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

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

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

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

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

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

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

(b) Revisions to Part 1065

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

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

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

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

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

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

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

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

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

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

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

(i) Subpart A: General Provisions

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

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

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

(ii) Subpart B: Equipment Specifications

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

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

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

(iii) Subpart C: Measurement Instruments

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

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

(iv) Subpart D: Calibrations and Verifications

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

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

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

(vi) Subpart F: Test Protocols

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

(vii) Subpart G: Calculations and Required Information

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

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

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

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

(ix) Subpart I: Oxygenated Fuels

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

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

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

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

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

(2) Certification Fuel

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

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

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

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

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

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

(3) Supplemental Emission Standards

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

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

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

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

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

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

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

(4) Emission Control Diagnostics

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

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

(5) Monitoring and Reporting of Emissions Related Defects

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

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

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

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

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

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

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

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

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

(6) Rated Power

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

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

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

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

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

(7) In-Use Compliance for SCR Operation

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

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

- That it be illegal to operate without acceptable quality urea when the urea is needed to keep the SCR system functioning properly.
- That manufacturers must include clear and prominent instructions to the operator on the need for, and proper steps for, maintaining urea, including a statement that it is illegal to operate the engine without urea.
- That manufacturers must include visible and audible alarms at the operator's console to warn of low urea levels or inadequate urea quality.
- That engines and locomotives must be designed to track and log, in nonvolatile computer memory, all incidents of engine operation with inadequate urea injection or urea quality.
- That operators must report to EPA in writing any incidence of operation with inadequate urea injection or urea quality within 30 days of each incident.
- That, when requested, locomotive and vessel operators must provide EPA with access to, and assistance in obtaining information from, the electronic onboard incident logs.

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

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

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

(8) Fuel Labels and Misfueling

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

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

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

(9) Emission Data Engine Selection

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

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

(10) Deterioration Factor Plan Requirements

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

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

(11) Labeling Simplification

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

(12) Production Line Testing

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

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

(13) Evaporative Emission Requirements

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

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

(14) Small Business Provisions

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

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

on whether additional flexibilities are needed.

(a) Locomotive Sector

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

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

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

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

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

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

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

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

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

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

(iv) Hardship Provisions

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

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

(b) Marine Sector

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

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

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

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

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

(ii) Broader Engine Families and Testing Relief

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

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

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

(iii) Delayed Standards

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

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

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

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

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

(iv) Engine Dressing Exemption

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

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

(v) Vessel Builder Provisions

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

(vi) Hardship Provisions

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

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

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

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

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

(15) Alternate Tier 4 NO_X+HC Standards

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

(16) Other Issues

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

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

B. Compliance Issues Specific to Locomotives

(1) Refurbished Locomotives

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

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

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

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

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

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

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

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

(2) Averaging, Banking and Trading

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

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

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

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

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

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

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

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

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

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

(3) Switch Credit Calculation

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

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

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

(4) Phase-in and Reasonable Cost Limit

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

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

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

(5) Recertification Without Testing

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

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

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

(6) Railroad Testing

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

(7) Test Conditions and Corrections

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

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

(8) Duty Cycles

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

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

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

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

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

TABLE IV–1.—TYPICAL LOCOMOTIVE NOTCH POWER LEVELS

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

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

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

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

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

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

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

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

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

(10) Auxiliary Emission Control Devices Triggered by GPS Data

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

(11) Mexican and Canadian Locomotives

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

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

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

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

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

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

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

TABLE IV–2.—PROPOSED IN-USE ADD-ONS

[g/bhp-hr]

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

C. Compliance Issues Specific to Marine Engines

(1) Useful Life

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

(2) Replacement Engines

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

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

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

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

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

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

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

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

(3) Personal Use Exemption

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

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

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

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

(4) Gas Turbine Engines

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

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

(5) Residual Fuel Engines

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

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

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

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

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

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

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

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

when the sulfur levels of the test fuel are high.

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

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

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

V. Costs and Economic Impacts

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

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

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

A. Engineering Costs

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

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

(1) New Engine and Equipment Variable Engineering Costs

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

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

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

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

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

[$Millions]

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

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

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

[$/engine]

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

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

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

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

(2) New Engine and Equipment Fixed Engineering Costs

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

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

($Million)

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

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

(3) Engine Operating Costs

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

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

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

TABLE V–4.—ESTIMATED INCREASED OPERATING COSTS
($Millions)

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

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

(4) Engineering Costs Associated With the Remanufacturing Program

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

TABLE V–5.—ESTIMATED ENGINEERING COSTS ASSOCIATED WITH THE LOCOMOTIVE REMANUFACTURING PROGRAM
($Millions)

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

(5) Total Engineering Costs

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

TABLE V–6.—TOTAL ENGINEERING COSTS OF THE PROPOSAL
[$Millions]

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

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

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

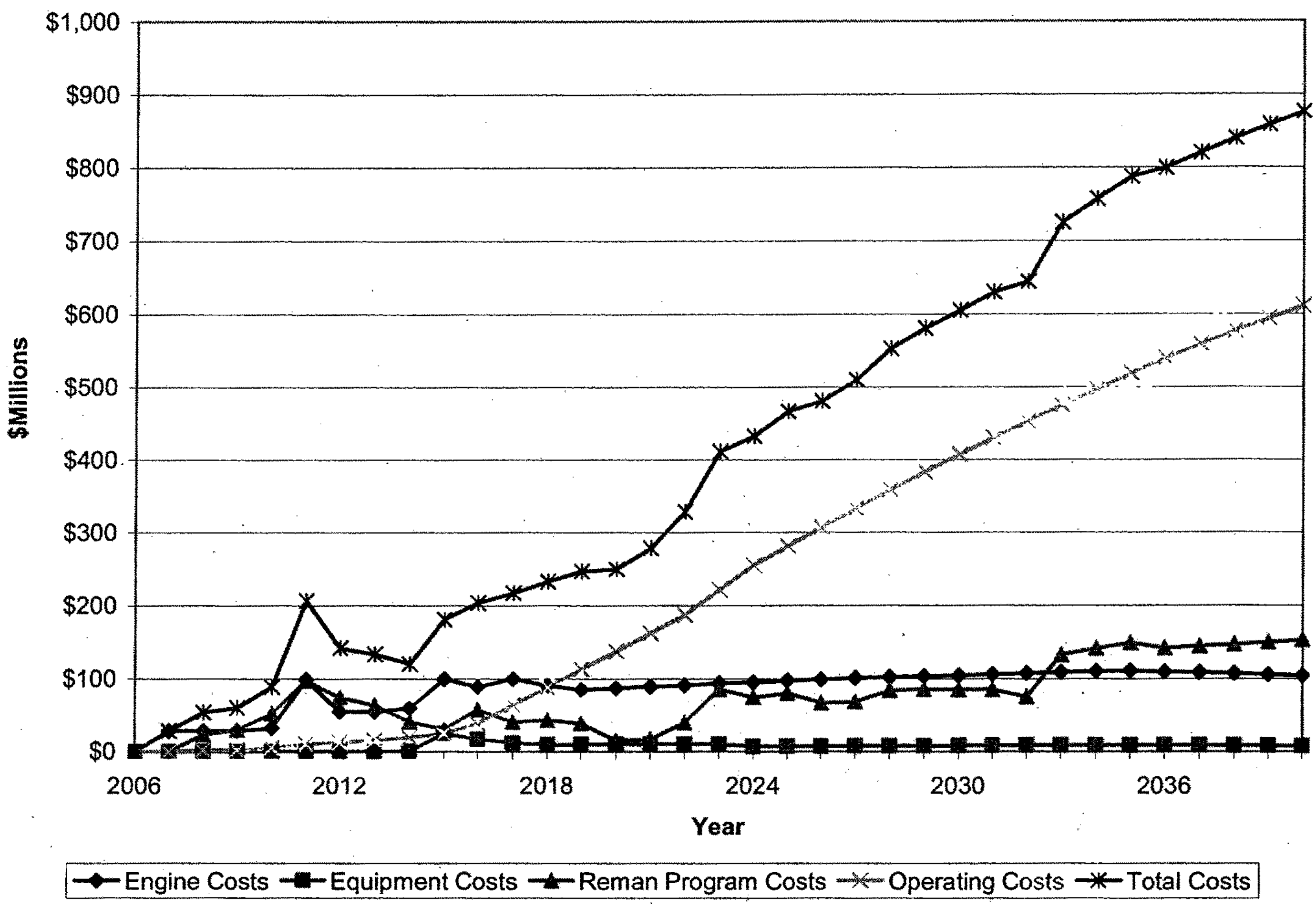
[$Millions]

Year	Engine related engineering costs	Equipment related engineering costs	Operating costs	Engineering costs of the remanufacturing program	Total engineering costs	Total PM costs	Total NO_X+NMHC costs
2015	100	25	25	31	181	93	88
2020	87	10	187	15	250	836	164
2030	105	8	407	85	605	159	446
2040	104	8	611	153	876	218	658
NPV at 3%	1,678	141	4,039	1,374	7,233	2,222	5,011
NPV at 7%	883	71	1,595	682	3,231	1,068	2,163

As shown, we have estimated the net present value of the annual engineering costs for the years 2006 through 2040 at $7.2 billion using a three percent discount rate and $3.2 billion using a seven percent discount rate. Roughly half of these costs are operating costs, with the bulk of those being urea related costs. As explained above in the operating cost discussion, because urea use is meant for controlling NO_X emissions, most of the operating costs and, therefore, the majority of the total engineering costs are associated with NO_X+NMHC control.

Figure V–1 graphically depicts the annual engineering costs associated with today's proposed program. The engine costs shown represent the engineering costs associated with engine research and tooling, etc., and the incremental costs for new hardware such as DPFs and urea SCR systems. The equipment costs shown represent the engineering costs associated with equipment redesign efforts and the incremental costs for new equipment-related hardware such as sheet metal and brackets. The remanufacturing program costs include incremental engineering costs for the locomotive remanufacturing program. The operating costs include incremental increases in operating costs associated with urea use, DPF maintenance, and a one percent fuel consumption increase for Tier 4 engines and remanufactured Tier 0 locomotives. The total program engineering costs are shown in Table V–6 as $7.2 billion at a three percent discount rate and $3.2 billion at a seven percent discount rate.

Figure V-1 Annual Engineering Costs of the Proposed New Engine Standards and Locomotive



Remanufacturing Program

B. Cost Effectiveness

One tool that can be used to assess the value of the proposed program is the engineering costs incurred per ton of emissions reduced. This analysis involves a comparison of our proposed program to other measures that have been or could be implemented. As summarized in this section and detailed in the draft RIA, the locomotive and marine diesel program being proposed today represents a highly cost effective mobile source control program for reducing PM and NO_X emissions.

We have calculated the cost per ton of our proposed program based on the net present value of all engineering costs incurred and all emission reductions generated from the current year 2006 through the year 2040. This approach captures all of the costs and emissions reductions from our proposed program including those costs incurred and emissions reductions generated by the locomotive remanufacturing program. The baseline case for this evaluation is the existing set of engine standards for locomotive and marine diesel engines and the existing locomotive remanufacturing requirements. The analysis timeframe is meant to capture both the early period of the program when very few new engines that meet the proposed standards would be in the fleet, and the later period when essentially all engines would meet the new standards.

Table V–7 shows the emissions reductions associated with today's proposal. These reductions are discussed in more detail in section II of this preamble and Chapter 3 of the draft RIA.

TABLE V–7.—ESTIMATED EMISSIONS REDUCTIONS ASSOCIATED WITH THE PROPOSED LOCOMOTIVE AND MARINE STANDARDS

[Short tons]

Year	$PM_{2.5}$	PM_{10} [a]	NO_X	NMHC
2015	7,000	7,000	84,000	14,000

TABLE V–7.—ESTIMATED EMISSIONS REDUCTIONS ASSOCIATED WITH THE PROPOSED LOCOMOTIVE AND MARINE STANDARDS—Continued

[Short tons]

Year	$PM_{2.5}$	PM_{10}[a]	NO_X	NMHC
2020	15,000	15,000	293,000	25,000
2030	28,000	29,000	765,000	39,000
2040	38,000	40,000	1,123,000	50,000
NPV at 3%	315,000	325,000	7,869,000	480,000
NPV at 7%	136,000	140,000	3,188,000	216,000

[a] Note that, $PM_{2.5}$ is estimated to be 97 percent of the more inclusive PM_{10} emission inventory. In Section II we generate and present $PM_{2.5}$ inventories since recent research has determined that these are of greater health concern. Traditionally, we have used PM_{10} in our cost effectiveness calculations. Since cost effectiveness is a means of comparing control measures to one another, we use PM_{10} in our cost effectiveness calculations for comparisons to past control measures.

Using the engineering costs shown in Table V–6 and the emission reductions shown in Table V–7, we can calculate the $/ton associated with today's proposal. These are shown in Table V–8. The resultant cost per ton numbers depend on how the engineering costs presented above are allocated to each pollutant. Therefore, as described in section V.A, we have allocated costs as closely as possible to the pollutants for which they are incurred. These allocations are also discussed in detail in Chapter 5 of the draft RIA.

TABLE V–8.—PROPOSED PROGRAM AGGREGATE COST PER TON AND LONG-TERM ANNUAL COST PER TON

Pollutant	2006 thru 2040 discounted lifetime cost per ton at 3%	2006 thru 2040 discounted lifetime cost per ton at 7%	Long-term cost per ton in 2030
NO_X+NMHC	$600	$630	$550
PM	6,840	7,640	5,560

The costs per ton shown in Table V–8 for 2006 through 2040 use the net present value of the annualized engineering costs and emissions reductions associated with the program for the years 2006 through 2040. We have also calculated the costs per ton of emissions reduced in the year 2030 using the annual engineering costs and emissions reductions in that year alone. These numbers are also shown in Table V–8 and represent the long-term annual costs per ton of emissions reduced.[140] All of the costs per ton include costs and emission reductions that will occur from the locomotive remanufacturing program.

In comparison with other emissions control programs, we believe that the proposed locomotive and marine program represents a cost effective strategy for generating substantial NO_X+NMHC and PM reductions. This can be seen by comparing the cost effectiveness of this proposed with the cost effectiveness of a number of standards that EPA has adopted in the past.Table V–9 and Table V–10 summarize the cost per ton of several past EPA actions to reduce emissions of NO_X+NMHC and PM from mobile sources.

[140] "Long-term" cost here refers to the ongoing cost of the program where only operating and variable costs remain (no more fixed costs). We have chosen 2030 to represent those costs here.

TABLE V–9.—PROPOSED LOCOMOTIVE AND MARINE STANDARDS COMPARED TO PREVIOUS MOBILE SOURCE

[Programs for NO_X+NMHC]

Program	$/ton NO_X+NMHC
Today's locomotive & marine proposal	600
Tier 4 Nonroad Diesel (69 FR 39131)	1,010
Tier 2 Nonroad Diesel (EPA420–R–98–016, Chapter 6)	630
Tier 3 Nonroad Diesel (EPA420–R–98–016, Chapter 6)	430
Tier 2 vehicle/gasoline sulfur (65 FR 6774)	1,400–2,350
2007 Highway HD (66 FR 5101)	2,240
2004 Highway HD (65 FR 59936)	220–430

Note: Costs adjusted to 2002 dollars using the Producer Price Index for Total Manufacturing Industries.

TABLE V–10.—PROPOSED LOCOMOTIVE AND MARINE STANDARDS COMPARED TO PREVIOUS MOBILE SOURCE

[Programs for PM]

Program	$/ton PM
Today's locomotive & marine proposal	6,840
Tier 4 Nonroad Diesel (69 FR 39131)	11,200
Tier 1/Tier 2 Nonroad Diesel (EPA420–R–98–016, Chapter 6)	2,390
2007 Highway HD (66 FR 5101)	14,180

Note: Costs adjusted to 2002 dollars using the Producer Price Index for Total Manufacturing Industries.

C. EIA

We prepared an Economic Impact Analysis (EIA) to estimate the economic impacts of the proposed emission control program on the locomotive and marine diesel engine and vessel markets. In this section we briefly describe the Economic Impact Model (EIM) we developed to estimate the market-level changes in price and outputs for affected markets, the social costs of the program, and the expected distribution of those costs across stakeholders. We also present the results of our analysis. We request comment on all aspects of the analysis, including the model and the model inputs.

We estimate the net social costs of the proposed program to be approximately $600 million in 2030.[141] [142] The rail sector is expected to bear about 64 percent of the social costs of the program in 2030, and the marine sector is expected to bear about 36 percent. In each of these two sectors, these social costs are expected to be born primarily by producers and users of locomotive and marine transportation services (63.3 and 33.2 percent, respectively). The remaining 3.5 percent is expected to be borne by locomotive, marine engine, and marine vessel manufacturers and fishing and recreational users.

With regard to market-level impacts in 2030, the average price of a locomotive is expected to increase about 2.6 percent ($49,100 per unit), but sales are not expected to decrease. In the marine markets, the expected impacts are different for engines above and below 800 hp (600 kW). With regard to engines above 800 hp and the vessels that use them, the average price of an engine is expected to increase by about 8.4 percent for C1 engines and 18.7 percent for C2 engines ($13,300 and $48,700, respectively). However, the expected impact of these increased prices on the average price of vessels that use these engines is smaller, at about 1.1 percent and 3.6 percent respectively ($16,200 and $141,600). The decrease in engine and vessel production is expected to be negligible, at less than 10 units. For engines less than 800 hp and the vessels that use them, the expected price increase and quantity decrease are expected to be negligible, less than 0.1 percent. Finally, even with the increases in the prices of locomotives and large marine diesel engines, the expected impacts on prices in the locomotive and marine transportation service markets are small, at 0.4 and 0.6 percent, respectively.

(1) What Is an Economic Impact Analysis?

An EIA is prepared to inform decision makers about the potential economic consequences of a regulatory action. The analysis consists of estimating the social costs of a regulatory program and the distribution of these costs across stakeholders. These estimated social costs can then be compared with estimated social benefits presented above. As defined in EPA's Guidelines for Preparing Economic Analyses, social costs are the value of the goods and services lost by society resulting from (a) the use of resources to comply with and implement a regulation and (b) reductions in output.[143] In this analysis, social costs are explored in two steps. In the market analysis, we estimate how prices and quantities of goods and services affected by the proposed emission control program can be expected to change once the program goes into effect. In the economic welfare analysis, we look at the total social costs associated with the program and their distribution across key stakeholders.

(2) What Is the Economic Impact Model?

The EIM is the behavioral model we developed to estimate price and quantity changes and total social costs associated with the emission controls under consideration. The EIM simulates how producers and consumers of affected products can be expected to respond to an increase in production costs as a result of the proposed emission control program. In this EIM, compliance costs are directly borne by producers of affected goods. Producers of affected products will try to pass some or all of the increased production costs on to the consumers of these goods through price increases. In response to the price increases, consumers will decrease their demand for the affected good. Producers will react to the decrease in quantity demanded by decreasing the quantity they produce; the market will react by setting a higher price for those fewer units. These interactions continue until a new market equilibrium price and quantity combination is achieved. The amount of the compliance costs that can be passed on to consumers is ultimately limited by the price sensitivity of purchasers and producers in the relevant market (represented by the price elasticity of demand and supply). The EIM explicitly models these behavioral responses and estimates new equilibrium prices and output and the resulting distribution of social costs across these stakeholders (producers and consumers).

(3) What Economic Sectors Are Included in This Economic Impact Analysis?

In this EIA we estimate the impacts of the proposed emission control program on two broad sectors: rail and marine. The markets analyzed are summarized in Table V–11.

TABLE V–11.—ECONOMIC SECTORS INCLUDED IN THE LOCO/MARINE ECONOMIC IMPACT MODEL

Sector	Market	Demand	Supply
Rail	Rail Transportation Services.	Entities that use rail transportation services as production input or for personal transportation.	Railroads.
	Locomotives	Railroads	Locomotive manufacturers (integrated manufacturers).
Marine	Marine Transportation Services.	Entities that use marine transportation services as production input.	Entities that provide marine transportation services. • Tug/tow/pushboat companies. • Cargo companies. • Ferry companies. • Supply/crew companies. • Other commercial users.

[141] All estimates presented in this section are in 2005$.

[142] The estimated 2030 social welfare cost of 267.3 million is based on an earlier version of the engineering costs of the rule which estimated $568.3 million engineering costs in 2030 (see table V–17). The current engineering cost estimate for 2030 is $605 million. See section V.C.5 for an explanation of the difference. The estimated social costs of the program will be updated for the final rule.

[143] EPA Guidelines for Preparing Economic Analyses, EPA 240–R–00–003, September 2000, p 113. A copy of this document can be found at *http://yosemite.epa.gov/ee/epa/eed.nsf/webpages/Guidelines.html*

TABLE V–11.—ECONOMIC SECTORS INCLUDED IN THE LOCO/MARINE ECONOMIC IMPACT MODEL—Continued

Sector	Market	Demand	Supply
	Marine Vessels	Entities that provide marine transportation services. • Tug/tow/pushboat companies. .... • Cargo companies. .... • Ferry companies. .... • Supply/crew companies. .... • Other commercial users. .... • Fishing persons. .... • Recreation users.	Vessel manufacturers.
	Marine Diesel Engines ..	Vessel manufacturers	Engine manufacturers.

(a) Rail Sector Component

The rail sector component of the EIM is a two-level model consisting of suppliers and users of locomotives and rail transportation services.

Locomotive Market. The locomotive market consists of locomotive manufacturers (line haul, switcher, and passenger) on the supply side and railroads on the demand side. The vast majority of locomotives built in any given year are for line haul applications; a small number of passenger locomotives are built every year, and even fewer switchers. The locomotive market is characterized by integrated manufacturers (the engine and locomotive are made by the same manufacturer) and therefore the engine and equipment impacts are modeled together. The EIM does not distinguish between power bands for locomotives. This is because while there is some variation in power for different engine models, the range is not large. On average line haul locomotives are typically about 4,000 hp, passenger locomotives are about 3,000 hp, and switchers are about 2,000 hp.

Recently, a new switcher market is emerging in which manufacturers are expected to be less integrated, and the manufacturer of the engine is expected to be separate from the manufacturer of the switcher.[144] Because the characteristics of this new market are speculative at this time, the switcher market component of the EIM is modeled in the same way as line haul locomotives (integrated manufacturers; same behavioral parameters), but uses separate baseline equilibrium prices and quantities. The compliance costs used for switchers reflect the expected design characteristics for these locomotives and their lower total power. We request comment on the switcher aspect of the model. Consistent with the engineering cost analysis, the passenger market is combined with the switcher market in this EIA because we do not have separate compliance costs estimates for each of those two market segments. We request comment on this, and on whether it would be more appropriate to model the passenger market like the line haul market.

Rail Transportation Services. The rail transportation services market consists of entities that provide and utilize rail transportation services. On this supply side, these are the railroads. On the demand side, these are rail transportation service users such as the chemical and agricultural industries and the personal transportation industry. The EIM does not estimate the economic impact of the proposed emission control program on ultimate finished goods markets that use rail transportation services as inputs. This is because transportation services are only a small portion of the total variable costs of goods and services manufactured using these bulk inputs. Also, changes in prices of transportation services due to the estimated compliance costs are not expected to be large enough to affect the prices and output of goods that use rail transportation services as an input.

(b) Marine Sector Component

The marine sector component of the EIM distinguishes between engine, vessel, and ultimate user markets (marine transportation service users, fishing users, recreational users). This is because, in contrast to the locomotive market, manufacturers in the diesel marine market are not integrated. Marine engines and vessels are manufactured by different entities.

Marine Engine Market. The marine engine markets consist of marine engine manufacturers on the supply side and vessel manufacturers on the demand side. The model distinguishes between three types of engines, commercial propulsion, recreational propulsion, and auxiliary. Engines are broken out into eight categories based on rated power and displacement: small engines below 50 hp (37 kW); five C1 engine categories (50–200 hp, 200–400 hp, 400–800 hp, 800–2,000 hp, >2,000 hp); and two C2 engine categories (800–2,000 hp, >2,000 hp). For the purpose of the EIA, the C1/C2 threshold is 5 l/cyl displacement, even though the new C1/C2 threshold is proposed to be 7 l/cyl displacement. The 5 l/cyl threshold was used because it is currently applicable limit. In addition, there is currently only one engine family in the 5 to 7 l/cyl range, and it is not possible to project what future sales will be in that range or if more engine families will be added.

Marine Vessel Market. The marine vessel market consists of marine vessel manufacturers on the demand side and marine vessel users on the supply side. The model distinguishes between seven vessel categories: Recreational, fishing, tow/tug/push, ferry, supply/crew, cargo, and other. Each of these vessels would have at least one propulsion engine and at least one auxiliary engine. For fishing and recreational vessels, the purchasers of those vessels are the end users and so the EIM is a two-level model for those two markets. For the fishing market, this approach is appropriate because demand for fishing vessels comes directly from the fishing industry; fishing vessels are a fixed capital input for that industry. For the recreational market, demand for vessels comes directly from households that use these vessels for recreational activities and acquire them for the personal enjoyment of the owner. For the other commercial vessel markets (tow/tug/push, ferry, supply/crew, cargo, other), demand is derived from the transportation services they provide, and so demand is from the transportation service market and the providers of those services more specifically. Therefore it is necessary to

[144] Until recently, switchers have typically been converted line haul locomotives and very few, if any, new dedicated switchers were built in any year. Recently, however, the power and other characteristics of line haul locomotives have made them less attractive for switcher usage. Their high power means they consume more fuel than smaller locomotives, and they have less attractive line-of-sight characteristics than what is needed for switchers. Therefore, the industry is anticipating a new market for dedicated switchers.

include the marine transportation services market in the model.

Marine Transportation Services. The marine transportation services market consists of entities that provide and utilize marine transportation services: vessel owners on the supply side and marine transportation service users on the demand side. The firms that use these marine transportation services are very similar to those that use locomotive transportation services: those needing to transport bulk chemicals and minerals, coal, agricultural products, etc. These transportation services are production inputs that depend on the amount of raw materials or finished products being transported and thus marine transportation costs are variable costs for the end user. Demand for these transportation services will determine the demand for vessels used to provide these services (tug/tow/pushboats, cargo, ferries, supply/crew, other commercial vessels).

(c) Market Linkages

The individual levels of the rail and marine components of the EIM are linked to provide feedback between consumers and producers in relevant markets. The locomotive and marine components of the EIM are not linked however, meaning there is no feedback mechanism between the locomotive and marine sectors. Although locomotives and marine vessels such as tugs, towboats, cargo, and ferries provide the same type of transportation service, the characteristics of these markets are quite different and are subject to different constraints that limit switching from one type of transportation service to the other. For the limited number of cases where there is direct competition between rail and marine transportation services, we do not expect this rule to change the dynamics of the choice between marine or rail providers of these services because (1) the estimated compliance costs imposed by this rule are relatively small in comparison with the total production costs of providing transportation services, and (2) both sectors would be subject to the new standards.

(4) What Are the Key Features of the Economic Impact Model?

A detailed description of the features of the EIM and the data used in this analysis is provided in Chapter 7 of the RIA prepared for this rule. The model methodology is firmly rooted in applied microeconomic theory and was developed following the methodology set out in OAQPS's Economic Analysis Resource Document.[145]

The EIM is a computer model comprised of a series of spreadsheet modules that simulate the supply and demand characteristics of each of the markets under consideration. The initial market equilibrium conditions are shocked by applying the compliance costs for the control program to the supply side of the markets (this is done by shifting the relevant supply curves by the amount of the compliance costs). The EIM uses the model equations, model inputs, and a solution algorithm to estimate equilibrium prices and quantities for the markets with the regulatory program. These new prices and quantities are used to estimate the social costs of the model and how those costs are shared among affected markets.

The EIM uses a multi-market partial equilibrium approach to track changes in price and quantity for the modeled markets. As explained in EPA's Guidelines for Preparing Economic Analyses, ''partial equilibrium'' means that the model considers markets in isolation and that conditions in other markets are assumed to be either unaffected by a policy or unimportant for social cost estimation. Multi-market models go beyond partial equilibrium analysis by extending the inquiry to more than just a single market and attempt to capture at least some of the interaction between markets.[146] In the marine sector, the model captures the interactions between the engine markets, the vessel markets, and the marine transportation service markets; in the rail sector, it captures the interactions between the locomotive markets and the rail transportation service markets.

The EIM uses an intermediate run time frame. This means that some factors of production are fixed and some are variable. In very short analyses, all factors of production would be assumed to be fixed, leaving the producers with no means to respond to the increased production costs associated with the regulation (e.g., they cannot adjust labor or capital inputs). Under this time horizon, the costs of the regulation fall entirely on the producer. In the long run, all factors of production are variable and producers can adjust production in response to cost changes imposed by the regulation (e.g., using a different labor/capital mix) and changes in consumer demand due to price changes. In the intermediate run there is some resource immobility which may cause producers to suffer producer surplus losses, but they can also pass some of the compliance costs to consumers.

The EIM assumes a perfectly competitive market structure. The perfect competition assumption is widely accepted for this type of analysis, and only in rare cases are other approaches used.[147] It should be noted that the perfect competition assumption is not about the number of firms in a market; it is about how the market operates. The markets included in this analysis do not exhibit evidence of noncompetitive behavior: These are mature markets; there are no indications of barriers to entry for the marine transportation, fishing, and recreational markets; the firms in the affected markets are not price setters; and there is no evidence of high levels of strategic behavior in the price and quantity decisions of the firms. The perfect competition assumption is discussed in more detail in Chapter 7 of the RIA.

The perfect competition assumption has an impact on the way the EIM is structured. In a competitive market the supply curve is based on the industry marginal cost curve; fixed costs do not influence production decisions at the margin. Therefore, in the market analysis, the model is shocked by variable costs only. However, an argument can be made that fixed costs must be recovered; otherwise manufacturers would go out of business. This analysis assumes that manufacturers cover their fixed costs through their current product development budgets. If this is the case, then the rule would have the effect of shifting product development resources to regulatory compliance from other market-based investment decisions. Thus, fixed costs are a cost to society because they displace other product development activities that may improve the quality or performance of engines and equipment. Therefore these costs are included in the social welfare costs, as a social cost that accrues to producers. We request comment on the extent to which manufacturers can be expected to use current product development resources to cover the fixed costs associated with the standards (thus foregoing product development projects in the short term),

[145] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Innovative Strategies and Economics Group, OAQPS Economic Analysis Resource Document, April 1999. A copy of this document can be found at *http://www.epa.gov/ttn/ecas/econdata/Rmanual2/*.

[146] EPA Guidelines for Preparing Economic Analyses, EPA 240–R–00–003, September 2000, pp. 125–6.

[147] See, for example, EPA Guidelines for Preparing Economic Analyses, EPA 240–R–00–003, September 2000, p 126.

and whether current product development budgets would cover the compliance costs in the year in which they occur. We also request comment on whether companies would instead attempt to pass on these fixed costs as an additional price increase and, if the latter, how much of the fixed costs would be passed on, and for how long.

The EIM is a market-level analysis that estimates the aggregate economic impacts of the control program on the relevant markets. It is not a firm-level analysis and therefore the supply elasticity or individual compliance costs facing any particular manufacturer may be different from the market average. This difference can be important, particularly where the rule affects different firms' costs over different volumes of production. However, to the extent there are differential effects, EPA believes that the wide array of flexibilities provided in this rule are adequate to address any cost inequities that may arise.

Finally, consistent with the proposed emission controls, this EIA covers locomotives and marine diesel engines and vessels sold in 50 states.

(5) What Are the Key Model Inputs?

Key model inputs for the EIM are the behavioral parameters, the market equilibrium quantities and prices, and the compliance costs estimates.

The model's behavioral paramaters are the price elasticities of supply and demand. These parameters reflect how producers and consumers of the engines and equipment affected by the standards can be expected to change their behavior in response to the costs incurred in complying with the standards. More specifically, the price elasticity of supply and demand (reflected in the slope of the supply and demand curves) measure the price sensitivity of consumers and producers. The price elasticities used in this analysis are summarized in V–12 and are described in more detail in Chapter 7 of the RIA. An ''inelastic'' price elasticity (less than one) means that supply or demand is not very responsive to price changes (a one percent change in price leads to less than one percent change in demand). An ''elastic'' price elasticity (more than one) means that supply or demand is sensitive to price changes (a one percent change in price leads to more than one percent change in demand). A price elasticity of one is unit elastic, meaning there is a one-to-one correspondence between a change in price and change in demand.

TABLE V–12.—BEHAVIORAL PARAMETERS USED IN LOCO/MARINE ECONOMIC IMPACT MODEL

Sector	Market	Demand elasticity	Source	Supply elasticity	Source
Rail	Rail Transportation Services.	−0.5 (inelastic)	Literature Estimate	0.6 (inelastic)	Literature Estimate.
	Locomotives (all types).	Derived	N/A	2.7 (elastic)	Calibration Method Estimate.
Marine	Marine Transportation Services.	−0.5 (inelastic)	Literature Estimate	0.6 (inelastic)	Literature Estimate.
	Vessels Commercial[a]	Derived	N/A	2.3 (elastic)	Econometric Estimate.
	Fishing	−1.4 (elastic)	Econometric Estimate	1.6 (elastic)	Econometric Estimate.
	Recreational	−1.4 (elastic)	Econometric Estimate	1.6 (elastic)	
	Engines	Derived	N/A	3.8 (elastic)	Econometric Estimate.

[a] Commercial vessels include tug/tow/pushboats, ferries, cargo vessels, crew/supply boats, and other commercial vessels.

Initial market equilibrium quantities for these markets are simulated using the same current year sales quantities used in the engineering cost analysis. The initial market equilibrium prices were derived from industry sources and published data and are described in Chapter 7 of the RIA.

The compliance costs used to shock the model, to simulate the application of the control program, are the same as the engineering costs described in Section V.A. However, the EIM uses an earlier version of the engineering costs developed for this rule. The engineering costs for 2030 presented in Section V.A. are estimated to be $605 million, which is $37 million more than the compliance costs used in this EIA. Over the period from 2007 through 2040, the net present value of the engineering costs in Section V.A. is $7.2 billion while the NPV of the estimated social costs over that period based on the compliance costs used in his chapter is $6.9 billion (3 percent discount rate). The differences are primarily in the form of operating costs ($22 million for the rail sector, $10 million for the marine sector). The variable costs for locomotives are slightly smaller ($4.0 million) and for marine are somewhat higher ($5.0 million). The difference for marine engines occurs in part because the engineering costs in Section V.A. include Tier 4 costs for recreational marine engines over 2,000 kW. There are also small differences for the estimated operating costs. As a result of these differences, the amount of the social costs imposed on producers and consumers of rail and marine transportation services as a result of the proposed program would be larger than estimated in this section, while the impacts on the prices and quantities of locomotives would be slightly less. In addition, there would be larger social costs for the recreational marine sector. Nevertheless, the estimated market impacts and the distribution of the social costs among stakeholders would be about the same as those presented below.

There are four types of compliance costs associated with the program: fixed costs, variable costs, operating costs, and remanufacturing costs. The timing of these costs are different and, in some cases, overlap.

Fixed costs are not included in the market analysis (they are not used to shock the model). However, the fixed costs associated with the standards are a cost to society (in the form of foregone product development) and therefore must be reflected in the total social costs as a cost to producers. In this EIA, fixed costs are accounted for in the year in which they occur and are attributed to the respective locomotive, marine engine, and vessel manufacturers. These manufacturers are expected to see losses of producer surplus as early as 2007.

Variable costs are the driver of the market impacts. There are no variable costs associated with the Tier 3 new engine standards because the Tier 3 standards are engine-out emission limits and engine manufacturers are expected to comply by maximizing the emission reduction potential of controls they are already using rather than adding new components. The variable costs associated with Tier 4 begin to apply in 2015, for locomotive PM standards; 2016, for marine PM and NO_X standards; and 2017, for locomotive NO_X standards.

Operating costs are the additional costs for associated with urea use and DPF maintenance as well as additional fuel consumption for both Tier 4 engines and remanufactured locomotive Tier 0 engines. These begin to occur when the standards go into effect. In the EIM, operating costs are attributed to railroads and vessel owners. On the marine side, all marine operating costs are applied to the marine transportation services market even though there will be Tier 4 engine in the recreational and fishing markets. This approach was taken because the operating costs (fuel and urea consumption) were estimated based on fuel consumption and we believe that most of the fuel consumed in the marine sector is by vessels in the marine transportation services sector. As a result of this assumption, the impacts on the marine transportation service market may be somewhat over-estimated. We request comment on this simplifying assumption.

Remanufacturing costs are incurred when locomotives are remanufactured (there is no corresponding remanufacture requirement for marine diesel, although we are requesting comment on such a program). These costs represent the difference between the cost of current remanufacture kits and those that will be required pursuant to the standards. In the EIM, these costs are allocated to the railroads; the remanufacture market is not modeled separately. This is appropriate because railroads are required to purchase these kits when they rebuild their locomotives. Their sensitivity to price changes is likely to be very inelastic because they cannot operate the relevant locomotives without using a certified remanufacture kit. This means the kit manufacturers would be able to pass most if not all of the costs of these kits to the railroads. We request comment on this approach for including remanufacture costs in the model.

(6) What Are the Results of the Economic Impact Modeling?

Using the model and data described above, we estimated the economic pacts of the proposed emission control program. The results of our analysis are summarized in this section. Detailed results for all years are included in the appendices to Chapter 7 of the RIA. Also included in Appendix 7H to that chapter are sensitivity analyses for several key inputs.

The EIA consists of two parts: a market analysis and welfare analysis. The market analysis looks at expected changes in prices and quantities for affected products. The welfare analysis looks at economic impacts in terms of annual and present value changes in social costs.

We performed a market analysis for all years and all engines and equipment types. Detailed results can be found in the appendices to Chapter 7 of the RIA. In this section we present summarized results for selected years.

Due to the structure of the program (see section V.C.5 above), the estimated market and social costs impacts of the program in the early years are small and are primarily due to the locomotive remanufacturing program. By 2016, the impacts of the program are more significant due to the operational costs associated with the Tier 4 standards (urea usage). Consequently, a large share of the social costs of the program after the Tier 4 standards to into effect fall on the marine and rail transportation service sectors. These operational costs are incurred by the providers of these services, but they are expected to pass along some of these costs to their customers.

(a) Market Analysis Results

In the market analysis, we estimate how prices and quantities of goods affected by the proposed emission control program can be expected to change once the program goes into effect. The analysis relies on the baseline equilibrium prices and quantities for each type of equipment and the price elasticity of supply and demand. It predicts market reactions to the increase in production costs due to the new compliance costs (variable, operating, and remanufacturing costs). It should be noted that this analysis does not allow any other factors to vary. In other words, it does not consider that manufacturers may adjust their production processes or marketing strategies in response to the control program.

A summary of the market analysis results is presented in Table V–13 for 2011, 2016, and 2030. These years were chosen because 2011 is the first year of the Tier 3 standards, 2016 is when the Tier 4 standards begin for most engines, and 2030 illustrates the long-term impacts of the program. Results for all years can be found in Chapter 7 of the RIA.

The estimated market impacts are designed to provide a broad overview of the expected market impacts that is useful when considering the impacts of the rule. Absolute price changes and relative price/quantity changes reflect production-weighted averages of the individual market-level estimates generated by the model for each group of engine/equipment markets. For example, the estimated marine diesel engine price changes are production-weighted averages of the estimated results for all of the marine diesel engine markets included in the group.[148] The absolute change in quantity is the sum of the decrease in units produced across sub-markets within each engine/equipment group. For example, the estimated marine diesel engine quantity changes reflect the total decline in marine diesel engines produced. The aggregated data presented in Table V–13 is intended to provide a broad overview of the expected market impacts that is useful when considering the impacts of the rule on the economy as a whole and not the impacts on a particular engine or equipment category.

Locomotive Sector Impacts. On the locomotive side, the proposed program is expected to have a negligible impact on locomotive prices and quantities. In 2011, the expected impacts are mainly the result of the operating costs associated with locomotive remanufacturing standards. These standards impose an operating cost on railroad transportation providers and are expected to result in a slight increase in the price of locomotive transportation services (about 0.1 percent, on average) and a slight decrease in the quantity of services provided (about 0.1 percent, on average). The locomotive remanufacturing program is also expected to have a small impact on the new locomotive market. The remanufacturing program will increase railroad operating costs, which expected to result in an increase in the price of transportation services. This increase will results in a decrease in demand for rail transportation services and

[148] As a result, estimates for specific types of engines and equipment may be different than the reported group average. The detail results for markets are reported in the Appendices to Chapter 7 of the RIA.

ultimately in a decrease in the demand for locomotives and a decrease in their price. In other words, the market will contract slightly. We estimate a reduction in the price of locomotives of about $425, or about 0.02 percent on average.

Beginning in 2016, the market impacts are affected by both the operating costs and the direct costs associated with the Tier 4 standards. As a result of both of these impacts, the price of a new locomotive is expected to increase by about 1.9 percent ($35,900), on average and the quantity produced is expected to decrease by about 0.1 percent, on average (less than one locomotive). Locomotive transportation service prices are expected to decrease by about 0.1 percent). By 2030, the price of new locomotives is expected to increase by about 2.6 percent ($49,000), on average, and the quantity expected to decrease by about 0.2 percent (less than one locomotive). The price of rail transportation services is expected to increase by about 0.4 percent.

Marine Sector Impacts. On the marine engine side, the expected impacts are different for engines above and below 800 hp (600 kW). With regard to engines above 800 hp and the vessels that use them, the proposed program does not begin to affect market prices or quantities until the Tier 4 standards go into effect, which is in 2016 for most engines. For these engines, the price of a new engine in 2016 is expected to increase between 11.0 and 24.6 percent, on average ($17,300 for C1 engines above 800 hp and $64,100 for C2 engines above 800 hp), depending on the type of engine, and sales are expected to decrease less than 2.0 percent, on average. The price of vessels that use them is expected to increase between 1.7 and 1.0 percent ($20,900 for vessels that use C1 engines above 800 hp and $188,600 for vessels that use C2 engines above 800 hp) and sales are expected to decrease less than 2.0 percent. The percent change in price in the marine transportation sector is expected to be about 0.1 percent. By 2030, the price of these engines is expected to increase between 8.4 and 18.7 percent, on average ($13,200 for C1 engines above 800 hp and $48,700 for C2 engine above 800 hp), depending on the type of engine, and sales are expected to decrease by less than 2 percent, on average. The price of vessels is expected to increase between 1 and 3.6 percent ($16,200 for vessels that use C1 engines above 800 hp and $141,600 for vessels that use C2 engines above 800 hp) and sales are expected to decrease by less than 2 percent. The percent change in price in the marine transportation is expected to be about 0.6 percent.

With regard to engines below 800 hp, the market impacts of the program are expected to be negligible.[149] This is because there are no variable costs associated with the standards for these engines. The market impacts associated with the program are indirect effects that stem from the impacts on the marine service markets for the larger engines that would be subject to direct compliance costs. Changes in the equilibrium outcomes in those marine service markets may lead to reductions for marine services in other marine engine and vessel markets, including the markets for smaller marine diesel engines and vessels. The result is that in some years there may be small declines in the equilibrium price in the markets for marine diesel engines less than 800 hp. This would occur because an increase in the price and a decrease in the quantity of marine transportation services provided by vessels with engines above 800 hp that results in a change in the price of marine transportation services may have follow-on effects in other marine markets and lead to decreases in prices for those markets. For example, the large vessels used to provide transportation services are affected by the rule. Their compliance costs lead to a higher vessel price and a reduced demand for those vessels. This reduced demand indirectly affects other marine transportation services that support the larger vessels, and leads to a decrease in price for those markets as well.

TABLE V–13.—ESTIMATED MARKET IMPACTS FOR 2011, 2016, 2030 (2005$)

Market	Average variable engineering cost per unit	Change in price		Change in variable	
		Absolute	Percent	Absolute	Percent
2011					
Rail Sector					
Locomotives	$0	−$425	−0.02	0	−0.1
Transportation Services	NA	NA[a]	0.1	NA[a]	0.1
Marine Sector					
Engines:					
C1>800 hp	0	0	0.00	0	0.0
C2>800 hp	0	0	0.00	0	0.0
Other marine	0	0	0.00	0	0.0
Vessels:					
C1>800 hp	0	0	0.00	0	0.0
C2>800 hp	0	0	0.00	0	0.0
Other marine	0	0	0.00	0	0.0
Transportation Services	NA	NA[a]	0.00	NA[a]	0.0
2016					
Rail Sector					
Locomotives	36,363	35,929	1.9	0	−0.1

[149] The market results for engines and vessels below 800 hp are provided in a Technical Support Document that can be found in the docket for this rule.

TABLE V–13.—ESTIMATED MARKET IMPACTS FOR 2011, 2016, 2030 (2005$)—Continued

Market	Average variable engineering cost per unit	Change in price		Change in variable	
		Absolute	Percent	Absolute	Percent
Transportation Services	NA	NA [a]	0.1	NA [a]	−0.1
Marine Sector [a]					
Engines:					
C1>800 hp	18,105	17,330	11.0	−7	−1.7
C2>800 hp	64,735	64,073	24.6	−1	−0.9
Other marine	0	0	0.00	0	0.0
Vessels:					
C1>800 hp	2,980	20,898	1.5	−9	−1.7
C2>800 hp	6,515	188,559	4.8	−1	−0.9
Other marine	0	−1	0.00	−0	0.0
Transportation Services	NA	NA [a]	0.1	NA [a]	−0.1
2030					
Rail Sector					
Locomotives	50,291	49,087	2.6	0	−0.2
Transportation Services	NA	NA [a]	0.4	NA [a]	−0.2
Marine Sector					
Engines:					
C1>800 hp	13,885	13,261	8.4	−6	−1.4
C2>800 hp	49,360	48,692	18.7	−1	−0.9
Other marine	0	0	0.0	0	0.0
Vessels:					
C1>800 hp	2,979	16,155	1.1	−8	−1.5
C2>800 hp	6,516	141,563	3.6	−1	−0.9
Other marine	0	−4	0.0	−2	0.0
Transportation Services	NA	NA [a]	0.6	NA [a]	−0.3

[a] The prices and quantities for transportation services are normalized ($1 for 1 unit of services provided) and therefore it is not possible to estimate the absolute change price or quanitity; see 7.3.1.5.

(b) Economic Welfare Analysis

In the economic welfare analysis we look at the costs to society of the proposed program in terms of losses to key stakeholder groups that are the producers and consumers in the rail and marine markets. The estimated surplus losses presented below reflect all engineering costs associated with the proposed program (fixed, variable, operating, and remanufacturing costs). Detailed economic welfare results for the proposed program for all years are presented in Chapter 7 of the RIA.

A summary of the estimated annual net social costs is presented in Table V–14. This table shows that total social costs for each year are slightly less than the total engineering costs. This is because the total engineering costs do not reflect the decreased sales of locomotives, engines and vessels that are incorporated in the total social costs. In addition, in the early years of the program the estimated social costs of the proposed program are not expected to increase regularly over time. This is because the compliance costs for the locomotive remanufacture program are not constant over time.

TABLE V–14.—ESTIMATED ANNUAL ENGINEERING AND SOCIAL COSTS, THROUGH 2040 (2005)

Year	Engineering costs						Total social costs
	Marine operating costs	Marine engine and vessel costs	Rail operating costs	Rail remanuf. costs	Rail new locomotive costs	Total	
2007	$0.0	$25.0	$0.0	$0.0	$3.2	$28.2	$28.2
2008	$0.0	$25.0	$1.3	$56.7	$3.2	$86.1	$86.1
2009	$0.0	$25.0	$1.4	$33.2	$3.2	$62.7	$62.7
2010	$0.0	$25.0	$3.8	$51.5	$7.3	$87.5	$87.5
2011	$0.0	$86.0	$7.9	$96.9	$10.8	$201.6	$201.5
2012	$0.0	$41.2	$9.7	$74.3	$12.3	$137.5	$137.5
2013	$0.0	$41.2	$12.0	$62.4	$12.3	$127.9	$127.9
2014	$2.8	$41.2	$12.6	$40.0	$16.9	$113.5	$113.5
2015	$5.6	$74.1	$14.9	$29.1	$48.8	$172.5	$172.5
2016	$14.8	$48.6	$19.0	$55.5	$55.3	$193.1	$192.6
2017	$23.9	$44.9	$32.7	$39.3	$66.5	$207.3	$206.7
2018	$36.0	$33.9	$44.6	$41.9	$67.9	$224.3	$223.9
2019	$48.0	$34.2	$56.5	$36.7	$61.9	$237.4	$236.9
2020	$60.0	$34.5	$68.5	$12.9	$64.0	$239.9	$239.5

TABLE V–14.—ESTIMATED ANNUAL ENGINEERING AND SOCIAL COSTS, THROUGH 2040 (2005)—Continued

Year	Engineering costs						Total social costs
	Marine operating costs	Marine engine and vessel costs	Rail operating costs	Rail remanuf. costs	Rail new locomotive costs	Total	
2021	$72.0	$34.8	$80.8	$14.9	$66.2	$268.7	$268.2
2022	$83.9	$35.1	$93.6	$37.4	$68.1	$318.1	$317.6
2023	$95.7	$35.4	$106.7	$83.2	$69.8	$390.8	$390.2
2024	$107.5	$35.7	$120.1	$72.0	$70.8	$406.0	$405.4
2025	$119.1	$35.9	$133.8	$76.5	$72.5	$437.9	$437.2
2026	$130.6	$36.2	$147.7	$63.2	$73.5	$451.2	$450.4
2027	$141.9	$33.6	$161.5	$64.6	$74.7	$476.3	$475.5
2028	$153.0	$33.9	$175.5	$80.3	$75.6	$518.2	$517.3
2029	$163.3	$34.2	$189.4	$81.8	$76.3	$544.9	$544.0
2030	$172.6	$34.5	$203.3	$81.2	$76.8	$568.3	$567.3
2031	$181.2	$34.8	$217.1	$81.4	$77.6	$592.1	$591.1
2032	$189.0	$35.1	$231.1	$77.2	$78.5	$610.9	$609.8
2033	$196.4	$35.4	$244.9	$133.5	$78.9	$689.2	$688.0
2034	$203.6	$35.7	$258.7	$142.6	$79.6	$720.1	$718.8
2035	$210.4	$36.0	$272.4	$150.1	$79.8	$748.8	$747.4
2036	$216.9	$36.4	$285.8	$143.2	$77.5	$759.7	$758.3
2037	$222.7	$36.7	$299.2	$145.9	$75.8	$780.3	$778.8
2038	$227.9	$37.0	$312.0	$148.8	$73.9	$799.6	$798.1
2039	$232.4	$37.3	$324.4	$152.0	$71.8	$818.0	$816.4
2040	$236.3	$37.7	$336.3	$155.0	$69.5	$834.7	$833.2
2040 NPV at 3% [a,b]						$6,907.8	$6,896.8
2040 NPV at 7% [a,b]						$3,107.7	$3,103.2
2030 NPV at 3% [a,b]						$3,938.7	$3,932.6
2030 NPV at 7% [a,b]						$2,175.5	$2,172.5

[a] EPA EPA presents the present value of cost and benefits estimates using both a three percent and a seven percent social discount rate. According to OMB Circular A–4, ''the 3 percent discount rate represents the 'social rate of time preference'* * * * [which] means the rate at which 'society' discounts future consumption flows to their present value''; ''the seven percent rate is an estimate of the average before-tax rate of return to private capital in the U.S. economy '' [that] approximates the opportunity cost of capital.

[b] *Note:* These NPV calculations are based on the period 2006–2040, reflecting the period when the analysis was completed. This has the consequence of discounting the current year costs, 2007, and all subsequent years are discounted by an additional year. The result is a smaller stream of social costs than by calculating the NPV over 2007–2040 (3% smaller for 3% NPV and 7% smaller for 7% NPV).

Table V–15 shows how total social costs are expected to be shared across stakeholders, for selected years. According to these results, the rail sector is expected to bear most of the social costs of the program, ranging from 57.3 percent in 2011 to 67.3 percent in 2016. Producers and consumers of locomotive transportation services are expected to bear most of those social costs, ranging from 51.9 percent in 2011 to 63.3 percent in 2030. As explained above, these results assume the railroads absorb all remanufacture kit compliance costs (the remanufacture kit manufacturers pass all costs of the new standards to the railroads). The marine sector is expected to bear the remaining social costs, ranging from 42.7 percent in 2011 to 32.7 percent in 2016. Producers of marine diesel engines are expected to bear more of the program costs in the early years (42.7 percent in 2011), but by 2020 producers and consumers in the marine transportation services market are expected to bear a larger share of the social costs, 31.5 percent.

TABLE V–15.—SUMMARY OF ESTIMATED SOCIAL COSTS FOR 2011, 2016, 2020, 2030

[2005$, $million]

Stakeholder group	2011		2016	
	Surplus change	Percent	Surplus change	Percent
Locomotives				
Locomotive producers	−$11.1	5.5	−$13.4	7.0
Rail transportation service providers	−$47.5	23.6	−$52.9	27.5
Rail transportation service consumers	−$57.0	28.3	−$63.5	33.0
Total locomotive sector	−$115.6	57.3	−$129.7	67.3
Marine				
Marine engine producers	−$86.0	42.7	−$0.9	0.5
C1 > 800 hp	−$22.8		−$0.7	
C2 > 800 hp	−$27.8		−$0.2	
Other marine	−$35.4		−$0.0	

TABLE V–15.—SUMMARY OF ESTIMATED SOCIAL COSTS FOR 2011, 2016, 2020, 2030—Continued

[2005$, $million]

Stakeholder group	2011		2016	
	Surplus change	Percent	Surplus change	Percent
Marine vessel producers	−$0	0.0	−$18.0	9.3
C1 > 800 hp	−$0		−$13.6	
C2 > 800 hp	−$0		−$4.4	
Other marine	−$0		−$0.0	
Recreational and fishing vessel consumers	−$0	0.0	−$9.6	5.0
Marine transportation service providers	−$0	0.0	−$15.6	8.1
Marine transportation service consumers	−$0	0.0	−$18.7	9.7
Total marine sector	−$86.0	42.7	−$62.9	32.7
Total Program	−$201.5		−$192.6	

Stakeholder group	2020		2030	
	Surplus change	Percent	Surplus change	Percent
Locomotives				
Locomotive producers	−$0.7	0.3	−$1.8	0.3
Rail transportation service providers	−$65.8	27.5	−$163.2	28.8
Rail transportation service consumers	−$78.9	32.9	−$195.9	34.5
Total locomotive sector	−$145.3	60.7	−$360.9	63.6
Marine				
Marine engine producers	−$0.8	0.3	−$0.9	0.2
C1 > 800 hp	−$0.6		−$0.7	
C2 > 800 hp	−$0.2		−$0.2	
Other marine	−$0.0		−$0.0	
Marine vessel producers	−$10.1	4.2	−$8.2	1.4
C1 > 800 hp	−$7.8		−$6.4	
C2 > 800 hp	−$2.3		−$1.6	
Other marine	−$0.1		−$0.1	
Recreational and fishing vessel consumers	−$7.8	3.3	−$8.5	1.5
Marine transportation service providers	−$34.3	14.3	−$85.8	15.1
Marine transportation service consumers	−$41.2	17.2	−$103.0	18.2
Total marine sector	−$94.1	39.3	−$206.5	36.4
Total Program	−$239.5	100.0	−$567.3	100.0

Table V–16 provides additional detail about the sources of surplus changes, for 2020 when the per unit compliance costs are stable. On the marine side, this table shows that engine and vessel producers are expected to pass along much of the engine and vessel compliance costs to the marine transportation service providers who purchase marine vessels. These marine transportation service providers, in turn, are expected to pass some of the costs to their customers. This is also expected to be the case in the rail sector.

TABLE V–16.— DISTRIBUTION OF ESTIMATED SURPLUS CHANGES BY MARKET AND STAKEHOLDER FOR 2020

[2005$, million$]

	Total engineering costs	Surplus change
Marine Markets		
Engine Producers	$29.3	−$0.8
Vessel Producers	$5.2	−$10.1
Engine price changes		−$8.1
Equipment cost changes		−$2.0
Recreational and Fishing Consumers		−$7.8
Engine price changes		−$6.2
Equipment cost changes		−$1.6
Transportation Service Providers	$60.0	−$34.3
Increased price vessels		−$6.9

TABLE V–16.— DISTRIBUTION OF ESTIMATED SURPLUS CHANGES BY MARKET AND STAKEHOLDER FOR 2020—Continued

[2005$, million$]

	Total engineering costs	Surplus change
Operating costs		−$27.4
Users of Transportation Service		−$41.2
Increased price vessels		−$8.2
Operating costs		−$32.9
Rail Markets		
Locomotive Producers	$64.0	−$0.7
Rail Service Providers	$81.4	−$65.8
Increased price new locomotives		−$28.8
Remanufacturing costs	$9.5	−$8.1
Operating costs	$63.6	−$28.9
Users of Rail Transportation Service		−$78.9
Increased price new locomotives		−$34.6
Remanufacturing costs		−$9.7
Operating costs		−$34.7
Total	$239.9	$239.6

The present value of net social costs of the proposed standards through 2040, shown in Table V–14, is estimated to be $6.9 billion (2005$).[150] This present value is calculated using a social discount rate of 3 percent and the stream of social welfare costs from 2006 through 2040. We also performed an analysis using a 7 percent social discount rate.[151] Using that discount rate, the present value of the net social costs through 2040 is estimated to be $3.1 billion (2005$).

Table V–17 shows the distribution of total surplus losses for the program from 2006 through 2040. This table shows that the rail sector is expected to bear about 65 percent of the total program social costs through 2040, and that most of the costs are expected to be borne by the rail transportation service producers and consumers. On the marine side, most of the marine sector costs are expected to be borne by the marine transportation service providers and consumers. This is consistent with the structure of the program, which leads to high compliance costs for those stakeholder groups.

TABLE V–17.—ESTIMATED NET SOCIAL COSTS THROUGH 2040 BY STAKEHOLDER

($million, 2005$)

Stakeholder groups	Surplus change NPV 3%	Percent of total surplus	Surplus change NPV 7%	Percent of total surplus
Locomotives				
Locomotive producers	$92.8	1.3%	$63.5	2.0%
Rail transportation service providers	$1,988.8	28.8%	$878.1	28.3%
Rail transportation service consumers	$2,386.4	34.6%	$1,053.7	33.9%
Total locomotive sector	$4,468.1	64.8%	$1,995.4	64.4%
Marine				
Marine engine producers	$313.3	4.5%	$242.3	7.8%
C1 > 800 hp	$102.1		$73.9	
C2 > 800 hp	$112.4		$84.4	
Other marine	$98.7		$84.0	
Marine vessel producers	$143.8	2.1%	$71.3	2.3%
C1 > 800 hp	$110.1		$54.3	
C2 > 800 hp	$32.4		$16.5	
Other marine	$1.3		$0.5	
Recreational and fishing vessel consumers	$110.0	1.6%	$51.0	1.6%
Marine transportation service providers	$846.2	12.3%	$338.2	10.9%
Marine transportation service consumers	$1,015.4	14.7%	$405.9	13.1%
Total marine sector	$2,428.7	35.2%	$1,107.7	35.7%
Total Program	$6,896.8		$3,103.1	

[150] **Note:** These NPV calculations are based on the period 2006–2040, reflecting the period when the analysis was completed. This has the consequence of discounting the current year costs, 2007, and all subsequent years are discounted by an additional year. The result is a smaller stream of social costs than by calculating the NPV over 2007–2040 (3% smaller for 3% NPV and 7% smaller for 7% NPV).

[151] EPA has historically presented the present value of cost and benefits estimates using both a 3 percent and a 7 percent social discount. The 3 percent rate represents a demand-side approach and reflects the time preference of consumption (the rate at which society is willing to trade current consumption for future consumption). The 7 percent rate is a cost-side approach and reflects the shadow price of capital.

(7) What Are the Significant Limitations of the Economic Impact Analysis?

Every economic impact analysis examining the market and social welfare impacts of a regulatory program is limited to some extent by limitations in model capabilities, deficiencies in the economic literatures with respect to estimated values of key variables necessary to configure the model, and data gaps. In this EIA, there three potential sources of uncertainty: (1) Uncertainty resulting from the way the EIM is designed, particularly from the use of a partial equilibrium model; (2) uncertainty resulting from the values for key model parameters, particularly the price elasticity of supply and demand; and (3) uncertainty resulting from the values for key model inputs, particularly baseline equilibrium price and quantities.

Uncertainty associated with the economic impact model structure arises from the use of a partial equilibrium approach, the use of the national level of analysis, and the assumption of perfect competition. These features of the model mean it does not take into account impacts on secondary markets or the general economy, and it does not consider regional impacts. The results may also be biased to the extent that firms have some control over market prices, which would result in the modeling over-estimating the impacts on producers of affected goods and services.

The values used for the price elasticities of supply and demand are critical parameters in the EIM. The values of these parameters have an impact on both the estimated change in price and quantity produced expected as a result of compliance with the proposed standards and on how the burden of the social costs will be shared among producer and consumer groups. In selecting the values to use in the EIM it is important that they reflect the behavioral responses of the industries under analysis.

Where possible, the EIA relies on published price elasticities of supply and demand. For those cases where there are no published sources, we estimated these parameters (see Appendix 7F of the RIA prepared for this rule). The methods used for estimation include a production fuction approach using data at the industry level (engines and recreational vessels) and a calibration approach (locomotiove supply). These methods were chosen because of limitations with the available data, which was limited to industry-level data. However, the use of aggregate industry level data may not be appropriate or an accurate way to estimate the price elasticity of supply compared to firm-level or plant-level data. This is because, at the aggregate industry level, the size of the data sample is limited to the time series of the available years and because aggregate industry data may not reveal each individual firm or plant production function (heterogeneity). There may be significant differences among the firms that may be hidden in the aggregate data but that may affect the estimated elasticity. In addition, the use of time series aggregate industry data may introduce time trend effects that are difficult to isolate and control.

To address these concerns, EPA intends to investigate estimates for the price elasticity of supply for the affected industries for which published estimates are not available, using an alternative method and data inputs. This research program will use the cross-sectional data model at either the firm level or the plant level from the U.S. Census Bureau to estimate these elasticities. We plan to use the results of this research provided the results are robust and they are available in time for the analysis for the final rule.

Finally, uncertainty in measurement of data inputs can have an impact on the results of the analysis. This includes measurement of the baseline equilibrium prices and quantities and the estimation of future year sales. In addition, there may be uncertainty in how similar engines and equipment were combined into smaller groups to facilitate the analysis. There may also be uncertainty in the compliance cost estimations.

To explore the effects of key sources of uncertainty, we performed a sensitivity analysis in which we examine the results of using alternative values for the price elasticity of suppy and demand and alternative methods to incorporate operational costs (across a larger group of marine vessels). The results of these analyses are contained in Appendix 7H of the RIA prepared for this rule.

Despite these uncertainties, we believe this economic impact analysis provides a reasonable estimate of the expected market impacts and social welfare costs of the proposed standards in future. Acknowledging benefits omissions and uncertainties, we present a best estimate of the social costs based on our interpretation of the best available scientific literature and methods supported by EPA's Guidelines for Preparing Economic Analyses and the OAQPS Economic Analysis Resource Document.

VI. Benefits

A. Overview

This section presents our analysis of the health and environmental benefits that can be expected to occur as a result of the proposed locomotive and marine engine standards throughout the period from initial implementation through 2030. Nationwide, the engines that are subject to the proposed emission standards in this rule are a significant source of mobile source air pollution. The proposed standards will reduce exposure to NO_X and direct PM emissions and help avoid a range of adverse health effects associated with ambient ozone and $PM_{2.5}$ levels. In addition, the proposed standards will help reduce exposures to diesel PM exhaust, various gaseous hydrocarbons and air toxics. As described below, the reductions in ozone and PM from the proposed standards are expected to result in significant reductions in premature deaths and other serious human health effects, as well as other important public health and welfare effects.

To estimate the net benefits of the proposed standards, we use the estimated costs presented in section V and sophisticated air quality and benefit modeling tools. The benefit modeling is based on peer-reviewed studies of air quality and health and welfare effects associated with improvements in air quality and peer-reviewed studies of the dollar values of those public health and welfare effects. These methods are generally consistent with benefits analyses performed for the recent analysis of the Clean Air Interstate Rule (CAIR) standards and the recently finalized PM NAAQS analysis.[152,153] They are described in detail in the RIA prepared for this rule.

EPA typically quantifies PM- and ozone-related benefits in its regulatory impact analyses (RIAs) when possible. In the analysis of past air quality regulations, ozone-related benefits have included morbidity endpoints and welfare effects such as damage to commercial crops. EPA has not recently included a separate and additive mortality effect for ozone, independent of the effect associated with fine particulate matter. For a number of

[152] U.S. Environmental Protection Agency. March 2005. Regulatory Impact Analysis for the Final Clean Air Interstate Rule. *Prepared by:* Office of Air and Radiation. Available at *http://www.epa.gov/cair.*

[153] U.S. Environmental Protection Agency. October 2006. Final Regulatory Impact Analysis (RIA) for the Proposed National Ambient Air Quality Standards for Particulate Matter. *Prepared by:* Office of Air and Radiation. Available at *http://www.epa.gov/ttn/ecas/ria.html.*

reasons, including (1) advice from the Science Advisory Board (SAB) Health and Ecological Effects Subcommittee (HEES) that EPA consider the plausibility and viability of including an estimate of premature mortality associated with short-term ozone exposure in its benefits analyses and (2) conclusions regarding the scientific support for such relationships in EPA's 2006 Air Quality Criteria for Ozone and Related Photochemical Oxidants (the CD), EPA is in the process of determining how to appropriately characterize ozone-related mortality benefits within the context of benefits analyses for air quality regulations. As part of this process, we are seeking advice from the National Academy of Sciences (NAS) regarding how the ozone-mortality literature should be used to quantify the reduction in premature mortality due to diminished exposure to ozone, the amount of life expectancy to be added and the monetary value of this increased life expectancy in the context of health benefits analyses associated with regulatory assessments. In addition, the Agency has sought advice on characterizing and communicating the uncertainty associated with each of these aspects in health benefit analyses.

Since the NAS effort is not expected to conclude until 2008, the agency is currently deliberating how best to characterize ozone-related mortality benefits in its rulemaking analyses in the interim. For the analysis of the proposed locomotive and marine standards, we do not quantify an ozone mortality benefit. So that we do not provide an incomplete picture of all of the benefits associated with reductions in emissions of ozone precursors, we have chosen not to include an estimate of total ozone benefits in the proposed RIA. By omitting ozone benefits in this proposal, we acknowledge that this analysis underestimates the benefits associated with the proposed standards. Our analysis, however, indicates that the rule's monetized $PM_{2.5}$ benefits alone substantially exceed our estimate of the costs.

The range of benefits associated with the proposed program are estimated based on the risk of several sources of PM-related mortality effect estimates, along with all other PM non-mortality related benefits information. These benefits are presented in Table VI–1. The benefits reflect two different sources of information about the impact of reductions in PM on reduction in the risk of premature death, including both the American Cancer Society (ACS) cohort study and an expert elicitation study conducted by EPA in 2006. In order to provide an indication of the sensitivity of the benefits estimates to alternative assumptions, in Chapter 6 of the RIA we present a variety of benefits estimates based on two epidemiological studies (including the ACS Study and the Six Cities Study) and the expert elicitation. EPA intends to ask the Science Advisory Board to provide additional advice as to which scientific studies should be used in future RIAs to estimate the benefits of reductions in PM. These estimates, and all monetized benefits presented in this section, are in year 2005 dollars.

TABLE VI–1.—ESTIMATED MONETIZED PM-RELATED HEALTH BENEFITS OF THE PROPOSED LOCOMOTIVE AND MARINE ENGINE STANDARDS

	Total benefits [a b c d] (billions 2005$)	
	2020	2030
PM mortality derived from the ACS cohort study; Morbidity functions from epidemiology literature		
Using a 3% discount rate	$4.4+B	$12+B
Confidence Intervals (5th–95th %ile)	($1.0–$10)	($2.1–$27)
Using a 7% discount rate	$4.0+B	$11+B
Confidence Intervals (5th–95th %ile)	($1.0–$9.2)	($1.8–$25)
PM mortality derived from lower bound and upper bound expert-based result; [e] Morbidity functions from epidemiology literature		
Using a 3% discount rate	$1.7+B – $12+B	$4.6+B – $33+B
Confidence Intervals (5th–95th %ile)	($0.2 – $8.5) – ($2.0 – $27)	($1.0 – $23) – ($5.4 – $72)
Using a 7% discount rate	$1.6+B – $11+B	$4.3+B – $30+B
Confidence Intervals (5th–95th %ile)	($0.2 – $7.8) – ($1.8 – $24)	($1.0 – $21) – ($4.9 – $65)

[a] Benefits include avoided cases of mortality, chronic illness, and other morbidity health endpoints.

[b] PM-related mortality benefits estimated using an assumed PM threshold of 10 μ/m^3. There is uncertainty about which threshold to use and this may impact the magnitude of the total benefits estimate. For a more detailed discussion of this issue, please refer to Section 6.6.1.3 of the RIA.

[c] For notational purposes, unquantified benefits are indicated with a "B" to represent the sum of additional monetary benefits and disbenefits. A detailed listing of unquantified health and welfare effects is provided in VI–4.

[d] Results reflect the use of two different discount rates: 3 and 7 percent, which are recommended by EPA's Guidelines for Preparing Economic Analyses and OMB Circular A–4. Results are rounded to two significant digits for ease of presentation and computation.

[e] The effect estimates of nine of the twelve experts included in the elicitation panel fall within the empirically-derived range provided by the ACS and Six-Cities studies. One of the experts fall below this range and two of the experts are above this range. Although the overall range across experts is summarized in this table, the full uncertainty in the estimates is reflected by the results for the full set of 12 experts. The twelve experts' judgments as to the likely mean effect estimate are not evenly distributed across the range illustrated by arraying the highest and lowest expert means. Likewise the 5th and 95th percentiles for these highest and lowest judgments of the effect estimate do not imply any particular distribution within those bounds. The distribution of benefits estimates associated with each of the twelve expert responses can be found in Tables 6.4–3 and 6.4–4 in the RIA.

B. Quantified Human Health and Environmental Effects of the Proposed Standards

In this section we discuss the $PM_{2.5}$ benefits of the proposed standards. We discuss how these benefits are monetized in the next section. It should be noted that the emission control scenarios used in the air quality and benefits modeling are slightly different than the emission control program being proposed. The differences reflect further refinements of the regulatory program since we performed the air quality modeling for this rule. Emissions and air quality modeling decisions are made early in the analytical process. Section 3.6 of the RIA describes the changes in the inputs and resulting emission inventories between the preliminary assumptions used for the air quality modeling and the final proposed emission control scenario.

(1) Estimated PM Benefits

To model the PM air quality benefits of this rule we used the Community Multiscale Air Quality (CMAQ) model. CMAQ simulates the numerous physical and chemical processes involved in the formation, transport, and deposition of particulate matter. This model is commonly used in regional applications to estimate the PM reductions expected to occur from a given set of emissions controls. The meteorological data input into CMAQ are developed by a separate model, the Penn State University/ National Center for Atmospheric Research Mesoscale Model, known as MM5. The modeling domain covers the entire 48-State U.S., as modeled in the Clean Air Interstate Rule (CAIR).[154] The grid resolution for the PM modeling domain was 36 x 36 km. More detailed information is included in the air quality modeling technical support document (TSD), which is located in the docket for this rule.

The modeled ambient air quality data serves as an input to the Environmental Benefits Mapping and Analysis Program (BenMAP).[155] BenMAP is a computer program developed by EPA that integrates a number of the modeling elements used in previous Regulatory Impact Analyses (e.g., interpolation functions, population projections, health impact functions, valuation functions, analysis and pooling methods) to translate modeled air concentration estimates into health effects incidence estimates and monetized benefits estimates.

Table VI–2 presents the estimates of reduced incidence of PM-related health effects for the years 2020 and 2030, which are based on the modeled air quality improvements between a baseline, pre-control scenario and a post-control scenario reflecting the proposed emission control strategy.

Since the publication of CAIR, we have completed the full-scale expert elicitation assessing the uncertainty in the concentration-response function for PM-related premature mortality. Consistent with the recommendations of the National Research Council (NRC) report ''Estimating the Public Health Benefits of Proposed Air Pollution Regulations,'' [156] we are integrating the results of this probabilistic assessment into the main benefits analysis as an alternative to the epidemiologically-derived range of mortality incidence provided by the ACS and Six-cities cohort studies (Pope et al., 2002 and Laden et al., 2006). Of the twelve experts included in the panel of experts, average premature mortality incidence derived from eleven of the experts are larger than the ACS-based estimate. One expert's average effect estimate falls below the ACS-based estimate. Details on the PM-related mortality incidence derived from each expert are presented in the draft RIA.

The use of two sources of PM mortality reflects two different sources of information about the impact of reductions in PM on reduction in the risk of premature death, including both the published epidemiology literature and an expert elicitation study conducted by EPA in 2006. In 2030, based on the estimate provided by the ACS study, we estimate that PM-related annual benefits would result in 1,500 fewer premature fatalities. When the range of expert opinion is used, we estimate between 460 and 4,600 fewer premature mortalities in 2030. We also estimate 940 fewer cases of chronic bronchitis, 3,300 fewer non-fatal heart attacks, 1,100 fewer hospitalizations (for respiratory and cardiovascular disease combined), one million fewer days of restricted activity due to respiratory illness and approximately 170,000 fewer work-loss days. We also estimate substantial health improvements for children from reduced upper and lower respiratory illness, acute bronchitis, and asthma attacks. These results are based on an assumed cutpoint in the long-term mortality concentration-response functions at 10 μg/m^3, and an assumed cutpoint in the short-term morbidity concentration-response functions at 10 μg/m^3. The impact using four alternative cutpoints (3 μg/m^3, 7.5 μg/m^3, 12 μg/m^3, and 14 μg/m^3) has on $PM_{2.5}$-related mortality incidence estimation is presented in Chapter 6 of the draft RIA.

TABLE VI–2 ESTIMATED REDUCTION IN INCIDENCE OF ADVERSE HEALTH EFFECTS RELATED TO THE PROPOSED LOCOMOTIVE AND MARINE ENGINE STANDARDS [a]

	2020	2030
Health effect	Mean incidence reduction (5th–95th percentile)	
PM-Related Endpoints		
Premature Mortality—Derived from Epidemiology Literature [b c] Adult, age 30±Range based on ACS cohort study (Pope *et al.* 2002	570 (220–920)	1,500 (590–2,400)
Infant, age <1 year—Woodruff *et al.* 1997	1 (1–2)	2 (1–4)
Premature Mortality—Derived from Expert Elicitation [c d] Adult, age 25±Lower and Upper Bound EE Results, Respectively.	180–1,700 (0–830)—(870–2,600)	460–4,600 (0–2,200)–(2,300–6,900)
Chronic bronchitis (adult, age 26 and over)	370 (68– 670)	940 (170–1,700)
Acute myocardial infarction (adults, age 18 andolder)	1,200 (640–1,700)	3,300 (1,800–4,800)
Hospital admissions—respiratory (all ages) [e]	130 (65–200)	350 (170–510)
Hospital admissions—cardiovascular (adults, age >18) [f]	270 (170–380)	770 (490–1,100)

[154] See the technical support document for the Final Clean Air Interstate Rule Air Quality Modeling. This document is available in Docket EPA–HQ–OAR–2004–0008.

[155] Information on BenMAP, including downloads of the software, can be found at *http://www.epa.gov/ttn/ecas/* benmodels.html.

[156] National Research Council (NRC). 2002. Estimating the Public Health Benefits of Proposed Air Pollution Regulations. Washington, DC: The National Academies Press.

TABLE VI–2 ESTIMATED REDUCTION IN INCIDENCE OF ADVERSE HEALTH EFFECTS RELATED TO THE PROPOSED LOCOMOTIVE AND MARINE ENGINE STANDARDS [a]—Continued

	2020	2030
Emergency room visits for asthma (age 18 years and younger)	460 (270–650)	1,000 (620–1,500)
Acute bronchitis (children, age 8–12)	1,000 (0–2,100)	2,600 (0–5,300)
Lower respiratory symptoms (children, age 7–14)	11,000 (5,400–17,000)	28,000 (14,000–43,000)
Upper respiratory symptoms (asthmatic children, age 9–18)	8,300 (2,600–14,000)	21,000 (6,600–35,000)
Asthma exacerbation (asthmatic children, age 6–18)	10,000 (1,100–29,000)	26,000 (2,800–74,000)
Work loss days (adults, age 18–65)	71,000 (62,000–81,000)	170,000 (150,000–190,000)
Minor restricted-activity days (adults, age 18–65)	420,000 (360,000–490,000)	1,000,000 (850,000–1,200,000)

[a] Incidence is rounded to two significant digits. PM estimates represent benefits from the proposed standards nationwide.

[b] Based on application of the effect estimate derived fromthe ACS study.[157] Infant premature mortality based upon studies by Woodruff, *et al.* 1997.[158]

[c] PM-related mortality benefits estimated using an assumed PM threshold at 10 μg/m³. There is uncertainty about which threshold to use and this may impact the magnitude of the total benefits estimate. For a more detailed discussion of this issue, please refer to Chapter 6 of the RIA.

[d] Based on effect estimates derived from the full-scale expert elicitation assessing the uncertainty in the concentration-response function for PM-related premature mortality (IEc, 2006).[159] The effect estimates of 11 of the 12 experts included in the elicitation panel falls estimate derived from the ACS study. One of the experts fall below the ACS estimate.

[e] Respiratory hospital admissions for PM include admissions for COPD, pneumonia, and asthma.

[f] Cardiovascular hospital admissions for PM include total cardiovascular and subcategories for ischemic heart disease, dysrhythmias, and heart failure.

C. Monetized Benefits

Table VI–3 presents the estimated monetary value of reductions in the incidence of health and welfare effects. Total annual PM-related health benefits are estimated to be between $4.6 and $33 billion in 2030, using a three percent discount rate (or $4.3 and $30 billion assuming a 7 percent discount rate). This estimate is based on the opinions of outside experts on PM and therisk of premature death, alongwith other non-mortality related benefits results. When the range of premature fatalities based on the ACS cohort study is used, we estimate the total benefits related to the proposed standards to be approximately $12 billion in 2030, using a three percent discount rate (or $11 assuming a 7 percent discount rate). All monetized estimates are stated in 2005 dollars. These estimates account for growth in real gross domestic product (GDP) per capita between the present and the years 2020 and 2030. As the table indicates, total benefits are driven primarily by the reduction in premature fatalities each year, which accounts for well over 90 percent of total benefits.

The above estimates of monetized benefits include only one example of non-health related benefits. Changes in the ambient level of $PM_{2.5}$ are known to affect the level of visibility in much of the U.S. Individuals value visibility both in the places they live and work, in the places they travel to for recreational purposes, and at sites of unique public value, such as at National Parks. For the proposed standards, we present the recreational visibility benefits of improvements in visibility at 86 Class I areas located throughout California, the Southwest, and the Southeast. These estimated benefits are approximately $150 million in 2020 and $400 million in 2030, as shown in Table VI–3.

Table VI–3 also indicates with a ''B'' those additional health and environmental benefits of the rule that we were unable to quantify or monetize. These effects are additive to the estimate of total benefits, and are related to two primary sources. First, there are many human health and welfare effects associated with PM, ozone, and toxic air pollutant reductions that remain unquantified because of current limitations in the methods or available data. A full appreciation of the overall economic consequences of the proposed standards requires consideration of all benefits and costs projected to result from the new standards, not just those benefits and costs which could be expressed here in dollar terms. A list of the benefit categories that could not be quantified or monetized in our benefit estimates are provided in Table VI–4. Second, the CMAQ air quality model only captures the benefits of air quality improvements in the 48 states and DC; benefits for Alaska and Hawaii are not reflected in the estimate of benefits.

157 Pope, C.A., III, R.T. Burnett, M.J. Thun, E.E. Calle, D. Krewski, K. Ito, and G.D. Thurston. 2002. ''Lung Cancer, Cardiopulmonary Mortality, and Long-term Exposure to Fine Particulate Air Pollution.'' Journal of the American Medical association 287: 1132–1141.

158 Woodruff, T.J., J. Grillo, and K.C. Schoendorf. 1997. ''The Relationship Between Selected Causes of Postneonatal Infant Mortality and Particulate Air Pollution in the United States.'' Environmental Health Perspectives 105(6): 608–612.

159 Industrial Economics, Incorporated (IEc). 2006. Expanded Expert Judgment Assessment of the Concentration-Response Relationship Between $PM_{2.5}$ Exposure and Mortality. Peer Review Draft. Prepared for: Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC. August.

TABLE VI–3.—ESTIMATED MONETARY VALUE IN REDUCTIONS IN INCIDENCE OF HEALTH AND WELFARE EFFECTS
[in millions of 2005$][a,b]

	2020	2030
$PM_{2.5}$-related health effect		Estimated mean value of reductions (5th and 95th %ile)
Premature mortality—Derived from Epidemiology Studies[c,d,e]		
Adult, age 30+—ACS study (Pope et al. 2002)		
3% discount rate	$3,900 ($500–$8,800)	$10,000 ($1,500–$24,000)
7% discount rate	$3,700 ($500–$7,900)	$9,400 ($1,300–$21,000)
Infant Mortality,<1 year —Woodruff et al. 1997		
3% discount rate	$8 ($1–$18)	$17 ($3–$37)
7% discount rate	$7 ($1–$16)	$15 ($2–$33)
Premature mortality—Derived from Expert Elicitation[c,d,e,f]		
Adult, age 25+—Lower bound EE result		
3% discount rate	$1,200 ($0–$7,200)	$3,300 ($0–$20,000)
7% discount rate	$1,100 ($0–$6,500)	$3,000 ($0–$18,000
Adult, age 25+—Upper bound EE result		
3% discount rate	$12,000 ($1,800–$25,000)	$31,000 ($4,800–$68,000)
7% discount rate	$11,000 ($1,600–$23,000)	$28,000 ($4,400–$62,000)
Chronic bronchitis (adults, 26 and over)	$200 ($10–$800)	$500 ($26–$2,100)
Non-fatal acute myocardial infarctions		
3% discount rate	$123 ($32–$270)	$330 ($80–$730)
7% discount rate	$119 ($30–$270)	$320 ($76–$720)
Hospital admissions for respiratory causes	$2.7 ($1.3–$4.0)	$7.2 ($3.6–$11)
Hospital admissions for cardiovascular causes	$7.3 ($4.6–$10)	$21 ($13–$28)
Emergency room visits for asthma	$0.16 ($0.09–$0.26)	$0.37 ($0.20–$0.60)
Acute bronchitis (children, age 8–12)	$0.44 ($0–$1.2)	$1.1 ($0–$3.1)
Lower respiratory symptoms (children, 7–14)	$0.21 ($0.07–$0.43)	$0.53 ($0.18–$1.1)
Upper respiratory symptoms (asthma, 9–11)	$0.24 ($0.05–$0.59)	$0.62 ($0.14–$1.5)
Asthma exacerbations	$0.53 ($0.04–$2.0)	$1.4 ($0.10–$5.1)
Work loss days	$11 ($9.6–$12)	$27 ($23–$30)
Minor restricted-activity days (MRADs)	$12 ($0.61–$25)	$29 ($1.5–$60)
Recreational Visibility, 86 Class I areas	$150 (na)[f]	$400 (na)
Monetized Total—PM-Mortality Derived from ACS Study; Morbidity Functions.		
3% discount rate	$4.4 ($1.0–$10)	$12 Billion ($2.1–$27)
7% discount rate Billion	$4.0 Billion ($1.0–$9.2)	$11 Billion ($1.8–$25)
Monetized Total—PM-Mortality Derived from Expert Elicitation[g]; Morbidity Functions.		
3% discount rate	$1.7–$12 Billion ($0.2–$8.5)—($2.0–$27)	$4.6–$33 Billion ($1.0–$23)—($5.4–$72)
7% discount rate	$1.6–$11 Billion ($0.2–$7.8)—($1.8–$24)	$4.3–$30 Billion ($1.0–$21)—($4.9–$65)

[a] Monetary benefits are rounded to two significant digits for ease of presentation and computation. PM benefits are nationwide.
[b] Monetary benefits adjusted to account for growth in real GDP per capita between 1990 and the analysis year (2020 or 2030)
[c] PM-related mortality benefits estimated using an assumed PM threshold of 10 μ/m^3. There is uncertainty about which threshold to use and this may impact the magnitude of the total benefits estimate.
[d] Valuation assumes discounting over the SAB recommended 20 year segmented lag structure. Results reflect the use of 3 percent and 7 percent discount rates consistent with EPA and OMB guidelines for preparing economic analyses (EPA, 2000; OMB, 2003).

[e] The valuation of adult premature mortality, derived either from the epidemiology literature or the expert elicitation, is not additive. Rather, the valuations represent a range of possible mortality benefits.

[f] We are unable at this time to characterize the uncertainty in the estimate of benefits of worker productivity and improvements in visibility at Class I areas. As such, we treat these benefits as fixed and add them to all percentiles of the health benefits distribution.

[g] It should be noted that the effect estimates of nine of the twelve experts included in the elicitation panel falls within the scientific study-based range provided by Pope and Laden. One of the experts fall below this range and two of the experts are above this range.

TABLE V1–4.—UNQUANTIFIED AND NON-MONETIZED POTENTIAL EFFECTS OF THE PROPOSED LOCOMOTIVE AND MARINE ENGINE STANDARDS

Pollutant/effects	Effects not included in analysis—changes in:
Ozone Health [a]	Premature mortality: short-term exposures Hospital admissions: respiratory Emergency room visits for asthma Minor restricted-activity days School loss days Asthma attacks Cardiovascular emergency room visits Acute respiratory symptoms Chronic respiratory damage Premature aging of the lungs Non-asthma respiratory emergency room visits Exposure to UVb (+/−) [d]
Ozone Welfare	Yields for -commercial forests -some fruits and vegetables -non-commercial crops Damage to urban ornamental plants Impacts on recreational demand from damaged forest aesthetics Ecosystem functions Exposure to UVb (+/−)
PM Health [b]	Premature mortality—short term exposures [c] Low birth weight Pulmonary function Chronic respiratory diseases other than chronic bronchitis Non-asthma respiratory emergency room visits Exposure to UVb (+/−)
PM Welfare	Residential and recreational visibility in non-Class I areas Soiling and materials damage Damage to ecosystem functions Exposure to UVb (+/−)
Nitrogen and Sulfate Deposition Welfare.	Commercial forests due to acidic sulfate and nitrate deposition Commercial freshwater fishing due to acidic deposition Recreation in terrestrial ecosystems due to acidic deposition Existence values for currently healthy ecosystems Commercial fishing, agriculture, and forests due to nitrogen deposition Recreation in estuarine ecosystems due to nitrogen deposition Ecosystem functions Passive fertilization
CO Health	Behavioral effects
HC/Toxics Health [e]	Cancer (benzene, 1,3-butadiene, formaldehyde, acetaldehyde) Anemia (benzene) Disruption of production of blood components(benzene) Reduction in the number of blood platelets (benzene) Excessive bone marrow formation (benzene) Depression of lymphocyte counts (benzene) Reproductive and developmental effects (1,3- butadiene) Irritation of eyes and mucus membranes(formaldehyde) Respiratory irritation (formaldehyde) Asthma attacks in asthmatics (formaldehyde) Asthma-like symptoms in non-asthmatics(formaldehyde) Irritation of the eyes, skin, and respiratory tract(acetaldehyde) Upper respiratory tract irritation and congestion(acrolein)
HC/Toxics Welfare	Direct toxic effects to animals Bioaccumulation in the food chain Damage to ecosystem function Odor

[a] In addition to primary economic endpoints, there are a number of biological responses that have been associated with ozone health effects including increased airway responsiveness to stimuli, inflammation in the lung, acute inflammation and respiratory cell damage, and increased susceptibility to respiratory infection. The public health impact of these biological responses may be partly represented by our quantified endpoints.

[b] In addition to primary economic endpoints, there are a number of biological responses that have been associated with PM health effects including morphological changes and altered host defense mechanisms. The public health impact of these biological responses may be partly represented by our quantified endpoints.

[c] While some of the effects of short-term exposures are likely to be captured in the estimates, there may be premature mortality due to short-term exposure to PM not captured in the cohort studies used in this analysis. However, the PM mortality results derived from the expert elicitation do take into account premature mortality effects of short term exposures.

[d] May result in benefits or disbenefits.

[e] Many of the key hydrocarbons related to this rule are also hazardous air pollutants listed in the Clean Air Act.

D. What Are the Significant Limitations of the Benefit-Cost Analysis?

Every benefit-cost analysis examining the potential effects of a change in environmental protection requirements is limited to some extent by data gaps, limitations in model capabilities (such as geographic coverage), and uncertainties in the underlying scientific and economic studies used to configure the benefit and cost models. Limitations of the scientific literature often result in the inability to estimate quantitative changes in health and environmental effects, such as potential increases in premature mortality associated with increased exposure to carbon monoxide. Deficiencies in the economics literature often result in the inability to assign economic values even to those health and environmental outcomes which can be quantified. These general uncertainties in the underlying scientific and economics literature, which can lead to valuations that are higher or lower, are discussed in detail in the RIA and its supporting references. Key uncertainties that have a bearing on the results of the benefit-cost analysis of the proposed standards include the following:

- The exclusion of potentially significant and unquantified benefit categories (such as health, odor, and ecological benefits of reduction in air toxics, ozone, and PM);
- Errors in measurement and projection for variables such as population growth;
- Uncertainties in the estimation of future year emissions inventories and air quality;
- Uncertainty in the estimated relationships of health and welfare effects to changes in pollutant concentrations including the shape of the C–R function, the size of the effect estimates, and the relative toxicity of the many components of the PM mixture;
- Uncertainties in exposure estimation; and
- Uncertainties associated with the effect of potential future actions to limit emissions.

As Table VI–3 indicates, total benefits are driven primarily by the reduction in premature fatalities each year. Some key assumptions underlying the premature mortality estimates include the following, which may also contribute to uncertainty:

- Inhalation of fine particles is causally associated with premature death at concentrations near those experienced by most Americans on a daily basis. Although biological mechanisms for this effect have not yet been completely established, the weight of the available epidemiological, toxicological, and experimental evidence supports an assumption of causality. The impacts of including a probabilistic representation of causality were explored in the expert elicitation-based results of the recently published PM NAAQS RIA. Consistent with that analysis, we discuss the implications of these results in the draft RIA for the proposed standards.
- All fine particles, regardless of their chemical composition, are equally potent in causing premature mortality. This is an important assumption, because PM produced via transported precursors emitted from locomotive and marine engines may differ significantly from PM precursors released from electric generating units and other industrial sources. However, no clear scientific grounds exist for supporting differential effects estimates by particle type.
- The C–R function for fine particles is approximately linear within the range of ambient concentrations under consideration (above the assumed threshold of 10 µg/m3). Thus, the estimates include health benefits from reducing fine particles in areas with varied concentrations of PM, including both regions that may be in attainment with $PM_{2.5}$ standards and those that are at risk of not meeting the standards.

Despite these uncertainties, we believe this benefit-cost analysis provides a conservative estimate of the estimated economic benefits of the proposed standards in future years because of the exclusion of potentially significant benefit categories. Acknowledging benefits omissions and uncertainties, we present a best estimate of the total benefits based on our interpretation of the best available scientific literature and methods supported by EPA's technical peer review panel, the Science Advisory Board's Health Effects Subcommittee (SAB–HES). EPA has also addressed many of the comments made by the National Academy of Sciences (NAS) in a September 26, 2002 report on its review of the Agency's methodology for analyzing the health benefits of measures taken to reduce air pollution in our analysis of the final PM NAAQS.[160] The analysis of the proposed standards incorporates this most recent work to the extent possible.

E. Benefit-Cost Analysis

In estimating the net benefits of the proposed standards, the appropriate cost measure is 'social costs.' Social costs represent the welfare costs of a rule to society. These costs do not consider transfer payments (such as taxes) that are simply redistributions of wealth. Table VI–5 contains the estimates of monetized benefits and estimated social welfare costs for the proposed rule and each of the proposed control programs. The annual social welfare costs of all provisions of this proposed rule are described more fully in section V of this preamble.[161]

The results in Table VI–5 suggest that the 2020 monetized benefits of the proposed standards are greater than the expected social welfare costs. Specifically, the annual benefits of the total program would be $4.4 + B billion annually in 2020 using a three percent discount rate (or $4.2 billion assuming a 7 percent discount rate), compared to estimated social costs of approximately $250 million in that same year. These benefits are expected to increase to $12 + B billion annually in 2030 using a three percent discount rate (or $11 billion assuming a 7 percent discount rate), while the social costs are estimated to be approximately $600 million. Though there are a number of health and environmental effects associated with the proposed standards that we are unable to quantify or monetize (represented by ''+B''; see Table VI–4), the benefits of the proposed standards far outweigh the projected costs. When we examine the benefit-to-

[160] U.S. Environmental Protection Agency. October 2006. Final Regulatory Impact Analysis (RIA) for the Proposed National Ambient Air Quality Standards for Particulate Matter. *Prepared by:* Office of Air and Radiation. Available at *HTTP://www.epa.gov/ttn/ecas/ria.html.*

[161] The estimated 2030 social welfare cost of 267.3 million is based on an earlier version of the engineering costs of the rule which estimated $568.3 million engineering costs in 2030 (see table 5–17). The current engineering cost estimate for 2030 is $605 million. See Section V.C.5 for an explanation of the difference. The estimated social costs of the program will be updated for the final rule.

cost comparison for the rule standards separately, we also find that the benefits of the specific engine standards far outweigh their projected costs.

TABLE VI–5.—SUMMARY OF ANNUAL BENEFITS, COSTS, AND NET BENEFITS OF THE PROPOSED LOCOMOTIVE AND MARINE ENGINE STANDARDS

(Millions, 2005$)[a]

Description	2020	2030
Estimated Social Costs[b]		
Locomotive	$150	$380
Marine	100	220
Total Social Costs	250	605
Estimated Health Benefits of the ProposedStandards[c d e]		
Locomotive		
3 percent discount rate	2,300+B	4,700+B
7 percent discount rate	2,100+B	4,300+B
Marine		
3 percent discount rate	2,100+B	7,100+B
7 percent discount rate	1,900+B	$6,400+B
Total Benefits		
3 percent discount rate	4,400+B	12,000+B
7 percent discount rate	4,000+B	11,000+B
Annual Net Benefits (Total Benefits—Total Costs)		
3 percent discount rate	4,150+B	11,000+B
7 percent discount rate	3,750+B	10,000+B

[a] All estimates represent annualized benefits and costs anticipated for the years 2020 and 2030. Totals may not sum due to rounding.
[b] The calculation of annual costs does not require amortization of costs over time. Therefore, the estimates of annual cost do not include a discount rate or rate of return assumption (see Chapter 7 of the RIA). In Section D, however, we do use both a 3 percent and 7 percent social discount rate to calculate the net present value of total social costs consistent with EPA and OMB guidelines for preparing economic analyses.
[c] Annual benefits analysis results reflect the use of a 3 percent and 7 percent discount rate in the valuation of premature mortality and nonfatal myocardial infarctions, consistent with EPA and OMB guidelines for preparing economic analyses (U.S. EPA, 2000 and OMB, 2003).[162 163]
[d] Valuation of premature mortality based on long-term PM exposure assumes discounting over the SAB recommended 20-year segmented lag structure described in the Regulatory Impact Analysis for the Final Clean Air Interstate Rule (March, 2005). Note that the benefits in this table reflect PM mortality derived from the ACS (Pope et al., 2002) study.
[e] Not all possible benefits or disbenefits are quantified and monetized in this analysis. B is the sum of all unquantified benefits and disbenefits. Potential benefit categories that have not been quantified and monetized are listed in Table V–13.

VII. Alternative Program Options

The program we have described in this proposal represents a broad and comprehensive approach to reduce emissions from locomotive and marine diesel engines. As we have developed this proposal, we have evaluated a number of alternatives with regard to the scope and timing of the standards. We have also examined an alternative that would require emission reductions from a significant fraction of the existing marine diesel engine fleet. This section presents a summary of our analysis of these alternative control scenarios. We are interested in comments on all of the alternatives presented. For a more detailed description of our analysis of these alternatives, including a year by year breakout of expected costs and emission reductions, please refer to Chapter 8 of the draft RIA prepared for this rulemaking.

[162] U.S. Environmental Protection Agency, 2000. Guidelines for Preparing Economic Analyses. *www.yosemite1.epa.gov/ee/epa/eed/hsf/pages/Guideline.html.*

[163] Office of Management and Budget, The Executive Office of the President, 2003. Circular A–4. *http://www.whitehouse.gov/omb/circulars.*

A. Summary of Alternatives

We have developed emission inventory impacts, cost estimates and benefit estimates for two types of alternatives. The first type looks at the impacts of varying the timing and scope of our proposed standards. The second considers a programmatic alternative that would set emission standards for existing marine diesel engines.

(1) Alternatives Regarding Timing, Scope

(a) *Alternative 1:* Exclusion of Locomotive Remanufacturing

Alternative 1 examines the potential impacts of the locomotive remanufacturing program by excluding it from the analysis (see section III.C.(1)(a)(i) for more details on the remanufacturing standards). Compared to the primary program, this analysis shows that through 2040 the locomotive remanufacturing program by itself would reduce $PM_{2.5}$ emissions by 65,000 tons NPV 3% (35,000 tons NPV 7%) and NO_X emissions by nearly 690,000 tons NPV 3% (400,000 tons NPV 7%) at a cost of $800 million NPV 3% ($530 million NPV 7%). The monetized health and welfare benefits of the locomotive remanufacturing program in 2030 are $2.9 billion at a 3% discount rate (DR) or $2.7 at a 7% DR. While this alternative could have the advantage of enabling industry to focus its resources on Tier 3 and Tier 4 technology development, given its substantial benefits in the early years of the program which are critical for NAAQS achievement and maintenance, we have decided to retain the locomotive remanufacturing program in our proposal.

(b) *Alternative 2:* Tier 4 Advanced One Year

Alternative 2 considers the possibility of pulling ahead the Tier 4 standards by one year for both the locomotive and marine programs, while leaving the rest of the proposed program unchanged. This alternative represents a more environmentally protective set of standards, and we have given strong consideration to proposing it. However, our review of the technical challenges to introduce the Tier 4 program, especially considering the locomotive remanufacturing program and the Tier 3 standards which go before it, leads us to conclude that introducing Tier 4 a year earlier is not feasible. We have included this alternative analysis here because of the strong consideration we have given it, and to provide commenters with an opportunity to comment on the timing of the Tier 4 standards within the context of the additional benefits that such a pull ahead could realize. Our analysis suggests that introducing Tier 4 one year earlier than our proposal could reduce emissions by an additional 9,000 tons of $PM_{2.5}$ NPV 3% (5,000 tons NPV 7%) and 420,000 tons of NO_X NPV 3% (210,000 tons NPV 7%) through 2040. We are unable to make an accurate estimate of the cost for such an approach since we do not believe it to be feasible at this time. However, we have reported a cost in the summary table reflecting the same cost estimation method we have used for our primary case and have denoted unestimated additional costs as 'C'. These additional unestimated costs would include costs for additional engine test cells, engineering staff, and engineering facilities necessary to introduce Tier 4 one year earlier. While we are unable to conclude that this alternative is feasible at this time, we request comment on that aspect of this alternative including what additional costs might be incurred in order to have Tier 4 start one year earlier.

(c) *Alternative 3:* Tier 4 Exclusively in 2013

Alternative 3 most closely reflects the program we described in our Advanced Notice of Proposed Rulemaking, whereby we would set new aftertreatment based emission standards as soon as possible. In this case, we believe the earliest that such standards could logically be started is in 2013 (3 months after the introduction of 15 ppm ULSD in this sector). Alternative 3 eliminates our proposed Tier 3 standards and locomotive remanufacturing standards, while pulling the Tier 4 standards ahead to 2013 for all portions of the Tier 4 program. As with alternative 2, we are concerned that it may not be feasible to introduce Tier 4 technologies on locomotive and marine diesel engines earlier than the proposal specifies. However, eliminating the technical work necessary to develop the Tier 3 and locomotive remanufacturing programs would certainly go a long way towards making such an approach possible. This alternative would actually result in substantially higher PM emissions than our primary case although it would provide additional reductions in NO_X emissions. Through 2040 this alternative would decrease $PM_{2.5}$ reductions by more than 60,000 NPV 3% tons (31,000 NPV 7%) while only adding approximately 180,000 additional tons NPV 3% (100,000 NPV 7%) of NO_X reductions. As a result in 2030 alone, this alternative realizes approximately $0.6 billion less at a 3% DR ($0.5 billion less at a 7% DR) in public health and welfare benefits than does our proposal. As was the case with alternative 2, we have used the same cost estimation approach for this alternative as that of our proposal, and have denoted the unestimated costs that are necessary to accelerate the development of Tier 4 technologies with a 'C' in the summary tables. While alternative 3 could have been considered the Agency's leading option going into this rulemaking process, our review of the technical challenges necessary to introduce Tier 4 technologies and the substantial additional benefits that a more comprehensive solution can provide has lead us to drop this approach in favor of the comprehensive proposal we have laid out today.

(d) Alternative 4: Elimination of Tier 4

Alternative 4 would eliminate the Tier 4 standards and retain the Tier 3 and locomotive remanufacturing requirements. This alternative allows us to consider the value of combining the Tier 3 and locomotive remanufacturing standards together as one program, and conversely, allows us to see the additional benefits gained when combining them with the Tier 4 standards. As a stand-alone alternative, the combined Tier 3 and locomotive remanufacturing program is very attractive, resulting in large emission reductions through 2040 of 207,000 tons of $PM_{2.5}$ NPV 3% (94,000 NPV 7%) and 2,910,000 tons NPV 3% (1,310,000 NPV 7%) of NO_X at an estimated cost of $950 million NPV 3% ($650 million NPV 7%) through the same time period. In 2030 alone, such a program is projected to realize health and welfare benefits of $6.2 billion at a 3% DR ($5.7 billion at a 7% DR). Yet, this alternative falls well short of the total benefits that our comprehensive program is expected to realize. Elimination of Tier 4 would result in the loss of 108,000 tons NPV 3% (41,000 tons at NPV 7%) of $PM_{2.5}$ reductions and almost 4,960,000 tons NPV 3% (1,870,000 tons at NPV 7%) of NO_X reductions as compared to our proposal through 2040. Through the addition of the Tier 4 standards, the estimated health and welfare benefits are nearly doubled in 2030. As these alternatives show, each element of our comprehensive program: The locomotive remanufacturing program, the Tier 3 emission standards, and the Tier 4 emission standards, represent a valuable emission control program on its own, while the collective program results in the greatest emission reductions we believe to be possible giving consideration to all of the elements described in today's proposal.

(2) Standards for Engines on Existing Vessels

We are also considering a fifth alternative that would address emissions from certain marine diesel engines installed on vessels that are currently in the fleet. Many of the large marine diesel engines installed on commercial vessels remain in the fleet in excess of 20 years and the contribution of these engines to air pollution inventories can be substantial. This alternative seeks to reduce these impacts.

This section describes the background for such a program and discusses how it could be designed. While this is an alternative under active consideration, we are seeking further information about this market to develop a complete regulatory program. We obtained information from marine transportation stakeholders about their remanufacturing practices that leads us to believe that, for engines above 800 hp, these practices are very similar to those in the rail transportation sector. However, the information we have about the structure of marine remanufacturing market does not provide a complete picture regarding the economic response of the market to such a program. Therefore, we request comment on the characteristics of the marine remanufacturing market with regard to its sensitivity to price changes. We also encourage comments on all aspects of the program described below, including the need for it and the design of its components.

(a) Background

As discussed in section III.C.(1)(b), we currently regulate remanufactured locomotive engines under section 213(a)(5) of the Clean Air Act as new locomotive engines. Specifically, in our 1998 rule we defined ''new locomotive'' and ''new locomotive engine'' to mean a locomotive or locomotive engine which has been remanufactured. Remanufactured was defined as meaning (i) to replace, or inspect and qualify each and every power assembly of a locomotive or locomotive engine, whether during a single maintenance event or cumulatively within a five-year period; or (ii) to upgrade a locomotive or locomotive engine; or (iii) to convert a locomotive or locomotive engine to enable it to operate using a fuel other than it was originally manufactured to use; or (iv) to install a remanufactured engine or a freshly manufactured engine into a previously used locomotive. As we explained in that rule, any of these events would result in a locomotive that is essentially new.

We believe a similar situation exists for large marine diesel engines installed on certain types of commercial marine vessels, including tugs, towboats, ferries, crewboats, and supply boats. The engines used for propulsion power in these vessels are often large and are used at high load to provide power for pulling or pushing barges or for assisting ocean-going vessels in harbor. These engines tend to be integral to the vessel and are therefore designed to last the life of the vessel, often 30 or more years. These engines are also relatively expensive, costing from tens of thousands of dollars for a small tug or ferry to several hundred thousand dollars for larger tugs, ferries, and cargo vessels. Because it is very difficult to remove the engines from these vessels (the engines are typically below deck and replacement requires cutting the hull or the deck), owners insist that these marine diesel engines last as long as the vessel. Therefore, these engines are usually characterized by an extremely durable engine block and internal parts.

Marine propulsion engines are frequently remanufactured to provide dependable power, and it is not unusual for an older vessel to have its original propulsion engines which have been remanufactured. Those parts or systems that experience high wear rates are designed to be easily replaced so as to minimize the time that the unit is out of service for repair or remanufacture. This includes power assemblies, which consists of the pistons, piston rings, cylinder liners, fuel injectors and controls, fuel injection pump(s) and controls, and valves. The power assemblies can be remanufactured to bring them back to as-new condition or they can be upgraded to incorporate the latest design configuration for that engine. As part of the routine remanufacturing process, power assemblies and key engine components are disassembled and replaced or requalified (i.e. determined to be within original manufacturing tolerances).

Marine engine remanufacturing procedures have improved to the point that engine performance for rebuilt engines is equivalent to that of new engines. Therefore, we believe it may be appropriate to consider a program that would set emission requirements for certain types of marine diesel engines that would apply when they are remanufactured. The program under consideration is described below. We request comment on whether marine remanufacturing processes should subject remanufactured engines to standards under the Act. We also request comment on any and all aspects of the program described below, including the appropriateness of applying such a program, the standards, and its certification and compliance procedures.

(b) Other Marine Engine Remanufacture Programs

The impact of engines on existing vessels on ambient air quality was recognized in MARPOL Annex VI. Although not specifically referred to as a remanufacturing program, Regulation 13 contains requirements for existing engines by requiring that the Regulation 13 NO_X limits apply to any engine above 130 kW that undergoes a major conversion on or after January 1, 2000. Major conversion is defined as (i) replacing the engine with a new engine (i.e., a repower); (ii) increasing the maximum continuous rating of the engine by more than 10 percent; or (iii) making a substantial modification to the engine (i.e., a change to the engine that would alter its emission characteristics).

EPA also recognized the importance of the inventory contribution from existing marine engines in our 1999 rule, and we requested comment on national requirements for existing marine diesel engines that would be similar to the locomotive remanufacturing program.[164] While we noted the potential advantages of such a program, we did not finalize a remanufacturing program for existing marine diesel engines. At the time we did not have a good understanding of the differences between the large marine diesel engines used on tugs, towboats, crew and supply boats, cargo boats, and ferries and the smaller engines used on fishing vessels and patrol boats, and the lack of uniformity in the remanufacturing practices used by owners of smaller engines led us to conclude that the industry was too fractured to allow a remanufactured engine program. However, we acknowledged the continuing importance of the contribution of existing marine diesel engines and noted in section VI of our 1999 rule (Areas for Future Action) that we would consider this issue again in the future.

Since we finalized our 1999 rule many states have continued to express concern about emissions from existing marine diesel engines and the impact of these emissions on their ability to attain and maintain their air quality goals. More recently, these states submitted comments to the ANPRM and letters to the Agency expressing the need for controlling existing engines. California is considering a program that would require all existing harborcraft (including tug/tow, ferries, crew, supply, pilot, work, and other vessels) to repower with an engine certified to the then-applicable federal standards. They are considering effective dates from 2008 through 2014, depending on the age of an existing vessel and its size. Alternatively, California would allow vessel owners to apply a retrofit technology that achieves equivalent emission reductions, or adopt an alternative compliance plan. The requirements under consideration for fishing vessels would be less stringent and phase in from 2011 through 2018.

We've also received information from vessel owner groups that suggests that the obstacles to a marine diesel engine remanufacturing program we noted in our 1999 rule may be less than critical, particularly for larger engines. Specifically, as noted above, many owners of large marine diesel engines have their engines rebuilt on a routine schedule and this maintenance is often performed by companies that also remanufacture locomotive engines. In addition, many owners of marinized locomotive engines use parts from the same remanufacturing kits that would apply to locomotives. Various retrofit programs, such as the Carl Moyer program in California, the TERP program in Texas, and EPA's retrofit program, may also make it easier to identify and install retrofit technologies on existing marine engines when they are remanufactured.

(c) Marine Diesel Engines To Be Included in the Program

The program for remanufactured marine diesel engines described below would apply to engines above 800 hp. We believe this threshold is appropriate because discussions with various user groups have indicated that these engines are most likely to be subject to the regular remanufacturing events described above. Engines below 800 hp are more likely to be installed on vessels used in fishing or recreational applications. These vessels often do not

[164] Pursuant to 40 CFR 92.2, remanufacture means ''(1)(i) to replace, or inspect and qualify, each and every power assembly of a locomotive or locomotive engine, whether during a single maintenance event or cumulatively within a five-year period; or (ii) to upgrade a locomotive or locomotive engine; or (iii) to convert nally manufactured to use; or (iv) to install a remanufactured engine or a freshly manufactured engine into a previously used locomotive.''

have the intense usage as tug/tow/pushboats, ferries, crew/supply vessels or cargo vessels. Maintenance is more likely to be ad hoc and performed only when there is a problem with the performance of the engine. These vessels are also most likely to be owner operated, and any maintenance that occurs may be performed by the owner. In addition, as explained elsewhere in this preamble, marine diesel engines above 800 hp are the largest contributors to national inventories of NO_X and PM emissions. Many of the vessels that use these engines, including tugs, ferries, crew and supply boats and cargo vessels, are in direct competition with locomotives, providing transportation services for passengers or bulk goods and materials.

A random sample of nearly 400 vessels from the Inland River Record (2006) suggests that the average age of vessels in that fleet is 30 years (with vessels built between 1944 and 2004), and the average horsepower of these vessels is 1709 hp (with a range of 165 to 9,180 hp). About 72 percent of the vessels have horsepower at or above 800 hp, with about 75% of those being built after 1973. In addition, about 60 percent of the vessels with engines at or above 800 hp have engines derived from locomotive engines. This suggests that there are significant emission reductions that may be achieved by setting requirements similar to the locomotive program for these engines.

Although the analysis of this alternative includes all engines above 800 hp, this remanufacturing program for marine diesel engines could further be limited to a subset of engines above 800 hp, for example those manufactured after 1973. The locomotive remanufacturing program has this age limitation, reflecting the fact that older locomotives are expected to be retired out of the Class I line haul fleet relatively soon. However, this may not make sense in the marine sector as there are a lot of vessels older than 1973 in the fleet (about 130 in our sample of about 400 vessels), and they are not systematically retired to lower use applications.

On the other hand, this option could be expanded to include other marine diesel engines including those below 800 horsepower. We do not believe this expansion is appropriate, for the reasons outlined above (i.e., maintenance may be more ad hoc and performed by the owner/operator instead of by a professional remanufacturer at a shipyard). However, we request comment on this issue.

The program described in this alternative could be further modified by specifying that all engines on a vessel would be considered to be subject to the remanufacturing requirements if the main propulsion engine falls under the scope of the program. In essence, this approach would treat all engines onboard a vessel as a system. While remanufacture kits may not be available for smaller auxiliary engines, it may be possible to retrofit them with emission controls that will achieve the 25 percent PM reduction. In addition, repowering auxiliary engines onboard these vessels may not be a limiting factor as these engines are often removed to be rebuilt and other engines installed in their place. We request comment on this aspect of expanding the program.

(d) Alternative 5: Existing Engines

Due to the impact of marine diesel engines on the environment, the need for reductions for states to achieve their attainment goals, and our better understanding of the marine remanufacturing sector, we are considering a programmatic alternative that would set emission requirements for marine diesel engines on existing vessels when they are remanufactured.

The program under consideration in this alternative would apply to marine diesel engines above 800 hp. We believe this is a reasonable threshold because of the long hours of use of these engines, often at high load, and their long service lives. The program would draw on features of the locomotive remanufacturing program, in that it would apply when a marine diesel engine is remanufactured. It would also draw on the certification requirements of the urban bus retrofit program (see 58 FR 21359 (April 21, 1993), 63 FR 14626 (March 26, 1998), 40 CFR part 85 subpart O), in that the standard would in part be a function of the emissions from the base engine and that the standard might be subject to a cost threshold.

This marine engine remanufacturing alternative consists of a two-part program. In the first part, which could begin as early as 2008, vessel owners and rebuilders (also called remanufacturers) would be required to use a certified kit when the engine is rebuilt (or remanufactured) if such a kit is available. Initially, these kits would be expected to be locomotive kits and therefore applicable only to those engines derived from similar locomotive engines. Eventually, however, it is expected that the large engine manufacturers would also provide kits for their engines. Kit availability would be expected to track the relative share of models to the total population of engines, so that kits for the most popular engine models would be made available first. Because the potential for emission reductions are expected to be quite varied across the diverse range of existing marine diesel engines, we could consider setting a multi-stepped emission standard similar to the Urban Bus program. For example, the program could set standards based on reductions of 60%, 40% and 20% with a requirement that a rebuilder must use a certified kit meeting the most stringent of these three standards if available. If no kit is available meeting the 60% reduction, then the rebuilder can use one meeting the 40% reduction, and similarly, if no kits are available meeting the 40% or 60% standards, then the rebuilder can use a kit meeting the 20% reduction. In this way, engines which can achieve a 60% reduction are likely to realize that reduction because a kit builder will be motivated to develop a kit meeting the most stringent standard possible. We request comment regarding the appropriateness of such an approach, and were we to adopt such a structure, the need for greater or less stratification across the potential emission standards.

In the second part, which could begin in 2013, the remanufacturer/owner of a marine diesel engine identified by the EPA as a high-sales volume engine model would have to meet specified emission requirements when the engine is remanufactured. Specifically, the remanufacturer or owner would be required to use a system certified to meet the standard; if no certified system is available, he or she would need to either retrofit an emission reduction technology for the engine that demonstrates at least a 25 percent reduction or repower (replace the engine with a new one). The mandatory use of an available kit is intended to create a market for kits to help ensure their development over the initial five years of the program.

To ensure that the program results in the expected emission reductions, an emission threshold could be set as well such that the retrofit technology would be required to demonstrate a 25 percent reduction with emissions not to exceed 0.22 g/kW-hr PM (equivalent to the new Tier 0/1 PM limit). We believe a threshold, if one is included, should focus on PM emissions over NO_X because PM reductions can be accomplished through the use of improved engine components, for example changing cylinder rings or liners to reduce oil consumption and PM emissions. We do not believe a NO_X threshold is appropriate because technologies to reduce NO_X may not be as amenable to a remanufacturing kit approach. However, we would welcome comments regarding the need for a threshold, and the limit at which it should be set, and the appropriateness of a NO_X standard as well.

The second part of the program is contingent on EPA developing a list of high volume marine diesel engines for which a remanufacture certificate must be available by 2013. EPA will continue to work with engine manufactures and other interested stakeholders to develop such a list, and seeks comment on the engine models that should be included. The goal of this list is to identify those engine models that occur frequently enough in the market to justify the development of a remanufacture kit; engine models with just a few units in the population may not be required to comply with the requirements.

Finally, the second step of the program could be made subject to a technical review in 2011. The object of such a review would be for EPA to assess the current and future availability of certified kits and to determine if any adjustments are necessary for the program including the effective date of the mandatory repower requirement and whether any change in the list of high-volume engine models is warranted due to new information.

With regard to technological feasibility, we believe engine manufacturers would utilize incremental improvements to existing engine components. Because such a remanufactured marine engine program would parallel our existing remanufactured locomotive program, we expect a direct transfer of emissions control technology from locomotives to marine engines for similar engines. In fact, in our discussions with vessel operators, they indicated that they are sometimes already using the EPA-certified lower emissions remanufacturing kits that are currently on the market to meet our locomotive remanufacturing program.

Engines that do not have a locomotive counterpart will in many cases start at a cleaner baseline than locomotive-based marine engines. Therefore, the same total reduction that could be expected from the locomotive remanufacture kits could not be expected from these engines. However, we would expect that similar PM emissions control technologies would be used to meet the requirements of the program. Technologies to achieve PM reductions include existing low-oil-consumption piston ring-pack designs and existing closed crankcase systems. Our discussions with marine diesel engine manufacturers suggest reductions of 25 percent with emissions not to exceed 0.22 g/kW-hr PM are feasible. These technologies would provide significant near-term PM reductions. Because all of the aforementioned technologies to reduce emissions already exist or can be developed and introduced into the market within a very short time period, we believe some of this technology could be implemented on a limited basis as early as 2008 on remanufactured marine engines. We also believe that these technologies could be fully implemented in a marine remanufacturing program by the end of 2012. In addition, it may be possible to include NO_X emission control technologies in these kits to achieve greater reductions.

To help ensure the remanufacturer's solutions are reasonably priced, the program could set a limit on the price the owner/remanufacturer could be expected to pay for the kit, similar to the urban bus program. Such a limit may be necessary because a program that would require the use of a certified kit may provide a potential short-term monopoly for kit certifiers, at least until other kits are certified. Such a monopoly environment may create the potential for kit prices to be unrelated to actual kit cost. However, unlike the urban bus program, the diverse nature of marine diesel engines makes setting a single cost limit per engine unreasonable. Instead, we would look to develop a factor that corresponds to engine size, power, or emissions. For example, we could consider setting a limit based on the PM reduction (the cost per ton of PM reduced). We could consider a limit of $45,000 per ton of PM reduced. This cost is far below the monetized health and welfare benefits we have estimated will be realized from a reduction in diesel PM emissions. We request comment on such an approach for setting a reasonable cost threshold.

As in the locomotive remanufacturing program, anyone could certify a remanufacturing kit, but only certified kits may be used to comply with the requirement. We expect this to be primarily engine manufacturers or aftermarket part manufacturers. However, a fleet owner with several vessels with the same model engine could choose to certify a kit, the use of which would then become mandatory for all engines of that model, unless another equivalent kit is also available for that model. In addition, certification could be streamlined for kit manufacturers. We would look to the Agency's past practices with the Urban Bus Program and the Voluntary Retrofit Verification Program when designing a certification procedure. However, as in the locomotive remanufacture program, the certifier is deemed to be a ''manufacturer'' subject to the emission standards and as such would be subject to all of the obligations on such an entity under our primary program, including warranty, recall, in-use liability, among others. With regard to the retrofit requirement, we request comment on how we could streamline the certification for these technologies such that their use will not impose a larger certification burden on the owner of the vessel. We welcome comments on all aspects of the implementation of this possible remanufacturing program.

The costs and benefits of a program as outlined above are included in Table VII–1 and Table VII–2. We estimate that the compliance costs for the marine remanufacturing program would be around $10 million per year in 2030. Using the benefits transfer approach from the primary control scenario to estimate the benefits of these inventory reductions, the additional monetized benefits would be expected to be about $0.3 billion at a 3% DR ($0.3 at a 7% DR) in 2030.

With regard to benefits, the application of locomotive remanufacture kits to similar marine diesel engines would be expected to result in similar reductions in PM and NO_X emissions. In some cases, this could be as much as 60 percent reduction for PM and 25 percent reduction for NO_X. However, because many marine diesel engines start at a cleaner baseline, we would not expect to accomplish the same reductions from all engines that would be subject to the program. Based on a minimal control case of a 25 percent PM reduction from existing marine diesel engines above 800 hp, we estimate about an additional 27,000 tons NPV 3% (16,000 tons at NPV 7%) of $PM_{2.5}$ reductions, and an additional 320,000 tons NPV 3% (220,000 tons at NPV 7%) of NO_X reductions through 2040.

B. Summary of Results

A summary of the five alternatives is contained in Table VII–1 and Table VII–2 below. Table VII–1 includes the expected emission reductions associated with each alternative, including: the estimated PM and NO_X reductions through 2040 for each alternative expressed as a net present value (NPV) using discounting rates of 3% and 7%. It also includes the estimated costs through 2040 associated with each alternative again expressed at 3% NPV and 7% NPV. For additional comparison, Table VII–2 shows the PM and NO_X inventory reductions, costs, and benefits of each alternative estimated for the year 2030.

TABLE VII–1.—SUMMARY OF INVENTORY AND COSTS AT NPV 3% AND 7%

Alternatives	Standards	Estimated $PM_{2.5}$ reductions 2006–2040 NPV 3% (7%)	Estimated NO_X reductions 2006–2040 NPV 3% (7%)	Total costs millions 2006–2040 NPV 3% (7%) [a]
Primary Case	• Locomotive Remanufacturing	315,000	7,870,000	$7,230
	• Tier 3 Near-term program	(135,000)	(3,180,000)	($3,230)
	• Tier 4 Long-term standards			
Alternative 1: Exclusion of Locomotive Remanufacturing.	• Tier 3 Near-term program	250,000	7,180,000	$6,430
	• Tier 4 Long-term standards	(100,000)	(2,780,000)	($2,700)
Alternative 2: Tier 4 Advanced One Year	• Locomotive Remanufacturing	324,000	8,290,000	$7,590+C
	• Tier 3 Near-term program	(140,000)	(3,390,000)	($3,440)+C
	• Tier 4 Long-term standards advanced one year.			
Alternative 3: Tier 4 Exclusively in 2013	• Tier 4 Long-term standards only in 2013	255,000	8,050,000	$7,410+C
		(104,000)	(3,280,000)	($3,220)+C
Alternative 4: Elimination of Tier 4	• Locomotive Remanufacturing	207,000	2,910,000	$950
	• Tier 3 Near-term program	(94,000)	(1,310,000)	($650)
Alternative 5: Inclusion of Marine Remanufacturing.	• Locomotive Remanufacturing	342,000	8,190,000	$7,650
	• Tier 3 Near-term program	(151,000)	(3,400,000)	($3,510)
	• Tier 4 Long-term standards			
	• Addition of Marine Remanufacturing			

[a] 'C' represents the additional costs necessary to accelerate the introduction of Tier 4 technologies that we are unable to estimate at this time.

TABLE VII–2.—INVENTORY, COSTS AND BENEFITS FOR 2030

	2030 $PM_{2.5}$ Emissions reductions (tons)	2030 NO_X Emissions reductions (tons)	2030 Total costs (millions)	2030 Benefits [a b] (billions) $PM_{2.5}$ only 3% (7%)
Primary Case	28,000	770,000	$610	$12 ($11)
Alternative 1: Exclusion of Locomotive Remanufacturing	25,000	740,000	$580	$8.8 ($8.0)
Alternative 2: Tier 4 Advanced One Year	28,000	790,000	$620	$12 ($11)
Alternative 3: Tier 4 Exclusively in 2013	25,000	770,000	$630	$11 ($10)
Alternative 4: Elimination of Tier 4	17,000	240,000	$22	$6.2 ($5.7)
Alternative 5: Inclusion of Marine Remanufacturing	29,000	770,000	$620	$12 ($11)

[a] Note that the range of PM-related benefits reflects the use of an empirically-derived estimate of PM mortality benefits, based on the ACS cohort study (Pope et al., 2002).
[b] Annual benefits analysis results reflect the use of a 3 percent and 7 percent discount rate in the valuation of premature mortality and nonfatal myocardial infarctions, consistent with EPA and OMB guidelines for preparing economic analyses (US EPA, 2000 and OMB, 2003). U.S. Environmental Protection Agency, 2000. Guidelines for Preparing Economic Analyses. *http://yosemite.epa.gov/ee/epa/eed.nsf/webpages/Guidelines.html*.

VIII. Public Participation

We request comment on all aspects of this proposal. This section describes how you can participate in this process.

A. How Do I Submit Comments?

We are opening a formal comment period by publishing this document. We will accept comments during the period indicated in the **DATES** section at the beginning of this document. If you have an interest in the proposed emission control program described in this document, we encourage you to comment on any aspect of this rulemaking. We also request comment on specific topics identified throughout this proposal.

Your comments will be most useful if you include appropriate and detailed supporting rationale, data, and analysis. Commenters are especially encouraged to provide specific suggestions for any changes to any aspect of the regulations that they believe need to be modified or improved. You should send all comments, except those containing proprietary information, to our Air Docket (see **ADDRESSES** located at the beginning of this document) before the end of the comment period.

You may submit comments electronically, by mail, or through hand delivery/courier. To ensure proper receipt by EPA, identify the appropriate docket identification number in the subject line on the first page of your comment. Please ensure that your comments are submitted within the specified comment period. Comments received after the close of the comment period will be marked ''late.'' EPA is not required to consider these late comments. If you wish to submit Confidential Business Information (CBI) or information that is otherwise protected by statute, please follow the instructions in section VIII.B.

B. How Should I Submit CBI to the Agency?

Do not submit information that you consider to be CBI electronically through the electronic public docket, *http://www.regulations.gov*, or by e-mail. Send or deliver information identified as CBI only to the following address: U.S. Environmental Protection Agency, Assessment and Standards Division, 2000 Traverwood Drive, Ann Arbor, MI 48105, Attention Docket ID EPA–HQ–OAR–2005–0036. You may claim information that you submit to EPA as CBI by marking any part or all of that information as CBI (if you submit CBI on disk or CD ROM, mark the outside of the disk or CD ROM as CBI and then identify electronically within the disk or CD ROM the specific information that is CBI). Information so marked will not be disclosed except in accordance with procedures set forth in 40 CFR part 2.

In addition to one complete version of the comment that includes any information claimed as CBI, a copy of the comment that does not contain the information claimed as CBI must be submitted for inclusion in the public docket. If you submit the copy that does not contain CBI on disk or CD ROM, mark the outside of the disk or CD ROM clearly that it does not contain CBI. Information not marked as CBI will be included in the public docket without prior notice. If you have any questions about CBI or the procedures for claiming CBI, please consult the person identified in the **FOR FURTHER INFORMATION CONTACT** section at the beginning of this document.

C. Will There Be a Public Hearing?

We will hold a public hearing on Tuesday, May 8, 2007 at the Hilton Seattle Airport & Conference Center, 17620 International Boulevard, Seattle, WA 98188–4001, *Telephone:* 206–244–4800. We will also hold a public hearing on Thursday, May 10, 2007 at the Sheraton Gateway Suites Chicago O'Hare, 6501 North Mannheim Road, Rosemont, IL 60018, *Telephone:* 847–699–6300. These hearings will both start at 10 a.m. local time and continue until everyone has had a chance to speak.

If you would like to present testimony at the public hearing, we ask that you notify the contact person listed under **FOR FURTHER INFORMATION CONTACT** at least ten days before the hearing. You should estimate the time you will need for your presentation and identify any needed audio/visual equipment. We suggest that you bring copies of your statement or other material for the EPA panel and the audience. It would also be helpful if you send us a copy of your statement or other materials before the hearing.

We will make a tentative schedule for the order of testimony based on the notifications we receive. This schedule will be available on the morning of the hearing. In addition, we will reserve a block of time for anyone else in the audience who wants to give testimony.

We will conduct the hearing informally, and technical rules of evidence won't apply. We will arrange for a written transcript of the hearing and keep the official record of the hearing open for 30 days to allow you to submit supplementary information. You may make arrangements for copies of the transcript directly with the court reporter.

D. Comment Period

The comment period for this rule will end on July 2, 2007.

E. What Should I Consider as I Prepare My Comments for EPA?

You may find the following suggestions helpful for preparing your comments:

- Explain your views as clearly as possible.
- Describe any assumptions that you used.
- Provide any technical information and/or data you used that support your views.
- If you estimate potential burden or costs, explain how you arrived at your estimate.
- Provide specific examples to illustrate your concerns.
- Offer alternatives.
- Make sure to submit your comments by the comment period deadline identified.
- To ensure proper receipt by EPA, identify the appropriate docket identification number in the subject line on the first page of your response. It would also be helpful if you provided the name, date, and **Federal Register** citation related to your comments.

IX. Statutory and Executive Order Reviews

A. Executive Order 12866: Regulatory Planning and Review

Under section 3(f)(1) of Executive Order (EO) 12866 (58 FR 51735, October 4, 1993), this action is an "economically significant regulatory action" because it is likely to have an annual effect on the economy of $100 million or more. Accordingly, EPA submitted this action to the Office of Management and Budget (OMB) for review under EO 12866 and any changes made in response to OMB recommendations have been documented in the docket for this action.

In addition, EPA prepared an analysis of the potential costs and benefits associated with this action. This analysis is contained in the draft Regulatory Impact Analysis that was prepared, and is available in the docket for this rulemaking and at the docket internet address listed under **ADDRESSES** above.

B. Paperwork Reduction Act

The information collection requirements in this proposed rule have been submitted for approval to the Office of Management and Budget (OMB) under the *Paperwork Reduction Act,* 44 U.S.C. 3501 *et seq.* The Information Collection Request (ICR) document prepared by EPA has been assigned EPA ICR numbers 1800.04 for locomotives and 1684.10 for marine diesels.

Section 208(a) of the Clean Air Act requires that manufacturers provide information the Administrator may reasonably require to determine compliance with the regulations; submission of the information is therefore mandatory. We will consider confidential all information meeting the requirements of section 208(c) of the Clean Air Act. Recordkeeping and reporting requirements for manufacturers would be pursuant to the authority of section 208 of the Clean Air Act.

The total annual burden associated with this proposal is about 25,209 hours for locomotives and 35,030 hours for marine diesels; $2,724,503 for locomotives, based on a projection of 7 respondents; and $2,018,607 for marine diesels based on a projection of 13 respondents. The estimated burden is a total estimate for both new and existing reporting requirements. Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information.

An agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. The OMB control numbers for EPA's regulations in 40 CFR are listed in 40 CFR part 9.

To comment on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including the use of automated collection techniques, EPA has established a public docket for this rule, which includes this ICR, under Docket ID number EPA–HQ–OAR–2003–0190. Submit any comments related to the ICR for this proposed rule to EPA and OMB. See **ADDRESSES**