, and a summary of the comments that have been received to date from those representatives. Once completed, the Panel report is provided to the agency issuing the proposed rule and included in the rulemaking record. The report provides the Panel and the Agency with an opportunity to identify and explore potential ways of shaping the proposed rule to minimize the burden of the rule on small entities while achieving the rule's purposes and when consistent with Clean Air Act statutory requirements.

EPA has approached this process with care and diligence. To identify representatives of small businesses for this process, we used the definitions provided by the Small Business Administration (SBA) for manufacturers of nonroad diesel engines and vehicles. The categories of small entities in the nonroad diesel sector that will potentially be affected by this rulemaking are defined in the following table:

Industry	Defined as small entity by SBA if:	Major SIC Codes
Engine manufacturers	Less than 1,000 employees	Major Group 35
Equipment manufacturers:		
- construction equipment	Less than 750 employees	Major Group 35
- industrial truck manufacturers (i.e. forklifts)	Less than 750 employees	Major Group 35
- all other nonroad equipment manufacturers	Less than 500 employees	Major Group 35

One small engine manufacturer and 5 small equipment manufacturers agreed to serve as Small Entity Representatives (SERs) throughout the SBAR Panel process for this proposal. These companies represented the nonroad market well, as the group of SERs consisted of businesses that manufacture various types of nonroad diesel equipment.

The following are the provisions recommended by the SBAR Panel, including both the provisions that we, EPA, are proposing and those on which we are requesting comment. As described in Section VII.B above, there are other provisions that apply to all equipment manufacturers; however, most of the discussion in this section is geared to small entities only. We request comment on all aspects of both the provisions recommended by the Panel and on those that we are proposing in today's action.

1. Nonroad Diesel Small Engine Manufacturers

a. Transition Provisions for Small Engine Manufacturers

i. What the Panel Recommended

The transition provisions recommended by the SBAR Panel for engines produced or imported by small entities are listed below. For all of the provisions, the Panel recommended that small engine manufacturers and small importers must have certified engines in model year 2002 or earlier in order to take advantage of these provisions. Each manufacturer would be limited to 2,500 units per year as this number allows for some market growth. The Panel recommended these stipulations in order to prohibit the misuse of the transition provisions as a tool to enter the nonroad diesel market or to gain unfair market position relative to other manufacturers.

Currently, certified nonroad diesel engines produced by small manufacturers all have a horsepower rating of 80 or less. The transition provisions that the Panel considered were dependent upon what approach, or approaches, were proposed for the rulemaking.

- For an approach with two phases of standards:
  - an engine manufacturer could skip the first phase and comply on time with the second; or,
  - a manufacturer could delay compliance with each phase of standards for three years.

- For an approach that entails only one phase of standards, the manufacturer could opt to delay compliance. It was recommended that the length of the delay be three years; however the Panel suggested that we request comment on whether this delay period should be two, three, or four years. Each delay would be pollutant specific (i.e., the delay would apply to each pollutant as it is phased in).

The Panel believed that these options could offer an opportunity to reduce the burden on small manufacturers while at the same time meet the regulatory goals of the Agency. The Panel further believed that these options would not put small manufacturers at a significant disadvantage as they would be in compliance with the Tier 4 standards in the long run and the options would give them more lead time to comply. The Panel also felt that a complete exemption from the upcoming standards (even assuming that such an exemption could be justified legally) would put these manufacturers at a competitive disadvantage as the rest of the market would be producing compliant engines and eventually there would not be equipment designed to accommodate their engines.

ii. What EPA is Proposing

Due to the structure of the standards and their timing as discussed in section III, EPA is proposing transition provisions for small engine manufacturers which encompass both approaches recommended by the Panel.

- First, with regard to PM:
  - Engines under 25 hp and those between 75 and 175 hp have only one standard so the manufacturer could delay compliance with these standards for up to three years. Based on available data, we believe that there are no small manufacturers of nonroad diesel engines above 175 hp.
  - For engines between 25 and 75 hp, EPA is proposing a one phase program with the option to delay compliance for one year if interim standards are met. For this power category we are treating the PM standard as a two phase standard with the stipulation that small manufacturers cannot use PM credits to meet the interim standard. Furthermore, if a small manufacturer elects the optional approach to the standard (skip the interim standard), no further relief will be provided.
- Second, with regard to NOx:
  - There is no change in the NOx standard for engines under 25 hp and those between 50 and 75 hp. For these two power bands EPA is proposing no special provisions.
  - For engines in the 25-50 hp and the 75-175 hp categories we are proposing a three year delay in the program consistent with the one-phase approach recommendation above. Based on available data, we believe that there are no small manufacturers of nonroad diesel engines above 175 hp.

b. Hardship Provisions for Small Engine Manufacturers

i. What the Panel Recommended

The Panel recommended two types of hardship provisions for small engine manufacturers. These provisions are:

- For the case of a catastrophic event, or other extreme unforseen circumstances, beyond the control of the manufacturer that could not have been avoided with reasonable discretion (i.e. fire, tornado, supplier not fulfilling contract, etc.); and
- For the case where a manufacturer has taken all reasonable business, technical, and economic steps to comply but cannot.

Either hardship relief provision would provide lead time for up to 2 years, and a manufacturer would have to demonstrate to EPA's satisfaction that failure to sell the noncompliant engines would jeopardize the company's solvency, EPA may also require that the manufacturer make up the lost environmental benefit.

ii. What EPA is Proposing

EPA is proposing to adopt the Panel recommendations for hardship provisions for small engine manufacturers, as these are the same provisions that are being extended to larger manufacturers. While perhaps ultimately not necessary given the phase-in schedule discussed above, such provisions provide a useful relief in the event of unforeseen extreme hardship.

c. Other Small Engine Manufacturer Issues

i. What the Panel Recommended

The Panel also recommended that an ABT program be included as part of the overall rulemaking program. In addition, the Panel suggested that EPA take comment on including specific ABT provisions for small engine manufacturers.

ii. What EPA is Proposing

As discussed above, an ABT program has been included in the overall program in this rule proposal. ABT is being proposed in today's action as it is intended to enhance the flexibility offered to engine manufacturers that will be of assistance in making the transition to meet the stringent standards proposed in today's rules in the leadtime proposed. As noted in Section VII.A, EPA is proposing to retain the basic structure of the current nonroad diesel ABT program, though a number of changes (which will help to accommodate implementation of the proposed emission standards) are being proposed today.

Though the Panel recommended small engine manufacturer-specific ABT provisions, such provisions are not being included in today's proposal. EPA does not believe it would be appropriate to provide a different ABT program for small engine manufacturers, especially given the special provisions that are proposed above. Discussions during the SBAR process indicated that small volume manufacturers would need extra time to comply due to cost and personnel constraints, and there is little reason to believe that small manufacturer specific ABT provisions could create an incentive to accelerate compliance. Small manufacturers would of course be able to participate in the general ABT program.

2. Nonroad Diesel Small Equipment Manufacturers

a. Transition Provisions for Small Equipment Manufacturers

i. What the Panel Recommended

The Panel recommended that EPA adopt the transition provisions described below for small manufacturers and small importers of nonroad diesel equipment. These transition provisions are similar to those in the Tier 2/3 rule (see 89.102). The recommended transition provisions are as follows:

- Percent-of-Production Allowance: Over a seven model year period, equipment manufacturers may install engines not certified to the new emission standards in an amount of equipment equivalent to 80 percent of one year's production. This is to be implemented by power category with the average determined over the period in which the flexibility is used.

- Small Volume Allowance: A manufacturer may exceed the 80 percent allowance in seven years as described above, provided that the previous Tier engine use does not exceed 700 total over seven years, and 200 in any given year. This is limited to one family per power category.
  Alternatively, the Panel also recommended, at the manufacturer's choice by hp category, a program that eliminates the "single family provision" restriction with revised total and annual sales limits as shown below:
  - for categories $\leq$175 hp - 525 previous Tier engines (over 7 years) with an annual cap of 150 units (these engine numbers are separate for each hp category defined in the regulations)
  - for categories of > 175hp - 350 previous Tier engines (over 7 years) with an annual cap of 100 units (these engine numbers are separate for each hp category defined in the regulations)

  The Panel recommended that EPA seek comment on the total number of engines and annual cap values listed above. In contrast to the Tier 2/Tier3 rule promulgated in 1998, SBA expects the transition to the Tier 4 technology will be more costly and technically difficult. Therefore, the small equipment manufacturers may need more liberal flexibility allowances especially for equipment using the lower hp engines. The Panel's recommended flexibility may not adequately address the approximately 50 percent of small business equipment models where the annual sales per model is less than 300 and the fixed costs are higher. Thus, the SBA and OMB Panel members recommended that comment be sought on implementing the small volume allowance (700 engine provision) for small equipment manufacturers without a limit on the number of engine families which could be covered in any hp category.

- Due to the changing nature of the technology as the manufacturers transition from Tier 2 to Tier 3 and Tier 4, the Panel recommended that the equipment manufacturers be permitted to borrow from the Tier3/Tier 4 flexibilities for use in the Tier 2/Tier 3 time frame.

- Lastly, the Panel recommended proposing a continuation of the current transition provisions, without modifications to the levels or nature of the provisions, that are available to these manufacturers.

To maximize the likelihood that the application of these provisions will result in the availability of previous Tier engines for use by the small equipment manufacturers, the Panel recommended that - similar to the application of flexibility options that are currently in place - these provisions should be provided to all equipment manufacturers.[260]

During the SBAR Panel process, an issue was raised requesting that EPA establish a provision which would allow small entity manufacturers to request limited “application specific” alternative standards for equipment configurations which present unusually challenging technical issues for compliance. The Panel recommended that EPA seek comment on the need for and value of special application specific standards for small equipment manufacturers.

ii. What EPA is Proposing

EPA is in fact proposing the Percent-of-Production and Small Volume Allowances for all equipment manufacturers, and explicitly took the Panel report into account in making that proposal (see section VII.B. above). The Agency believes that this proposal should provide the type of transition leeway recommended by the Panel. EPA believes that the transition provisions could allow small equipment manufacturers to postpone any redesign needed on low sales volume or difficult equipment packages, thus saving both money and strain on limited engineering staffs. Within limits, small equipment manufacturers would be able to continue to use their current engine/equipment configuration and avoid out-of-cycle equipment redesign until the allowances are exhausted or the time limit passes.

With respect to these transition provisions, EPA requests comment on the Panel’s suggested exemption and annual cap values listed above. As discussed above in Section VII.B, EPA also requests comment on implementing the small volume allowance provision without the single family limit provision using caps slightly lower than 700 units, with this provision being applied separately to each engine power category subject to the proposed standards.

EPA is also proposing the Panel’s recommendation that equipment manufacturers be

[260] The Panel recognized that, similar to the Tier 2/3 standards, it may be necessary to provide transition provisions for all equipment manufacturers, not just for small entities; and the Panel recommended that this be taken into account. However, the work of the SBAR Panel is meant to develop regulatory alternatives for small manufacturers, thus the Panel nominally recommended transition provisions for small equipment manufacturers only.

allowed to borrow from Tier 4 flexibilities in the Tier2/3 timeframe. See the more extended discussion on this issue in Section VII.B above.

With regard to the Panel recommendation for a provision allowing small manufacturers to request limited “application specific” alternative standards for equipment configurations which present unusually challenging technical issues for compliance, EPA requests comment on this recommendation. EPA believes that the need for such a provision has not been established and putting it forth without more information could provide more lead time than can be justified, and could undermine emission reductions which are achievable. Moreover, no participant in the SBAR process offered any empirical support that such a problem even exists. Nor have such issues been demonstrated (or raised) by equipment manufacturers, small or large, in implementing the current nonroad standards. In addition, EPA believes that any application-specific difficulties can be accommodated by the transition provisions the Agency is proposing including ABT. Nonetheless, in keeping with the SBAR recommendations, comment is requested on the value of, and need for, special application specific standards for small equipment manufacturers.

b. Hardship Provisions for Small Equipment Manufacturers

i. What the Panel Recommended

The Panel also recommended that two types of hardship provisions be extended to small equipment manufacturers. These provisions are:

- For the case of a catastrophic event, or other extreme unforseen circumstances, beyond the control of the manufacturer that could not have been avoided with reasonable discretion (i.e. fire, tornado, supplier not fulfilling contract, etc.).

- For the case where a manufacturer has taken all reasonable business, technical, and economic steps to comply but cannot. In this case relief would have to be sought before there is imminent jeopardy that a manufacturer’s equipment could not be sold and a manufacturer would have to demonstrate to the Agency’s satisfaction that failure to get permission to sell equipment with a previous Tier engine would create a serious economic hardship. Hardship relief of this nature cannot be sought by a ‘integrated’ manufacturer (one which also manufactures the engines for its equipment).

ii. What EPA is Proposing

EPA is proposing that the Panel recommended hardship provisions be extended to small equipment manufacturers in addition to the transition provisions described above. Though this section deals mainly with small manufacturers, these hardship provisions are the same as those being extended to larger manufacturers, as described in Section VII.B.2.c. To be eligible for these hardship provisions (as well as the proposed transition provisions), equipment manufacturers and importers must have reported equipment sales using certified engines in model year 2002 or earlier. As explained earlier, this proposal is needed to thwart misuse of these provisions as a loophole to enter the nonroad diesel equipment market or to gain unfair market position relative to other manufacturers and we request comment on this restriction.

As explained earlier, hardship relief would not be available until other allowances have been exhausted. Either relief provision would provide additional lead time for up to two (2) model years based on the circumstances, but EPA may require recovery of the lost environmental benefit.

EPA requests comment on all of the aspects of the proposed hardship provisions for small equipment manufacturers.

E. Phase-In Provisions

1. Compliance With Phase-in Schedules

In Section III we described the proposed NOx and NMHC standards phase-in schedule. This phase-in requirement is based on percentages of a manufacturer's production for the U.S. market. We recognize, however, that manufacturers need to plan for compliance well in advance of the start of production, and that actual production volumes for any one model year may differ from their projections. On the other hand, we believe that it would be inappropriate and infeasible to base compliance solely on a manufacturer's projections. That could encourage manufacturers to overestimate their production of complying phase-in engines, and could result in significantly lower emission benefits during the phase-in. We voiced the same concern with respect to the highway HDDE phase-in schedule(see 66FR at 5109). As in the highway HDDE program we propose to initially only require nonroad diesel manufacturers to project compliance with the phase-in based on their projected production volumes, provided that they made up any deficits (in terms of percent of production) the following year.

Because we expect that a manufacturer making a good-faith projection of sales would not be very far off of the actual production volumes, we are proposing to limit the size of the deficit that would be allowed, as in the highway program.. In all cases, the manufacturer would be required to produce at least 25% of its production in each phase-in power category as “phase-in” engines (meeting the proposed NOx and NMHC standards or demonstrating compliance through use of ABT credits) in the phase-in years (after factoring in any adjustments for Blue Sky Series engine credits). Another important proposed restriction is that manufacturers would not be allowed to have a deficit in the year immediately preceding the completion of the phase-in to 100%. This would help ensure that manufacturers are able to make up the deficit. Since they could not produce more than 100% low-NOx engines after the final phase-in year, it would not be possible to make up a deficit from this year. These provisions are identical to those adopted in the highway HDDE program.

F. What Might Be Done to Encourage Innovative Technologies?

1. Incentive Program for Early or Very Low Emission Engines

In our rulemakings for heavy-duty highway engines and light-duty Tier 2 vehicles, we expressed our view that providing incentives for manufacturers to introduce engines emitting at very low levels early, or at levels significantly below the final standards, is appropriate and beneficial. We believe that such inducements may help pave the way for greater and/or more cost effective emission reductions from future engines and vehicles. We believe this also holds for the early introduction of low-emitting *nonroad diesel* engines, and more so considering the long leadtimes before these standards would take effect, the large variety of applications (and therefore potential pull-ahead opportunities) in the nonroad sector, the large number of machines fueled at dedicated fuel stations on construction sites, farms, and industrial complexes, and the widespread availability of very low sulfur diesel fuel at highway outlets after 2006, even sooner in some areas. Thus we are proposing an incentive program very similar to that adopted for highway engines and vehicles.

Specifically, we are proposing that manufacturers be permitted to take credit for engines certified to this rule's proposed standards prior to the 2011 model year in exchange for making fewer engines certified to these standards in or after the 2011 model year. In other words, a clean engine sold earlier than required displaces the requirement to sell a similar engine later. Note that the emission standards must be met to earn the early introduction credit. That is, emission credits earned under averaging, banking, and trading cannot be used to demonstrate compliance. Therefore, the early introduction engine credit is an alternative to the ABT program in that any early engines or vehicles can earn either the engine credit or the ABT emission credit, but not both. The purpose of the incentive is to encourage introduction of clean technology engines earlier than required in exchange for added flexibility during the phase-in years.

Any early engine credits earned for a diesel-fueled engine would, of course, be predicated on the assurance by the manufacturer that the engine would indeed be fueled with low sulfur diesel fuel in the marketplace. We expect this would occur through selling such engines into fleet applications, such as municipal maintenance fleets, large construction company fleets, or any such well-managed centrally-fueled fleet. Because of the challenge of obtaining a reliable supply of 15 ppm sulfur diesel fuel for nonroad use prior to 2011, we believe it is necessary and appropriate to provide a greater incentive for early introduction of clean diesel technology. Therefore, we propose to count one early diesel engine as 1.5 diesel engines later. This extra early credit for diesel engines means that fewer clean diesel engines than otherwise would be required may enter the market during the years 2011 and later. But, more importantly, it means that emission reductions would be realized earlier than under our base program. We believe that providing incentives for early emission reductions is a worthwhile goal for this program. Therefore, we are proposing these provisions for manufacturers willing to make the early investment in cleaner engines.

We are proposing to provide this early introduction credit to diesel engines at or above 25 hp that meet all of today's Tier 4 emissions standards (NOx, PM, and NMHC) in the applicable power category. We are also providing this early introduction credit to diesel engines that pull-ahead compliance with only the PM standard. However, a PM-only early engine would offset only the "phase-out" engines during the phase-in years (those required to meet the Tier 4 standard for PM but not for NOx or NMHC); they would not offset engines required the meet the Tier 4 NOx, NMHC, and PM standards. Tier 4 engines certified to, or required to meet, the 2008 PM standard would not participate in this program, either as credit generators or as credit users.

An important aspect of the early incentive provision is that it must be done on an engine or vehicle count basis. That is, a diesel engine meeting new standards early would count as 1.5 such diesel engines later. This contrasts with a provision done on an engine percentage basis which would count one percent of diesel engines early as 1.5 percent of diesel engines later. Basing the incentive on an engine count would alleviate any possible influence of fluctuations in engine and vehicle sales in different model years.

Another important aspect of this proposed program is that it would be limited to engines sold prior to the 2011 model year for engines at or above 175 hp, or prior to the 2012 model year for engines between 25 and 175 hp. In other words, as in the highway program, nonroad diesel engines sold during the transitional "phase-in" model years would not be considered "early" introduction engines and would, therefore, receive no early introduction credit. However, such engines and vehicles would still be able to generate ABT credits. As with the phase-in itself, and for the same reasons, we are proposing that an early introduction credit could only be used to offset requirements for engines in the same power category as the credit-generating engine (see section III.B).

As further incentive to introduce clean engines and vehicles early, we are also proposing a provision that would give manufacturers an early introduction credit equal to two engines during the phase-in years. This "Blue Sky" incentive would apply for diesel engines meeting one-half of the proposed final NOx standard while also meeting the NMHC and PM standards. Due to the extremely low emission levels to which these Blue Sky series engines and vehicles would need to certify, we believe that the double engine count credit is appropriate. Table VII.F-1 shows the emission levels that would be required for diesel engines to earn any early introduction credits (other than ABT credits).

TABLE VII.F-1 – PROPOSED PROGRAM FOR EARLY INTRODUCTION OF CLEAN ENGINES AT OR ABOVE 25 HP

Category	Must Meet [a]	Early Engine Credit [b]
Early PM-only	0.01 g/bhp-hr PM (≥ 75 hp) or 0.02 g/bhp-hr PM (< 75 hp)	1.5-to-1 PM-only
Early Engine	above-indicated PM standard + 0.30 / 0.14 g/bhp-hr NOx / NMHC (≥ 75 hp) or 3.5 g/bhp-hr NMHC + NOx (< 75 hp)	1.5-to-1
Blue Sky Series Engine	as above for Early Engine, except must meet 0.15 g/bhp-hr NOx standard	2-to-1

[a] Engines in all 3 categories must also meet the Tier 4 crankcase emissions requirements.
[b] Engine count credits must be earned prior to the start of phase-in requirements in applicable power categories.

We welcome comment on these proposed provisions, as well as other ideas for encouraging the introduction of Tier 4 engines early, or of engines cleaner than Tier 4 levels. One area we especially seek comment on is whether or not engines below 25 hp that meet a 0.02 g/bhp-hr PM standard, or engines below 75 hp that meet a 0.30 g/bhp-hr NOx standard, should gain credits under this program that could be used to offset requirements for larger engines, as a means of encouraging the migration of clean technologies to smaller engines.

2. Continuance of the Existing Blue Sky Program

In the 1998 final rule, the Agency established its original Blue Sky Series Engine program for nonroad diesel engines (63 FR 56968, October 23, 1998; see preamble Section III.I). This program encourages the early introduction of engines with emission levels (as measured on a transient test) about 40% lower than the Tier 2 standards levels. Manufacturers could designate these engines as Blue Sky Series engines and sell them for use in state, municipal, or commercial programs calling for these cleaner engines (but not in the ABT program, to avoid double-counting of emission reductions). Because the Agency's direction for the nonroad engine program was not completely settled at the time, the 1998 final rule limited the Blue Sky program to engines built in the 2004 and earlier model years, but discussed our intent to consider extending it later. This Tier 4 proposal does provide more clarity for the future direction of the nonroad engine program, and so at this time we are asking for comment on extending or revising the existing Blue Sky Series engine program. We believe that the levels set for the existing Blue

Sky program are not stringent enough to warrant their continuance into the Tier 4 years, but we also note that the lack of a transient certification test in Tier 3 may make continuance of this program beyond 2004, perhaps through Tier 3 (and Tier 2 for engines under 50 hp), useful. We welcome comment on this, as well as on any experience with the program thus far, plans to use it in the future, whether the standards and test cycle should be changed and, if so, beginning in what model year.

G. Provisions for Other Test and Measurement Changes

This section contains further detail and explanation regarding several related nonroad diesel engine emissions test and measurement provisions. There are five topics which will be discussed: 1) EPA's proposed supplemental nonroad transient test; 2) an additional cold start transient test requirement for nonroad diesel engines; (3) an optional provision for control of smoke testing; (4) general improvements to test procedure precision; and 5) a clarification to existing EPA defeat device regulations.

Existing nonroad regulations prohibit the use of a defeat device (see 40 CFR 89.107) in nonroad diesel engines. The defeat device prohibition is intended to ensure that engine manufacturers do not use auxiliary emission control devices (AECD) which sense engine operation in a regulatory test procedure and as a result reduce the emission control effectiveness[261] of that procedure. In today's notice we are proposing to supplement existing nonroad test procedures with a transient engine test cycle and NTE emission standards with associated test requirements. As such, the Agency believes that a clarification of the existing nonroad diesel engine regulations regarding defeat devices is required in light of these proposed additional emission test requirements. The defeat device prohibition makes it clear that AECDs which reduce the effectiveness of the emission control system are defeat devices, unless one of several conditions is met. One of these conditions is that an AECD which operates under conditions "included in the test procedure"[262] is not a defeat device. While the existing defeat device definition does contain the term "test procedure", and therefore should be interpreted as including the supplemental testing requirements, we want to make it clear that both the supplemental transient test cycle and NTE emission test procedures are included within the defeat device regulations as conditions under which an operational AECD will not be considered a defeat device. Therefore, we are proposing to clarify the defeat device regulations by specifying the appropriate test procedures (i.e., the existing steady-state procedures and the

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[261] Auxiliary emission control device is defined at 40 CFR 89.2 as " any element of design that senses temperature, vehicle 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."

[262] 40 CFR 89.107(b)(1) states "Defeat device includes any auxiliary emission control device (AECD) that reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal operation and use unless such conditions are included in the test procedure."

supplemental tests).

1. Supplemental Transient Test

Nonroad diesel engines and equipment for the most part run on a more transient basis than their on-highway diesel counterparts through operations such as shifting loads, powering auxiliary equipment and performing repetitive tasks. A smaller, but significant, transient segment of nonroad equipment operates in a constant-speed manner for most or all of its useful life as with power generating sets, irrigation units and the like. However, nonroad test regulations to date have tended to not capture a broad area of real world operating characteristics and the emissions which result from these modes of equipment operation. The Agency believes that it is important to ensure that nonroad engines meet emission standards in-use under typical operating conditions so that the expected benefits of the program will be achieved over its entire duration. The supplemental nonroad diesel engine transient test provisions EPA is proposing are intended to help achieve this goal. Steady-state emission testing of nonroad diesel engines would still be retained because it covers types of in-use heavy-duty diesel engine operation not represented in nonroad diesel transient operation and gives a good general indication of operating emission levels. Steady-state emission testing provides a benchmark as well for simpler test programs, like Selective Enforcement Audits. EPA is proposing to supplement this steady-state emission testing in nonroad diesel engines with a transient duty emission test procedure for nonroad diesel engines, the Nonroad Transient Composite (NRTC)[263] test cycle. The Agency's NRTC cycle is described in proposed regulations at 40 CFR 1039. A detailed discussion of the proposed transient test cycle is contained in Chapter 4 of the Draft RIA for this proposal. Like current nonroad diesel standards, any new emission standards would apply to certification, equipment in actual use and selective enforcement audits for engines covered by the standards.

Manufacturers of nonroad diesel engines under 37 kW (50 hp) are required beginning in 2008 to demonstrate that their engines will meet the transient nonroad emission standard for PM but submission of transient test data will not be required of engines in this power category until 2013. EPA requests comment on accepting from these engine manufacturers, for the 2008 to 2012 time frame only, an engineering analysis and determination of the transient operating emissions of their engines in lieu of submitting transient cycle emissions test data. EPA recognizes that the timing of interim standards for these engines could force small engine manufacturers to have to certify under the proposed NRTC duty cycle test requirement before the requirement falls on all engine manufacturers in the 2011 to 2013 time frame.

Manufacturers of nonroad diesel engines over 560 kW (750 hp) will likewise need to demonstrate that their engines will be in compliance with transient nonroad emission standards in

[263] Memoranda to Docket A-2001-28: "Speed and Load Operating Schedule for the Nonroad Transient Composite test cycle" (Document ###) and "NRTC Cycle Construction" (Document ###).

the 2011 time frame. The Agency notes however that some manufacturers report difficulties measuring transient PM emissions in large 560 kW (750hp) and over engines under full flow constant volume sampling (CVS) emission measurement systems. Whether this is due to apportioning the large exhaust volumes to sample emissions or due to operating unwieldy exhaust flow hardware when operating these large engines has not been reported. Likewise, PM emissions gathered from these large engines using partial flow sampling systems (PFSS) tend to be high in volatile PM fractions[264] under some low load operating modes. To date, volatile PM measured from PFSS has not been proven to be consistently comparable to volatile PM measured by a full-flow CVS. The pressure across the filter and other sample zone conditions, coupled with the differences in the dilution rate, residence time and method, may have combined to yield a different PM composition in PFSS than in full-flow CVS systems at these operating condition. EPA requests comment from manufacturers on both of these test practices for PM emission data collection in these large displacement engines. Recognizing that there may be practical difficulties with testing large engines over 560 kW (750 hp) which often have multiple exhaust manifolds and may incorporate several catalysts or other pieces of emission control equipment, the Agency asks for comment on accepting an engineering analysis and determination of the transient operating emissions from this class of nonroad diesel engines by the manufacturers of these engines in lieu of submitting actual nonroad transient cycle emissions test data.

EPA is also proposing a Constant Speed Variable Load (CSVL) transient duty cycle. The CSVL transient duty cycle is derived from the EPA's Arc Welder Highly Transient Torque application duty cycle. The CSVL cycle is described in the proposed regulations at 40 CFR 1039.510. Because of the more limited range of engine operation in the CSVL cycle, manufacturers must ensure that engines certified with data generated with this cycle are used exclusively in constant-speed applications. Accordingly, these engines must include labeling information indicating this limited emission certification. Engines in this category of nonroad diesel equipment include generating sets, refrigeration units and other pieces of nonroad diesel equipment which are very tightly governed for operating speed (possibly using an isochronous form of governor) and also contain other "constant speed" equipment which may be less closely regulated for changes in speed by a 3% droop-type of engine speed governor, for example. This latter group might be expected to generate more acceptable cycle performance statistics over a constant speed transient cycle than the more speed change-sensitive former group represented by, for example, electric power generating sets. However, both types of constant speed engines do experience some fluctuations in speed and load during operation in-use and the CSVL duty cycle would capture emissions from these infrequent modes of operation, as well.

EPA recently adopted a similar transient duty cycle for spark-ignition constant-speed engines (67 FR 68242, November 8, 2002). This duty cycle, which is based on the same

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[264] Memorandum to Docket "Partial Flow Testing Concerns in Large Nonroad Diesel Engines as Regards Emission Testing Through Partial Flow Sampling", Docket A-2001-28, Document ### .

underlying engine operation with the arc welder powered by a diesel engine, includes a combination of equal parts typical and high-transient operation. There was no effort to modify the schedule of engine operation to make it more representative of spark-ignition engines, so the expectation was that the same cycle would eventually apply to nonroad diesel engines. Aside from the different selection of engine operation from the available operating welder described above, the proposed constant-speed transient cycle includes several adjustments that would need to be factored into the "spark-ignition" cycle before it could be applied to nonroad diesel engines. These adjustments include renormalization with a more robust engine map (based on updated specifications of the original engine) and "I-alpha" corrections to synchronize measurements made with and without a flywheel (see Section 4.2.6.1 of the Draft RIA). EPA requests comment on whether the previously adopted constant-speed transient cycle (in modified form) should apply equally to nonroad diesel engines. Conversely, if EPA adopts the proposed constant-speed transient cycle for nonroad diesel engines, we would expect to change the regulations for spark-ignition engines to align with the conclusions in this rulemaking. EPA accordingly requests comment on these same issues as they relate to spark-ignition engines.

EPA is considering the appropriateness, for constant-torque engines, of having these engines certify to the two-mode Transport Refrigeration Unit (TRU) cycle being developed by the California Air Resources Board[265] (see 40 CFR 1039.510) and will take comment as to having this cycle available as a certification test procedure. Manufacturers certifying their engines on this test cycle would be similarly constrained, as with constant-speed engine manufacturers, to notify the users of their engines as to the limited operating characteristics of their constant-torque engines for practical applications. While these engines would not run the transient duty cycles, the EPA believes that these engines would be subject to not-to-exceed standards based on any normal operation that they might experience in the field. This transient cycle would not apply to "pin-on'-type electrical generator sets frequently found attached to transport refrigeration units, as these units are operate generally in a constant-speed manner.

2. Cold Start Testing

EPA is proposing to include a requirement for a cold start transient test to be run in conjunction with the Agency's proposed nonroad diesel engine transient test. Unable to find a database of emissions information to characterize cold start emissions from all power categories of nonroad diesel engines, though, EPA undertook a process to analyze the second-by-second operation of some forty pieces of Tier 1 and older nonroad equipment. From this study, the Agency characterized the "average" workday of each piece of equipment in the data set[266] and

[265] Information on the proposed TRU cycle may be found on and downloaded from the CARB website at http://www.arb.ca.gov/diesel/dieselrrp.htm.

[266] Memorandum to Docket, "Analysis of Second-by-Second Emission and Activity Data for a Private Rental Fleet of Construction Equipment" Docket A-2001-28, Document ###.

attempted to define the role of "cold start"operation played in engine emissions. Generally, the Agency found that times when the engine was operating at less than stabilized operating temperature or cold start, generally characterized by lower exhaust temperatures and higher idle operation speeds, higher engine emission rates were seen than during normal, temperature-stabilized operation of the engine. These cold start, or "warming-up", periods were seen to last on average ten minutes after equipment start-up for the equipment in our study. The Agency further found, that over an eight to ten hour workday, a piece of nonroad equipment would spend between 25 and 35 percent of its in-use day running at its low idle engine speed. With downtime on the equipment for operator lunch times and equipment transport, there could be a further period of an hour or more of lower to no emissions from the equipment in-use. At first key-on or cold start, and with each additional "key-on" cold start event during the day, the equipment experiences a period of higher emissions until it reaches a stabilized operating temperature. Start up for the equipment after periods of downtime which lasted an hour or more was generally seen to experience rates of engine emissions similar to those seen at first "cold start". The total time the equipment in the study would spend at these higher rates of "cold start" engine emissions would generate approximately one-tenth of the engine emissions that the equipment would be expected to produce over the whole workday. Therefore, EPA proposes to weight the emission test results from its additional cold start transient test requirement as one tenth of the composite transient emission test results for a particular engine. The Agency requests comments as to the robustness of this weighting factor and as to its applicability across the spectrum of nonroad diesel equipment.

In addition, EPA requests comment on the potential to rely on the approach adopted for industrial spark-ignition engines, in which engines operate over a single "warm-start" cycle to address cold-start emissions without additional testing (see 40 CFR 1048.510). The three-minute warm-up period specified for spark-ignition engines would likely need to be extended to about ten minutes to account for the operating characteristics of diesel engines and their associated emission-control technologies. Any comments regarding this approach should address how the changed procedure would affect measured emission levels and how the emission standard should be adjusted to reflect this.

3. Control of Smoke

Manufacturers are responsible for testing and reporting results for nonroad steady-state and transient operation smoke emissions. These regulations are detailed in 40 CFR 89.113[267] and refer the reader back to 40 CFR 86, subpart "I", which was developed for highway engines. This rulemaking however proposes to replace the present Federal Smoke Procedure for nonroad

[267] Smoke testing guidelines are detailed under ISO 8178-9, First Ed. 10-15-2000, "Reciprocating internal combustion engines-Exhaust emission measurement- Part 9: Test cycles and test procedures for test bed measurement of exhaust gas smoke emissions from compression ignition engines operating under transient conditions". A copy of the testing procedure may be found for reference only in Docket A-2001-28, Document ###.

engines with the ISO 8178 Part 9 nonroad smoke procedure as the method and standard by which engine manufacturers may certify their nonroad engines.

The ISO-TC70/SC8/WG1 committee developed a nonroad smoke test procedure, ISO 8178-9 and finalized it on October 15, 2000. Recognizing the value of harmonized test procedures and limit standards, EPA is proposing through this rulemaking to use ISO 8178-9 for smoke certification of nonroad diesel engines. EPA has analyzed ISO 8178-9 and concluded that it is appropriate for adoption within the Agency's nonroad test procedures. It is important to note that the ISO 8178-9 smoke emissions test procedure is very different from the procedure specified in Subpart I of Part 86. As a consequence, in adopting the ISO 8178-9 procedure, EPA proposes to revise the numerical limit value associated with this ISO procedure. EPA proposes that the appropriate (maximum) numerical standard for ISO 8178-9 peak (acceleration) smoke value measurement will be 20 percent opacity, peak smoke values at 3x, 6x, and 9x will be 18 percent opacity, 16 percent opacity and 14 percent opacity, respectively, and the lug smoke value will be 10 percent opacity. The Agency has determined this value on review of data from smoke tests on various engines[268] across differing programs and EPA requests comments as to the appropriateness of these particular limit values with respect to engines operating under proposed Tier 3 and Tier 4 levels of engine emission standards.

Some state governments have expressed a desire for a federal smoke regulatory program that would enable them to test in-use nonroad engines in a manner that would permit action against gross emitters of smoke. In a like manner, EPA may propose in-use smoke testing regulations as part of any future rulemaking which could address manufacturer's in-use test program requirements. The main elements of this program would be a certification smoke requirement for new engines, guidance from EPA for state in-use smoke control programs (including an in-use smoke test procedure and accompanying limit values), and a means by which the data from the two programs could be related. The current smoke test procedure from Part 86, Subpart I, does not provide data comparable to the most practical in-use smoke test procedure, a snap-idle acceleration test with measured opacity. However, based on the current ISO 8178-9 procedure, EPA believes the ISO 8178-9 certification smoke test would provide the desired linkage.

In applying nonroad smoke standards and procedures to engines rated 37 kW (50 hp) and under, EPA had chosen to waive the testing requirement for one-cylinder engines, the large majority of which are being used in generator sets and other steady-state applications. EPA still believes that testing of these engines is unique in ways that would need to be addressed before requiring smoke tests for this class of engines. Similarly, EPA will not propose smoke testing requirements for constant-speed engines until a smoke test becomes available for these engines

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[268] "Nonroad Diesel Engine Smoke Testing and Limited Filter Analysis" May, 2001.Final Report to Engine Manufacturers Association from Southwest Research Institute. Docket A-2001-28, Document ###

because current smoke testing procedures cannot be effectively performed on them. Nonroad equipment which is certified as constant-speed will retain its exemption from the smoke testing requirements of this section. The Agency will likewise waive smoke testing requirements on constant-torque engines. The Agency believes the air quality impact of not requiring these smoke tests for these engines at this time will be minimal because constant-speed or constant-torque engines do not often experience acceleration modes, which are the principal focus of smoke standards. EPA expects to reconsider this issue in the future in relation to other in-use testing concerns. Finally, the Agency proposes to exempt from smoke testing requirements those nonroad diesel engines which have certified emission levels or Family Emission Limits below 0.07 g/kW-hr.

4. Improvements to the Test Procedures

We are proposing changes to the test procedures to improve the precision of emission measurements. These changes address the potential effect of measurement precision on the feasibility of the standards. It is important to note that these changes are not intended to bias results high or low, but only to improve the precision of the measurements. Based on our experience with these modified test procedures, and our discussions with manufacturers about their experiences, we are confident that these changes will not affect the stringency of the standards. These changes are summarized briefly here, and the rationale for the changes affecting CVS and PM testing are summarized in a memo to the docket (Air Docket A-99-06, IV-B-11), which was originally submitted in support of the recent on-highway heavy-duty diesel engine rule (66 FR 5001, January 18, 2001). The rationale for any other changes are summarized in a memo to the docket for this proposal.

Many of the changes are to the PM sampling procedures. The PM procedures will be the same as those finalized as part of the on-highway heavy-duty diesel engine rule (66 FR 5001, January 18, 2001). These include changes to the type of PM filters that are used and improvements in how PM filters are weighed before and after emission measurements, including requirements for more precise microbalances.

Another area includes changes to the CVS dilution air and flow measurement specifications to allow for lower dilution ratios. These changes are also the same as those changes finalized in the on-highway rule.

Another area of change is the NOx calibration procedure. These changes are also the same as those changes finalized in the on-highway rule. The new calibration procedures will result in more precise continuous measurement of very low concentrations of NOx.

Other changes are being proposed to allow for other measurement options, including the complete or partial adoption of the International Standards Organization’s test procedures as specified in ISO 8178-1 (2002-2003 revision) and ISO 8178-11 DIS. EPA has participated in draft changes to these procedures and feels that adopting these procedures, at least in part, would not only allow for the use of the most technically correct procedures, but would also improve harmonization with international standards, which might offer cost savings for some manufacturers. EPA requests comments on the appropriateness of adopting parts of or all of ISO 8178-1 (2002-2003 revision) and ISO 8178-11 DIS. Also refer to the proposed regulations in 40 CFR Part 1065 for specific wording of these proposed regulations.

Manufacturers will be allowed to use the new procedures immediately for all certifications of all engines, and manufacturers will also be able to use their current procedures up to a certain transition date to allow for a gradual transition to the new procedures. The reason for this is that some of these changes may not be convenient or cost-effective in the short term, and manufacturers may be willing to live with some slightly lower measurement precision in order to lower short-term testing costs. We believe that manufacturers should be able to individually optimize their test facilities in this manner. However, it is important for manufacturers to understand that we will conduct our confirmatory testing in the manner specified in these regulations.

We are also including a new regulatory provision that specifies the steps that someone would need to follow to demonstrate that their own alternate measurement procedure is as good as or better than the procedure specified by our regulations. This provision will be the same as that finalized for on-highway testing, which can be found in 40 CFR 86.1306–07. The proposed test procedure changes just discussed can be found in 40 CFR Part 1065 of the proposed regulations.

EPA requests comment on specifying that weighted steady-state modal tests be executed by compiling the weighted modal cycles proportionally into single time-weighted second-by-second test cycles. These cycles would consist of the same steady-state test modes, but each test mode would be joined to the subsequent mode by a brief period of transient operation. All sampling would occur continuously from the first second through the last second of the cycle.

EPA also requests comment on the appropriateness of allowing a manufacturer to choose for each engine family to certify and conduct all subsequent modal emissions tests using either: 1). the current modal procedure or 2). the aforementioned continuous sampling procedure.

H. Not-To-Exceed Requirements

EPA proposes to adopt not-to-exceed (NTE) emission standards for new non-road diesel engines which are similar to those the Agency set for on-highway heavy-duty diesel engines. Specifically, the Agency proposes to adopt for non-road diesel engines NTE specifications similar to those finalized as part of the heavy-duty on-highway diesel engine rulemaking (66 Fed. Reg. 5001 January 18, 2001). These specifications are currently published in 40 CFR Part 86 Subpart A §86.007-11 and 40 CFR Part 86 Subpart N §86.1370-2007.

NTE standards are set as multipliers of FTP standards, therefore, the NTE standards are also set as emissions mass per unit work performed (i.e. brake-specific, g/kW-hr). EPA proposes that non-road NTE standards are applicable to NOx, CO, THC, and PM mass emissions. These standards are evaluated against EPA-prescribed procedures for conducting in-use testing. Such tests may be conducted in an engine or chassis dynamometer laboratory, or they may be conducted on a piece of non-road equipment operating normally in-use by using EPA-prescribed field-testing procedures.

For new nonroad diesel engines, EPA proposes that manufacturers state in their application for certification that they are able to meet the NTE standards under all conditions that may reasonably be expected to occur in normal equipment operation and use. Manufacturers will have to maintain a detailed description of any testing, engineering analysis, and other information that forms the basis for their statement. This information may include a variety of steady-state emission measurements not included in the prescribed emission testing duty cycles. It may also include a continuous trace showing how emissions vary during the transient test or operation manufacturers believe are representative of the way their engines normally operate in the field. This data may also consist of field testing data. Any of the aforementioned data may be analyzed using the NTE data reduction procedures proposed in this regulation; with the final emissions data set then compared to the appropriate NTE standards.

EPA requests comment on an alternative NTE specification that is different compared to provisions found in the on-highway NTE rule. These differences eliminate the need for measuring engine torque, which can be particularly difficult on-board non-road vehicles. These alternative procedures also eliminate the need for an absolute exhaust flow measurement. This significantly improves the repeatability of any NTE test. Also, the longer averaging time minimizes dynamic errors caused by signal misalignment. This also improves NTE test repeatability significantly. For more detailed information on EPA's NTE provisions, refer to Chapter 4 of the draft RIA of this proposal.

I. Certification Fuel

It is well-established that measured emissions are 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. Because we are proposing to lower the upper limit for sulfur content in the field to 500 ppm in 2007, and again to 15 ppm in 2010, we are also proposing to establish new ranges of allowable sulfur content for testing. These are proposed to be 300 to 500 ppm (by weight) for model year 2008 to 2010 engines, and 7 to 15 ppm (by weight) for 2011 and later model year engines. We believe that these ranges best correspond to the fuels that diesel machines will potentially see in use. (See 66FR at 5112-5113 where we adopted a similar approach to certification fuels for highway HDDEs.) These specifications will apply to emission testing conducted for Certification and Selective Enforcement Audits, as well as any other laboratory engine testing for compliance purposes for engines in the designated model years. Any compliance testing of previous model year engines will be done with the fuels designated in our regulations for those model years.

It is important to note that while these specifications include the maximum sulfur level allowed for in-use fuel, we believe that it is generally appropriate to test using the most typical fuels. As for highway fuel, we expect that refineries will typically produce diesel fuel with about 7 ppm sulfur, and that the fuel could have slightly higher sulfur levels after distribution. Thus, we expect that we would use fuel having a sulfur content between 7 and 10 ppm sulfur for our emission testing. This is the same as the range we indicated would be used for HDDE engine testing in model year 2007 and later (66 FR at 5002); and as with the highway fuel, should we determine that the typical in-use nonroad diesel fuel has significantly more sulfur than this, we would adjust this target upward.

We recognize that some Tier 4 engines may not require the 15 ppm fuel and may be are capable of using the 500 ppm fuel. One example would be smaller engines that use less sulfur-sensitive technologies. Therefore, we are proposing to allow manufacturers the option of certifying engines based on higher sulfur test fuels. Since the higher sulfur level in the test fuel would effectively prohibit manufacturers from using technologies that are very sensitive to sulfur, these engines could be allowed to use higher sulfur fuel in-use, where available.

We are also proposing to allow the optional use of the new 7 to 15 ppm diesel test fuel beginning in the 2007 model year for engines employing sulfur-sensitive technology. (Model year 2007 coincides approximately with the introduction of 15 ppm highway fuel.) This allowance to use the new fuel in model years before 2011 would only be available for engines for which the manufacturer demonstrates will be operated in use on fuel with 15 ppm sulfur or less. Any testing that we perform on these engines would also use fuel meeting this lower sulfur specification. This optional certification fuel provision is intended to encourage the introduction of low-emission diesel technologies in the nonroad sector. The provision accounts for the fact that these engines will use the lower sulfur fuel during most, perhaps all, of their operating life, given the explicit manufacturer recommendation for use of 15 ppm sulfur fuel in these engines, combined with prospects for early availability of this fuel under the highway program, and the assured availability of this fuel for nonroad engines by mid-2010.

We are also proposing to extend a provision adopted in the 1998 final rule. In that rule we set a 2000 ppm upper limit on the test fuel sulfur concentration for any testing to be performed by the Agency on Tier 1 engines under 50 hp and Tier 2 engines at or above 50 hp. We did not extend this provision to later model year engines at that time because we felt that more time was needed to assess trends in fuel sulfur levels for fuels used in nonroad diesels. At this time we are not aware of any additional information that would indicate that a change in this test specification is warranted. More importantly, because the fuel regulation we are proposing would make 500 ppm maximum sulfur nonroad diesel fuel available by mid-2007, Tier 3 engines at or above 50 hp (which phase in beginning in 2006) will be in the field for only 1½ years prior to the in-use introduction of 500 ppm fuel, and Tier 2 engines under 50 hp (which phase in beginning in 2004) will be in the field for at most 3½ years prior to this time, we believe it is appropriate to avoid adding the unnecessary complication of frequent multiple changes to the test fuel specification. We are therefore proposing to extend the 2000 ppm limit to testing conducted on engines until the 2008 model year when the 500 ppm maximum test fuel sulfur level takes effect as discussed above.

J. Labeling and Notification Requirements

As explained in Section III, the emissions standards contained in the proposed regulations would make it necessary for manufacturers to employ exhaust emission control devices that require very low-sulfur fuel (less than 15 ppm) to ensure proper operation. This action therefore proposes to restrict the sulfur content of diesel fuel used in these engines. However, the 2008 emissions standards would be achievable with less sensitive technologies and thus it could be approporiate for those engines to use diesel fuel with up to 500 ppm sulfur. There could be situations in which vehicles requiring either 15 ppm fuel or 500 ppm may be accidentally or purposely misfueled with higher-sulfur fuel. Any of these misfueling events could seriously degrade the emission performance of sulfur-sensitive exhaust emission control devices, or perhaps destroy their functionality altogether.

In the highway rule we adopted a requirement that heavy-duty vehicle manufacturers notify each purchaser that the vehicle must be fueled only with the applicable low-sulfur diesel fuel. We also required that diesel vehicles be equipped by the manufacturer with labels near the refueling inlet to indicate that low sulfur fuel is required.[269] We are proposing similar requirements here. Specifically, we are proposing that manufacturers notify each purchaser that the nonroad engine must be fueled only with the applicable low-sulfur diesel fuel, and ensure that the equipment is labeled near the refueling inlet to indicate that low sulfur fuel is required. We believe that these measures would help owners find and use the correct fuel and would be sufficient to address misfueling concerns. Thus, more costly provisions, such as fuel inlet restrictors, should not be necessary.

Beginning in model year 2011, the required fuel would generally be 15 ppm. For these engines, the label should state: [INSERT SPECIFIC LABEL LANGUAGE HERE]. However, engine manufacturers may choose to certify engines using the 500 ppm test fuel. In this case, the label should state: [INSERT SPECIFIC LABEL LANGUAGE HERE]. Also for model years 2008 to 2010, when the proposed test fuel would contain 300 to 500 ppm sulfur, the label should state: [INSERT SPECIFIC LABEL LANGUAGE HERE]. Engine manufacturers may choose,

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[269] We also required that highway vehicles be labeled on the dashboard. Given the type of equipment using nonroad CI engines, we are proposing equivalent dashboard requirement here.

especially during early model years, to certify engines using test fuel with sulfur levels between 500 and 2,000 ppm. We would not require that these engines be labeled.

This approach would ensure that the proper functioning of the emission controls is not compromised by misfueling, while allowing owners flexibility with respect to in-use fuels in those cases in which their engines do not use sulfur-sensitive technologies.

For non-integrated manufacturers, the engine manufacturer will be required to provide such a label to the equipment manufacturer, which the equipment manufacturer will be required to install. Optionally, if an equipment manufacturer chooses to install its own label, the engine manufacturer will not be required to provide the label.

K. Temporary In-Use Compliance Margins

The Tier 4 standards will be challenging for diesel engine manufacturers to achieve, and will require manufacturers to develop and adapt new technologies for a large number and wide variety of engine platforms. Not only will manufacturers be responsible for ensuring that these technologies will allow engines to meet the standards at the time of certification, they will 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. Furthermore, for the first time, these nonroad diesel engines will be subject to a new transient test cycle and NTE standards in any such assessment of in-use compliance. 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 it is appropriate to adjust the compliance levels for assessing in-use compliance for diesel engines equipped with particulate traps or NOx adsorbers. This would provide assurance to the manufacturers that they will 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 light-duty highway Tier 2 final rule (65 FR at 6796) and the highway heavy-duty rule (66 FR at 5113-5114), both of which involve similar approaches to introducing the new technologies.

Table VII.K-1 shows the in-use adjustments that we propose to apply. These adjustments would be added to the appropriate FELs (or for engines certified to the standards without the use of credits, to the standards themselves) in determining the in-use compliance level for a given in-use hours accumulation. These adjustment levels were chosen to be roughly equivalent to the temporary in-use standard adjustments adopted for the heavy-duty highway program. Note too in the table footnote, the limiting of these adjustments to engines certified to levels below certain threshold levels. This is similar to the approach taken in the heavy-duty rule which applied the in-use standards only to vehicles using advanced low-emission technologies (see 66 FR at 5113-5114). Our intent is that these add-on levels be available only for highly-effective advanced technologies such as particulate traps and NOx adsorbers. As in our other mobile source programs, we do not believe that the standards are stringent enough or the required technology change radical enough to warrant add-ons for other proposed standards changes (the NOx standard for 25-75 hp engines, the 2008 PM standards for engines below 75 hp, or the NMHC standards).

TABLE VII.K-1 – ADD-ON LEVELS USED IN DETERMINING IN-USE STANDARDS

Engine power	Model years	NOx Add-on Level to FEL[a] (g/bhp-hr)	PM Add-on Level to FEL[b] (g/bhp-hr)
$25 \le$ hp < 75 ($19 \le$ kW < 56)	2013-2014	none	
$75 \le$ hp < 175 ($56 \le$ kW < 130)	2012-2015	0.10 for operating hours ≤ 4000 0.20 for operating hours > 4000	0.01
hp ≥ 175 (kW ≥ 130)	2011-2015	0.10 for operating hours ≤ 4000 0.20 for operating hours > 4000	

[a] Applicable only to those engines with FELs at or below 1.5 g/bhp-hr NOx.
[b] Applicable only to those engines with FELs at or below the Tier 4 PM standard.

Note that these in-use add-on levels apply only to engines certified through the first few model years of the new standards and having FELs below the specified levels. The in-use add-ons are available through model year 2015 for such engines above 75 hp because our proposed implementation schedule does not complete the phase-in process in these power categories until 2014. The 2015 date provides 2 years for the designers of those engine models that are last to be phase in (which may comprise upwards of 50% of sales and a large number of low-volume engine models) to surface and resolve any problems not showing up in the certification process or developmental testing.[270] This is the same period as that provided in the highway HDDE rule.

During the certification demonstration, manufacturers will still be required to demonstrate compliance with the *unadjusted* Tier 4 certification standards using deteriorated emission rates. Therefore, the manufacturer will not be able to use these in-use standards as the design targets for the engine. They will need to project that most engines would meet the standards in-use without adjustment. The in-use adjustments will merely provide some assurance that they would not be forced to recall engines or vehicles because of some small miscalculation of the expected deterioration rates.

[270] Flexibility provisions such as our ABT program and the incentive program for early or very low emission engines may result in some engines that incorporate the advanced emission control technologies even later. However, we do not believe it is appropriate to adjust the in-use compliance levels for engines on which achieving the standard is delayed by manufacturer's choice, nor did we do so in our highway HDDE program.

L. Defect Reporting

As described in the proposed regulation, we are proposing to apply the defect reporting requirements of 40 CFR part 1068 to Tier 4 nonroad CI engines. These requirements would replace for these nonroad engines the currently applicable provisions of 40 CFR part 85, subpart T. Just like the the existing regulations, the proposed defect reporting requirements would obligate manufacturers to tell us when they learn that emission control systems are defective. The new regulations would also require them to conduct investigations under certain other circumstances to determine if an emission-related defect is present. More specifically, the proposed regulations would require manufacturers to initiate these investigations using warranty information, parts shipments, and any other information which is available. We believe the investigation requirement in this rule will allow both EPA and the engine manufacturers to fully understand the significance of any unusually high rates of warranty claims and parts replacement for systems or parts that may have an impact on emissions. We believe that any prudent and responsible engine manufacturer would, and should, conduct a thorough investigation as part of its normal product quality practices when in possession of data indicating an usually high number of recurring parts failures.

The part 85 provisions, which were developed in 1977 for passenger cars, require that manufacturers file a defect report to EPA whenever they become aware of any emission-related defect that occurs within at least 25 engines. This threshold is applicable to all size engine families. The new approach is based on the percentage of engines of an engine family in which the defect is observed, and should result in fewer overall defect reports being submitted by manufacturers than would otherwise be required under the old defect reporting requirements because the number of defects triggering the submission requirement rises proportionally with the engine family size.

The general threshold for investigation in today's proposal is 4 percent of total production, or 4,000 engines, whichever is less, for any single engine family in one model year. The thresholds are reduced by 50 percent for defects related to aftertreatment devices, because these components typically play such a significant role in controlling engine emissions. For example, for an engine family with a sales volume of 20,000 units in a given model year, the manufacturer must investigate for emission-related defects if there were warranty or parts shipments claims for replacing electronic control units in 800 or more engines or catalytic converters on 400 or more engines. For a family with sales volume of 200,000 or more units in a given model year, the manufacturer must investigate for emission-related defects if there were warranty or claims or parts shipments for replacing electronic control units in 4,000 or more engines or catalytic converters on 2,000 or more engines. Please note, manufacturers need 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 are not aggregated for the purpose of triggering the investigation threshold.

The second general threshold in today's proposal specifies when a manufacturer must report that there is an emission-related defect. This threshold involves a smaller number of engines because each possible occurrence has been screened to confirm that it is an emission-related defect. In counting engines to compare with the defect-reporting threshold, the manufacturer must consider a single engine family and model year. However, when a defect report is required, the manufacturer must report all occurrences of the same defect in all engine families and all model years. For engines subject to this proposal, the threshold for reporting a defect is 0.25 percent of total production for any single engine family, or 250 defects, whichever is less. The thresholds are reduced 50 percent for reporting defects related to aftertreatment devices.

While we believe that these general thresholds would work well for most engine families, part 1068 has special provisions for engines over 750 hp. Typically, engine families in this size range include only a few engines per year. If we applied the general defect reporting thresholds, manufacturers would be required to file a defect report for a single defect in these families. Therefore to minimize the burden, part 1068 includes the following separate thresholds for engines over 750 hp:

- For investigations, one percent or five engines, whichever is greater; and
- For reports, one-half perecent or two engines, whichever is greater.

This approach balances the need to minimize the burden on manufacturers and the potential for excessive emissions due to emission-related defects in even a small number of very large engines.

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 or parts shipment data, later indicates that there may be additional defective engines, all the information must be considered in 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 must be submitted even if the trigger for investigating has not yet been met. For example, if manufacturers receive from their dealers, technical staff or other field personnel information showing conclusively that there is a recurring emission-related defect, they must submit a defect report.

At specified times the manufacturer must also report the open investigations as well as recently closed investigations that did not require a defect report. One manufacturer indicated that investigations of potential defects can sometimes take a long time. We agree and, therefore, are not specifying a time limit for manufacturers to complete their investigations. The periodic reports required by the regulations, however, will allow us to monitor these investigations and determine if it is necessary or appropriate for us to take further action.

In general, we believe this updated approach to defect reporting will decrease the number of defect reports submitted by manufacturers overall while significantly improving their quality and their value to both EPA and the manufacturer.

M. Rated Power

We are proposing to add a definition of "rated power" to the regulations. This would allow for more objective applicability of the standards, which apply differently depending on the rated power of the engines. More specifically, we are proposing that:

> Rated power means the measured maximum brake power output of an engine. The rated power of an engine family is the highest rated power of the engines within the family.

Currently, rated power is undefined, and is determined by the engine manufacturer. This makes the applicability of the standards too 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 rated speed in defining which standards an engine must meet and when, we believe that it is critical that a singular rated power be determined objectively according to a specific regulatory definition.

N. Hydrocarbon Measurement and Definition

Both the existing standards and the proposed Tier 4 standards apply to nonmethane hydrocarbons, rather than total hydrocarbons. Methane emissions generally are considered to be nonreactive with respect to ozone, and are not regulated under part 89. However, excluding methane requires that it be separately measured, which complicates the measurement procedures. While we are not proposing to change the standards to total hydrocarbons we are reqesting comment on the need to measure methane and the appropriateness of excluding it from our standards.

O. Other Compliance Issues

As described in the proposed regulation, we are proposing other minor changes to the compliance program for nonroad engines. For example, we are proposing that engine manufacturers be required to provide installation instructions to equipment manufacturers to ensure that engine cooling systems, exhaust emission controls, and related sensors are properly installed by the equipment manufacturer. Proper installation of these systems is critical to the emission performance of the equipment. Equipment manufacturers would be expected to following the instructions to avoid improper installation that could render emission controls inoperative, and subject the equipment manufacturer to penalties for tampering.

We are also proposing to add a provision that would require that mechanically-controlled engines and electronically-controlled engines be certified in separate engine families. This is not likely to have a significant impact, since we expect few, if any, mechanically-controlled engines to be certified to the Tier 4 standards.

We are proposing to clarify the applicability of the nonroad CI standards to engines alcohols and other oxygenated fuels. As part of this, we are proposing to add a requirement that compression-ignition alcohol-fueled engines be required to comply with the evaporative emission control requirements in 40 CFR 1048.105. That section allows manufacturers to comply with the requirement by incorporating simple emission controls. This requirement is not expected to have a significant impact on manufacturers since we are not aware of any alcohol-fueled nonroad engines in production currently. The proposed provision is merely intended to prevent new emission problem from occurring in the future.

We are proposing to allow manufacturers additional flexibility in determining deterioration factors (DFs) for trap-equipped engines. The current regulations specify that the DFs for engines with aftertreatment devices must be multiplicative; that is, they must be expressed as a proportion of the engine's initial emission rate. We are proposing to allow manufacturers the alternative of specifying an additive DF for PM that accounts for a fixed amount of deterioration and is independent of the engine's initial emission rate.

We are proposing to extend to CI engines that operate on unrefined natural gas a flexibility that SI engines that operate on unrefined natural gas. Such engines are sometimes used to operate pumps at oil fields where unrefined natural gas is a readily available and inexpensive fuel source. This provision would allows manufacturers greater flexibility with respect to engine adjustment.

Finally, we are proposing to require that manufacturers label uncertified engines that they produce for stationary applications. Because these engines look the same as (or very similar to) regulated nonroad engines, it can be difficult to distinguish the two without labels.

VIII. Nonroad Diesel Fuel Program: Compliance and Enforcement Provisions

Section IV above describes the proposed program for the reduction of sulfur in nonroad, locomotive and marine (NRLM) diesel fuel. In general, this proposal would require refiners and importers to meet a 500 ppm sulfur standard for nonroad, locomotive, and marine diesel fuel starting June 1, 2007 and to meet a 15 ppm standard for nonroad diesel fuel beginning June 1, 2010. Locomotive and marine diesel fuel would remain subject to the 500 ppm standard. Among other provisions, Section IV also describes a non-highway distillate baseline percentage method to differentiate volumes of diesel fuel subject to the NRLM standards and volumes of diesel fuel subject to the highway fuel standards; provisions to identify unregulated fuel such as heating oil; provisions for credit banking and trading; and special provisions for small refiners, refiners seeking hardship relief, and parties supplying fuel to Alaska and U.S. territories.

As with earlier fuel programs, we have developed a comprehensive set of compliance and enforcement provisions designed to promote effective and efficient implementation of this fuel program and thus to achieve the full environmental potential of the program. The proposed compliance provisions are designed to ensure that proposed nonroad, locomotive, and marine diesel fuel sulfur content requirements are met throughout the distribution system, from the refiner or importer through the end user, subject to certain provisions applicable during the early transition years. Several of these provisions are described in Section IV above, and all others are summarized in this section. The full details of all proposed provisions are found in the regulatory language associated with today's notice.

The proposed compliance and enforcement provisions discussed in this section fall into several broad categories:

- Fuel uses covered and not covered under the proposed program;
- Provisions not described in Section IV applicable to refiners and importers;
- Provisions not described in Section IV applicable to parties downstream of the refinery or importer, including segregation of products to avoid contamination of lower sulfur fuel by higher sulfur fuel, and including prohibitions against fueling certain engines with diesel fuel not meeting the applicable sulfur standard;
- Special provisions regarding additives, kerosene and use of motor oil in fuel;
- Fuel testing and sampling requirements;
- Records required to be kept for compliance with the standards (including those applying under the small refiner and refiner hardship provisions);
- Reporting requirements;
- Exemptions from the program; and
- Provisions concerning liability, defenses, and penalties for noncompliance.

A. Fuel Covered and Not Covered by this Proposal

1. Covered Fuel

As discussed in Section IV.A.1 above, today's proposed standards generally covers all the diesel fuel that is intended or likely to be used in mobile applications that is not already covered by the standards for highway diesel fuel. For the purposes of this preamble, this fuel is defined primarily by the type of engine which it is used to power: land-based nonroad, locomotive, and marine diesel engines. These fuels typically include:

1) Any number 1 and 2 distillate fuels used in or intended to be used in land-based nonroad, locomotive or marine diesel engines and
2) Any number 1 distillate fuel (e.g., kerosene) added to such number 2 diesel fuel (e.g., to improve its cold flow properties.

2. Special Fuel Provisions and Exemptions

Section IV.A.1 above also describes several types of petroleum distillate that are not covered by today's proposal, including jet fuel and heating oil. In addition, the next paragraphs discuss several provisions and exemptions for nonroad diesel fuel that we propose to apply in special circumstances.

a. Fuel Used in Military Applications

We propose to treat distillates used in military applications in the same manner as the recent highway diesel rule. We propose to define NRLM diesel fuel so that JP-5 and JP-8 military fuel that is used or intended for use in NRLM diesel engines would be subject to all of the requirements applicable to NRLM diesel fuel. However, we also propose to exempt JP-5 and JP-8 fuels from today's proposed diesel fuel requirements in certain circumstances. First , these fuels would be exempt if they were used in tactical military equipment that have a national security exemption. Second, these fuels would also be exempt if they were used in tactical military equipment that are not covered by a national security exemption but for national security reasons, such as the need to be ready for immediate deployment overseas, need to be fueled on the same fuel as motor vehicles or nonroad equipment with a national security exemption.

Use of JP-5 and JP-8 fuel not meeting the proposed NRLM diesel fuel standards in a NRLM diesel engine piece of equipment other than the tactical military equipment described above would be prohibited under today's rule. Due to national security considerations, EPA's existing regulations allow the military to request and receive national security exemptions (NSE) for their NRLM diesel engines from emissions regulations if the operational requirements for such engines warrant such an exemption. Today's proposal would not change these provisions.

We also recognize that there are tactical military equipment manufactured before the requirements of today's rule become effective that for national security purposes need to continue to be operated on JP-5 or JP-8 fuel while in the U.S. to facilitate their readiness to be fueled on whatever fuel is available overseas.

To clearly identify the tactical nonroad equipment to be covered by the diesel fuel exemption, we propose that the Department of Defense would submit a notification to EPA describing the rationale and supporting data for the request and a description of the covered tactical nonroad equipment. The one-time notification would need to be sent to EPA by December 31, 2004 in order to provide sufficient time for EPA to review the information as well as lead time to the Department of Defense for logistics planning purposes. EPA would then respond to DOD identifying all nonroad equipment that are covered by the fuel exemption. Based on data provided by the Department of Defense to date in the context of the highway program, EPA believes that providing an exemption for JP-5 and JP-8 fuel used in tactical nonroad equipment would not have any significant environmental impact.

b. Fuel Used in Research and Development

Today's proposed rule would permit parties to seek an exemption from the sulfur standards for nonroad diesel fuel used for research, development and testing purposes ("R & D exemption"). We recognize that there may be legitimate research programs that require the use of diesel fuel with higher sulfur levels than allowed under today's proposed rule. As a result, today's proposal contains provisions for obtaining an exemption from the prohibitions for persons distributing, transporting, storing, selling, or dispensing nonroad diesel fuel that exceeds the standards, where such diesel fuel is necessary to conduct a research, development, or testing program.

Under the proposed rule, parties seeking an R & D exemption would be required to submit to EPA an application for exemption that describes the purpose and scope of the program and the reasons that the use of the higher-sulfur diesel fuel is necessary. Upon presentation of the required information, an exemption could be granted at the discretion of the Administrator, with the condition that EPA could withdraw the exemption in the event the Agency determines the exemption is not justified. In addition, an exemption based on false or inaccurate information would be void *ab initio*. Fuel subject to an exemption would be exempt from certain provisions of today's proposed rule, including the sulfur standards, provided certain requirements are met. These requirements include the segregation of the exempt fuel from non-exempt nonroad and highway diesel fuel, identification of the exempt fuel on product transfer documents, pump labeling, and where appropriate, the replacement, repair, or removal from service of emission systems damaged by the use of the high sulfur fuel.

c. Fuel Used in Racing Equipment

Today's proposed rule would provide no exemption from the sulfur content standard and other requirements of the proposal for diesel fuel used in racing. Under certain conditions, racing vehicles would not be considered nonroad vehicles. See, for example, 40 CFR 89.2, definition of "nonroad vehicle". We believe that there is a realistic chance that such fuel also could be used in NRLM equipment, and therefore, should be considered NRLM fuel. During the highway diesel rulemaking, we received no comments supporting the need for such an exemption. We are not aware of any advantage for racing vehicles, or racing equipment to use fuel having higher sulfur levels than are required by today's proposed rule, and we are concerned about the potential for misfueling of nonroad equipment and motor vehicles that could result from having a high sulfur (*e.g.,* 3,400 ppm) fuel for vehicle or nonroad equipment available in the marketplace. Consequently, as was the case with the highway diesel rule, today's proposal does not provide an exemption from the nonroad diesel fuel requirements for fuel used in racing vehicles or equipment.

d. Fuel for Export

Fuel produced for export, and that is actually exported for use in a foreign country, would be exempt from the standards and baseline requirements of today's proposed rule. Such fuel would be considered as intended for use in the U.S. and subject to today's proposed standards unless it was designated by the refiner as for export and product transfer documents stated that the fuel was for export only. Fuel intended for export would need to be kept segregated from all fuel intended for use in the U.S., and distributing or dispensing such fuel for domestic use would be illegal.

B. Additional Requirements for Refiners and Importers

The primary requirements proposed today for refiners and importers are discussed in Section IV above. In that section, we discuss the general structure of the compliance and enforcement provisions applicable to refiners and importers, including standards, baseline provisions, and credit provisions. In this subsection, we discuss several additional requirements for refiners and importers that are not addressed in Section IV. In addition, Sections VIII.D, E, and F below discuss several provisions that apply to all parties in the diesel fuel production and distribution system, including refiners and importers.

1. Transfer of Credits

Today's proposal includes requirements and restrictions on credit transfers that are essentially identical to other fuels rules that have credits provisions. As in other fuels rules, nonroad diesel credits could only be transferred between the refiner or importer generating the credits and the refiner or importer using the credits. If a credit purchaser could not use all the credits it purchased from the refiner who generated them, the credits could be transferred one additional time. We recognize that there is potential for credits to be generated by one party and subsequently purchased and used in good faith by another party, yet the credits are later found to have been calculated or created improperly, or otherwise found to be invalid. As with the reformulated gasoline rule, the Tier 2/Gasoline Sulfur rule, and the highway diesel rule, invalid credits purchased in good faith would not be permitted to be legally used. To allow such use would not be consistent with the environmental goals of the regulation. In addition, both the seller and purchaser of invalid credits would have to adjust their credit calculations to reflect the proper credits and either party (or both) could be deemed in violation if the adjusted calculations demonstrated noncompliance.

Nevertheless, in a situation where invalid credits are transferred, our strong preference would be to hold the credit seller liable for the violation, rather than the credit purchaser. As a general matter we would expect to enforce a shortfall in credit compliance calculations against the credit seller, and we would expect to enforce a compliance shortfall (caused by the good faith purchase of invalid credits) against a good faith purchaser only in cases where we are unable to recover sufficient valid credits from the seller to cover the shortfall. Moreover, in settlement of such cases we would strongly encourage the seller to purchase credits to cover the good faith purchaser's credit shortfall. EPA would consider the covering of a credit deficit through the purchase of valid credits a very important factor in mitigation of any case against a good faith purchaser, whether the purchase of valid credits is made by the seller or by the purchaser.

2. Additional Provisions for Importers and Foreign Refiners Subject to the Credit Provisions or Hardship Provisions

Since today's proposed rule includes several compliance options that could be used by NRLM diesel fuel importers and foreign refiners, we are also proposing specific compliance and enforcement provisions to ensure compliance for imported NRLM diesel fuel. These additional foreign refiner provisions are similar to those under the conventional gasoline regulations, the gasoline sulfur regulations and the highway diesel fuel regulations (see 40 CFR §§ 80.94, 80.410 and 80.620).

Under today's proposal, standards for NRLM diesel fuel produced by foreign refineries must be met by the importer, unless the foreign refiner has been approved to produce NRLM diesel fuel under the credit provisions, small refiner provisions or hardship provisions of today's proposal. If the foreign refiner is approved for any refinery, the volume requirements would be met by the foreign refinery and the foreign refinery would be the entity generating, using, banking or trading credits for the nonroad diesel fuel produced and imported into the U.S. We are proposing that importers themselves not be eligible for small refiner or hardship relief. Importers may participate in the proposed credit programs; however, an importer and a foreign refiner may not generate credits for the same fuel.

Any foreign refiner that applies for and obtains approval to produce NRLM diesel fuel subject to credit provisions, small refiner provisions or the hardship provisions would be subject to the same requirements as domestic refiners operating under the same provisions. Additionally, we are proposing provisions for foreign refiners similar to the provisions at 40 CFR §§ 80.94, 80.410, and 80.620, which include:

- Segregation of nonroad diesel fuel produced at the foreign refinery until it reaches the U.S. and separately tracking volumes imported into each PADD;
- Controls on product designation;
- Load port and port of entry testing;
- Attest requirements; and
- Requirements regarding bonds and sovereign immunity.

These provisions would aid the Agency in tracking nonroad diesel fuel from the foreign refinery to its point of import into this country. We believe these provisions would be necessary and sufficient to ensure that foreign refiners' compliance could be monitored and that the proposed requirements of this NPRM could be enforced against foreign refiners. (For more discussion of the rationale for these enforcement provisions, see preamble to the final Anti-Dumping Foreign Refineries rule (see 62 FR 45533 (Aug. 28, 1997)) and the gasoline sulfur rule (see 65 FR 6698)

3. Proposed Provisions for Transmix Facilities Under the Nonroad Diesel Rule

In the petroleum products distribution system, certain types of interface mixtures in product pipelines cannot be easily added to either of the adjoining products that produced the interface. These mixtures are known as "transmix." The pipeline and terminal industries' practice is to transport transmix via truck, pipeline, or barge to a facility with an on-site fractionator that is designed to separate the products. The owner or operator of such a facility is called a "transmix processor," and is generally considered to be a refiner under EPA fuel regulations.

Under the non-highway baseline percentage approach proposed in today's nonroad diesel rule, and absent special treatment, transmix processors that wished to commingle highway and NRLM fuel would need to comply with the baseline percentage requirements. Transmix processors, as with conventional refiners, are also currently subject to the "80 percent/20 percent" production requirements for 15 ppm and 500 ppm highway fuel (the Temporary Compliance Option). In both of these cases, producing fuel in set percentages appears to be inconsistent with the inherent nature of the transmix processors' business. Unlike conventional refiners they process shipments of fuel that vary -- largely unpredictably. Complying with set percentages of different highway and NRLM sulfur grades would be very difficult, probably resulting in either a need to purchase credits or to postpone processing of some shipments.

In light of this disproportionate burden on transmix processors, we propose that transmix processors could choose to not be covered by the percentage production requirements of today's proposed non-highway baseline provision and the TCO provisions for highway diesel fuel applicable to other refiners, but only for diesel fuel produced according to legitimate operational practices and not, for example, due to the blending of blend stocks. If the processor chooses not to be covered by these provisions, then the processor could produce highway or NRLM diesel fuel without restrictions on volumes or percentage. For example, the processor could choose whether they produce 15 ppm highway, 500 ppm highway, 500 ppm NRLM, or 15 ppm NR, during the time periods when the non-highway baseline volume percentage or the highway TCO are applicable. The processor would still need to properly designate the fuel with product transfer documents and, in the case of heating oil (between 2007 and 2014) and locomotive and marine fuel (between 2010 and 2014), to apply the specified marker and comply with other reporting and record keeping requirements applicable to refiners. A processor choosing this approach would not be eligible to generate or use nonroad or highway credits. However, if a transmix processor operated under the non-highway baseline percentage approach or the highway TCO , it could, like any refiner, generate and use credits.

Because the volume of fuel involved would be small and the fuel processed would already have been “off-spec”, we believe that providing these options for transmix processors would have essentially no environmental impact and would not affect the efficient functioning of today’s proposed program or the existing highway diesel program.

4. Diesel Fuel Treated as Blendstock (DTAB)

Under today’s proposed program, a situation could arise with importers in which fuel that was expected to comply with the 15 ppm NR or highway standard is found to be slightly higher in sulfur than the standard. Rather than require that importer to account for, and report, that fuel as 500 ppm fuel, we propose to allow the importer to designate the non-complying fuel as blendstock -- “diesel fuel treated as blendstock” or DTAB -- rather than as either highway or nonroad diesel fuel. Then, in its capacity as a refiner, the party could blend this DTAB fuel with lower sulfur fuel to cause the sulfur level of the combined product to meet the 15 ppm nonroad or highway standard.

Where previously certified diesel fuel is used to reduce the sulfur level of the DTAB to 15 ppm or less, the party, in its refiner capacity, would report only the volume of the imported DTAB as diesel fuel produced. This avoids the double counting that would result if the same diesel fuel is reported twice. If the product that is blended with the DTAB is not previously certified diesel fuel, but is merely blendstock, the total combined volume of the DTAB and other blendstock would constitute the batch produced.

Where an importer classifies diesel fuel as DTAB, that DTAB would not count toward the importer’s calculations relating to the highway diesel rule temporary compliance option, or toward credit generation or use, or for compliance calculations under the non-highway baseline approach.[271] The party, in its capacity as refiner, would include the DTAB in such calculations. We believe such an approach would increase the supply of 15 ppm fuel by reducing the volume of near-compliant fuel that is downgraded to higher sulfur designations.

In addition, we propose to apply this DTAB provision to imported highway diesel fuel, for the same reasons. We request comment on this proposed action.

C. Requirements for Parties Downstream of the Refinery or Import Facility

In order for the environmental potential of today's proposed program to be ensured, parties in the fuel distribution system downstream of the refinery (including pipelines, terminals, bulk plants, wholesale purchaser-consumers, and retailers) must in most cases keep the various grades of fuel in the system separate. Owners and operators of nonroad diesel equipment must also be required in certain circumstances to use fuels meeting specific sulfur content standards. The following paragraphs discuss several provisions that we propose to apply to these parties: A downstream sulfur measurement adjustment; segregation of various fuel sulfur grades; diesel fuel pump labeling; use of used motor oil in diesel fuel; use of kerosene in diesel fuel; use of additives in diesel fuel; requirements for end users; and provisions covering downgrading of undyed diesel fuel to different grades of fuel.

1. Product Segregation and Contamination

This subsection discusses the various grades and uses of NRLM fuel under today's proposed program and how in most cases these fuel grades must be segregated from each other. In later subsections, we discuss related requirements for product transfer documents to identify fuels throughout the distribution system and provisions relating to the liability all parties in the distribution face for preventing contamination of these different fuel sulfur grades.

a. The Period From June 1, 2007 through May 31, 2010

Starting June 1, 2007, NRLM fuel having a sulfur content exceeding 500 ppm that is produced or imported under the credit, small refiner, or hardship provisions would need to be segregated from other NRLM fuel subject to the 500 ppm standard, until the point where IRS dye is added. After that point the 500 ppm NRLM fuel could be mixed with NRLM small refiner fuel or credit fuel, but could not be mixed with heating oil. However, during this period there would also be nonroad equipment equipped with engines subject to "pull-ahead" emission standards, and some of this equipment is expected to be equipped with sulfur sensitive technology that needs to operate on 500 ppm or less sulfur fuel in order to meet the proposed

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[271] Importer/refiners availing themselves of the DTAB provisions would still be subject to the non-highway distillate baseline provisions, downgrading provisions, and other provisions applicable to any importer or refiner.

emission standards in-use. Fuels sold for use in, or dispensed into, these engines would need to be identified as meeting the 15 ppm standard or the 500 ppm standard, as applicable, and prevented from being contaminated with higher sulfur fuels.

As noted below (subsection C.8), we are proposing that the downgrading limitations under the highway diesel rule, with some modification, would apply to all undyed 15 ppm diesel fuel until June 1, 2010.

We are proposing an additional segregation requirement for heating oil. As provided in Section IV of the preamble, such fuel would be required to be identified by a marker and segregated throughout the distribution system to the end user. It could not be used as nonroad, locomotive or marine fuel but could only be used as heating oil. To be able to effectively enforce the segregation of heating oil, we are proposing that this fuel must be marked by the addition of 6 mg/L of solvent yellow 124.

b. The Period From June 1, 2010 through May 31, 2014

Because of the extreme sulfur sensitivity of the expected nonroad diesel engine emission control systems beginning in model year 2011, it would be imperative that the distribution system segregate nonroad diesel fuel subject to the 15 ppm sulfur standard from higher sulfur distillate products, such as 500 ppm and high-sulfur small refiner fuel and credit fuel allowed under the program, heating oil, and jet fuel.

We are also concerned about potential misfueling of engines requiring 15 ppm fuel at retail or wholesale purchaser-consumer facilities as defined under this proposal, or other end-user facilities, even when segregation of 15 ppm fuel from the higher-sulfur grades of diesel fuel has been maintained in the distribution system. Thus, downstream compliance and enforcement provisions of the proposed rule are aimed at both preventing contamination of nonroad diesel fuel subject to the 15 ppm sulfur standard and preventing misfueling of new nonroad equipment.

As proposed in Section IV above, small refiners would be able to continue to produce 500 ppm nonroad fuel after 2010, until June 1, 2014. Other refiners could also produce fuel to meet the 500 ppm nonroad standard through the use of credits, but only until June 1, 2012. In either case, we are proposing that during this period, the 500 ppm fuel must be segregated from 15 ppm nonroad fuel throughout the distribution system, including the end user. We are also proposing that refiners [and importers?] wishing to distribute 500 ppm nonroad fuel during this period must petition the Agency for approval of a plan projecting how such fuel would be segregated. The plan would also be required to include a quality assurance program that would ensure that the 500 ppm fuel would not cause fuel subject to the 15 ppm standard to be contaminated, and to ensure that model year 2011 and later engines would not be misfueled.

As discussed in Section IV above, we propose that during this period, locomotive and marine fuel be segregated using the same marker as was used for heating oil before June 1, 2010. During this time, heating oil would not be marked but would be segregated based on its sulfur content, since no other fuel could exceed 500 ppm.

c. After May 31, 2014

After all regulatory flexibilites have expired, the three remaining fuels (15 ppm highway and nonroad fuel, 500 ppm locomotive and marine fuel, and heating oil) would be segregated based on their sulfur content and identifying information on product transfer documents.

2. Diesel Fuel Pump Labeling to Discourage Misfueling

For any multiple-fuel program like the two-step program proposed today, we believe that the clear labeling of nonroad diesel fuel pumps would be vital so that end users could readily distinguish between the several grades of fuel that may be available at fueling facilities and properly fuel their equipment. Section VII above describes the labels that manufactures would be required to place on model year 2011 and later nonroad equipment, and information that would be provided to nonroad equipment owners. Today's proposed requirements for labeling fuel pump stands at retail facilities, including bulk plants or portable fuel storage facilities used as a fueling facility, and wholesale purchaser-consumer facilities address the fact that more than one fuel would be available.

To help prevent misfueling of nonroad, locomotive and marine engines, and to thus assure the environmental benefits of the program are realized, we are proposing pump labeling requirements similar to those adopted in the highway diesel rule. See 40 CFR 80.570. These labels would apply to diesel fuel dyed for tax purposes, and thus could not be used in highway vehicles. The proposed fuel pump stand labeling requirements are discussed separately for each of three time periods: June 1, 2007–August 31, 2010; September 1, 2010- August 31, 2014; and September 1, 2014 and beyond.

We also propose to delete from the highway diesel pump label the reference to diesel fuel for nonroad equipment. See 40 CFR 80.561(c). The nonroad diesel labeling provisions below would supercede this earlier language.

a. Pump Labeling Requirements 2007-2010

As stated in Section IV of the preamble, between June 1, 2007 and August 31, 2010, the proposed rule would not require end users to dispense or use fuel meeting the 500 ppm sulfur standard into nonroad equipment. During this time, small refiner fuel and fuel produced under the credit provisions with sulfur levels exceeding 500 ppm would still exist in the distribution system. Furthermore this fuel could be mixed downstream at the point where the fuels were dyed for IRS tax purposes with fuel meeting the 500 ppm standard and introduced into nonroad, locomotive or marine engines. At the same time, there would also be nonroad equipment during this period equipped with engines subject to "pull-ahead" emission standards, that is engines equipped with emission controls that allow them to meet standards earlier than required. Some of this pull-ahead equipment is expected to be equipped with sulfur sensitive technology that would need to operate on fuel of 500 ppm or less sulfur in order to meet the proposed emission standards in-use. For this reason, it is important that nonroad end users be able to know what the sulfur level is of the fuel they are purchasing. Therefore, fuel pump dispensers for the various sulfur grades would also need to be properly labeled to reflect the various sulfur grades.

For pumps dispensing 500 ppm sulfur diesel fuel, we propose that the label read as follows:

LOW-SULFUR NONROAD, LOCOMOTIVE, OR MARINE DIESEL FUEL
(500 parts per million (ppm))
Required for Nonroad Engines Certified for Use on 500 ppm Fuel.
Not For Use In Highway Vehicles.

It is also likely that prior to June 1, 2010 some 15 ppm diesel fuel will be introduced into the nonroad market early. Both the engine and fuel credit provisions envision such early introduction of 2011-compliant engines and 15 ppm fuel. Thus, it is important that nonroad end users be able to know when they are purchasing diesel fuel with 15 ppm or less sulfur.

For pumps dispensing 15 ppm sulfur diesel fuel, we propose that the label read as follows:

ULTRA LOW-SULFUR NONROAD, LOCOMOTIVE, OR MARINE DIESEL FUEL
(15 parts per million (ppm))
Required for Nonroad Engines Certified for Use on 15 ppm Fuel.
Not For Use In Highway Vehicles.

For all other nonroad equipment, diesel fuel pumps (i.e., pumps dispensing diesel fuel that may have a sulfur content greater than 500 ppm), we propose that the label read as follows:

HIGH-SULFUR NONROAD, LOCOMOTIVE, OR MARINE DIESEL FUEL
(May Exceed 500 parts per million (ppm))
Federal Law **Prohibits** Use in Nonroad Engines that are Certified for Use on Diesel Fuel of Less Than 500 ppm.
Not For Use In Highway Vehicles.

For pumps dispensing high-sulfur fuel for use as heating oil or otherwise, we propose that the label read as follows:

HEATING OIL
Federal Law **Prohibits** Use in Nonroad, Locomotive, or Marine Engines or Highway Vehicles.

b. Pump Labeling Requirements 2010-2014

Starting September 1, 2010, with certain exceptions, all fuel introduced into any nonroad engine, regardless of year of manufacture, would be required to meet the 15 ppm standard. The exceptions are that segregated small refiner nonroad diesel fuel and credit-based nonroad diesel fuel would be allowed to meet the 500 ppm sulfur standard, for use in pre-model year 2011 engines only. This limited use of 500 ppm fuel would continue until September 1, 2014,[272] at which time all nonroad fuel would have to meet the 15 ppm standard. Fuel for use in locomotive and marine engines would be required to meet the 500 ppm standard without exception.

For pumps dispensing 15 ppm sulfur diesel fuel, we propose that the label read as follows:

ULTRA LOW-SULFUR NONROAD, LOCOMOTIVE, OR MARINE DIESEL FUEL
(15 parts per million (ppm))
Recommended for Use in All Diesel-Powered Nonroad, Locomotive and Marine Engines.
Required for all Model Year 2011 and Later Nonroad Engines.
Required for all Nonroad Engines Certified for Use on 15 ppm Fuel.
Not For Use In Highway Vehicles.

For pumps dispensing segregated small refiner or credit 500 ppm nonroad diesel fuel, we propose that the label read as follows:

LOW-SULFUR NONROAD, LOCOMOTIVE, OR MARINE DIESEL FUEL
(500 ppm maximum)
WARNING
May Damage Model Year **2011** and Later Nonroad Engines.
Federal Law **Prohibits** Use in All Model Year **2011** and Later Nonroad Engines.
Federal Law **Prohibits** Use in Nonroad Engines Certified for Use on 15 ppm Fuel.
Not For Use In Highway Vehicles.

For pumps dispensing locomotive or marine diesel fuel, we propose that the label read as

[272] Production of 500 ppm fuel under the credit provisions would be allowed until June 1, 2012, but small refiner fuel subject to the 500 ppm standard could continue to be produced until June 1, 2014 and would be available to end users until September 1, 2014.

follows:

LOCOMOTIVE OR MARINE DIESEL FUEL
Federal Law **Prohibits** Use in Other Nonroad Engines or in Highway Vehicles.

For pumps dispensing high-sulfur fuel for use as heating oil, we propose that the label read as follows:

HEATING OIL
Federal Law **Prohibits** Use in Nonroad Equipment Engines or Highway Vehicle Engines.

c. Pump Labeling Requirements Starting September 1, 2014

Starting September 1, 2014, all nonroad fuel would be required to meet the 15 ppm standard, without exception. Locomotive and marine fuel would continue to be subject to the 500 ppm standard, without exception. The pump labels for marine and locomotive fuel and heating oil would continue to be the same as for the period 2010 through 2014.

For pumps dispensing nonroad diesel fuel, we propose that the label read as follows:

ULTRA LOW-SULFUR NONROAD DIESEL FUEL (15 parts per million)
Required for all Nonroad Engines.
Not For Use In Highway Vehicles.

For pumps dispensing locomotive or marine diesel fuel, we propose that the label read as follows:

LOCOMOTIVE OR MARINE DIESEL FUEL
Federal Law **Prohibits** Use in Other Nonroad Engines or in Highway Vehicles.

For pumps dispensing high-sulfur fuel for use as heating oil, we propose that the label read as follows:

HEATING OIL
Federal Law **Prohibits** Use in Nonroad, Locomotive, or Marine Engines or Highway Vehicles.

d. Nozzle Size Requirements or other Requirements to Prevent Misfueling

Like the highway diesel fuel program, the proposed nonroad fuel program does not include a nozzle size requirement, in part because we are not aware of an effective and practicable scheme to prevent misfueling through the use of different nozzle sizes or shapes, and in part because we do not believe that improper fueling would be a significant enough problem to warrant such an action. In the preamble to the highway diesel fuel rule, we stated our belief that the use of unique nozzles, color-coded scuffguards, or dyes to distinguish the grades of diesel fuel may be useful in preventing accidental use of the wrong fuel. (See 66 FR 5119, January 18, 2001.) However, we did not finalize any such requirements, for the reasons described in the RIA for that final rule (Chapter IV.E.).

Similar reasoning applies to the proposed nonroad fuel program. For example, 15 ppm fuel would be the dominant fuel in the market by 2010, likely comprising more than 80 percent of all number 2 distillate. Furthermore, after 2010, we believe that 500 ppm fuel would have limited availability until 2014. High-sulfur distillate for heating oil purposes would remain, but will only exist in significant volumes in certain parts of the country. In any event, we believe that most owners and operators of new nonroad engines and equipment would not risk voiding the general warranty and the emissions warranty by misfueling.

3. Use of Used Motor Oil in New Diesel Nonroad Equipment

We understand that used motor oil is sometimes blended with diesel fuel for use as fuel in nonroad diesel equipment. Such practices range from blending used motor oil directly into the equipment fuel tank, to blending it into the fuel storage tanks, to blending small amounts of motor oil from the engine crank case into the fuel system as the equipment is being operated.

However, motor oil normally contains high levels of sulfur. Thus, the addition of used oil to nonroad diesel fuel could substantially impair the sulfur-sensitive emissions control equipment expected to be used by engine manufacturers to meet the emissions standards proposed in today’s NPRM. Depending on how the oil is blended, it could increase the sulfur content of the fuel burned by as much as 200 ppm. As a result, we believe blending used oil into nonroad diesel fuel could render inoperative the expected emission control technology on the equipment and potentially cause driveability problems, and should be prohibited as a violation of the tampering prohibition in the Act (see CAA Sections 203(a)(3), 213(d)).

Therefore, like the highway diesel rule, today's proposal would prohibit any person from introducing or causing or allowing the introduction of used motor oil, or diesel fuel containing used motor oil, into the fuel delivery systems of nonroad equipment engines manufactured in model year 2011 and later. The only exception to this would be where the engine was explicitly certified to the emission standard with oil added and the oil was added in a manner consistent with the certification.

4. Use of Kerosene in Diesel Fuel

As we discussed in the highway diesel fuel final rule preamble (see 66 FR 5120 (Jan. 18, 2001)), kerosene is commonly added to diesel fuel to reduce fuel viscosity in cold weather. Today’s proposal would not limit this practice with regard to nonroad diesel fuel. Consistent with the highway diesel fuel rule, under today's proposal, kerosene that is used, intended for use, or made available for use as, or for blending with, 15 ppm sulfur NRLM diesel fuel would itself be required to be classified as "nonroad diesel fuel" (unless it was already classified as "motor vehicle diesel fuel") and meet the 15 ppm standard starting June 1, 2010. This classification for nonroad diesel fuel use may be made by the fuel's refiner or may be made by a downstream party at the point when that party chooses to use the kerosene in its possession for use as nonroad diesel fuel subject to the 15 ppm sulfur standard.

To help ensure that only distillates that comply with the proposed 15 ppm nonroad diesel fuel standard are blended into 15 ppm nonroad diesel fuel, today's proposal would require that kerosene meeting the 15 ppm standard and distributed by the transferring party for use in nonroad equipment engines must be accompanied by PTDs accurately stating that the product meets the 15 ppm sulfur standard. (See Section VIII.E.7, below.)

As a general matter, any party who would blend kerosene, or any blendstock, into nonroad diesel fuel, or who would produce nonroad diesel fuel by mixing blendstocks, would be a refiner and would be subject to the requirements and prohibitions applicable to refiners under the proposed rule. However, under today's proposal, in deference to the longstanding and widespread practice of blending kerosene into diesel fuel at downstream locations, downstream parties who only blend kerosene into nonroad diesel fuel will not be subject to the requirements applicable to refiners, provided that they do not alter the fuel in any other way. This activity is treated the same way under the final highway diesel rule. Further, downstream parties choosing to blend kerosene into 15 ppm nonroad diesel fuel would be entitled to the 2 ppm adjustment factor discussed above for both the kerosene and the diesel fuel into which it is blended at downstream locations, provided that the kerosene had been transferred to the party with a PTD indicating compliance with that standard. Sulfur test results from downstream locations of parties who do not have such a PTD for their kerosene will not be subject to this adjustment factor, either for the kerosene itself, or for the nonroad diesel fuel into which it is blended.

In order to ensure the continued compliance of 15 ppm fuel with the 15 ppm standard, downstream parties choosing to blend kerosene into 15 ppm nonroad diesel fuel would be required to either have a PTD for that kerosene indicating compliance with the 15 ppm standard, or to have test results for the kerosene establishing such compliance.

Any party who causes the sulfur content of nonroad diesel fuel subject to the 15 ppm sulfur standard to exceed 15 ppm by blending kerosene into nonroad diesel fuel, or by using high sulfur kerosene as nonroad diesel fuel, would be subject to liability for violating the sulfur standard. Similarly, parties who cause the sulfur level of nonroad diesel fuel subject to the 500 ppm nonroad diesel fuel to exceed that standard by blending kerosene into the fuel, would also be subject to liability.

The proposed rule would not require refiners or importers of kerosene to produce or import kerosene meeting the 15 ppm sulfur standard. However, we believe that refiners will produce low sulfur kerosene in the same refinery processes that they use to produce low sulfur diesel fuel, and that the market will drive supply of low sulfur kerosene for those areas where, and during those seasons when, the product is needed for blending with nonroad, as well as on-highway, diesel fuel. We request comments regarding this proposed provision.

5. Use of Diesel Fuel Additives

Diesel fuel additives include lubricity improvers, corrosion inhibitors, cold-operability improvers, and static dissipaters. Use of such additives is distinguished from the use of kerosene by the low concentrations at which they are used and their relatively more complex chemistry.[273] The suitability of diesel fuel additives for use in diesel fuel meeting a 500 ppm sulfur specification has been well established due to the existence of 500 ppm highway diesel fuel in the marketplace since 1993. The suitability of additives for use in 15 ppm diesel fuel was addressed in the highway diesel program, which requires highway diesel fuel to meet a 15 ppm sulfur standard beginning in 2006. Our review of data submitted by additive and fuel manufacturers to comply with EPA's Fuel and Fuel Additive Registration requirements (40 CFR Part 79) indicates that additives to meet every purpose (including static dissipation) are currently in common use which meet a 15 ppm cap on sulfur content.[274] Since such low-sulfur additives are currently in use side-by-side with high-sulfur additives, it is reasonable to conclude that there is not a significant difference in their cost. The ability of industry to provide low-sulfur additives is supported by the fact that diesel fuel meeting a 10 ppm cap on sulfur content has been marketed in Sweden for some time, and 15 ppm diesel fuel is now being made available to a number of centrally fueled fleets across the U.S.

Even if not yet available for certain purposes, we believe that it is reasonable to assume that low-sulfur additives will become available before the 15 ppm sulfur standard for highway diesel fuel becomes effective in 2006. This will be well in advance of the proposed 2010 implementation date for a 15 pm sulfur standard on nonroad diesel fuel. We request comment on what actions EPA should take to ensure a smooth transition to the use of additives suitable for use in 15 ppm nonroad diesel fuel beyond those already undertaken for highway diesel fuel meeting a 15 ppm sulfur standard.

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[273] Diesel fuel additives are used at concentrations commonly expressed in parts per million. Diesel fuel additives can include specially-formulated polymers and other complex chemical components. Kerosene is used at much higher concentrations, expressed in volume percent. Unlike diesel fuel additives, kerosene is a narrow distillation fraction of the range of hydrocarbons normally contained in diesel fuel. See Section VII.C.4. above regarding the requirements associated with the addition of kerosene to diesel fuel.

[274] See Chapter IV.D. of the RIA for the highway diesel fuel rule for more information on diesel fuel additives, EPA Air docket A-99-06, docket item V-B-01

As discussed in section V of today's preamble, we expect that reducing the sulfur content of off-highway diesel engine fuel to the meet the proposed sulfur standards would not have a disproportionate impact on fuel lubricity compared to the reduction in lubricity associated with desulfurizing highway diesel fuel. We have no reason to expect that this situation would be any different with respect to the potential impact on off-highway diesel engine fuel properties other than fuel lubricity which might require the use of additives such as cold flow, and susceptibility to static build up. Consequently, our estimate of the increase in additive use that would result from the adoption of today's proposed rule parallels that under the highway program. We estimate that the use of lubricity additives would increase, and that the use of other additives would be unaffected.[275] We request comment on this assessment.

Similar to the highway diesel rule, today's proposed rule would allow the use of diesel fuel additives with a sulfur content greater than 15 ppm in nonroad diesel fuel. However, nonroad diesel fuel containing such additives would remain subject to the proposed 15 ppm sulfur cap. We believe that it is most appropriate for the market to determine how best to accommodate increases in the fuel sulfur content from the refinery gate to the end user, while maintaining the 15 ppm cap, and whether such increases result from contamination in the distribution system or diesel additive use. By providing this flexibility, we anticipate that market forces will encourage an optimal balance between the competing demands of manufacturing fuel lower than the15 ppm sulfur cap, limiting contamination in the distribution system, and limiting the additive contribution to fuel sulfur content.

As in the highway diesel program, additive manufacturers that market additives with a sulfur content higher than 15 ppm and blenders that use them in nonroad diesel fuel subject to the proposed 15 ppm sulfur standard would have additional requirements to ensure that the 15 ppm sulfur cap is not exceeded. The 15 ppm sulfur cap on highway diesel fuel that becomes effective in 2006 may encourage the gradual retirement of additives that do not meet a 15 ppm sulfur cap. The proposed 15 ppm sulfur cap for nonroad diesel fuel in 2010 may further this trend. However, we do not anticipate that this will result in disruption to additive users and producers or a significant increase in cost. Additive manufacturers commonly reformulate their additives on a periodic basis as a result of competitive pressures. We anticipate that any reformulation that might need to occur to meet a 15 ppm sulfur cap will be accomplished prior to the implementation of the 15 ppm sulfur cap on highway diesel fuel in 2006.

Like the highway diesel fuel rule, today's proposed rule would limit the continued use in nonroad diesel fuel (subject to the proposed 15 ppm sulfur standard) of additives that exceed 15 ppm sulfur to concentrations of less than one volume percent. We believe that this limitation is appropriate and would not cause any undue burden because the diesel fuel additives for which

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[275] See section IV.G. of today's preamble for a discussion of the potential impact of the proposed sulfur standards on fuel lubricity.

this flexibility was included are always used today at concentrations well below one volume percent. Further, one volume percent is the threshold above which the blender of an additive becomes subject to all the requirements applicable to a refiner (40 CFR 79.2(d)(1)).

The specific proposed requirements regarding the use of diesel fuel additives in nonroad diesel fuel meeting the proposed 15 ppm standard are as follows:

- Additives that have a sulfur content at or below 15 ppm must be accompanied by a PTD that states: "The sulfur content of this additive does not exceed 15 ppm."

- Additives that exceed 15 ppm sulfur could continue to be used in nonroad diesel fuel meeting the proposed 15 ppm sulfur standard provided that they are used at a concentration of less than one volume percent and their transfer is accompanied by a PTD that lists the following:
    1) a warning that the additive's sulfur content exceeds 15 ppm
    2) the additive's maximum sulfur concentration
    3) the maximum recommended concentration for use of the additive in diesel fuel, and
    4) the contribution to the sulfur level of the fuel that would result if the additive is used at the maximum recommended concentration.

Blenders of additives that exceed 15 ppm in sulfur content would be liable if their actions caused the sulfur content of the finished nonroad diesel fuel to exceed 15 ppm. In some cases, blenders may not find it feasible to conduct testing, or otherwise obtain information on the sulfur content of the fuel either before or after additive blending, without incurring substantial cost. We anticipate that blenders would manage the risk associated with the use of additives above 15 ppm in sulfur content under such circumstances with actions such as the following:

- selecting an additive with minimal sulfur content above 15 ppm that is used at a low concentration, and
- working with their upstream suppliers to provide fuel of sufficiently low sulfur content to accommodate the small increase in sulfur content which results from the use of the additive.

This is similar to the way distributors would manage contamination from their distribution hardware (tank trucks, etc.). Distributors would not necessarily test for fuel sulfur content after each opportunity for contamination, but rather will rely on mechanisms set up to minimize the contamination, and to obtain fuel sufficiently below the standard to accommodate the increase in sulfur content from the contamination.

The recordkeeping, reporting, and PTD provisions associated with these proposed requirements are discussed in Section VIII.E below. The liability provisions are discussed in Section VIII.F below.

The 1993 and 2007 highway diesel programs did not contain any requirements regarding the maximum sulfur content of additives used in highway diesel fuel meeting a 500 ppm sulfur cap.[276] Our experience under the highway program indicates that application of the 500 ppm sulfur cap throughout the distribution system to the end-user has been sufficient to prevent the use of additives from jeopardizing compliance with the 500 ppm sulfur standard. The potential increase of several ppm in the sulfur content of diesel fuel which might result from the use of diesel additives raises substantial concerns regarding the impact on compliance with a 15 ppm sulfur cap. However, this is not the case with respect to the potential impact on compliance with a 500 ppm sulfur cap. The current average sulfur content of highway diesel fuel of 340 ppm provides ample margin for the minimal increase in the fuel sulfur content which might result from the use of additives. We expect that this would also be the case for NRLM fuel meeting the proposed 500 ppm sulfur standard. Therefore, we are not proposing any requirements regarding the sulfur content of additives used in NRLM fuel meeting the proposed 500 ppm sulfur standard. We believe that the proposed requirement that NRLM fuel comply with the 500 ppm sulfur cap throughout the distribution system to the end-user would be sufficient to ensure that entities who introduce additives into such fuel take into account the potential increase in fuel sulfur content. We request comment on this assessment.

6. End User Requirements

In light of the importance of ensuring that the proper fuel is used in nonroad, locomotive, and marine engines covered by today's proposed program, we propose to prohibit any person from fueling such an engine with fuel not meeting the applicable sulfur standard.

We propose that 1) no person may introduce, or permit the introduction of, fuel that exceeds 15 ppm into equipment with a model year 2011 or later engine (or with an earlier engine certified to operate only on 15 ppm fuel); 2) beginning June 1, 2010, no person may introduce, or permit the introduction of locomotive or marine fuel into any nonroad engine, and no person may introduce, or permit the introduction of any fuel exceeding 15 ppm into any nonroad engine regardless of year of manufacture, except that segregated 500 ppm diesel fuel produced by qualified small refiners or refiners using credits may be introduced into pre-2011 model year engines not certified for use on 15 ppm fuel; and 3) beginning June 1, 2014, no person may introduce, or permit the introduction of, fuel exceeding 15 ppm into any nonroad diesel equipment.

7. Anti-Downgrading Provisions

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[276] The 500 ppm highway diesel final rule contains the requirement that highway diesel fuel not exceed 500 ppm in sulfur content at any point in the fuel distribution system including after the blending of additives. Fuel Quality Regulations for Highway Diesel Fuel Sold in 1993 and Later Calendar Years, Final Rule, 55 FR 34120, August 21, 1990.

The highway diesel rule placed restrictions on downgrading of 15 ppm diesel fuel to 500 ppm highway diesel fuel from June 1, 2006 - May 31, 2010 in order to prevent downstream entities from intentionally downgrading 15 ppm fuel and protect the nationwide availability of 15 ppm fuel. The concern was that since both 15 ppm fuel and 500 ppm highway fuel were expected to be comparably priced, entities downstream of the refinery could simply take delivery of whichever fuel was cheapest and commingle the two fuel grades. We chose not to restrict downgrading to non-highway fuel grades, however, for three reasons. First, in order to avoid reprocessing costs, an outlet was needed for legitimately downgraded fuel produced through contamination in the distribution system. Second, the price differential between 15 ppm fuel and high sulfur non-highway fuel was expected to be sufficient to deter any intentional downgrading. Third, many of the entities (e.g., retailers and fleets) that might have an incentive to downgrade 15 ppm highway fuel do not market non-highway fuel, and therefore would have no opportunity to do so.

With today's proposal, however, all NRLM diesel fuel would also be required to meet the 500 ppm standard beginning June 1, 2007 and permitted to be fungible with highway fuel up to the point where dye is added for IRS excise tax purposes. As a result, application of the anti-downgrading provision in light of today's proposal is ambiguous with respect to what would and would not allowed. Furthermore, the assumption in the highway rule that the price differential between 15 ppm highway and non-highway fuel would be sufficient to deter intentional downgrading is not necessarily valid any longer, given that the application of the 500 ppm NRLM standard would tend to close the price differential between the fuels. For these reasons, we propose that the anti-downgrading provisions contained in § 80.527 be modified to restrict downgrading of undyed 15 ppm fuel to any 500 ppm fuel, whether intended for highway purposes or NRLM purposes, but to continue to allow unrestricted downgrading of undyed 15 ppm fuel to fuel which under today's proposal is marked as heating oil.

We further propose that the restriction apply to any 15 ppm fuel produced, whether designated as highway or as NRLM (under the early credit provisions). Since the two fuels would be distributed together, this expansion of the downgrading limitations would be needed to enable enforcement of the highway diesel fuel downgrading limitations. We do not propose that the anti-downgrading provisions be extended beyond their current sunset date of June 1, 2010. The purpose of these provisions was to ensure availability of 15 ppm highway fuel nationwide, and we do not anticipate this being a concern after June 1, 2010. We request comment on these proposed revisions of the anti-downgrading provisions.[277]

While these proposed downgrading provisions apply primarily to parties in the

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[277] Since the time of the highway final rule, we have become aware of several other needs for clarification of the anti-downgrading provisions. We intend to address these general issues through a future amendment to the highway diesel rule.

distribution system downstream of the refiners and importers, these requirements would also apply to refiners and importers.

D. Diesel Fuel Sulfur Sampling and Testing Requirements

1. Testing Requirements

As part of today's action, we are proposing a new approach for fuel sulfur measurement. The details of this approach are described below, followed by a description of who would be required to conduct fuel sulfur testing as well as what fuel they would be required to test.

a. Test Method Approval, Recordkeeping, and Quality Control Requirements

Most current and past EPA fuel programs designated specific analytical methods which refiners, importers, and downstream parties use to analyze fuel samples at all points in the fuel distribution system for regulatory compliance purposes. Some of these programs have also allowed certain specific alternative methods which may be used as long as they are correlated to the designated test method. The highway diesel rule (66 FR 5002, January 18, 2001), for example, specifies one designated test method[278] and three alternative methods[279] for measuring the sulfur content of highway diesel fuel subject to the 15 ppm sulfur standard.

While the highway diesel fuel sulfur rule specified a designated method as well as certain alternative methods, the rule also announced the Agency's intention to adopt a performance-based test method approach in the future, as well as our intention to continue working with the industry to develop and improve sulfur test methods. Under the performance-based approach, a given test method could be approved for use in a specific laboratory by meeting certain precision and accuracy criteria (described in more detail below). Properly selected precision and accuracy values potentially would allow multiple methods and multiple commercially available

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[278] ASTM D 6428-99, *Test Method for Total Sulfur in Liquid Aromatic Hydrocarbons and Their Derivatives by Oxidative Combustion and Electrochemical Detection*.

[279] As clarified in EPA's response to the American Petroleum Institute's Petition for Reconsideration of the final rule, the rule also allows the following alternative test methods:

a. ASTM D 5453-00, *Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Motor Fuels and Oils by Ultraviolet Fluorescence,*

b. ASTM D 3120-96, *Standard Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry*, and

c. ASTM D 2622-98 as modified, *Standard Test Method for Sulfur in Petroleum Products by X-Ray Spectrometry* instruments to be approved, thus providing greater flexibility in method and instrument selection while also encouraging the development and use of better methods and instrumentation in the future. Under this approach, there would be no designated sulfur test method as specified under previous regulations.

Since any test method that meets the specified performance criteria may qualify, this type of approach does not conflict with the "National Technology Transfer and Advancement Act of 1995" (NTTAA), section 12(d) of Public Law 104-113, or the Office of Management and Budget (OMB) Circular A -119. Both of these documents are designed to encourage the adoption of standards developed by "voluntary consensus bodies" and to reduce reliance on government-unique standards where such consensus standards would suffice. Under the performance criteria approach proposed today, methods developed by consensus bodies as well methods not yet approved by a consensus body would qualify for approval provided they met the specified performance criteria as well as the recordkeeping and reporting requirements for quality control purposes.

i. How Can a Given Method be Approved?

Under the proposed performance criteria approach, a given test method would be approved for use under today's program by meeting certain precision and accuracy criteria. Approval would apply on a laboratory/facility-specific basis. If a company chooses to employ more than one laboratory for fuel sulfur testing purposes, then each laboratory would have to separately seek approval for each method it intends to use. Likewise, if a laboratory chooses to use more than one sulfur test method, then each method would have to be approved separately. Separate approval would not be necessary for individual operators or laboratory instruments within a given laboratory facility.

The specific precision and accuracy criteria that we are proposing were derived from existing sulfur test methods that are either required or allowed under the highway diesel fuel sulfur program.[280] The first criterion, precision, refers to the consistency of a set of measurements and is used to determine how closely analytical results can be duplicated based on repeat measurements of the same material under prescribed conditions. To demonstrate the precision of a given sulfur test method under the performance-based approach, a laboratory facility would perform 20 repeat tests over several days on samples taken from a homogeneous supply of a commercially available diesel fuel. We request comment on the specific number of days over which these 20 repeat tests should be conducted. Using the test results[281] of ASTM D

[280] ibid.

[281] Sulfur Repeatability of Diesel by Method at 15 ppm, ASTM Report on Low Level Sulfur Determination in Gasoline and Diesel Interlaboratory Study - A Status Report, June 2002.

3120, the precision would have to be less than 0.72 ppm.[282]

The second criterion, accuracy, refers to the closeness of agreement between a measured or calculated value and the actual or specified value. To demonstrate the accuracy of a given test method under the performance-based approach, a laboratory facility would be required to perform 10 repeat tests, the mean of which could not deviate from the Accepted Reference Value (ARV) of the standard by more than 0.50 ppm. These tests would be performed using commercially available gravimetric sulfur standards. Ten tests would be required using each of two different sulfur standards–one in the range of 1-10 ppm and the other in the range of 10-20 ppm sulfur. Therefore, a minimum of 20 total tests would be required for sufficient demonstration of accuracy for a given sulfur test method at a given laboratory facility. Finally, any known interferences for a given test method would have to be mitigated.

These requirements are not intended be overly burdensome. Indeed, we believe these requirements are equivalent to what a laboratory would do during the normal start up procedure for a given test method. In addition, we believe this approach would allow regulated entities to know that they are measuring diesel fuel sulfur levels accurately and within reasonable site reproducibility limits. Nevertheless, we request comment on this performance criteria approach and the specific precision and accuracy criteria we are proposing.

ii. What Information Would Have To Be Reported to the Agency?

For test methods that have already been approved by a voluntary consensus standards body[283] (VCSB), such as ASTM, or the International Standards Organization (ISO), each laboratory facility would be required to report to the Agency the precision and accuracy results as described above for each method for which it is seeking approval. Such submissions to EPA's Office of Enforcement and Compliance Assurance, as described elsewhere, would be subject to the Agency's review for 30 days, and the method would be considered approved in the absence of EPA comment. Laboratory facilities would be required to retain samples for a limited amount of time (e.g., 30 days).

For test methods that have not been approved by a VCSB, full test method documentation, including a description of the technology/instrumentation that makes the method functional, as well as subsequent EPA approval of the method would also be required. These submissions would also be subject to the Agency's review for 60 days, and the method would be

[282] 0.72 ppm is equal to 1.5 times the standard deviation of ASTM D 3120 where the standard deviation is equal to the repeatability of ASTM D 3120 (1.33) divided by 2.77.

[283] These are standard-setting organizations, like ASTM, and ISO that have broad representation of all interested stakeholders and make decisions by consensus.

considered approved in the absence of EPA comment. Submission of VCSB methods would not be required since they are available in the public domain. In addition, industry and the Agency have likely had substantial experience with such methods. The approval of non-VCSB methods would be valid for five years. After this time period, the approval would be rescinded unless the method had been adopted by a consensus body. If, ultimately, a consensus body does not approve the method then the method could no longer be used.

As described above, federal government and EPA policy is to use standards developed by voluntary consensus bodies when available. The purpose of the NTTAA and OMB policies, at least in part, is to foster consistency in regulatory requirements, to take advantage of the collective industry wisdom and wide-spread technical evaluation required before a test method is approved by a consensus body, and to take advantage of the ongoing oversight and evaluation of a test method by the consensus body that results from wide-spread use of an approved method (e.g., the ongoing round-robin type analysis and typical annual updating of the method by the consensus body). These goals are not met where the Agency allows use of a non-consensus body test method in perpetuity. Moreover, it is not possible to realize many of the advantages that result from consensus status where a test method is used by only one or a few companies; it will not have the practical scrutiny that comes from ongoing wide-spread use, or the independent scrutiny of the consensus body and periodic updating. In addition, EPA does not have the resources to conduct the degree of initial scrutiny or ongoing scrutiny that are practiced by consensus bodies. Nevertheless, EPA believes it is appropriate to allow limited use of a proprietary test method for a limited time, even though the significant advantages of consensus test methods are absent unless and until the method gains consensus approval, because a company may have invested significant resources in developing a method and because EPA can at least evaluate the initial quality of a method. However, if after a reasonable time a test method fails to gain consensus body approval, EPA believes approval of the method should be withdrawn because of the absence of ongoing consensus oversight.

To assist the Agency in determining the performance of a given sulfur test method (non-VCSB methods, in particular), we propose to reserve the right to send samples of commercially available fuel to laboratories for evaluation. Such samples would be intended for situations in which the Agency had concerns regarding a test method and, in particular, its ability to measure the sulfur content of a random commercially available diesel fuel. Laboratory facilities would be required to report their results from three tests of this material to the Agency.

iii. What Quality Control Provisions Would Be Required?

We are proposing to require ongoing Quality Control (QC) procedures for sulfur measurement instrumentation. These are procedures used by laboratory facilities to ensure that the test methods they have qualified and the instruments on which the methods are run are yielding results with appropriate accuracy and precision (e.g., that the results from a particular instrument do not “drift” over time to yield unacceptable values). It is our understanding that most laboratories already employ QC procedures, and that these are commonly viewed as important good laboratory practices. Under the performance-based approach, laboratories would be required to abide by the following QC procedures:

1) Follow the mandatory provisions of ASTM D 6299-02, *Standard Practice for Applying Statistical Quality Assurance Techniques to Evaluate Analytical Measurement System Performance*. Laboratories would be required to construct control charts from the mandatory QC sample testing prescribed in paragraph 7.1, following the guidelines under A 1.5.1 for individual observation charts and A 1.5.2 for moving range charts.

2) Follow ASTM D 6299-02 paragraph 7.3.1 (check standards) using a standard reference material. Check standard testing would be required to occur at least monthly and should take place following any major change to the laboratory equipment or test procedure. Any deviation from the accepted reference value of the check standard greater than 1.44 ppm[284] would have to be investigated.

3) Upon discovery of any QC testing violation of A 1.5.1.3 or A 1.5.3.2 or check standard deviation greater than 1.44 ppm, as provided in item ii. above, any measurements made while the system was out of control would be required to be tagged as suspect and an investigation conducted into the reasons for this anomalous performance. We also propose that refiners and importers would be required to retain batch samples for a limited amount of time. For example, a retain period could be equal to the interval between QC sample tests. If an instrument was found to be out of control, all of the retained samples since the last time the instrument was shown to be in control would have to be retested. We seek comment on alternative ways to handle situations in which a method goes out of control at some unknown point in time between check standard tests or between QC sample tests.

4) QC records, including investigations under item iii. above would be required to be retained for five years and to be provided to the Agency upon request.

b. Requirements for Conducting for Fuel Sulfur Testing.

Given the importance of assuring that diesel fuel designated to meet the 15 ppm sulfur standard in fact meets that standard, we are proposing that refiners and importers must test each batch of nonroad diesel fuel designated to meet the 15 ppm sulfur standard and to maintain records of such testing. Requiring that refiners and importers test each batch of fuel subject to

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[284] 1.44 ppm is equal to two times the proposed precision of 0.72 ppm.

the 15 ppm nonroad standard would assure that compliance could be confirmed through testing records, and even more importantly, would assure that fuel exceeding the 15 ppm standard was not introduced into commerce as fuel for use in nonroad equipment having sulfur-sensitive emission control devices. Batch testing is not required under the highway diesel rule; instead such testing is typically performed to establish a defense to potential liability. However, for the reasons discussed above, we are also proposing to extend this requirement to 15 ppm sulfur highway diesel fuel beginning in 2006. We are not proposing to require downstream parties to conduct every batch testing. However, we believe most downstream parties would voluntarily conduct "periodic" sampling and testing for quality assurance purposes if they wanted to establish a defense to presumptive liability, as discussed in VIII.F. below.

Tests performed under the batch testing requirement for refiners and importers must be conducted with approved sulfur test methods following the protocol described in section IV.D.1.a., above. On the other hand, other tests that are performed (e.g., for downstream entities who are not required to conduct batch testing) would not be required to be conducted using an approved sulfur test method. However, the Agency seeks comment on whether testing for downstream parties should be conducted using an approved method if such parties wish to establish a defense to presumptive liability.

2. Two Part-Per-Million Downstream Sulfur Measurement Adjustment

We believe that it would be appropriate to recognize sulfur test variability in determining compliance with the proposed nonroad diesel fuel sulfur standard downstream of a refinery or import facility. Thus, we propose that for all 15 ppm sulfur nonroad diesel fuel at locations downstream of the refinery or import facility, sulfur test results could be adjusted by subtracting ppm. The sole purpose of this downstream compliance provision is to address test variability concerns even though we anticipate that the reproducibility of sulfur test methods is likely to improve to two ppm or even less by the time the 15 ppm sulfur standard for highway diesel fuel is implemented – four years before implementation date of the proposed 15 ppm standard for nonroad diesel fuel. With this provision, we anticipate that refiners would be able to produce diesel fuel with an average sulfur level of approximately 7-8 ppm,, without fear of causing a downstream violation due solely to test variability. As test methods improve in the future, we propose to reevaluate whether two ppm is the appropriate allowance for purposes of this compliance provision.

3. Sampling Requirements

Today's proposed rule would adopt the same sampling methods adopted by the highway diesel rule (66 FR 5002, January 18, 2001). The requirement to use these methods would be effective for nonroad diesel fuel June 1, 2007. These same methods were also adopted for use in the Tier 2/Gasoline Sulfur rule.[285] These sampling methods are American Society for Testing and Materials (ASTM) D 4057-95 (manual sampling) and D 4177-95 (automatic sampling from pipelines/in-line blending).

4. Alternative Sampling and Testing Requirements for Importers of Diesel Fuel Who Transport Diesel Fuel by Tanker Truck

We understand that importers who transport diesel fuel into the U.S. by tanker truck are frequently relatively small businesses that could be subject to a substantial burden if required to sample and test each batch of nonroad or highway diesel fuel imported by truck, especially where a trucker imports many small loads of diesel fuel. Therefore, we are proposing that truck importers may, in the alternative, demonstrate compliance with a sampling and testing program of the foreign truck loading terminal if certain conditions are met. For an importer to be eligible for the alternative sampling and testing requirement, the terminal would have to conduct sampling and testing of the nonroad or highway diesel fuel immediately after each receipt into its terminal storage tank or immediately before loading product into the importer's tanker truck storage compartments. Moreover, the importer would be required to conduct periodic quality assurance testing of the terminal's diesel fuel, and the importer would be required to assure that EPA would be allowed to make unannounced inspections and audits, and to sample and test fuel at the foreign terminal facility, and to assure that the terminal would maintain sampling and testing records, and to submit such records to EPA upon request. We request comment on this proposal.

E. Requirements for Recordkeeping, Reporting and Product Transfer Documents

1. Registration of Refiners and Importers

By December 31, 2004, refiners and importers that may produce or supply NRLM diesel fuel by June 1, 2007 would be required to register with EPA. There would be no need to register if a refiner (and all its refineries), or an importer, is already registered under the highway diesel program. The registration would include the following information:

- Corporate name and address of the refiner or importer and any parent companies and a contact person
- Name and address of all refineries or import facilities (including, for importers, the PADD(s))
- A contact person

[285] 65 FR 6833-34 (Feb. 10, 2000). These methods are also proposed for use under the RFG and CG rules. See 62 FR 37337 *et seq*. (July 11, 1997).

- Location of records
- Business activity (refiner or importer)
- Capacity of each refinery in barrels of crude oil per calendar day

2. Application for Small Refiner Status

We propose that an application of a refiner for small refiner status be submitted to EPA by June 1, 2005 and include the following information:

- The name and address of each location at which any employee of the company, including any parent companies or subsidiaries,[286] worked during the 12 months preceding January 1, 2003;

- The average number of employees at each location, based on the number of employees for each of the company's pay periods for the 12 months preceding January 1, 2003;

- The type of business activities carried out at each location; and

- The total crude oil refining capacity of the corporation. We define total capacity as the sum of all individual refinery capacities for multiple-refinery companies, including any and all subsidiaries, as reported to the Energy Information Administration (EIA) for 2002, or in the case of a foreign refiner, a comparable reputable source, such as professional publication or trade journal[287]. Refiners do not need to include crude oil capacity used in 2002 through a lease agreement with another refiner in which it has no ownership interest.

The crude oil capacity information reported to the EIA or comparable reputable source is presumed to be correct. However, in cases where a company disputes this information, we propose to allow 60 days after the company submits its application for small refiner status for that company to petition us with detailed data it believes shows that the EIA or other source's data was in error. We would consider this data in making a final determination about the refiner's crude oil capacity.

3. Applying for Refiner Hardship Relief

As discussed above in Section IV.C.2, a refiner seeking general hardship relief under

[286] "Subsidiary" here covers entities of which the parent company has 50 percent or greater ownership.

[287] We will evaluate each foreign refiner's documentation of crude oil capacity on an individual basis.

today's proposed program would apply to EPA and provide several types of financial and technical information, such as internal cash flow data and information on bank loans, bonds, and assets as well as detailed engineering and construction plans and permit status. Applications for hardship relief would be due June 1, 2005.

4. Applying for a Non-Highway Distillate Baseline Percentage

As discussed in Section IV above, we are proposing that refiners or importers wishing to distribute highway and NRLM fuel from any refinery (or import facility) together be required to apply to EPA for a baseline percentage of its non-highway distillate fuel for each such refinery or facility. Refiners or importers would provide EPA with data to quantify its annual average production or importation of distillate that was dyed for use in any non-highway application for each year during the period from January 1, 2003 through December 31, 2005. Specifically, this data would consist of the following for each batch of diesel fuel during this period:

- The date the refiner finished production of the batch
- The volume of the batch
- Whether the fuel in the batch was dyed

We propose that applications for non-highway baselines be received by EPA by February 28, 2006. We would act on these baselines by June 1, 2006, in time for the refiner or importer to earn early credits if they wished.

5. Pre-Compliance Reports

We believe that an early general understanding of the progress of the refining industry in complying with the requirements proposed today would be valuable to the affected industries as well as EPA. As with the highway diesel program, we propose that each refiner and importer provide annual reports on the progress of and plans for each of their refineries or import facilities. These pre-compliance reports would be required by June 1 of each year beginning in 2005 and continuing up through 2010, or until the entity produced or imported 15 ppm nonroad fuel, whichever is later.

As with any reports, EPA would maintain the confidentiality of information submitted in pre-compliance reports to the full extent authorized by law. We would report generalized summaries of this data following the receipt of the pre-compliance reports. We recognize that plans may change for many refiners or importers as the compliance dates approach. Thus, there would be no obligation to follow through on plans projected in the pre-compliance reports.

Pre-compliance reports could, at the discretion of the refiner/importer, be submitted in conjunction with the annual compliance reports proposed below and/or the pre-compliance and annual compliance reports required under the highway diesel program, so long as all information required in all reports is clearly provided.

In their pre-compliance reports, refiners and importers would need to include the following information:

- Any changes in their basic corporate or facility information since registration.
- Estimates of the volumes (in gallons) of each sulfur grade of highway and nonhighway fuel produced (or imported) at each refinery (or facility). These volume estimates would be provided both for fuel produced from crude oil and well as any fuel produced from other sources.
- For entities expecting to participate in the credit program, estimates of numbers of credits to be earned and/or used.
- Information regarding engineering plans (e.g., design and construction), the status of obtaining any necessary permits, and capital commitments for making the necessary modifications to produce low sulfur nonroad diesel fuel, and actual construction progress.
- The pre-compliance reports in 2006 and later years must provide an update of the progress in each of these areas.

6. Annual Compliance Reports and Batch Reports for Refiners and Importers

After the nonroad diesel sulfur requirements begin June 1, 2007, refiners and importers would be required to submit annual compliance reports for each refinery that demonstrated compliance with the proposed requirements. If a refiner produces 15 ppm or 500 ppm fuel early under the credit provisions, its annual compliance reporting requirement would begin on June 1 following the beginning of the early fuel production. These reporting requirements would sunset after all flexibility provisions end; i.e., 2012 for non-small refiners and 2014 for small refiners. Annual compliance reports would be due on August 31 [?? If the periods are June to June, wouldn't a report date of August 31 be more appropriate??] of each year.

A refiner's (for each refinery) or importer's annual compliance report would include the following information:

- Report demonstrating compliance with the sulfur content production requirements using the baseline production or importation requirements or demonstrating compliance using an alternative compliance option (*e.g.*, a small refiner option or the option to dye all nonroad, locomotive/marine diesel fuel at the refinery), as applicable.
- Report on the generation, use, transfer and retirement of credits. Credit transfer information would include the identification of the number of credits obtained from, or transferred to, each entity. Reports would also show the credit balance at the start of the period, and the balance at the end of the period. Nonroad credit information would be required to be stated separately from highway diesel credit information since the 2 credit programs would be segregated.
- Attest reports regarding compliance with sulfur content requirements using the

baseline approach or alternative compliance option and credit requirements.

- Batch reports for each batch produced providing information regarding volume, sulfur level, cetane/aromatics standard compliance and whether the fuel was dyed and/or marked. The certification that fuel was marked with the specified chemical marker at the refinery or import facility would apply to heating oil for the period June 1, 2007 through June 1, 2010 and to locomotive and marine fuel for the period June 1, 2010 thorough June 1, 2014.
- For a small refiner that elects to produce 15 ppm fuel by June 1, 2006 and in turn is eligible for a limited relaxation in its interim small refiner gasoline sulfur standards, the annual reports would also include specific information on gasoline sulfur levels and progress toward highway and nonroad diesel desulfurization.

7. Product Transfer Documents (PTDs)

Today we are proposing requirements that refiners and importers provide information on commercial PTDs that would identify diesel fuel distributed for use in nonroad equipment or nonroad equipment and motor vehicles, as appropriate, and state which sulfur standard the fuel is subject to. PTDs must state whether NRLM fuel complies with the 500 ppm sulfur standard or the 15 ppm sulfur standard. This would continue to be necessary even after 2010, since locomotive and marine engines could still use 500 ppm diesel fuel after all nonroad equipment would have to use 15 ppm fuel. Until no highway fuel sulfur content can exceed 15 ppm 2010, it would be necessary for PTDs to indicate if 500 ppm fuel is dyed or undyed, and in all cases, PTDs would need to indicate if 15 ppm fuel is dyed or undyed so that its appropriate use can be determined by transferees. Moreover, some nonroad fuel (segregated small refiner fuel) could exceed the 15 ppm standard until as late as August 31, 2014; however, it could only be used in model year 2010 and earlier nonroad engines.

We believe this additional information on commercial PTDs is necessary because of the importance of keeping the several sulfur grades and uses of diesel fuel separate from one another in the distribution system. Each party in the system would better be able to identify which type of fuel it is dealing with and could more effectively ensure that they were meeting the proposed requirements of the program. This in turn would help ensure that misfueling of sulfur sensitive engines does not occur and that the program would otherwise result in the needed emission reductions.

Except for transfers to truck carriers, retailers and wholesale purchaser-consumers, today's proposal would allow use of product codes to convey the information. We believe that more explicit language on PTDs to these parties is necessary since employees of such parties are less likely to be aware of the meaning of product codes. PTDs would not be required for transfers of product into nonroad equipment at retail outlets or wholesale purchaser-consumer facilities.

a. The Period from June 1, 2007 through May 31, 2010

During the first years of the program, unique PTDs would be required to distinguish the types of fuel that could be produced and sold and any restrictions on its use[288]:

- Undyed 500 ppm fuel
- Undyed 15 ppm fuel
- Dyed 500 ppm fuel (not for use in highway vehicles)
- Dyed 15 ppm fuel (not for use in highway vehicles)
- Dyed high-sulfur fuel (not for use in highway vehicles or certain nonroad engines)
- Marked heating oil (not for use in nonroad equipment or highway vehicles)

b. The Period from June 1, 2010 through May 31, 2014

Beginning June 1, 2010, unique PTDs would be required to distinguish the types of fuel that could be produced and sold during this period:

- Undyed 15 ppm
- Dyed 15 ppm fuel (not for use in highway vehicles)
- Undyed 500 ppm fuel (not for use in 2011 and later nonroad engines or highway vehicles)
- Dyed 500 ppm fuel (not for use in 2011 and later nonroad engines or highway vehicles)
- Marked 500 ppm locomotive and marine fuel (not for use in nonroad equipment or highway vehicles)
- Heating oil (not for use in nonroad equipment or highway vehicles)

c. The Period After May 31, 2014

Beginning June 1, 2014, unique PTDs would be required to distinguish remaining types of fuel that could be produced and sold during this period.

- Undyed 15 ppm fuel
- Dyed 15 ppm fuel (not for use in highway vehicles)
- 500 ppm locomotive and marine fuel (not for use in nonroad equipment or highway vehicles)
- Heating oil (not for use in highway vehicles or nonroad equipment)

d. Kerosene and Other Distillates to Reduce Viscosity

To assure that downstream parties can determine the sulfur level of kerosene or other

[288] Note that for each time period discussed in this subsection, few if any areas would be supplied with all the potential types of fuel listed.

distillates that may be distributed for use for blending into 15 ppm highway or NRLM diesel fuel to reduce viscosity in cold weather, today's proposal would require that PTDs identify distillates distributed for such use as meeting the 15 ppm standard.

e. Exported Fuel

Consistent with other fuels rules, nonroad diesel fuel to be exported from the U.S. would not be required to meet the sulfur content requirements of today's proposed regulations. For example, where a refiner designates a batch of diesel fuel for export, and can demonstrate through commercial documents that the fuel was exported, that volume would not be used in calculating compliance with applicable baselines. Product transfer documents accompanying the transfer of custody or title to such fuel at each point in the distribution system would be required to state that the fuel is for export only and may not be used in the United States.

f. Additives

Today's proposal would require that PTDs for additives for use in nonroad diesel fuel to state whether the additive complies with the 15 ppm sulfur standard. Like the highway diesel rule, today's proposal would allow the sale of additives, for use by fuel terminals or other parties in the diesel fuel distribution system, that have a sulfur content greater than 15 ppm under specified conditions. As a result, under today's proposal the PTD provisions for such additives would be as follows:

For additives that have a sulfur content not exceeding 15 ppm, the PTD would state: "The sulfur content of this additive does not exceed 15 ppm."

For additives that have a sulfur content exceeding 15 ppm, the additive manufacturer's PTD, and PTDs accompanying all subsequent transfers, would provide: a warning that the additive's sulfur content exceeds 15 ppm; the maximum sulfur content of the additive; the maximum recommended concentration for use of the additive in diesel fuel, stated as gallon of additive per gallon of diesel fuel; and the increase in sulfur concentration of the fuel the additive will cause when used at the maximum recommended concentration.

We are also proposing provisions for end user additives for use in diesel powered nonroad equipment. This is because of the concern that additives designed for engines not requiring 15 ppm sulfur content fuel, such as locomotives or marine engines, could accidentally be introduced into nonroad engines if they have no label stating appropriate use. Under today's proposal, end user additives for use in highway or NRLM diesel engines would be required to be accompanied by information that states that the additive either: complies with the sulfur content requirements for highway diesel vehicles and/or NRLM diesel engines; or that it has a sulfur content exceeding 15 ppm and is not for use in model year 2011 or later nonroad equipment. We believe this information is necessary for end users to determine if an additive is appropriate for nonroad equipment use.

8. Recordkeeping Requirements

Under the highway rule, refiners that produce (or importers that import) highway diesel fuel must maintain the following records for each batch of diesel fuel produced (or imported): The batch designations; the applicable sulfur content standard; whether the fuel is dyed or undyed; whether the fuel is marked or unmarked; the batch volumes; whether the fuel was dyed or undyed, and sampling and testing records. The refiner or importer would also be required to maintain records regarding credit generation, use, transfer, purchase, or termination, separately for highway and nonroad credit programs.

We propose that these requirements from the highway rule be applied to all nonroad, locomotive, and marine diesel fuel subject to this rule as well.

9. Record Retention

Today's proposal would adopt a retention period of 5 years for all records required to be kept by the rule. This is the same period of time required in other fuels rules, and it coincides with the applicable statute of limitations. We believe that for other reasons, most parties in the distribution system would maintain some or all of these records for this length of time even without the requirement.

This retention period would apply to PTDs, records of any test results performed by any regulated party for quality assurance purposes or otherwise (whether or not such testing was required by this rule), along with supporting documentation such as date of sampling and testing, batch number, tank number, and volume of product. Business records regarding actions taken in response to any violations discovered would also be required to be maintained for 5 years.

All records required to be maintained by refiners or importers participating in the generation or use of credits, hardship options (or by importers of diesel fuel produced by a foreign refiner approved for the temporary compliance option or a hardship option), including small refiner options, would also be covered by the retention requirement.

F. Liability and Penalty Provisions for Noncompliance

1. General

The liability and penalty provisions of the proposed nonroad diesel sulfur rule would be very similar to the liability and penalty provisions found in the highway diesel sulfur rule, the gasoline sulfur rule, the RFG rule and other EPA fuels regulations.[289] Regulated parties would be subject to prohibitions which are typical in EPA fuels regulations, such as selling or distributing fuel that does not comply with the applicable standard, and causing others to commit prohibited acts. Liability would also arise under the nonroad diesel rule for prohibited acts specific to the diesel sulfur control program, such as introducing diesel fuel not meeting the 15 ppm sulfur standard into model year 2011 or later nonroad equipment. In addition, parties would be liable for a failure to meet certain requirements, such as the recordkeeping, reporting, or PTD requirements, or causing others to fail to meet such requirements.

Under today's proposal, the party in the diesel fuel distribution system that controls the facility where a violation occurred, and other parties in that fuel distribution system (such as the refiner, reseller, and distributor), would be presumed to be liable for the violation.[290] As in the Tier 2 gasoline sulfur rule ("Tier 2 sulfur rule") and the highway diesel fuel rule, today's proposed rule would explicitly prohibit causing another person to commit a prohibited act or causing non-conforming diesel fuel to be in the distribution system. Non-conforming includes: (1) diesel fuel with sulfur content above 15 ppm incorrectly designated as appropriate for model year 2011 or later nonroad equipment or other engines requiring 15 ppm fuel; (2) diesel fuel with sulfur content above 500 ppm incorrectly designated as appropriate for nonroad equipment or locomotives or marine engines after the applicable date for the 500 ppm standard for these pieces of equipment; or (3) distillates not containing required markers or otherwise not complying with the requirements of today's proposal. Parties outside the diesel fuel distribution system, such as diesel additive manufacturers and distributors, would also be subject to liability for those diesel rule violations which could have been caused by their conduct.

Today's proposal also would provide affirmative defenses for each party presumed liable for a violation, and all presumptions of liability would be rebuttable. In general, in order to rebut the presumption of liability, parties would be required to establish that: (1) the party did not cause the violation; (2) PTD(s) exist which establish that the fuel or diesel additive was in compliance while under the party's control; and (3) the party conducted a quality assurance sampling and testing program. Diesel fuel refiners, diesel fuel additive manufacturers, and blenders of high sulfur additives into diesel fuel, would also be required to provide test results establishing the conformity of the product prior to leaving that party's control. Branded refiners would have additional affirmative defense elements to establish. The proposed defenses under the nonroad diesel sulfur rule are similar to those available to parties for violations of the highway diesel

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[289] See section 80.5 (penalties for fuels violations); section 80.23 (liability for lead violations); section 80.28 (liability for volatility violations); section 80.30 (liability for highway diesel violations); section 80.79 (liability for violation of RFG prohibited acts); section 80.80 (penalties for RFG/CG violations); section 80.395 (liability for gasoline sulfur violations); section 80.405 (penalties for gasoline sulfur regulations).

[290] An additional type of liability, vicarious liability, is also imposed on branded refiners under these fuels programs.

sulfur, RFG, volatility, and the Tier 2 sulfur regulations. Today's proposed rule would also clarify that parent corporations are liable for violations of subsidiaries, in a manner consistent with the Tier 2 sulfur rule and the highway diesel sulfur rule. Finally, the proposed nonroad diesel sulfur rule mirrors the Tier 2 sulfur rule and the highway diesel sulfur rule by clarifying that each partner to a joint venture would be jointly and severally liable for the violations at the joint venture facility or by the joint venture operation.

As is the case with the other EPA fuels regulations, today's proposed diesel sulfur rule would apply the provisions of section 211(d)(1) of the Clean Air Act (Act) for the collection of penalties. These penalty provisions currently subject any person that violates any requirement or prohibition of the diesel sulfur rule to a civil penalty of up to $31,500 for every day of each such violation and the amount of economic benefit or savings resulting from the violation. A violation of a diesel sulfur standard would constitute a separate day of violation for each day the diesel fuel giving rise to the violation remains in the fuel distribution system. Under the proposed regulation, the length of time the diesel fuel in question remains in the distribution system is deemed to be twenty-five days unless there is evidence that the fuel remained in its distribution system a lesser or greater amount of time – the same time presumption that is incorporated in the RFG, Tier 2 sulfur and highway diesel sulfur rules. The penalty provisions would also be similar to the penalty provisions for violations of these regulations.

EPA has included in today's proposal two prohibitions for "causing" violations: (1) causing another to commit a violation; and (2) causing non-complying diesel fuel to be in the distribution system. These causation prohibitions are like similar prohibitions included in the Tier 2 gasoline sulfur and the highway diesel sulfur regulations, and, as discussed in the preamble to those rules, EPA believes they are consistent with EPA's implementation of prior motor vehicle fuel regulations. See the liability discussion in the preamble to the Tier 2 final rule, at 65 FR 6812 *et seq*.

The prohibition against causing another to commit a violation would apply where one party's violation is caused by the actions of another party. For example, EPA may conduct an inspection of a terminal and discover that the terminal is offering for sale nonroad diesel fuel designated as complying with the 15 ppm sulfur standard, while it, in fact, had an actual sulfur content greater than the standard.[291] In this scenario, parties in the fuel distribution system, as well as parties in the distribution system of any diesel additive that had been blended into the fuel, would be presumed liable for causing the terminal to be in violation. Each party, of course, would have the right to present an affirmative defense to rebut this presumption.

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[291] At downstream locations the violation would occur if EPA's test result showed a sulfur content of greater than 17 ppm, which takes into account the two ppm adjustment factor for testing reproducibility for downstream parties.

The prohibition against causing non-complying diesel fuel to be in the distribution system would apply, for example, if a refiner transfers non-complying diesel fuel to a pipeline. This prohibition could encompass situations where evidence shows high sulfur diesel fuel was transferred from an upstream party in the distribution system, but EPA may not have test results to establish that parties downstream also committed violations with this fuel.

The Agency would expect to enforce the liability scheme of the nonroad diesel sulfur rule in the same manner that we have enforced the similar liability schemes in our prior fuels regulations. As in other fuels programs, we would attempt to identify the party most responsible for causing the violation in determining that party that should primarily be liable for penalties for the violation.

2. What are the Proposed Liability Provisions for Additive Manufacturers and Distributors, and Parties That Blend Additives into Diesel Fuel?

a. General

The final highway diesel rule permits the blending of diesel additives with sulfur content in excess of 15 ppm into 15 ppm highway diesel fuel under limited circumstances. As more fully discussed earlier in this preamble, today's proposed rule would permit downstream parties to blend into 15 ppm nonroad diesel fuel additives having a sulfur content exceeding 15 ppm, provided that: (1) the blending of the additive does not cause the diesel fuel's sulfur content to exceed the 15 ppm sulfur standard; (2) the additive is added in an amount no greater than one volume percent of the blended product; and (3) the downstream party obtained from its additive supplier a product transfer document ("PTD") with the additive's sulfur content and the recommended treatment rate, and that it complied with such treatment rate.

Since the proposed rule would permit the limited use in nonroad diesel fuel of additives with high sulfur content, the Agency believes it wold be more likely that a diesel fuel sulfur violation could be caused by the use of high sulfur additives. This could result from the additive manufacturer's misrepresentation or inaccurate statement of the additive's sulfur content or recommended treat rate on the additive's PTD, or an additive distributor's contamination of low sulfur additives with high sulfur additives during transportation. The increased probability that parties in the additive distribution system could cause a violation of the sulfur standard warrants the imposition by the Agency of increased liability for such parties. Therefore, the proposed rule, like the final highway diesel rule, would explicitly make parties in the additive distribution system liable for the sale of nonconforming diesel fuel additives, even if such additives have not yet been blended into diesel fuel. In addition, the proposed rule would impose presumptive liability on parties in the additive distribution system if diesel fuel into which the additive has been blended is determined to have a sulfur level in excess of its permitted concentration. This presumptive liability would differ depending on whether the blended additive was designated as meeting the 15 ppm sulfur standard (a "15 ppm additive") or designated as a greater than 15 ppm sulfur additive (a "high sulfur additive"), as discussed below.

b. Liability When the Additive Is Designated as Complying with the 15 ppm Sulfur Standard

With the sole exception of diesel additives blended into nonroad diesel fuel at a concentration no greater than one percent by volume of the blended fuel, any additive blended into diesel fuel downstream of the refinery would be required to have a sulfur content no greater than 15 ppm, and be accompanied by PTD(s) accurately identifying them as complying with the 15 ppm sulfur standard.

All parties in the fuel and additive distribution systems would be subject to presumptive liability if the blended fuel exceeds the sulfur standard (with the two ppm downstream adjustment applied when EPA tests the fuel subject to the 15 ppm sulfur standard). Low sulfur additives present a less significant threat to diesel fuel sulfur compliance than would occur with the use of additives designated as possibly exceeding 15 ppm sulfur. Thus, parties in the additive distribution system of the low sulfur additive could rebut the presumption of liability by showing the following: (1) additive distributors would only be required to produce PTDs stating that the additive complies with the 15 ppm sulfur standard; (2) additive manufacturers would also be required to produce PTDs complying in an accurate manner with the regulatory requirements, as well as producing test results (or retained samples on which tests could be run) establishing the additive's compliance with the 15 ppm sulfur standard prior to leaving the manufacturer's control. Once their presumptive liability would be refuted by producing such documentation in a convincing manner, these additive system parties would only be held responsible for the diesel fuel non-conformity in situations in which EPA can establish that the party actually caused the violation.

Under today's proposed rule, parties in the diesel fuel distribution system would have the typical presumptive liability defenses of other fuels rules. For parties blending an additive into their diesel fuel, the requirement of producing PTDs showing that the product complied with the regulatory standards would necessarily include PTDs for the additive that was used, affirming the compliance of the additive and the fuel.

c. Liability When the Additive Is Designated as Having a Possible Sulfur Content Greater than 15 ppm

Under today's proposed rule, if an additive manufacturer produces an additive for use in 15 ppm nonroad diesel fuel at a concentration no greater than one volume percent of the blended fuel, then the additive would be permitted to have a maximum sulfur content above 15 ppm. However, if nonroad diesel fuel containing that additive is found by EPA to have high sulfur content, then all the parties in both the additive and the fuel distribution chains would be presumed liable for causing the diesel fuel violation. Since this type of high sulfur additive presents a much greater probability of causing diesel fuel non-compliance, parties in the additive's distribution system would have to satisfy an additional element to establish an affirmative defense. In addition to the elements of an affirmative defense described above, parties in the distribution system for such a high sulfur additive would also be required to establish that they did not cause the violation, an element of an affirmative defense that is typically required in EPA fuel programs to rebut presumptive liability.

Parties in the diesel fuel distribution system would essentially have to establish the same affirmative elements as in other rules fuels rules, with one addition (which also exists in the highway diesel fuel rule). Blenders of high sulfur additives into 15 ppm sulfur diesel fuel, by the act of blending such an additive into that fuel, would have to establish a more rigorous quality control program than would exist without the addition of such a high sulfur additive. The Agency believes that parties blending high sulfur additives into their 15 ppm sulfur diesel fuel should be required to produce test results establishing that the blended fuel was in compliance with the 15 ppm sulfur standards after being blended with the high sulfur additive. This additional defense element would be required as an added safeguard to ensure diesel fuel compliance, since the blender has voluntarily chosen to use an additive which increases the risk of diesel fuel non-compliance.

G. How Would Compliance with the Sulfur Standards Be Determined?

EPA is today proposing that compliance with the diesel sulfur standards would be determined based on the sulfur level of the diesel fuel, as measured using a testing methodology approved under the provisions discussed in section VIII.D of this preamble. We further propose that any evidence from any source or location could be used to establish the diesel fuel sulfur level, provided that such evidence is relevant to whether the level would have been in compliance if the regulatory sampling and testing methodology had been correctly performed. This is consistent with the approach taken under the Tier 2 sulfur rule and the highway diesel sulfur rule.

The proposed regulations would provide that the primary determinant of compliance with the standards will be use of an approved test method. Additionally, other information could be used under the proposed rule, including test results using a non-approved method, if the evidence is relevant to determining whether the sulfur level would meet applicable standards had compliance been determined using an approved test methodology.

For example, the Agency might not have sulfur results derived from an approved test method for diesel fuel sold by a terminal, yet the terminal's own test results, based on testing using methods other than those approved under the regulations, could reliably show an exceedence of the sulfur standard. Under today's proposed rule, evidence from the non-approved test method could be used to establish the diesel fuel's sulfur level that would have resulted if an approved test method had been conducted. This type of evidence is available for use by either the EPA or the regulated party, and could be used to show either compliance or noncompliance.

Similarly, absent the existence of sulfur test results using an approved method, commercial documents asserting the sulfur level of diesel fuel or additive could be used as some evidence of that sulfur level if the product would have been tested using an approved method.

The Agency believes that the same statutory authority for EPA to adopt the Tier 2 sulfur rule's evidentiary provisions (Clean Air Act section 211(c)), provides appropriate authority for our adoption of the evidentiary provisions of today's diesel rule. For a fuller explanation of this statutory authority, see Section VI(I) of the Tier 2 final rule preamble, 65 FR 6815, February 10, 2000.

IX. Public Participation

We request comment on all aspects of this proposal. This section describes how you can participate in this process.

A. How and to Whom Do I Submit Comments?

We are opening a formal comment period by publishing this document. We will accept comments for the period indicated under "DATES" above. If you have an interest in the program described in this document, we encourage you to comment on any aspect of this rulemaking. We request comment on various topics throughout this proposal.

Your comments will be most useful if you include appropriate and detailed supporting rationale, data, and analysis. If you disagree with parts of the proposed program, we encourage you to suggest and analyze alternate approaches to meeting the air quality goals described in this proposal. You should send all comments, except those containing proprietary information, to our Air Docket (see "Addresses") before the end of the comment period.

You may submit comments electronically, by mail, by facsimile, 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 CBI or information that is otherwise protected by statute, please follow the instructions in Section IX.B. Do not use EPA Dockets or e-mail to submit CBI or information protected by statute."

1. Electronically

If you submit an electronic comment as prescribed below, EPA recommends that you include your name, mailing address, and an e-mail address or other contact information in the body of your comment. Also include this contact information on the outside of any disk or CD ROM you submit, and in any cover letter accompanying the disk or CD ROM. This ensures that you can be identified as the submitter of the comment and allows EPA to contact you in case EPA cannot read your comment due to technical difficulties or needs further information on the substance of your comment. EPA's policy is that EPA will not edit your comment, and any identifying or contact information provided in the body of a comment will be included as part of the comment that is placed in the official public docket, and made available in EPA's electronic public docket. 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.

i. EPA Dockets

Your use of EPA's electronic public docket to submit comments to EPA electronically is EPA's preferred method for receiving comments. Go directly to EPA Dockets at http://www.epa.gov/edocket, and follow the online instructions for submitting comments. To access EPA's electronic public docket from the EPA Internet Home Page, select "Information Sources," "Dockets," and "EPA Dockets." Once in the system, select "search," and then key in Docket ID No. A-2001-28. The system is an "anonymous access" system, which means EPA will not know your identity, e-mail address, or other contact information unless you provide it in the body of your comment.

ii. E-mail

Comments may be sent by electronic mail (e-mail) to **[insert the appropriate e-mail address]**, Attention Docket ID No. A-2001-28. In contrast to EPA's electronic public docket, EPA's e-mail system is not an "anonymous access" system. If you send an e-mail comment directly to the Docket without going through EPA's electronic public docket, EPA's e-mail system automatically captures your e-mail address. E-mail addresses that are automatically captured by EPA's e-mail system are included as part of the comment that is placed in the official public docket, and made available in EPA's electronic public docket.

iii. Disk or CD ROM

You may submit comments on a disk or CD ROM that you mail to the mailing address identified in Section IX.A.2.. These electronic submissions will be accepted in WordPerfect or ASCII file format. Avoid the use of special characters and any form of encryption.

2. By Mail

Send your comments to: Air Docket, Environmental Protection Agency, Mailcode: 6102T, 1200 Pennsylvania Ave., NW, Washington, DC, 20460, Attention Docket ID No. A-2001-28.

3. By Hand Delivery or Courier

Deliver your comments to: **[insert LOCATION or courier delivery address for the Docket]**, Attention Docket ID No. A-2001-28. Such deliveries are only accepted during the Docket's normal hours of operation as identified in Section XX.

4. By Facsimile

Fax your comments to: [Insert fax number], Attention Docket ID. No. A-2001-28.

B. How Should I Submit CBI To the Agency?

Do not submit information that you consider to be CBI electronically through EPA's electronic public docket or by e-mail. Send or deliver information identified as CBI only to the following address: **[insert the appropriate CBI address]**, Attention Docket ID No. A-2001-28. 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 and EPA's electronic 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 and EPA's electronic 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.

C. Will There Be a Public Hearing?

We will hold three public hearings; in Los Angeles, Chicago, and New York City. The hearings will be held on the following dates and start at the following times, and continue until everyone present has had an opportunity to speak.

Hearing Location	Date	Time
Los Angeles	[insert date]	[time] PST
Chicago	[insert date]	[time] CST
New York City	[insert date]	[time] EST

If you would like to present testimony at a public hearing, we ask that you notify the contact person listed above 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 each 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.

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D. Comment Period

The comment period for this rule will end 45 days after [insert date of Los Angeles hearing], the date of the Los Angeles hearing.

E. What Should I Consider as I Prepare My Comments for EPA?

You may find the following suggestions helpful for preparing your comments:

1. Explain your views as clearly as possible.
2. Describe any assumptions that you used.
3. Provide any technical information and/or data you used that support your views.
4. If you estimate potential burden or costs, explain how you arrived at your estimate.
5. Provide specific examples to illustrate your concerns.
6. Offer alternatives.
7. Make sure to submit your comments by the comment period deadline identified.
8. 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.

X. Statistical and Executive Order Reviews

A. Executive Order 12866: Regulatory Planning and Review

Under Executive Order 12866 (58 FR 51735, October 4, 1993), the Agency must determine whether the regulatory action is "significant" and therefore subject to review by the Office of Management and Budget (OMB) and the requirements of this Executive Order. The Executive Order defines a "significant regulatory action" as any regulatory action that is likely to result in a rule that may:

- Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, Local, or Tribal governments or communities;
- Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs, or the rights and obligations of recipients thereof; or
- Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

A draft Regulatory Impact Analysis has been prepared and is available in the docket for this rulemaking and at the internet address listed under "ADDRESSES" above. This action was submitted to the Office of Management and Budget for review under Executive Order 12866. Estimated annual costs of this rulemaking are estimated to be $**XXX** million per year, thus this proposed rule is considered economically significant. Written comments from OMB and responses from EPA to OMB comments are in the public docket for this rulemaking.

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 Agency proposes to collect information to ensure compliance with the provisions in this rule. This includes a variety of requirements, both for engine manufacturers and for fuel producers. Information-collection requirements related to engine manufacturers are in EPA ICR #1897.05; requirements related to fuel producers are in EPA ICR #1718.05. 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.

These collections of information have an estimated annual burden of **XXX** hours and

$**XXX**, based on a projection of **XXX** respondents per year. 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; 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 are listed in 40 CFR part 9 and 48 CFR chapter 15.

Comments are requested on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques. Send comments on the ICR to the Director, Collection Strategies Division; U.S. Environmental Protection Agency (2822); 1200 Pennsylvania Ave., NW; Washington, DC 20460; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, 725 17th St., NW, Washington, DC 20503, marked "Attention: Desk Officer for EPA." Include the ICR number in any correspondence. Since OMB is required to make a decision concerning the ICR between 30 and 60 days after [Insert date of publication in the FEDERAL REGISTER], a comment to OMB is best ensured of having its full effect if OMB receives it by [Insert date 30 days after publication in the FEDERAL REGISTER]. The final rule will respond to any OMB or public comments on the information collection requirements contained in this proposal.

C. Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), 5 USC 601 et. seq

1. Overview

The Regulatory Flexibility Act (RFA) generally requires an agency to prepare a regulatory flexibility analysis for any rule subject to notice and comment rulemaking requirements under the Administrative Procedures 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 the purposes of assessing the impacts of today's rule on small entities, a small entity is defined as: (1) a small business that meets the definitions based on the Small Business Administration's (SBA) size standards (see table below); (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:

Industry	Defined as small entity by SBA if:	Major SIC[a] Codes
Engine manufacturers	Less than 1,000 employees	Major Group 35
Equipment manufacturers:		
- construction equipment	Less than 750 employees	Major Group 35
- industrial truck manufacturers (i.e. forklifts)	Less than 750 employees	Major Group 35
- all other nonroad equipment manufacturers	Less than 500 employees	Major Group 35
Fuel refiners	Less than 1500 employees[b]	2911
Fuel distributors	<varies>	<varies>

[a] Standard Industrial Classification
[b] EPA has included in past fuels rulemakings a provision that, in order to qualify for the small refiner flexibilities, a refiner must also have a company-wide crude refining capacity of no greater than 155,000 barrels per calendar day. EPA has included this criterion in the small refiner definition for a nonroad diesel sulfur program as well.

2. Background

Controlling emissions from nonroad engines and equipment, in conjunction with diesel fuel quality controls, has very significant public health and welfare benefits, as explained in section II of this preamble. We are proposing new engine standards and related provisions under sections 213(a)(3) and (4) of the Clean Air Act which, among other things, direct us to establish (and from time to time revise) emission standards for new nonroad diesel engines. Similarly, section 211(c)(1) authorizes EPA to regulate fuels if any emission product of the fuel causes or contributes to air pollution that may endanger public health or welfare, or that may impair the performance of emission control technology on engines and vehicles.

In accordance with Section 603 of the RFA, EPA prepared an initial regulatory flexibility analysis (IRFA) that examines the impact of the proposed rule on small entities along with regulatory alternatives that could reduce that impact. The IRFA is available for review as part of the draft RIA for the rule. This is available in the public docket and is summarized below.

3. Summary of Regulated Small Entities

The following section discusses the small entities directly regulated by this proposed rule.

a. Nonroad Diesel Engine Manufacturers

Using information from the industry profile that was conducted for the nonroad diesel sector, EPA identified a total of 61 engine manufacturers. The top 10 engine manufacturers comprise 80 percent of the total market, while the other 51 companies make up the remaining 20 percent[292]. Of the 61 manufacturers, four fit the SBA definition of a small entity. These four manufacturers were Anadolu Motors, Farymann Diesel GMBH, Lister-Petter Group, and V & L Tools (parent company of Wisconsin Motors LLC, formerly 'Wis-Con Total Power'). These businesses comprise 8 percent of the total engine sales for the year 2000.

b. Nonroad Diesel Equipment Manufacturers

To determine the number of equipment manufacturers, EPA also used the industry profile that was conducted. From this, EPA identified over 700 manufacturers with sales and/or employment data that could be included in the screening analysis. These businesses included manufacturers in the construction, agricultural, and outdoor power equipment (mainly, lawn and garden equipment) sectors of the nonroad diesel market. The equipment produced by these manufacturers ranged from small walk-behind equipment (sub-25 hp engines) to large mining and construction equipment (using engines in excess of 750 hp). Of the manufacturers with available sales *and* employment data (approximately 500 manufacturers), small equipment manufacturers represent 68 percent of total equipment manufacturers (and these manufacturers account for 11 percent of nonroad diesel equipment industry sales). Thus, the majority of the small entities that could potentially experience a significant impact as a result of this rulemaking are in the nonroad equipment manufacturing sector.

c. Nonroad Diesel Fuel Refiners

Our current assessment is that 26 refiners (collectively owning 33 refineries) meet SBA's definition of a small business for the refining industry. The 33 refineries appear to meet both the employee number and production volume criteria mentioned above. These small refiners currently produce approximately 6 percent of the total high-sulfur diesel fuel. It should be noted that because of the dynamics in the refining industry (e.g., mergers and acquisitions), the actual number of refiners that ultimately qualify for small refiner status under a future nonroad diesel sulfur program could be different than this initial estimate.

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[292] All sales information used for this analysis was 2000 data.

d. Nonroad Diesel Fuel Distributors and Marketers

The industry that transports, distributes, and markets nonroad diesel fuel encompasses a wide range of businesses, including bulk terminals, bulk plants, fuel oil dealers, and diesel fuel trucking operations, and totals thousands of entities that have some role in this activity. More than 90 percent of these entities would meet small entity criteria. Common carrier pipeline companies are also a part of the distribution system; 10 of them are small businesses.

4. Potential Reporting, Record Keeping, and Compliance

As with any emission control program, the Agency must have the assurance that the regulated entities will meet the emissions standards and all related provisions. For engine and equipment manufacturers, EPA is proposing to continue the reporting, recordkeeping, and compliance requirements prescribed for these categories in 40 CFR 89. Key among these are certification requirements and provisions related to reporting of production, emissions information, use of transition provisions, etc.

For any fuel control program, EPA must have the assurance that fuel produced by refiners meets the applicable standard, and that the fuel continues to meet the standard as it passes downstream through the distribution system to the ultimate end user. This is particularly important in the case of diesel fuel, where the aftertreatment technologies expected to be used to meet the engine standards under consideration are highly sensitive to sulfur. The recordkeeping, reporting and compliance provisions of the proposed rule are fairly consistent with those in place today for other fuel programs, including the current 15 ppm highway diesel regulation. For example, recordkeeping involves the use of product transfer documents, which are already required under the 15 ppm highway diesel sulfur rule (40 CFR 80.560).

5. Relevant Federal Rules

The proposed certification fees rule, through the Agency's Certification and Compliance Division (CCD), may have some impact on the upcoming rule, and the Panel recommended that we take into consideration the effects that this rule may have on small businesses.

The fuel regulations that we expect to propose would be similar in many respects to the existing sulfur standard for highway diesel fuel. We are not aware of any area where the regulations under consideration would directly duplicate or overlap with the existing federal, state, or local regulations; however, several small refiners will also be subject to the gasoline sulfur and highway diesel sulfur control requirements, as well as air toxics requirements.

More stringent nonroad diesel sulfur standards may require some refiners to obtain permits from state and local air pollution control agencies under the Clean Air Act's New Source Review program prior to constructing the desulfurization equipment needed to meet the standards.

The Internal Revenue Service (IRS) has an existing rule that levies taxes on highway diesel fuel only. The rule requires that nonroad diesel (un-taxed) fuel be dyed so that regulators and customers will know which type of fuel is which. Because of the need to separate dyed from undyed diesel fuel, some marketers may choose to install extra tanks. Therefore, fuel marketers have claimed that, if two grades of nonroad fuel are allowed in the marketplace, they may decide to maintain two segregated tanks for both nonroad (dyed 500 ppm and dyed 15 ppm) and highway diesel fuels (undyed 500 ppm and undyed 15 ppm), during the transition periods for both of these fuels.

6. Summary of SBREFA Panel Process and Panel Outreach

a. Significant Panel Findings

The Small Business Advocacy Review Panel (SBAR Panel, or the Panel) considered many regulatory options and flexibilities that would help mitigate potential adverse effects on small businesses as a result of this rule. During the SBREFA Panel process, the Panel sought out and received comments on the regulatory options and flexibilities that were presented to SERs and Panel members. The major flexibilities and hardship relief provisions that are recommended by the Panel are described below, and are also located in Section 9 of the SBREFA Final Panel Report which is available in the public docket.

b. Panel Process

As required by section 609(b) of the RFA, as amended by SBREFA, we also conducted outreach to small entities and convened a SBAR Panel to obtain advice and recommendations of representatives of the small entities that potentially would be subject to the rule's requirements.

On October 24, 2002, EPA's Small Business Advocacy Chairperson convened a Panel under Section 609(b) of the RFA. In addition to the Chair, the Panel consisted of the Deputy Director of EPA's Office of Transportation and Air Quality, the Chief Counsel for Advocacy of the Small Business Administration, and the Administrator of the Office of Information and Regulatory Affairs within the Office of Management and Budget. As part of the SBAR Panel process, we conducted outreach with representatives from the various small entities that would be affected by the proposed rulemaking. We met with these Small Entity Representatives (SERs) to discuss the potential rulemaking approaches and ways to decrease the impact of the rulemaking on their industries. We distributed outreach materials- including background on the nonroad diesel sector, possible regulatory approaches, and possible rulemaking alternatives- to the SERs on October 30, 2002. On November 13, 2002 the Panel met with the SERs to discuss the outreach materials and receive initial feedback on the approaches and alternatives detailed in the outreach packet. The Panel received written comments from the SERs following the meeting in response to discussions had at the meeting and the questions posed to the SERs by the Agency. The SERs were specifically asked to provide comment on regulatory alternatives that could help to minimize the impact on small businesses as a result of the rulemaking.

In general, SERs representing the nonroad diesel equipment manufacturers raised concerns about the added cost of compliance and the increase in size of compliant engines (and how this would affect their products). SERs representing the nonroad diesel fuel industry raised comments that generally included anticipated difficulty in going to a lower grade of fuel and the need for increased tankage to carry interim grades of fuel. All SERs raised concerns that small entities do not have the capital and have fewer resources which make compliance difficult. Thus, they maintain that there is a need to provide alternatives and provisions to address these issues, as (per their view) more stringent emission standards could impose more significant adverse impacts on small entities than on large businesses. (For the most part, EPA has not found the facts to support these contentions in this proposal, and thus is not proposing separate provisions applicable only to small entities.)

The Panel's findings and discussions are based on the information that was available during the term of the Panel and issues that were raised by the SERs during the outreach meetings and in their comments. It was agreed that EPA should consider the issues raised by the SERs (and discussions had by the Panel itself) and that EPA should propose and/or request comment on various alternatives to mitigate these concerns. Though some of the flexibilities suggested may be appropriate to apply to all entities affected by the rulemaking, the Panel's discussions and recommendations are focused mainly on the impacts, and ways to mitigate adverse impacts, on small businesses. A summary of these recommendations is detailed below, and a full discussion of the regulatory alternatives and hardship provisions discussed and recommended by the Panel can be found in the SBREFA Final Panel Report. A complete discussion of the transition and hardship provisions that we are proposing in today's action can be found in Sections VII.C and III.A of this preamble. Also, the Panel Report includes all comments received from SERs (Appendix B of the Report), a summary of those comments (Section 8), and summaries of the two outreach meetings that were held with the SERs (Appendices C and D). In accordance with the RFA/SBREFA requirements, the Panel evaluated the aforementioned materials and SER comments on issues related to the Initial Regulatory Flexibility Analysis (IRFA). The following sections describe the Panel recommendations from the SBAR Panel Report.

c. Transition Flexibilities

The Panel recommended that EPA consider and seek comment on a wide range of regulatory alternatives to mitigate the impacts of the rulemaking on small businesses, including those flexibility options described below. As previously stated, the following discussion is a summary of the SBAR Panel recommendations; our proposals regarding these recommendations are located in earlier sections of this rule preamble.

i. Nonroad Diesel Engines

(a) Transition Flexibility Alternatives for Small Engine Manufacturers

The Panel recommended the following transition flexibilities to be considered, which were dependent upon what approach, or approaches, EPA proposes for the rulemaking.

- For an approach with two phases of standards:
  - an engine manufacturer could skip the first phase and comply on time with the second; or,
  - a manufacturer could delay compliance with each phase of standards.

- For an approach that entails only one phase of standards, the manufacturer could opt to delay compliance. The Panel recommended that the length of the delay be a three year period; the Panel also recommended that EPA take comment on whether this delay period should be two, three, or four years. Each delay would be pollutant specific (i.e., the delay would apply to each pollutant as it is phased in).

(b) Hardship Provisions for Small Engine Manufacturers

The Panel also recommended that two types of hardship provisions be extended to small engine manufacturers. These provisions are:

- For the case of a catastrophic event, or other extreme unforseen circumstances, beyond the control of the manufacturer that could not have been avoided with reasonable discretion (i.e. fire, tornado, supplier not fulfilling contract, etc.); and

- For the case where a manufacturer has taken all reasonable business, technical, and economic steps to comply but cannot do so.

Either relief provision would provide lead time for up to 2 years-- in addition to the transition flexibilities listed above-- and a manufacturer would have to demonstrate to the Agency's satisfaction that failure to sell the noncompliant engines would jeopardize the company's solvency. EPA could require that the manufacturer make up the lost environmental benefit through the use of programs such as supplemental environmental projects.

For the transition flexibilities listed above, the Panel recommended that engine manufacturers and importers must have certified engines in model year 2002 or earlier in order to take advantage of these provisions. Each manufacturer would be limited to 2500 units per year. This number allows for some market growth. The Panel recommended these provisions in order to prohibit the misuse of these transition provisions as a tool to enter the nonroad diesel market or to gain unfair market position relative to other manufacturers.

(c) Other Small Engine Manufacturer Issues

It was also recommended by the SBAR Panel that an averaging, banking, and trading (ABT) program be included as part of the overall rulemaking program, and, as discussed above, ABT has been included in the program.

ii. Nonroad Diesel Equipment

(a) Transition Flexibility Alternatives for Small Equipment Manufacturers

The Panel recommended that EPA propose to continue the transition flexibilities offered for the Tier 1 and Tier 2 nonroad diesel emission standards, as set out in 89 CFR section 102, with some potential modifications. The recommended transition flexibilities are:

- Percent-of-Production Allowance: Over a seven model year period, equipment manufacturers may install engines not certified to the new emission standards in an amount of equipment equivalent to 80 percent of one year's production. This is to be implemented by power category with the average determined over the period in which the flexibility is used.

- Small Volume Allowance: A manufacturer may exceed the 80 percent allowance in seven years as described above, provided that the previous Tier engine use does not exceed 700 total over seven years, and 200 in any given year. This is limited to one family per power category. Alternatively, at the manufacturer's choice by hp category, a program that eliminates the "single family provision" restriction with revised total and annual sales limits as shown below:

  - For categories ≤175 hp - 525 previous Tier engines (over 7 years) with an annual cap of 150 units (these engine numbers are separate for each hp category defined in the regulations)
  - For categories of > 175hp - 350 previous Tier engines (over 7 years) with an annual cap of 100 units (these engine numbers are separate for each hp category defined in the regulations)

  The Panel recommended that EPA seek comment on the total number of engines and annual cap values listed above. Specifically, SBA and OMB recommended that EPA seek comment on implementing the small volume allowance (700 engine provision) for small equipment manufacturers without a limit on the number of engine families which could be covered in any hp category.

- In addition, due to the changing nature of the technology as the manufacturers transition from Tier 2 to Tier 3 and Tier 4, the Panel recommended that the equipment manufacturers be permitted to borrow from the Tier3/Tier 4 transition flexibilities for use in the Tier 2/Tier 3 time frame.

To maximize the likelihood that the application of these transition provisions will result in the availability of previous Tier engines for use by the small equipment manufacturers, the Panel recommended that these three provisions be provided to all equipment manufacturers. As explained earlier in the preamble, this is essentially the approach that EPA is proposing.

(b) Hardship Provisions for Small Equipment Manufacturers

The Panel also recommended that two types of hardship provisions be extended to small equipment manufacturers. These are generally the same as provided above for small engine manufacturers:

- For the case of a catastrophic event, or other extreme unforseen circumstances, beyond the control of the manufacturer that could not have been avoided with reasonable discretion (i.e. fire, tornado, supplier not fulfilling contract, etc.); and

- For the case where a manufacturer has taken all reasonable business, technical, and economic steps to comply but cannot. In this case relief would have to be sought before there is imminent jeopardy that a manufacturer's equipment could not be sold and a manufacturer would have to demonstrate to the Agency's satisfaction that failure to get permission to sell equipment with a previous Tier engine would create a serious economic hardship. Hardship relief of this nature cannot be sought by a manufacturer which also manufactures the engines for its equipment.

Hardship relief would not be available until other allowances have been exhausted. Either relief provision would provide additional lead time for up to 2 model years based on the circumstances, but EPA could require recovery of the lost environmental benefit. To be eligible for the hardship provisions listed above (as well as the flexibilities detailed above), the Panel recommended that equipment manufacturers and importers must have reported equipment sales using certified engines in model year 2002 or earlier. This requirement is to prohibit the misuse of these flexibilities as a loophole to enter the nonroad diesel equipment market or to gain unfair market position relative to other manufacturers.

iii. Nonroad Diesel Fuel Refiners

(a) Regulatory Flexibility Alternatives for Diesel Fuel Refiners

The Panel considered a range of options and regulatory alternatives for providing small refiners with flexibility in complying with new sulfur standards for nonroad diesel fuel. Taking into consideration the comments received on these ideas, as well as additional business and technical information gathered about potentially affected small entities, the Panel recommended that whether EPA proposes a one-step or a two-step approach, EPA should provide for delayed compliance for small refiners as shown below.

Small Refiner Options Under 2-Step Nonroad Diesel Base Programs
Recommended Sulfur Standards (in parts per million (ppm))*

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015+
Under 2-Step Program										
Non-Small**	--	500	500	500	15	15	15	15	15	15
Small	**--**	**--**	**--**	**--**	**500**	**500**	**500**	**500**	**15**	**15**

* New standards are assumed to take effect June 1 of the applicable year.

** Assumes 500 ppm standard for marine + locomotive fuel for non-small refiners for 2007 and later and for small refiners for 2010 and later.

(b) Small Refiner Incentives for Early Compliance

In addition to these standards, the Panel recommended that EPA propose certain transition provisions to encourage early compliance with the diesel fuel sulfur standards. The Panel recommended that EPA propose that small refiners be eligible to select one of the two following options:

- Credits for Early Desulfurization: The Panel recommended that the Agency propose, as part of an overall trading program, a credit trading system that allows small refiners to generate and sell credits for nonroad diesel fuel that meets the small refiner standards earlier than that required in the above table. Such credits could be used to offset higher sulfur fuel produced by that refiner or by another refiner that purchases the credits.

- Limited Relief on Small Refiner Interim Gasoline Sulfur Standards: The Panel recommended that a small refiner producing its entire nonroad diesel fuel pool at 15 ppm sulfur by June 1, 2006, and that chooses not to generate nonroad credits for its early compliance, receive a 20 percent relaxation in its assigned small refiner interim gasoline sulfur standards. However, the Panel recommended that the maximum per-gallon sulfur cap for any small refiner remain at 450 ppm.

(c) Refiner Hardship Provisions

The Panel recommended that EPA propose refiner hardship provisions modeled after those established under the gasoline sulfur and highway diesel fuel sulfur program (see 40 CFR 80.270

and 80.560). Specifically, the Panel recommended that EPA propose a process that, like the hardship provisions of the gasoline and highway diesel rules, allows refiners to seek case-by-case approval of applications for temporary waivers to the nonroad diesel sulfur standards, based on a demonstration to the Agency of extreme hardship circumstances. This provision would allow domestic and foreign refiners, including small refiners, to request additional flexibility based on a showing of unusual circumstances that result in extreme hardship and significantly affect the ability of the refiner to comply by the applicable date, despite its best efforts.

iv. Nonroad Diesel Fuel Distributors and Marketers

The diesel fuel approach being considered by the Agency includes the possibility of there being two grades of nonroad diesel fuel (500/15 ppm) in the market place for at least a transition period. The distributors support a one-step approach because it has no significant impact on their operations. The distributors offered some suggestions on how they might deal with this issue, but indicated that there would be adverse impact in some circumstances. The Panel recommended that EPA study this issue further. The costs and related issues relevant to fuel distributors are further discussed in Chapter 7 of the proposed rule Regulatory Impact Analysis.

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), Public Law. 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 of 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. EPA believes that the proposal represents the least costly, most cost-effective approach to achieve the air quality goals of the rule. The costs and benefits associated with the proposal are discussed above and in the Draft Regulatory Impact Analysis, as required by the UMRA.

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."

Under Section 6 of Executive Order 13132, EPA may not issue a regulation that has federalism implications, that imposes substantial direct compliance costs, and that is not required by statute, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by State and local governments, or EPA consults with State and local officials early in the process of developing the proposed regulation. EPA also may not issue a regulation that has federalism implications and that preempts State law, unless the Agency consults with State and local officials early in the process of developing the proposed regulation.

Section 4 of the Executive Order contains additional requirements for rules that preempt State or local law, even if those rules do not have federalism implications (i.e., the rules 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). Those requirements include providing all affected State and local officials notice and an opportunity for appropriate participation in the development of the regulation. If the preemption is not based on express or implied statutory authority, EPA also must consult, to the extent practicable, with appropriate State and local officials regarding the conflict between State law and Federally protected interests within the agency's area of regulatory responsibility.

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 has also consulted representatives from STAPPA/ALAPCO, which represents state and local air pollution officials.

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 6, 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. This rule will be implemented at the Federal level and impose compliance costs only on engine manufacturers and ship builders. Tribal governments will be affected only to the extent they purchase and use equipment with regulated engines. 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, Section 5-501 of the Order directs the Agency to 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 the Executive Order because it does not involve decisions on environmental health or safety risks that may disproportionately affect children.

The effects of ozone and PM on children's health were addressed in detail in EPA's rulemaking to establish the NAAQS for these pollutants, and EPA is not revisiting those issues here. EPA believes, however, that the emission reductions from the strategies proposed in this rulemaking will further reduce air toxic emissions and the related adverse impacts on children's health.

H. Executive Order 13211: Actions that Significantly Affect Energy Supply, Distribution, or Use

This rule is not a "significant energy action" as defined in Executive Order 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use" (66 Fed. Reg. 28355 (May 22, 2001)) because it is not likely to have a significant adverse effect on the supply, distribution, or use of energy. If promulgated, this proposed rule would decrease fuel production by less than 4000 barrels per day and would increase fuel production costs, distribution costs, and prices by less than ten percent. The reader is referred to Section V above for the estimated cost, price and production impacts of today's proposed fuel program.

I. National Technology Transfer Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 ("NTTAA"), Public Law 104-113, section 12(d) (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless doing 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. NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

This proposed rule involves technical standards. The following paragraphs describe how we specify testing procedures for engines subject to this proposal.

The International Organization for Standardization (ISO) has a voluntary consensus standard that can be used to test nonroad diesel engines. However, the current version of that standard (ISO 8178) is applicable only for steady-state testing, not for transient testing. As described in the Draft Regulatory Impact Analysis, transient testing is an important part of the proposed emission-control program for these engines. We are therefore not proposing to adopt the ISO procedures in this rulemaking.

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.

J. Plain Language

This document follows the guidelines of the June 1, 1998 Executive Memorandum on Plain Language in Government Writing. To read the text of the regulations, it is also important to understand the organization of the Code of Federal Regulations (CFR). The CFR uses the following organizational names and conventions.

Title 40—Protection of the Environment
- Chapter I—Environmental Protection Agency
  - Subchapter C—Air Programs. This contains parts 50 to 99, where the Office of Air and Radiation has usually placed emission standards for motor vehicle and nonroad engines.
  - Subchapter U—Air Programs Supplement. This contains parts 1000 to 1299, where we intend to place regulations for air programs in future rulemakings.
    - Part 1039—Control of Emissions from New Nonroad Compression-ignition Engines. Most of the provisions in this part apply only to engine manufacturers.
    - Part 1065—General Test Procedures for Engine Testing. Provisions of this part apply to anyone who tests engines to show that they meet emission standards.
    - Part 1068—General Compliance Provisions for Engine Programs. Provisions of this part apply to everyone.

Each part in the CFR has several subparts, sections, and paragraphs. The following illustration shows how these fit together.

Part 1039
- Subpart A
  - Section 1039.1
    - (a)
    - (b)
      - (1)
      - (2)
        - (i)
        - (ii)

A cross reference to §1039.1(b) in this illustration would refer to the parent paragraph (b) and all its subordinate paragraphs. A reference to "§1039.1(b) introductory text" would refer only to the single, parent paragraph (b).

XI. Statutory Provisions and Legal Authority

Statutory authority for the engine controls proposed today can be found in sections 213 (which specifically authorizes controls on emissions from nonroad engines and vehicles), 203, 206, 207, 208 and 301 of the CAA, 42 U.S.C. 7547, 7522, 7525, 7541, 7542, and 7601.

Statutory authority for the proposed fuel controls is found in sections 211 (c) and 211 (i) of the CAA, which allow EPA to regulate fuels that either contribute to air pollution which endangers public health or welfare or which impair emission control equipment which is in general use or has been in general use. 42 U.S.C. 7545 (c) and (i). Additional support for the procedural and enforcement-related aspects of the fuel controls in the proposed rule, including the record keeping requirements, comes from sections 114 (a) and 301 (a) of the CAA. 42 U.S.C. sections 7414 (a) and 7601 (a).

List of Subjects

40 CFR Part 80

Fuel additives, Gasoline, Imports, Labeling, Motor vehicle pollution, Penalties, Reporting and recordkeeping requirements.

40 CFR Part 89

Environmental protection, Administrative practice and procedure, Confidential business information, Imports, Labeling, Motor vehicle pollution, Reporting and recordkeeping requirements, Research, Vessels, Warranties.

40 CFR Part 1039

Environmental protection, Administrative practice and procedure, Confidential business information, Imports, Labeling, Motor vehicle pollution, Reporting and recordkeeping requirements, Research, Vessels, Warranties.

40 CFR Part 1048

Environmental protection, Administrative practice and procedure, Air pollution control, Confidential business information, Imports, Incorporation by reference, Labeling, Penalties, Reporting and recordkeeping requirements, Research, Warranties.

40 CFR Part 1065

Environmental protection, Administrative practice and procedure, Incorporation by reference, Reporting and recordkeeping requirements, Research.

40 CFR Part 1068

Environmental protection, Administrative practice and procedure, Confidential business information, Imports, Motor vehicle pollution, Penalties, Reporting and recordkeeping requirements, Warranties.

Dated: ______________________

____
Christine Todd Whitman, Administrator