

# Summary and Analysis of Comments on the Notice of Proposed Rulemaking for Emission Standards for Locomotives and Locomotive Engines

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## Introduction

On February 11, 1997 EPA published a Notice of Proposed Rulemaking (NPRM) which put forth proposed emission standards and test procedures for new locomotives and new locomotive engines. In that notice the Agency proposed emission standards applicable to all new production and much of the existing locomotive fleet beginning in 2000. In addition to the emission standards and test procedures, the NPRM also contained a proposed compliance program with provisions for certification and production line and in-use testing. Finally, EPA proposed provisions preempting state and local authority from imposing certain requirements relating to the control of emissions from locomotives.

EPA held a public hearing on the NPRM in Romulus, Michigan on May 15, 1997. At that hearing oral comments on the NPRM were received and recorded. A written comment period remained open following the hearing until June 16, 1997. A complete list of organizations and individuals which provided comments on the NPRM is contained in the following table. Common abbreviations for the organization names are also listed.

This summary and analysis of comments document contains a detailed summary of all comments EPA received on the NPRM as well as the Agency's analysis of each comment and response.

## List of Commenters

<u>Commenter</u>	<u>Abbreviation</u>
American Short Line Railroad Association	ASLRA
American Trucking Association	ATA
Amtrak	--
Association of American Railroads	AAR
Brotherhood of Locomotive Engineers and the United Transportation Union	--
California Air Resources Board	CARB
Caterpillar, Incorporated	--
Coalition of Independent Locomotive Aftermarket Suppliers	CILAS
County of San Diego Air Pollution Control District	--
Energy Conversion, Incorporated	ECI
Engine Manufacturers Association	EMA
General Electric Transportation Systems	GETS
General Motors Electromotive Division	GM or EMD
Inland Steel Company	ISC
Institute of Clean Air Companies	ICAC
Manufacturers of Emission Controls Association	MECA
Missouri State Department of Natural Resources	--
MotivePower Industries, Incorporated	MPI
New York State Department of Environmental Conservation	NYDEC
NJ TRANSIT	NJT
Natural Resources Defense Council	NRDC
Northeast States Coordinated for Air Use Management	NESCAUM
Railway Association of Canada	RAC
Siemens Power Corporation	--
South Coast Air Quality Management District	SCAQMD
State and Territorial Air Pollution Program Administrators and Local Air Pollution Control Officials	STAPPA/ALAPCO
State of Utah Department of Environmental Quality	--
Texas Utilities Services, Incorporated	TUSI
Carol A. Tino	--
Transtar, Incorporated	--
Wisconsin Central, Ltd.	WCL



## **CHAPTER 1 APPLICABILITY AND SCOPE**

EPA proposed to define "new" locomotives so as to include remanufactured as well as freshly-manufactured locomotives; it placed regulatory requirements on the end users as well as the producers of locomotives, and it proposed to preempt certain state controls relating to the control of emissions from new as well as in-use locomotives.

### **A. Definition of New Locomotive**

#### **Summary of Proposal:**

EPA proposed to define "new" for locomotives and locomotive engines in a manner consistent with, but not identical to, the statutory definition of "new motor vehicle" in Clean Air Act (CAA) Section 216, and the definition of "new nonroad vehicle" in 40 CFR part 89. For locomotives, EPA proposed to define "new" to include remanufactured locomotives and engines, based on the nature of the remanufacturing process, described in more detail in the NPRM.

#### **Summary of Comments:**

EPA received several comments on its proposed definition of "new" for locomotives and locomotive engines. ATA supported the inclusion of remanufactured engines in the proposed definition because, unlike other categories of engines that EPA regulates, locomotive engines have the longest useful life and are subsequently prone to the possibility of increasing emissions due to age and maintenance level. ATA opposed the alternative definitions of "new" raised by locomotive manufacturers and operators, noting that these definitions would not serve any public interest, and would be inconsistent with the long-standing existing definitions of "new" for other mobile sources. This inconsistency, this commenter stated, could result in a "double standard" for locomotives compared to other mobile sources, and may prompt petitions for similar treatment by fleets of heavy duty vehicles and other vehicle categories. This commenter also expressed concern that locomotive owners and operators could avoid any state-imposed in-use requirements under a definition of "new" that included as new all locomotives and engines manufactured or remanufactured after the date of enactment of the 1990 amendments to the Clean Air Act. San Diego APCD supported a flexible definition for "new engine," but did not elaborate further on its position.

EPA also received a comment from NRDC supporting the Agency's proposal to adopt standards for remanufactured locomotives and engines, based on the level and timing of emissions reductions expected from regulation of these sources, but stating that such locomotives and engines are not new. This commenter's view is that EPA has authority to regulate remanufactured locomotives and engines under its general authority pursuant to Section 301 of the Clean Air Act, because, without regulation of remanufactured locomotives and engines, emissions reductions from the rule would be minimal, and EPA could not regulate a locomotive that has been remanufactured for the remainder of its operational life.

NESCAUM opposed EPA's proposed definition of "new" recommended that EPA adopt a definition of "new" for locomotives that is consistent with the definition of "new motor vehicle" in Section 216 of the CAA. NESCAUM also pointed to the D.C. Circuit's opinion in Engine Manufacturers Assoc. v. EPA, 88 F.3d. 1075 (D.C. Cir. 1996), in which the court upheld EPA's definition of "new" for nonroad vehicles and engines (excluding locomotives and locomotive engines) as consistent with the CAA. NESCAUM noted that states would

effectively be preempted from ever regulating locomotives, under the proposed definition of “new” and the proposed preemption regulation. NYDEC opposing the proposed definition called EPA’s proposed preemption provision a “ridiculous and strained interpretation of the word ‘new,’” stating its position that locomotives are no longer new once they have been returned to service after maintenance, and that preemption should end there.

NJ TRANSIT commented that the definition of remanufactured should be consistent with industry standards, and only then can EPA consider remanufactured engines to be new. SCAQMD opposed EPA’s proposed definition of “new,” stating that the definition should not include remanufactured and upgraded engines, because an engine could be in use for 20 or 30 years and still be considered new, which limits the ability of state and local agencies to adopt emissions standards for in-use engines. The proposed definition, SCAQMD stated, in combination with EPA’s proposed definition of “useful life” would allow a locomotive operator to avoid a local standard simply by periodically having the engine remanufactured or upgraded.

Carol Tino recommended that the proposed definition of “new” be revised to include pre-1972 engines remanufactured to pre-1972 configuration, and that it should apply until the end of the engine’s useful life and as long afterward as it is in compliance with EPA’s standards. CILAS questioned whether EPA has authority to regulate remanufactured locomotives and engines, but did not oppose the proposed definition of “new,” stating its recognition that such regulation is necessary to ensure broad preemption.

AAR, EMA, GETS, and GM supported the alternative definitions of “new” discussed in the NPRM. EMA stated that, in order to provide certainty to manufacturers and railroads, EPA should adopt a definition of “new” under which all engines and locomotives manufactured or remanufactured after a certain date are considered to be new. EMA recommended that such “date certain” be the date of enactment of the 1990 amendments to the CAA (November 15, 1990), but should be no later than the effective date of this rule. AAR, which supported a definition of new under which all engines and locomotives manufactured or remanufactured after November 15, 1990, are considered new, stated that such a definition would be better suited to accomplishing EPA’s regulatory goals. Such a definition would provide for regulation at the federal, not state, level in clear and certain terms, AAR stated, and would provide an unambiguous jurisdictional line between EPA and states. AAR noted that EPA’s proposed definition of “new” would, in contrast, leave open the possibility that states would regulate locomotives because preemption would exist only for discrete preemption periods. AAR also stated that its recommended definition of “new” would allow EPA clear authority to regulate locomotive emissions from the time of manufacturing or remanufacturing until the locomotive was retired, removing any uncertainty over EPA’s authority to regulate remanufactured locomotives and engines or to require manufacturers and railroads to conduct in-use emissions tests. AAR also stated its view that the plain language of the CAA provides EPA discretion to define “new” appropriately for the railroad industry, because, unlike motor vehicles, Congress did not adopt a statutory definition of “new locomotive” or “new locomotive engine.” Moreover, AAR stated that a definition of “new” for locomotives different from that for other mobile sources is consistent with Congress’ decision to distinguish between locomotives and other nonroad engines. AAR noted that the CAA permits state regulation of emissions from new nonroad vehicles and engines, except in the case of locomotives and small farm and construction equipment. AAR also stated that the railroad industry is the only industry operating nonroad engines for which Congress included broad preemption, and that this approach is in keeping with Congress’ long history of recognizing that railroads should be regulated at the federal level, with broad preemption of state regulation. AAR also stated its view that EPA’s proposed definition of

new, while not the approach preferred by AAR, could work, and supported EPA's modifications to the historical definition of "new" for motor vehicles (*i.e.*, the inclusion of remanufactured locomotives and engines, providing examples of state requirements that are preempted, and defining specific preemption periods).

GETS supported a definition of "new" that would include any locomotive or engine manufactured or remanufactured after November 15, 1990, noting that Congress did not adopt a definition of "new" for locomotives and locomotive engines when it could easily have done so, limiting the definition of "new motor vehicle" in Section 216 to motor vehicles only. GETS stated that it is more logical to assume that Congress intended "new" in the context of locomotives to mean "not yet manufactured or remanufactured," which is the common understanding of the term "new." GETS also stated its view that this is how the word "new" was understood by the legislators who drafted Section 209, and is further supported by the dictionary definition of "new" ("having originated or occurred lately"). GETS also noted that Congress indicated when it wanted the term "new" to be interpreted in a different manner, citing to Section 216's definition of "new motor vehicle," Section 218's ban on manufacturing of engines requiring leaded gasoline for model years after 1992, and Section 211(f)'s references to motor vehicles manufactured after a certain date.

GETS also stated that its recommended definition of "new" is consistent with the need for nationwide uniformity in locomotive emissions regulation, and that preemption becomes meaningless if states can impose regulations immediately after title passes. In addition, GETS stated that EPA's proposed definition of "new" effectively reads the term "new engines used in locomotives" out of Section 209(e)(1) -- if "new" means that title has not yet passed, states would not be preempted from regulating remanufactured engines because title to such engines will have passed years earlier. GETS stated that Congress could not have intended such a result, given the burden on interstate commerce that would result, and the missed potential for emissions reductions that can be achieved from regulating remanufactured engines. GETS also pointed to the legislative history of the 1990 amendments to the CAA to support its position, and specifically to (1) a statement in the House Report accompanying the House bill that describes Section 209(e) preemption as not applying to "existing nonroad vehicles or engines," (2) a statement made during floor debate in the House objecting to the House bill's preemption provision for nonroad vehicles and engines on the grounds that it foreclosed state regulation of nonroad emissions, (3) a statement by the Chairman of the House Energy and Commerce Committee stating that, for new locomotives and new locomotive engines, Congress balanced the need to control emissions from new locomotives against its belief that state efforts to regulate locomotive emissions or operations would impose an unconstitutional burden on interstate commerce, and (4) statements made during debate on the Conference bill regarding the breadth of preemption of nonroad vehicles and engines, including a statement recognizing that states could continue to require existing and in-use engines to reduce emissions by setting fuel requirements.

GETS also stated that Allway Taxi has no bearing on locomotives because (1) that decision involved the statutory definition of "new motor vehicle," which Congress did not extend to locomotives, and (2) the Allway Taxi court's reasoning was that the motor vehicle statutory preemption scheme was designed to avoid an interstate commerce burden on the manufacturers of motor vehicles, and locomotives are different from motor vehicles with respect to operation in interstate commerce. In addition, GETS stated that the EMA v. EPA decision upholding EPA's definition of new for nonroad vehicles and engines other than locomotives did not address preemption under Section 209(e)(1)(B), and, because subsection (B) refers to locomotives and

engines used in locomotives, unlike subsection (A) which refers only to engines used in certain farm and construction equipment, subsection (B) differs from subsection (A), which was the only provision at issue in the EMA case.

#### Analysis of the Comments:

EPA is finalizing the proposed definitions of “new locomotive” and “new locomotive engine,” for the reasons described in the NPRM. The NPRM described in detail EPA’s basis for including remanufactured locomotives and engines in the definition of “new” -- the extensive nature of the remanufacturing process and the unique role of remanufactured engines in the locomotive industry. EPA did not receive comments regarding its views on the nature of the remanufacturing process, and whether that process was sufficiently exhaustive so that the resulting remanufactured locomotive or engine should be considered new. NRDC, which stated that such engines are not new, so EPA should regulate them under Section 301 rather than under Section 213, did not provide support for its assertion that remanufactured engines are not new. EPA continues to believe that, for the reasons described in the NPRM, the nature of the remanufacturing process is such that it is reasonable to consider such engines new.

EPA disagrees with CILAS concerning EPA’s authority to include remanufactured locomotives and engines as new, and to set emissions standards for such vehicles and engines. While Congress adopted a definition of “new motor vehicle or engine” in Section 216 of the CAA, it did not define “new locomotive” or “new locomotive engine.” Had Congress intended EPA to apply a particular definition of “new” for locomotives and locomotive engines, Congress would presumably have adopted such a definition in the CAA. However, in the absence of a statutory definition of “new” for locomotives and locomotive engines, EPA has discretion to adopt a reasonable definition that is consistent with Congressional intent. In EMA v. EPA, the court held that EPA’s adoption of a definition of “new” for nonroad vehicles and engines other than locomotives was reasonable, and EPA’s discretion to adopt a definition consistent with Section 216’s definition of “new motor vehicle” was not precluded by Congress’ failure to define “new nonroad engine” in a manner consistent with the definition of “new motor vehicle.” The court therefore upheld EPA’s definition under a Chevron step two analysis. [cite to Chevron, EMA] While NESCAUM noted that the EMA case is not relevant to the definition of “new” for locomotives and locomotive engines in Section 209(e)(1)(B), because EMA addressed EPA’s interpretation of Section 209(e)(1)(A), which refers only to certain nonroad engines and not to nonroad vehicle categories, EPA notes that Section 209(e)(1) uses the word “new” to modify both subsections (A) and (B): “No state or political subdivision thereof shall adopt or attempt to enforce any standard or other requirement relating to the control of emissions from **either of the following new** nonroad engines or nonroad vehicles ... (A) New engines which are used in construction equipment or vehicles or used in farm equipment or vehicles and which are smaller than 175 horsepower. (B) New locomotives or new engines used in locomotives.” (emphasis added). It is difficult to believe that Congress would have used a single word (new) once to modify two categories of nonroad vehicles and engines, and intended that single word to be interpreted differently for each category. Therefore, EPA believes that Congress intended the definitions of “new” for each category in Section 209(e)(1) to be interpreted in a consistent manner, differing only where justified by differences in the two categories, and that the D.C. Circuit’s opinion in EMA v. EPA is relevant to EPA’s interpretation of “new” for locomotives and locomotive engines.

EPA also disagrees with commenters who stated that EPA’s proposed definition of “new”

for locomotives and locomotive engines is inconsistent with the CAA definition of “new motor vehicle” and the Agency’s regulatory definition of “new” for other nonroad vehicles and engines. As described in the NPRM, EPA’s proposed definition of “new” is modeled on the definition previously adopted for other nonroad vehicles and engines, which, in turn, is consistent with CAA Section 216’s definition of “new motor vehicle.” The definition of “new” adopted today, like the definitions for other mobile sources, states that a locomotive or engine is new from the time of initial manufacture until it is sold (or placed into service). As described above, and in the NPRM, the inclusion of remanufactured engines as new is reasonable, and is consistent with the definitions of “new” for other mobile sources, because locomotive engines, unlike other mobile source engines, are remanufactured through a process that is very extensive and results in an engine that is new in all material respects, both mechanically and in terms of how it is used. Consistent with the approach for freshly manufactured locomotives, and for other new vehicles and engines, remanufactured locomotives and engines will be considered to be new from the time of remanufacture until they are placed back into service. For these reasons, EPA does not agree that the definition of “new” for locomotives and engines adopted today is a “ridiculous and strained” interpretation of that term; instead, it is a reasonable interpretation consistent with past practice, and justified by the unique aspects of remanufactured locomotives described above and in the NPRM.

EPA disagrees with commenters who stated that EPA’s proposed definition of “new” is inconsistent with Congressional intent, based on Congress’ failure to explicitly define “new locomotive” or “new locomotive engine” in a manner consistent with Section 216’s definition of “new motor vehicle.” As stated above, the court in EMA v. EPA held that the absence of a definition of “new nonroad engine” in Section 216 does not foreclose the possibility that, in Title II, “new” was intended to mean the same thing in the adoption of the 1990 amendments that it meant in the past (*i.e.*, in Section 216). Moreover, the EMA court cited to various factors supporting EPA’s interpretation of “new” for nonroad vehicles and engines in a manner consistent with the statutory definition of “new motor vehicle,” including the “parallel treatment” of nonroad vehicles and motor vehicles in the CAA, the similarity of the structure of nonroad regulation and motor vehicle regulation compared to stationary source regulation, and the placement of nonroad source regulation in Title II of the CAA rather than Title I. [cite to page] These factors also apply to locomotives and locomotive engines, and similarly support the reasonableness of a definition of “new” for such vehicles and engines that is consistent with Section 216.

EPA particularly disagrees that Congress intended “new” for locomotives and locomotive engines to be defined in a manner similar to the definition of “new” for stationary sources under Title I of the CAA. This issue was addressed at length in EMA v. EPA, and, as described above, EPA believes that the court’s reasoning in that case also applies to the locomotives context. In particular, the court rejected EMA’s arguments that the legislative history of the 1990 amendments to the CAA indicate Congress intended “new” for nonroad vehicles and engines to be defined so as to include all locomotives and engines manufactured after the date of enactment of the 1990 amendments. In fact, the EMA court specifically stated that a statement in the legislative history that preemption under Section 209 “does not apply to existing nonroad vehicles or engines” is “insufficient to bar the EPA’s interpretation, especially because it was written before the conferees substantially altered the preemption language in the House bill as part of a compromise with the Senate bill that contained no preemption.” [cite to page] As described in the comment summary above, GETS referred to the same statement in the legislative history to support its assertion that Congress could not have intended “new” for locomotives to be defined as EPA proposed. EPA agrees with the D.C. Circuit’s opinion in

EMA regarding this piece of legislative history, and does not believe that this isolated statement compels a definition of “new” for locomotives and locomotive engines that differs so significantly from previous definitions.

GETS also referred to a statement by Chairman Dingell during the House debate on the Senate preemption provision stating that, for new locomotives and new locomotive engines, Congress balanced the need to control emissions from new locomotives against its belief that state efforts to regulate locomotive emissions or operations would impose an unconstitutional burden on interstate commerce. EPA agrees that this statement, cited in the NPRM, indicates Congress’ concern that state regulation of locomotives in particular could result in a disruption of interstate commerce. However, EPA disagrees with the commenter’s conclusion that this statement supports a definition of new for locomotives that is radically different than that for all other vehicles and engines. The commenter states that Chairman Dingell makes no mention of the “title passing” definition of new. EPA disagrees that the lack of any reference to the definition of new for locomotives being consistent with the definition of new for other vehicles and engines evidences Congressional intent to have a different definition of new. In fact, the lack of any such reference in Chairman Dingell’s statement is more likely evidence that no drastically different definition of new was intended for locomotives. In any event, EPA believes that clear evidence of Congressional intent to define new differently for locomotives than for all other mobile sources would be needed to support such a definition, and the absence of any reference to the definition of new does not constitute such evidence.

EPA also disagrees with GETS’s interpretation of Sen. Chafee’s statement regarding state regulation of locomotives. GETS argues that Sen. Chafee’s statement that “because the preemption is limited to new engine standards only, states can continue to require existing and in-use engines to reduce emissions by setting fuel requirements on the use of such equipment” does not indicate that Congress intended there to be a distinction between new and in-use locomotives and engines, but instead that Sen. Chafee was referring to locomotives existing before the passage of the 1990 amendments to the Clean Air Act, and not yet remanufactured. GETS claims that this is the only category of locomotives that states are not preempted from regulating. EPA disagrees with this interpretation. Sen. Chafee’s statement clearly indicates that Congress intended a distinction between new locomotives and engines (to which the preemption provision is limited, according to Sen. Chafee’s statement), and existing and in-use locomotives (which are not new, and are therefore not covered by the statutory preemption provision). EPA believes that its interpretation of Sen. Chafee’s statement is eminently reasonable, and is in fact the most natural reading of this statement, in light of the statutory language of the preemption provision, other legislative history, and the D.C. Circuit’s opinion in EMA v. EPA.

EPA also disagrees with GETS’s interpretation of a statement by Rep. Moorehead during the House debate on H.R. 3030. GETS stated that Rep. Moorehead objected to the nonroad preemption provision in the House bill because it totally foreclosed the states from any regulation of nonroad emissions. However, GETS stated, the House bill passed despite Moorehead’s objections. EPA notes that the preemption provision in H.R. 3030 as passed the House is not the same as the preemption provision finally adopted as Section 209(e)(1). H.R. 3030’s preemption provision stated that “[n]o state or any political subdivision thereof shall adopt or attempt to enforce any standard or other requirement relating to the control of emissions **from new nonroad engines or nonroad vehicles subject to regulation under this Act.**” (emphasis added). Because the Moorehead statement referred to a preemption provision different from that finally adopted, EPA disagrees that this statement, and the House’s passage of H.R. 3030 over Moorehead’s objections, indicates that Congress intended Section 209(e)(1) to

preclude all state regulation of locomotives. As described in the NPRM, the Senate bill, in contrast to the House bill, contained no express preemption of state regulation of nonroad vehicles and engines. In conference the House and Senate agreed to limit the House bill's broad preemption to only two categories of nonroad vehicles and engines: (new farm and construction equipment of 175 hp or less, and new locomotives).

EPA also disagrees with GETS's statement that Allway Taxi has no bearing on locomotives. While the Allway Taxi decision specifically addressed preemption of state regulation of motor vehicles under Section 209(a), Congress adopted a very similar preemption approach for nonroad vehicles and engines under Section 209(e). Moreover, the court in EMA v. EPA recognized that Allway Taxi is relevant to Section 209(e), stating that in reviewing proposed California standards for which California is seeking a waiver of federal preemption under Section 209(e)(2), EPA can apply its expertise to determine whether the California standards violate Allway Taxi. [cite to page, also to fn 39] This indicates that the court believed it was appropriate for EPA to apply the principles of Allway Taxi in the context of nonroad vehicles and engines; there is no reason to believe that Allway Taxi is relevant to nonroad vehicles and engines generally, but not to locomotives and locomotive engines. Moreover, while EPA agrees that the locomotive industry poses unique issues regarding interstate commerce, compared to the motor vehicle industry, Allway Taxi is not irrelevant to locomotives for that reason. The Allway Taxi court referred to prevention of undue burdens on motor vehicle manufacturers as the purpose of Section 209(a)'s preemption of state standards for new motor vehicles. Presumably, similar concerns prompted Congress to adopt a similar preemption provision for new locomotives and new locomotive engines. In addition, EPA has addressed the unique interstate commerce concerns that apply to the locomotive industry compared to the motor vehicle industry in its preemption regulation, which is based on the significant effects that certain state and local requirements would have on manufacturers (including remanufacturers) of new locomotives and new locomotive engines.

EPA does agree that national uniformity of emissions regulation is particularly important in the locomotive industry, compared to other mobile source industries. As described in Section C of this Chapter regarding preemption of state and local requirements, EPA has clearly defined the scope of preemption of such requirements, including specification of certain categories of state and local requirements that are preempted for a period exceeding the useful life of the locomotive or engine. Therefore, EPA disagrees with the commenter who stated that EPA's proposed definition of "new" renders preemption meaningless. First, EPA notes that the EMA court rejected EMA's argument that EPA's definition of "new" for nonroad vehicles and engines other than locomotives rendered Section 209(e)(1)'s preemption provision a nullity. The court stated that the Section 216 definition of "new motor vehicle," which was similar to EPA's regulatory definition of "new" for nonroad vehicles and engines other than locomotives, has not rendered Section 209(a) preemption a nullity, and noted that the Allway Taxi interpretation serves to prevent the definition of "new motor vehicle" from nullifying the motor vehicle preemption regime. Since the definition of "new" adopted today is consistent with the regulatory definition of "new" for nonroad vehicles and engines, and with the statutory definition of "new motor vehicle," the same analysis applies here. In addition, EPA is codifying the Allway Taxi interpretation as applied to preemption of state and local requirements relating to emissions from new locomotives and new locomotive engines in a manner that ensures that Section 209(e)(1) preemption will be effective and will be applied to further the goals of Congress in enacting Section 209(e)(1). Under the regulations adopted today, remanufactured locomotives and engines are considered new from the time of remanufacture until placed back into service, regardless of when title passed. Moreover, states and localities are preempted from

adopting certain categories of emissions requirements for such engines for a period equivalent to 133 percent of the useful life of the remanufactured locomotive or engine, as discussed in Section D of this Chapter.

## **B. Railroad Requirements**

### Summary of the Proposal:

EPA proposed several requirements applicable to the operators of locomotives (i.e., railroads). First, the railroads must reasonably supply locomotives to the manufacturers for purposes of testing under the manufacturer in-use testing program. In cases where a railroad failed to meet this requirement EPA could, under section 114 of the Act, require that railroad to perform the testing itself. Second, the railroads themselves must comply with the in-use testing requirements of the post-useful life railroad in-use testing program. Third, failure to perform all proper maintenance would subject a railroad to civil penalties for tampering. Finally, EPA proposed that these requirements apply to the operator of a leased locomotive rather than its owner.

### Summary of the Comments:

EPA received one comment objecting to the proposed requirements that locomotive operators, rather than owners, perform required maintenance in the case of leased locomotives. AAR commented that the owner of a locomotive should be responsible for maintenance, since the owner possesses the records needed to determine when routine maintenance should be performed. AAR also pointed out that a lessee might not possess a locomotive for a long period of time or have complete maintenance information. CILAS agreed with EPA's proposal that the railroad requirements are more appropriately placed on the operator rather than the owner in the case of leased locomotives. CILAS noted that the operator of a leased locomotive is much better prepared than the locomotive owner to comply with these requirements.

Comments received on EPA's proposed railroad in-use testing and maintenance requirements, except comments relating to leased locomotives, are addressed in the sections on in-use testing and maintenance elsewhere in this document.

### Analysis of the Comments:

EPA believes that it is appropriate to require a railroad to provide locomotives to the manufacturers for the purposes of in-use testing, to comply with the railroad in-use testing requirements and to perform the required maintenance on the locomotives it owns and operates. Specific comments on how these different programs should be structured are addressed elsewhere in this document. EPA agrees with AAR that, in the case of leased locomotives, the locomotive owner is better prepared than the locomotive operator to ensure compliance with these requirements. This would be especially true in cases maintenance in the context of shorter term leases where the operator may not know when the last maintenance was performed. Thus, EPA will hold the owners of leased locomotives liable for compliance with the railroad requirements. While it may be more appropriate to require the operator to perform the proper maintenance in cases of long term leasing, EPA believes that it would unnecessarily complicate these requirements to attempt to define when an owner is responsible and when an operator is



responsible. Also, for purposes of enforcement simplicity, EPA desires to hold a single entity liable for proper maintenance, and thus does not desire an approach which holds both the owner and operator liable for compliance with the railroad requirements. The Agency believes the parties involved in a leasing agreement can make their own alternate arrangements concerning responsibility for complying with the railroad requirements as part of that leasing agreement. In such cases, however, EPA will ultimately hold the owner liable for compliance.

### **C. Preemption of State Regulation**

#### Summary of Proposal:

EPA proposed to adopt a regulatory provision to codify its interpretation of the statutory preemption of state and local standards and requirements relating to the control of emissions from new locomotives and new locomotive engines in CAA Section 209(e)(1). EPA proposed to interpret Section 209(e)(1)'s preemption as prohibiting states from regulating in-use locomotives and engines in a manner that affects the design and manufacture of new (including remanufactured) locomotives and engines. EPA proposed to specify certain state requirements that would be preempted for a period equivalent to 1.25 times useful life, based on EPA's analysis of expected effects of certain state standards and requirements.

#### Summary of Comments:

EPA received several comments regarding the regulations proposed to implement Section 209(e)(1) of the CAA. AAR, EMA, Amtrak, GETS, and GM supported EPA's proposed regulation, stating that preemption of a broad range of state and local emissions standards and requirements is critical for the railroad industry due to the interstate nature of its operations, and that broad preemption is also needed to make the federal program workable. Some of the supporting comments recommended extending the preemption provision to include auxiliary engines used in locomotives, and to post-1972 locomotives and engines exempt from the Tier 0 standards. NRDC disagreed that the railroad industry would be unduly disrupted by state requirements, and also opposed the proposed preemption regulation due to the need for NOx reductions from locomotives in California's South Coast basin. NRDC stated that remanufactured locomotives and engines are not new, and Section 209(e)(1) only preempts state and local emissions standards and requirements for new locomotives and engines. NRDC referred to statements in the legislative history of the 1990 amendments to the CAA to support its position.

NESCAUM stated that EPA's proposed scope of preemption is contrary to law because it departs from the historical regulation of motor vehicles and engines and other nonroad vehicles and engines. NESCAUM agreed that state emissions standards that significantly impact the original design or manufacture of a locomotive or engine should be preempted; however, NESCAUM disputed EPA's application of the relevant caselaw (specifically, Allway Taxi v. City of New York, 340 F.Supp. 1120 (S.D.N.Y., aff'd, 468 F.2d. 642 (2d Cir. 1972)) to the context of locomotive regulation, stating that the scope of preemption should not extend beyond the concern expressed by the court in Allway Taxi regarding the effects of state and local regulation on interstate commerce. Moreover, NESCAUM noted, Allway Taxi stands for Congressional intent to preempt state regulation of new automobiles, and does not represent a principle of preemption for vehicles and engines that are not new. NESCAUM stated that EPA cannot preempt state in-use testing requirements, retrofit requirements, fuel requirements, or use restrictions that do not have an impact on the initial design or manufacture. While EPA is the

logical agency to regulate emissions from locomotives because of the interstate nature of the industry, NESCAUM stated, EPA does not need to preempt state action to have effective enforcement of its federal standards. Carol Tino opposed preemption of state in-use testing requirements identical to the FTP, based on EPA's proposed definitions of "new" and "useful life," and the proposed in-use testing requirements. Carol Tino stated that increasing the number of engines tested should not affect the design of the new locomotive or engine, and, even if state in-use testing would induce manufacturers and remanufacturers to alter their designs, categorical preemption of state in-use testing is not justified -- it may be that federal in-use testing is inadequate, and that technology does in fact exist to achieve additional emissions reductions. AAR supported preemption of state in-use testing programs using testing requirements identical to the FTP. AAR noted EPA's statement in the NPRM that state testing requirements could affect engine design, and also stated that all state in-use testing programs, regardless of whether they utilize the FTP, would be redundant because such programs would be in addition to the proposed federal in-use testing programs that EPA has determined are cost-effective. AAR also suggested that the preemption period apply to any state requirement pertaining to locomotive emissions, not just to the categories of state requirements enumerated in the regulation.

NYDEC stated that EPA's proposed preemption regulation goes beyond the intent of Congress, and represents a strained interpretation of the word "new." In addition, NYDEC said that the proposed scope of preemption would hamper states' ability to regulate nuisances, and to control their emissions inventories. In particular, NYDEC opposed preemption of state in-use testing requirements, recommending that EPA delegate in-use testing to states, and also allow states to adopt additional testing requirements. The commenter questioned EPA's basis for preempting state in-use testing requirements, asking why EPA would use the potential of additional emissions reductions from a high rate of in-use testing to preempt states from having their own inspection programs -- all engines should be designed to meet emissions standards, regardless of the rate of in-use testing. Utah DEQ opposed preemption of state inspection and maintenance programs for locomotives, noting that the preemption regulation proposed for locomotives could set an undesirable precedent for on-highway vehicles and engines, and other nonroad sectors. Utah DEQ noted that federal inspection is likely to be more sporadic and less stringent than local testing, and that local control is important for achieving SIP goals, especially in nonattainment areas, and especially if EPA adopts a NAAQS for PM-2.5. SCAQMD opposed preemption, stating that the proposed preemption provision goes beyond statutory preemption and forecloses the possibility of more stringent standards in the future if needed. In addition, SCAQMD stated that remanufactured engines should not be considered new, because, in light of the proposed preemption regulation, local regulation could be avoided by periodic remanufacturing. SCAQMD also stated that EPA's implementation of Section 209(e)(1) in a way that ensures no in-use restrictions or standards directly conflicts with the intent of Congress in enacting that provision. Moreover, SCAQMD believes that EPA's analysis of Allway Taxi conflicts with Congressional intent in enacting Section 209(e)(2), which envisions EPA authorizing emissions standards for non-new locomotives and engines.

STAPPA/ALAPCO opposed preemption of state standards for remanufactured locomotives and engines, stating that preemption of such standards was inappropriate unless specifically required by Congress, ties states' hands unnecessarily, and precludes states from taking advantage of technological advances in remanufacturing. NYDEC requested clarification from EPA that state regulation of the manufacturing or remanufacturing process would not be preempted, such as VOC RACT requirements for surface coating.

#### Analysis of Comments:

EPA is finalizing the preemption regulation as proposed, for the reasons described in the NPRM. To implement Section 209(e), as directed by Congress, and particularly Section 209(e)(1)(B), EPA is adopting regulations to define the scope of preemption of state and local emissions standards and other requirements for new locomotives and new engines used in locomotives. EPA's interpretation of this provision of the CAA is consistent with Congressional intent, and represents an appropriate balancing of the competing policy goals. EPA also believes that new auxiliary engines are covered by the preemption provisions because they are engines used in locomotives.

EPA disagrees with commenters who characterized EPA's proposed regulations as inconsistent with Allway Taxi. Although the specific facts of that case involved local regulation of motor vehicles, it is relevant because Congress clearly modeled the language of Section 209(e) on Section 209(a). As the Allway Taxi court recognized, the goal of Congress in enacting Section 209(a) was to avoid the burden on interstate commerce that could result from state or local emissions requirements that significantly affect the design or manufacture of a new motor vehicle. States cannot circumvent the CAA's statutory preemption provision by regulation of non-new vehicles and engines in a manner that affects the design or manufacture of a new vehicle or engine, because such state regulation would essentially operate as a regulation of the new vehicle or engine.

EPA disagrees with NESCAUM's comment that EPA's proposed scope of preemption is contrary to law because it departs from the historical regulation of motor vehicles and engines. While Congress did adopt the same general approach to preemption for nonroad vehicles and engines, including locomotives, as for motor vehicles and engines, EPA has discretion to interpret the statutory preemption provision for locomotives in a manner consistent with Congressional intent, pursuant to Section 209(e)'s directive that EPA promulgate regulations to implement that section. Moreover, EPA notes that NESCAUM's concern regarding the scope of preemption stems from its opposition to EPA's inclusion of remanufactured locomotives and engines in the proposed definitions of "new locomotive" and "new locomotive engine." NESCAUM agrees that state requirements that impact the "initial design or initial manufacture" of the locomotive or engine should be preempted by Section 209, but recommends that EPA adopt a definition of "new" for locomotives that does not include remanufactured locomotives and engines. EPA's rationale to support its definition of "new" for locomotives is addressed in Section A of this Chapter. For the reasons described in that section and in the NPRM, EPA determined that remanufactured locomotives and engines should be considered new locomotives and engines until they are placed back into service, and that this definition is consistent with EPA's definition of new for other nonroad vehicles and engines.

While EPA recognizes that the preemption regulation adopted for locomotives will give states less flexibility to regulate locomotive emissions than emissions from other mobile sources, this broader preemption is reasonable in light of the unique circumstances of the locomotive industry. For the reasons described in the NPRM, EPA determined that certain categories of state standards and requirements would significantly affect the design of the new (including remanufactured) locomotive or engine, and are therefore preempted by Section 209(e). To provide the locomotive industry with a degree of certainty regarding the scope of preemption, which is appropriate in light of the interstate nature of locomotive operations, EPA is codifying

its proposed determination regarding these categories of state standards and requirements.<sup>1</sup> EPA received no comments challenging its conclusions regarding the impact on new locomotives and engines of such state standards. EPA solicited comment on preemption of state in-use testing programs that use test procedures identical to the federal test procedure. EPA has reviewed the comments received, and finds them sufficiently compelling to conclude that such state in-use testing programs should not be categorically preempted. However, EPA is finalizing its proposed determination that state in-use testing programs using non-federal test procedures are preempted because of the impact such programs would have on the design and manufacture of new locomotives and engines. EPA believes that federal enforcement testing, combined with manufacturer and railroad in-use testing requirements adopted today, will ensure widespread testing of in-use locomotives, and will address commenters' concerns that expected reductions will not be achieved. EPA notes that its preemption of non-federal state in-use testing programs is based on the agency's determination regarding the effect of such programs on new locomotive design or manufacture, and is not an attempt to make federal enforcement more effective. EPA intends federal enforcement of the standards and requirements adopted today to be comprehensive and effective in any case. Moreover, EPA disagrees that the scope of preemption adopted today forecloses the possibility of more stringent standards for locomotives in the future -- EPA may well adopt "Tier 3" standards for new locomotives and engines in the future, if appropriate. In addition, states may regulate the use and operation of locomotives in a manner that does not significantly affect the design or manufacture of a new (including remanufactured) locomotive or engine, potentially allowing states to control nuisances.

EPA disagrees with SCAQMD's comment that EPA's interpretation of Allway Taxi conflicts with Congressional intent in enacting Section 209(e)(2), which envisions EPA authorizing emissions standards for non-new locomotives and engines. Pursuant to Section 209(e)(2), California may obtain a waiver of federal preemption for standards and other requirements relating to the control of emissions from non-new locomotives and engines, as well as certain other categories of nonroad vehicles and engines. The preemption regulation finalized today simply clarifies that certain emissions standards and requirements for non-new locomotives would significantly affect the design or manufacture of a new locomotive, and are therefore preempted by Section 209(e)(1)'s prohibition against state standards for new locomotives. California can still seek a waiver under Section 209(e)(2) for state standards and requirements that do not significantly affect the design or manufacture of a new locomotive. Even for those state standards and requirements that are not expressly included in the preemption regulation adopted today, EPA would not grant California a waiver under Section 209(e)(2) unless the state's regulation was consistent with Section 209(e)(1) -- a state regulation purporting to control emissions from non-new locomotives would be inconsistent with Section 209(e)(1) if it significantly affected the design or manufacture of a new locomotive, and no waiver would be granted.

Finally, EPA notes that the preemption regulation adopted today only addresses state regulation of emissions from locomotives and locomotive engines, not emissions produced during the process of manufacturing or remanufacturing new locomotives and engines.

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<sup>1</sup> As noted in the NPRM for this rulemaking, the legislative history of the 1990 amendments to the CAA indicates Congress' concern that state regulation of locomotive emissions in particular could result in a disruption of interstate commerce.

## **D. Period of Preemption**

### Summary of Proposal:

EPA proposed that the local and state standards and requirements relating to the control of emissions from new locomotives and locomotive engines discussed in the previous section be preempted for a period equivalent to 1.25 times the locomotive's useful life. EPA chose this value to balance the need for flexibility in the scheduling of remanufactures with EPA's concerns that the emission reductions expected are actually achieved.

### Summary of Comments:

AAR commented that the proposed preemption period should be 1.5 times the useful life, stating that railroads are already operating their 4000 hp locomotives for periods beyond the proposed preemption period prior to remanufacture. AAR stated that if the preemption period is not lengthened then railroads face a risk of state regulation. As described in Chapter 7, AAR submitted railroad remanufacturing interval data after the comment period suggesting that a preemption period of 1.69 times useful life would encompass 95 percent of locomotives prior to remanufacture.

### Analysis of Comments:

The remanufacture data that AAR submitted showed a distinct bimodal distribution, as shown in Appendix C. EPA's proposed preemption multiplier would cover most, but not all, of the group of locomotives encompassing the shorter remanufacture interval peak. While EPA believes that it is appropriate to increase the preemption multiplier to include more of the locomotives in the shorter remanufacture interval peak, it cannot assume that remanufacture intervals will always have this bimodal distribution. If EPA were to set a preemption period which would encompass most of the locomotives represented by the data AAR submitted, EPA would have to substantially increase the preemption period from that proposed. As discussed in the NPRM, EPA believes that it is appropriate to link the useful life and preemption periods in order to have some assurances that locomotives falling within the preemption period will have good emissions performance. Further, as discussed in the "Useful Life" Section in Chapter 2, EPA believes that the useful life values it is finalizing are appropriate. The locomotives in the AAR data represented by the longer remanufacture interval peak belong to a single railroad which does a tremendous amount of running maintenance and replacement of worn components, resulting in remanufacture intervals for that railroad far greater than are typical for the rest of the railroad industry. If the railroad industry average remanufacture intervals increased noticeably it would be a good indication that locomotives are being designed and manufactured or remanufactured to have longer mechanical lives. If this were the case, EPA would require that the useful lives of those locomotives be specified at values greater than the default useful life value, as discussed in the "Useful Life" Section in Chapter 2. A longer useful life than the default would increase the actual period of preemption correspondingly. Thus, EPA is finalizing a preemption period of 1.33 times useful life in order to include the majority of locomotives it believes are remanufactured according to standard industry practice, and believes that its useful life provisions should provide preemption periods appropriate for the railroad industry.

## **E. Auxiliary Engines**

### Summary of the Proposal:

It is not uncommon for passenger locomotives to have an auxiliary engine dedicated to the generation of electrical power for use in the passenger cars for such things as lighting, heating, and air conditioning (i.e., hotel power). Such engines tend to be well under 1000 hp and are separate from engines used to propel the passenger locomotive. These auxiliary engines are currently required to meet emission standards for nonroad compression ignition engines above 37 kW (59 FR 31335, June 17, 1994, and 40 CFR part 89). EPA did not propose any changes to this regulatory scheme, and proposed that such auxiliary engines continue to be covered by the provisions of 40 CFR part 89 regardless of the emissions standards ultimately adopted for locomotives (and locomotive engines providing propulsion power).

#### Summary of the Comments:

EPA only received one substantive comment concerning the regulation of locomotive auxiliary engines. CARB stated that, while most of these auxiliary engines are on passenger locomotives, some non-passenger locomotives may also have such engines. CARB thus requested that EPA clarify that the 40 CFR part 89 provisions apply to all such auxiliary engines, not just those on passenger locomotives. EPA also received some comments regarding the status of preemption of state regulation of auxiliary engines used on locomotives. Preemption issues relating to auxiliary engines are discussed In Section C of this Chapter.

#### Analysis of the Comments:

EPA agrees with CARB that the 40 CFR part 89 provisions should appropriately apply to auxiliary engines on all locomotives, not just passenger locomotives. Thus, EPA is clarifying the applicability of the 40 CFR part 89 provisions so it is clear that these provisions apply to all new compression ignition auxiliary engines used on locomotives. It should be noted that the definition of "new" is somewhat different for engines under the 40 CFR part 89 provisions than under the locomotive regulations, and that the 40 CFR part 89 provisions do not cover in-use engines at the time of remanufacture. However, the tampering prohibition contained in the Clean Air Act requires that if they are remanufactured, it is done in such a manner that they still meet the applicable emission standards.

## **CHAPTER 2 EMISSION STANDARDS**

EPA proposed three different tiers of locomotive emission standards: Tier 0 and Tier 1 standards, effective on January 1, 2000, and Tier 2 standards, effective on January 1, 2005, with the applicability of the standards dependent on the date of original manufacture of the locomotive. All new locomotives would be required to meet these standards based on testing over representative line haul and switching duty cycles. The Agency also proposed that the standards must be met over the full useful life of the locomotive. Appendices A and B contain additional analysis of the lead time and feasibility comments.

### **A. Duty-cycles**

#### **A.1. Duty-cycles/Notch Caps**

##### **Summary of the Proposal:**

In general, there are three distinct types of locomotive operation: switch operations, passenger service, and line-haul operations. Each of these types of operation tends to have a different average duty-cycle associated with it.<sup>2</sup> In general, switch operation involves much time in idle and low power notches, whereas line-haul operation is characterized by a much higher percentage of time in the high power notches, especially notch 8. Passenger locomotive operation tends to fall between switch and line-haul operation. EPA developed duty-cycle notch weighting factors representative of each of these three types of operation based on in-use operations data and historical duty-cycles developed by the locomotive manufacturers and railroads.

In the proposal, EPA expressed a desire to effectively control the emissions of locomotives over the variety of usage patterns they are operated over, while minimizing the cost and burden of such control. EPA considered three options for applying standards to the different types of locomotives: the class-specific option, the dual cycle option and the single cycle option. Also, in order to assure that the emissions from locomotives operating in usage patterns which differ significantly from the standard operating cycles are effectively controlled, EPA considered separate standards, or notch caps, for each throttle notch, and actually proposed notch caps for notches four through eight.

Under the dual cycle option, which EPA proposed as the primary option, all locomotives would be required to comply with both the line-haul and switch duty cycle standards, regardless of intended usage. Under this approach, idle and low power notch emissions would effectively be controlled by requiring compliance with the switch duty-cycle standards, while the high power notches would be controlled by requiring compliance with the line-haul duty-cycle standards. EPA also proposed notch caps on notches four through eight. The Agency did not propose low power and idle notch caps because of concerns such caps might unnecessarily constrain manufacturers' and remanufacturers' flexibility in meeting the duty-cycle emission standards. EPA did propose notch caps on notches four through eight to assure that emissions in the higher

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<sup>2</sup> A duty-cycle is a representation of an engine or vehicle's usage pattern, based on the percent of time spent at defined loads, speeds or other readily identifiable parameters. Locomotive emission levels vary depending on the duty-cycle used to measure emissions.

power, higher fuel consumption modes would be effectively controlled. EPA noted that, through the use of electronic controls, manufacturers and remanufacturers could design locomotives which meet the duty cycle standards but that have some high power notches calibrated for low emissions and some calibrated for low fuel consumption and higher emissions.

The Agency also requested comment on whether Tier 0 locomotives under 2000 hp should only be required to meet the switch duty-cycle standards. The reason that EPA requested comment on this provision is that there are a small number of switch locomotives subject to the Tier 0 standards which will have difficulty meeting the line-haul standards, and will likely require some flexibility such as averaging, banking and trading. These locomotives are primarily low power locomotives in switch operation and it is very unlikely that they would ever see usage patterns approaching line-haul operation.

#### Summary of the Comments:

CARB, MPI and NESCAUM all supported the dual cycle approach, with CARB commenting that the high power notch caps are necessary and appropriate. EMA stated that it would prefer a single cycle approach, but that it supported the dual cycle approach without notch caps. EMA stated that the dual cycle option, in conjunction with the notch caps, results in far too many standards that have to be met, and is far too complex.

Both EMA and AAR oppose any type of notch caps. EMA stated that notch caps would constrain a manufacturer's flexibility in meeting the standards and could force compromises in design, since emission controls are not evenly effective over all notches. If EPA needs notch caps, EMA commented, they should be limited to notches seven and eight. EMA also stated that EPA did not demonstrate the feasibility of or need for notch caps. Finally, both EMA and AAR commented that the type of notch "gaming" that EPA cited as justification for notch four through eight notch caps is unrealistic and ignores marketplace realities. Railroads have a high incentive to get all of the power possible out of an investment of as much as \$2.5M, according to EMA. EMA also pointed out that, not only would such "gaming" be prohibited by EPA's proposed defeat device regulations, it would require the collusion of the purchasing railroad and the manufacturer in setting of notch schedules and in operating the locomotive.

AAR commented that as line-haul locomotives increase in power there is a growing gap between line-haul and switch locomotives, and that to require line-haul locomotives to meet the switch standards could result in less fuel efficient locomotives. Thus, AAR suggested a variation of the class-specific option where locomotives under 2000 hp would be required to meet only the switch duty cycle standards and locomotives greater than 2000 hp would be required to meet only the line-haul duty cycle standards. AAR also pointed out that this approach would greatly simplify the emissions averaging, banking and trading program, since each locomotive would only have to meet one set of standards. As outlined in Chapter 7, AAR stated in a meeting after the comment period closed that 2300 hp would be a more appropriate cut point for any switch locomotive-related provisions.

EMA and Caterpillar requested that EPA develop a "generic" notch schedule that manufacturers could use as an option. Such a generic schedule would allow manufacturers of locomotive engines to develop and certify their engines without knowing the characteristics, such as the actual notch schedules, of the locomotives they will ultimately be used in. Such a generic notch schedule would also allow manufacturers of locomotives to certify an engine once and use it in different locomotives with different notch schedules.



CARB supported EPA's proposal to allow Tier 0 locomotives to comply only with the switch standards. CARB stated, however, that EPA must take steps (such as labeling requirements) to assure that any locomotives certified under this provision would be limited to switch operation. Finally, NJ TRANSIT suggested that EPA consider the class-specific option to accommodate passenger locomotives. NJ TRANSIT commented that manufacturers are no longer just adapting their line-haul locomotives to passenger service, but are designing locomotives specifically for passenger service.

#### Analysis of the Comments

EPA believes that, given the wide range in usage patterns of locomotives, it is important to control emissions in such a way that large variations in usage do not result in high emissions in some modes. Thus, EPA continues to believe that the dual cycle approach is the most effective means of controlling locomotive emissions over a variety of usage patterns. Such an approach effectively controls idle and low power notch emissions through the switch cycle, and effectively controls the high power notch emissions through the line-haul cycle.

EPA does not agree that the proposed notch caps on notches four through eight constitute an unnecessarily burdensome design restraint. However, EPA's concern in proposing these notch caps was to efficiently implement the prohibition on defeat devices, by setting a performance standard that would address the bulk of situations where defeat devices might be employed. There is no reason for in-use notch emissions to be significantly higher than certification level notch emissions, unless there is a specific defeat device such as a method to advance injection timing (which would improve fuel consumption but increase emissions) after a locomotive operates in a specific notch setting for a given period of time. This is based in large part on the steady state nature of engine operation when in notch.

EPA is eliminating the proposed certification notch caps which are tied to the duty-cycle standards, and replacing them with in-use notch standards that is based on the level of emissions measured in the notch at certification. This is a more effective way to identify devices that are defeat devices, because it is tailored to the emissions characteristics of each engine, and compares certification to in-use levels, instead of relying on a single set of industry-wide numerical standards. These notch standards will apply in-use, and it will be a violation of the standards if the in-use engine fails to meet them.

In order to allow for locomotive to locomotive variability as well as test variability, a level of 10 percent above the emissions level measured in a notch at certification plus the compliance margin evidenced at certification (based on line-haul duty-cycle compliance) is an appropriate level to set. This should effectively eliminate, through an emissions performance standard, the main possibility for the use of defeat devices. The prohibition on defeat devices is retained in the regulations, as an appropriate back-stop to address the potential for other kinds of defeat devices that may not be addressed by the notch caps. As contained in section 92.012 of the regulations, EPA is allowing additional flexibility during the phase-in period of the standards.

EPA believes that this approach to notch caps is appropriate for several reasons. First, it addresses the concerns expressed by the affected industries about the design constraints that certification notch caps impose by eliminating notch cap requirements at certification. Second, it addresses EPA's concerns about individual notch defeat devices. Finally, it does not impose any additional testing burden, since notch emissions must be measured to determine compliance with the duty cycle standards, both at certification and in-use.

EPA does not believe that, in general, a "generic" notch schedule is appropriate for locomotives. It is a locomotive engine's performance in the locomotive that determines actual in-use emissions. As such, it is important that the certification testing be done at the speed and load points the engine will actually see in a locomotive. EPA is concerned that, through the use of electronic controls, it would be too easy to "game" such a generic notch schedule for certification while not providing the expected emissions reductions in-use. This could be done by optimizing emissions performance in the notches included in the generic cycle while using different notch values in the actual locomotive which could be optimized for fuel economy, possibly at the expense of emissions performance. EPA believes that the provisions which allow for engines certified under 40 CFR part 89 to be used for locomotive repowering are sufficient to address the stated concerns for an engine manufacturer that sells 25 or fewer engines per year for purposes of repowering existing locomotives. Further, as discussed in Chapter 6, EPA is allowing a small number of engines certified under 40 CFR part 89 to be used for freshly manufactured switch locomotives, and any engine manufacturer that is developing engines for broader use in freshly manufactured locomotives should be able to work with the locomotive manufacturer at the time of development and certification in order to assure that the proper notch schedules are used for certification. Thus, EPA believes that there is a need for an EPA-defined notch schedule only for engine manufacturers which intend to sell more than 25 engines per year for repowering of existing locomotives. For these manufacturers, EPA believes that it would be appropriate to use the average locomotive notch schedule presented in the RSD as a starting point, and through consultation with the engine manufacturer develop a notch schedule appropriate for the engine which is to be certified. EPA believes this approach is more appropriate than setting a generic notch schedule in the regulations since the evolution of the railroad industry and locomotive designs may make any generic schedule EPA adopts inappropriate in the future. Also, EPA believes that setting a generic notch schedule would make the type of "gaming" previously described too easy.

Although EPA does not believe that a generic notch schedule should be provided as a readily available option, it does recognize the merits of the arguments provided in the case of engine-only manufacturers. The locomotive regulations do allow for alternate test procedures approved by the Administrator. Thus, such a notch schedule could be submitted for approval. EPA would have the authority to and would be likely to condition the approval of such a notch schedule on the manufacturer's agreement that in-use testing be done on a locomotive, and that the locomotive test results be accepted as valid for enforcement purposes.

EPA agrees with CARB that it is appropriate to allow older (*i.e.*, Tier 0) switch locomotives to be certified only to the switch duty cycle standards. However, EPA agrees with AAR that some of these older switch locomotives are rated up to 2300 hp. Thus, EPA is allowing older Tier 0 switch locomotives up to 2300 hp to be certified only to the switch duty cycle standards. Since such locomotives are extremely unlikely to ever be used in line-haul service EPA does not believe that it is necessary to provide safeguards to prevent them from being used in such service. Such a practice is not currently widespread, and EPA does not expect this to change. However, since the dual cycle approach was intended, among other things, as a means of controlling idle emissions from line-haul locomotives, EPA does not believe it would be appropriate to include a similar provision allowing non-switch locomotives to only meet the line-haul duty cycle standards.

EPA does not agree with NJ TRANSIT that it would be appropriate to have a separate passenger-specific locomotive certification provision. While locomotive manufacturers are

currently developing locomotives specifically for passenger use, the engines used in those passenger locomotives are generally very similar to those used in other locomotives. Thus, having such a provision would likely require locomotive manufacturers to create two locomotive engine families from what would otherwise often be a single locomotive engine family, resulting in increased testing and certification costs. However, EPA is addressing some concerns about passenger locomotive compliance by delaying Tier 0 compliance until 2007, as discussed in Chapter 5.

## **A.2. Passenger Locomotive Hotel Power**

### **Summary of the Proposal:**

Many locomotives developed for use in passenger application have two distinct modes of operation available to them; tractive power only mode, which is similar to line-haul and switch locomotive operation; and tractive plus hotel power mode, during which the locomotive engine provides electrical power for use in the passenger cars as well as generating tractive power to move the train. EPA proposed to require new locomotives equipped with hotel power to comply with both the switch and line-haul duty cycle standards in both tractive power only and tractive plus hotel power mode in order to account for passenger locomotive emissions. The testing in tractive plus hotel power mode was proposed to be done at 80 percent of hotel power load. EPA also requested comment on whether it should only require compliance with the line-haul duty cycle standards when in tractive plus hotel power mode.

### **Summary of the Comments:**

EMA stated that passenger locomotives only burn two percent of the fuel consumed by railroads, and that separate hotel power compliance requirements for passenger locomotives are not justified. Further, EMA stated that the technologies applied to locomotives to reduce emissions can be expected to result in similar emissions reductions in both tractive power only and tractive plus hotel power modes, although actual emission levels in hotel and non-hotel power mode differ.

Amtrak commented in favor of only requiring passenger locomotives to comply with the line-haul duty cycle standards when in tractive plus hotel power mode, stating that on those rare occasions when passenger locomotives are used in switch operation they are not in tractive plus hotel power mode.

GETS commented that there should be separate standards for Tier 0 passenger locomotives. GETS provided emissions data on one of its Genesis passenger locomotives which showed higher emissions in tractive plus hotel power mode than in tractive power only mode. Further, the data showed that while a Tier 0 remanufacture system applied to this locomotive could essentially bring it into compliance with the line-haul NO<sub>x</sub> standard in tractive power only mode, it would clearly not meet the Tier 0 NO<sub>x</sub> standard in tractive plus hotel power mode. The data did show, however, that the percentage NO<sub>x</sub> reductions achieved through the application of the Tier 0 remanufacture system were about the same in both tractive only and tractive plus hotel power mode. GETS stated that under EPA's proposal for passenger locomotives, additional technology and lead time would be required for passenger locomotives to comply with the standards than would be required for line-haul locomotives. GETS stated that the technology required for Tier 0 passenger locomotives would be closer to that required for Tier 1 line-haul locomotives.

### Analysis of the Comments:

As the data that GETS submitted demonstrates, similar percentage reductions in NO<sub>x</sub> can be expected in both tractive only and tractive plus hotel power mode through the application of NO<sub>x</sub> reduction technology. Thus, EPA agrees with EMA that the potential benefits do not justify the cost and complexity of requiring passenger locomotives to comply with the emissions standards when tested in tractive plus hotel power mode given their small population. The data submitted by GETS seems to support EMA's claim that roughly similar NO<sub>x</sub> reductions can be expected to result in tractive plus hotel power mode and tractive power only mode with the application of emissions reduction technology. Thus, EPA believes it appropriate to not require passenger locomotives to demonstrate compliance with the applicable emissions standards when in tractive plus hotel power mode. This is especially true when the testing is done, as was proposed, at only one hotel power load point, and passenger locomotives are capable of providing hotel power at any number of different levels. However, EPA is concerned that in the absence of hotel power testing requirements, the potential for defeat devices in tractive plus hotel power mode, such as injection timing changes for improved fuel economy, is high. For the reasons previously stated, EPA does not believe that it is appropriate to require passenger locomotives to meet the emissions standards while in tractive plus hotel power mode. However, this does not mean that passenger locomotive emissions will be uncontrolled in hotel power mode. EPA expects that the same emission controls which function during non-hotel power operation also function during hotel power operation. Due to concerns about the potential for defeat devices, EPA retains the right to require testing in that mode, and at any hotel power load point, in order to assure the absence of defeat devices. In cases where emissions in hotel power mode proved to be significantly higher than corresponding emissions in non-hotel power mode, EPA would investigate the possibility of the presence of a defeat device. This approach essentially eliminates any compliance costs unique to passenger locomotives with the exception of somewhat higher testing costs in case where EPA requires testing in tractive plus hotel power mode, while assuring that the lack of a certification standard for hotel power mode emissions does not provide an opportunity to circumvent the intent of the standards.

## **B. NO<sub>x</sub> and PM Emission Standards**

This section contains an analysis of the comments received on the proposed NO<sub>x</sub> and PM standards. Additional analysis of the lead time and feasibility comments is contained in Appendices A and B.

### **B.1. Tier 0 NO<sub>x</sub> and PM Emission Standards**

#### Summary of the Proposal:

EPA proposed Tier 0 emission standards for 1973 through 1999 locomotives applicable at the time of remanufacture beginning January 1, 2000. The proposed Tier 0 NO<sub>x</sub> standards were intended to generate NO<sub>x</sub> reductions of about one-third from uncontrolled levels. The Tier 0 PM standards, in contrast, were proposed at levels above the uncontrolled baseline in order to assure that all Tier 0 locomotives could meet the Tier 0 NO<sub>x</sub> standards. The Agency requested comment on whether it should set the Tier 0 PM standards at more stringent levels to assure that no Tier 0 locomotives had PM levels above the uncontrolled baseline. EPA proposed two years of lead time for the Tier 0 standards because the technology required for compliance is well understood and because the manufacturers have known the approximate levels of the standards

that EPA was considering for quite some time.

#### Summary of the Comments:

The comments EPA received on the Tier 0 NO<sub>x</sub> and PM standards fell into two general categories. First, many commenters addressed the issue of whether the Tier 0 standards were set at appropriate levels of stringency, given the currently available technology. The second main issue on which EPA received comments is the proposed lead time for compliance with Tier 0 standards. The level of stringency and the issue of lead time are not independent of one another. However, for purposes of this analysis these topics are discussed separately in the following paragraphs.

With the exception of GM in reference to two specific types of its locomotives (which EPA addressed in the proposal through the high baseline 33 percent NO<sub>x</sub> reduction option), nobody commented that the proposed Tier 0 standards were generally too stringent given the current status of locomotive emission reduction technology. However, some commenters suggested that the proposed Tier 0 standards were set at levels too lenient, and should be more stringent. Both STAPPA/ALAPCO and CARB argued that the Tier 0 PM standards were too lenient and would allow for substantial increases in PM emissions from locomotives originally manufactured in 1973 through 1999. STAPPA/ALAPCO argued that EPA either needs to tighten the Tier 0 PM standards or modify the averaging, banking and trading (ABT) program in order to prevent such PM increases. MECA commented that oxidation catalysts could be used on Tier 0 locomotives to enable compliance with more stringent PM standards, or to offset increases in PM that can occur when an engine is calibrated for low NO<sub>x</sub> emissions. MECA pointed out that several oxidation catalyst systems are currently certified under EPA's urban bus retrofit and rebuild rule to provide at least a 25 percent reduction in PM emissions, and that such catalysts have been demonstrated to have a very long useful life. In contrast to those comments, CILAS argued that EPA should not increase the stringency of the Tier 0 PM standards since Tier 0 NO<sub>x</sub> reductions will result in increased fuel consumption, which would increase HC, CO and PM.

NRDC stated that the Tier 0 standards should be set at levels more stringent than proposed in order to promote the movement toward the use of alternative fuels, notably liquefied natural gas. Also, in an apparent misunderstanding of the proposal, NRDC commented that EPA should not apply the Tier 0 standards to locomotives originally certified to the Tier 1 or Tier 2 standards when those locomotives are remanufactured, but rather should apply more stringent standards.

The biggest issue surrounding the feasibility of the Tier 0 standards is that of lead time. The manufacturers argued that even if the standards are technologically feasible using currently understood technology, the two years of lead time that EPA proposed for the Tier 0 standards is not enough. EMA argued out that two years is not enough time to develop test facilities, design and develop technology, prove reliability and durability, define engine families, develop production plans and actually manufacture the locomotives or remanufacture systems. GM and GETS argued that they cannot truly begin the task of complying with the standards until the standards, and especially test procedures, are final. EMA stated that EPA cannot expect anyone to expend resources working toward compliance with standards that are not yet certain.

One of the biggest issues raised with respect to Tier 0 lead time is that of adequate time for reliability testing. EMA pointed out that locomotive failures are a major concern for

railroads. As the trend continues toward the production of higher power locomotives, trains are using fewer locomotives. Under these conditions, EMA stated that on track failures of locomotives can have much more severe impacts than in the past. In some cases, the failure of a single locomotive can result in the train being stopped on the tracks. This situation would not only require a new locomotive be sent to pull the train, it would result in a stoppage of traffic until the train can get moving again. Given this high need for reliable locomotives, EMA argued, EPA cannot set lead times which are too short for adequate reliability testing. GETS stated that reliability testing would take a minimum of two years, while GM stated that it takes at least a year, and preferably eighteen months. Given this need, in conjunction with time required before the reliability testing to identify the appropriate designs and technology mixes and the time required after reliability testing to go through certification testing and production planning, EMA argued that a minimum of four years lead time is required. EMA argued that Congress mandated four years lead time in the case of new emission standards for on-highway truck engines, and that there is no reason to believe that locomotive compliance would take any less time. One other complicating factor is that systems will need to be developed for a variety of Tier 0 engine families and they will all need to be available at the beginning of 2000. Also, the 2000 compliance date for Tier 1 locomotives means that Tier 0 and Tier 1 work must happen at the same time. The manufacturers argued that EPA's proposal to have the same applicable dates for all Tier 0 and Tier 1 locomotives further complicates the lead time issue by requiring development resources to be spread over a large number of engine families.

While the manufacturers argued that four years of lead time must be provided before EPA can require compliance systems be made available for all Tier 0 engine families, they also suggested that some systems may be available before the end of that four year period. GM stated that some Tier 0 remanufacture systems could be available in 2000. With this in mind, EMA suggested that EPA only require a 1973 through 1999 locomotive that is remanufactured in 2000 or 2001 to comply with the standards if there were an EPA-certified system available for it. EMA suggested that compliance with the Tier 0 standards become mandatory in 2002 for all Tier 0 locomotives when remanufactured. EMA argued that this approach would resolve the Tier 0 lead time concerns while providing incentive to develop and certify Tier 0 system. EMA stated that an entity that was the first to certify a system for a given engine family would have a guaranteed market, at least until a competitor offered a system for the same family. This approach would also provide incentive to develop systems for the highest volume engine families first, maximizing the early environmental benefits.

In contrast to EMA's claimed need of four years lead time, MPI commented that it would only need three years lead time to comply with the Tier 0 standards. MPI also argued that other aftermarket companies similarly situated to MPI would also need three years lead time. MPI stated that it believed the locomotive manufacturers could meet the proposed 2000 date for Tier 0 compliance, but that maintaining an effective date that only the manufacturers could meet would put the aftermarket at a competitive disadvantage since the manufacturers would be able to develop customer relationships before the aftermarket could enter the market. MPI also commented that EPA should not consider a phase in of the Tier 0 requirements by model year, especially if the phase in consisted of requiring compliance with more recent model year locomotives first. MPI stated that its experience is that older locomotives are easier to bring into compliance with the Tier 0 standards than are newer locomotives.

CILAS expressed its own unique concerns about the proposed Tier 0 lead time. Since CILAS member companies tend to be aftermarket parts and services suppliers, and not integrated locomotive manufacturers or remanufacturers, they tend to have a very narrow business focus

(e.g., cylinder liner plating, fuel injector manufacturing). In order to assure a place in the market for locomotive remanufacturing, CILAS argued, these companies must certify Tier 0 remanufacture systems. Given the aftermarket company's narrow focus, however, such certification would require that these companies change their fundamental way of operating. CILAS argued that developing and certifying a remanufacture system would require these companies to enter into business relationships with each other such that all of the needed components are available to them, and develop emission control technology expertise that they currently do not have. This would require a new way of doing business, and making this transition would take time in addition to that actually needed for technology development and certification. CILAS recommended that EPA delay the Tier 0 requirements for two years beyond what was proposed. More specifically CILAS recommended that EPA delay the Tier 0 requirements for two years beyond the applicable date for the Tier 1 standards. Delaying the Tier 0 standards in this manner would allow the aftermarket companies some time to gain a better understanding of the required emission control technology by looking at complying Tier 1 locomotives. AAR also expressed concerns about the potential adverse impact that the proposed Tier 0 compliance date might have on the aftermarket industry. The railroads argued that they need the continued existence of a competitive aftermarket industry in order to assure the availability of low priced remanufacture systems. Thus, while AAR commented in support of the 2000 applicability date for Tier 0, it also urged EPA to consider a partial deferral of the Tier 0 requirements in order to accommodate the aftermarket industry. Finally, NRDC commented in support of the proposed 2000 applicability date for Tier 0.

#### Analysis of the Comments:

In general, EPA continues to believe that the stringency of the Tier 0 standards is appropriate. However, EPA agrees with STAPPA/ALAPCO and CARB that the Tier 0 PM standards would allow increases in overall PM emissions over current levels given the proposed ABT provisions. As a result, EPA is making revisions to the ABT program to minimize the potential for increases in PM emissions from current levels. These revisions are discussed in detail in the ABT section at the end of this chapter. NRDC's comment that EPA should set more stringent remanufacture standards for freshly manufactured locomotives was a misreading of the proposal. EPA is finalizing its proposal that freshly manufactured locomotive are required when remanufactured to meet the standards they were originally certified as meeting. For example, a locomotive originally manufactured in compliance with the Tier 2 standards will have to continue to meet the Tier 2 standards at any subsequent remanufacture.

EPA believes that the ABT revisions address the stated concerns about PM emissions increases, and does not believe that the Tier 0 PM standards need to be made more stringent. It is true that oxidation catalysts are being successfully introduced into on-highway diesel applications. While EPA believes that oxidation catalysts also have the potential to reduce PM emissions from locomotives, they have not yet been shown to have the kind of durability that would be required in a locomotive application. Also, the catalyst formulations being used in on-highway applications are not optimized for low sulfur to sulfate conversion since on-highway trucks use low sulfur diesel fuel. Since locomotives are not required to use low sulfur diesel fuel, work must be done to minimize the conversion of fuel sulfur to sulfate aerosols in order for oxidation catalysts to be feasible for use on locomotives. Thus, while EPA sees promise in the use of oxidation catalysts for locomotives, the Agency believes that durability demonstrations and the resolution of the sulfate conversion issues, as well as packaging and space constraints, make their use unlikely in the time frame of the Tier 0 standards. Durability demonstrations can take up to two years, and cannot be started until the sulfate conversion and space/packaging

issues are addressed. Thus, EPA does not believe that it would be appropriate to make the Tier 0 PM standards more stringent than proposed based on the availability of oxidation catalyst technology.

EPA disagrees with NRDC that the Tier 0 standards should be more stringent than proposed in order to promote the conversion to alternative fuels. While the Agency sees longer term potential for significant emission reductions through the use of LNG, it does not believe that this technology will be available for widespread application in the time frame of the Tier 0 standards.

As discussed in the RSD, EPA expects in-use locomotive models to require the use of varying levels of technology to comply with the Tier 0 standards. Some locomotive models are expected to comply through simple means like injection timing retard while others will require more extensive means such as aftercooling improvements. The time needed for technology development is expected to be very short for those models utilizing only injection timing retard, while other locomotive models to EPA expects that there is little or no need for development work on those locomotive models only requiring injection timing retard. However, regardless of any time required for the development of the technology, EPA believes that 12 to 18 months of durability testing is required to successfully bring a new locomotive design element to market, as discussed in Appendix A.

As discussed in Chapter 7 of this document, EMA proposed an approach to resolving the Tier 0/Tier 1 lead time issue after the close of the public comment period. EPA believes that EMA's proposal is reasonable in light of the real need for durability/reliability testing and in conjunction with GM's statement that some Tier 0 systems could be made available in 2000. In essence, the locomotive manufacturers believe that, while requiring complete Tier 0 compliance beginning January 1, 2000 is unreasonable, a two year delay of the program until 2002 is not necessary. This is because some locomotive models will be easier to bring into compliance than others. Thus, EPA is generally adopting EMA's proposal as described in the following paragraphs. This approach will allow for the phased-in introduction of cleaner locomotives models as they are ready to be introduced. Thus, EPA believes that this approach results in the greatest achievable emission reductions considering cost, lead time and other factors. To require all locomotive models to comply sooner than the final phase-in schedule would not be feasible, and waiting until all locomotive models can comply before making the standards effective would sacrifice a year or two of emission benefits from locomotives that could otherwise comply.

The Tier 0 standards will apply to new production in the 2001 model year, as well as for any 1994 through 2001 model year non-passenger locomotives when remanufactured January 1, 2001 or later. The Tier 0 standards also apply to all 1973 through 2001 model year non-passenger locomotives when remanufactured on or after January 1, 2002. Passenger locomotive Tier 0 compliance is required beginning January 1, 2007. Finally, beginning January 1, 2000, any 1990 or later locomotive for which a certified Tier 0 retrofit system is available for a reasonable cost must comply with the Tier 0 standards when remanufactured. Reasonable cost encompasses the cost of hardware, fuel and maintenance associated with the complying remanufacture. The concept of reasonable cost will also encompass the idea that the remanufactured locomotive will have reliability throughout its useful life that is similar to the locomotive would have had had it been remanufactured without the certified remanufacture system (*i.e.*, well maintained certified locomotives would not have significantly more road failures than would an uncertified locomotive). For further details of reasonable cost see section 92.012 of the regulatory text and docket item IV-B-6 in public docket A-94-31.



An alternative to the provisions discussed in the previous paragraph is being provided for manufacturers for the 1994 through 2001 model year locomotives. Any manufacturer which makes certified Tier 0 retrofit systems available by January 1, 2000 for its primary 1994 through 1999 model year locomotives will only be required to meet the Tier 0 standards on new production in 2000 and 2001 for locomotives similar (*i.e.*, the same basic locomotive model line) to their primary 1994 through 1999 models. However, new production locomotives in 2000 and 2001 not meeting any emission standards when originally manufactured will be required to meet the Tier 0 standards at the time of remanufacture. Although not defined in the regulatory text, under this option the primary 1994 and later model year locomotives would be locomotives powered by 710 series engines for GM-EMD, and the Dash 9/AC4400 series of locomotives for GETS. The other Tier 0 provisions (the trigger provision for 1990 and later locomotives, and the January 1, 2007 applicability date for passenger locomotives) would be implemented under this option in the same manner as discussed above.

EPA has also included a provision under which the Agency may approve similar options for compliance with the standards in 2000 and 2001. Where a manufacturer or remanufacturer has demonstrated that some other combination of new locomotives will provide greater emissions reductions than would otherwise be achieved by compliance with the option discussed in the above paragraph, EPA may allow the manufacturer or remanufacturer to certify that combination of new locomotives instead of complying with the option described in the paragraph above. One possible scenario EPA could approve under this provision would be for a manufacturer to develop its new Tier 1 locomotive model (*i.e.*, a model not in widespread use before January 1, 1998) sooner than expected, so that it could achieve greater emissions reductions without certifying any remanufacture systems for its existing locomotive models. Manufacturers may only use this option with EPA's prior approval of the manufacturer's determination that greater emissions reductions will be achieved. Such approval would need to be obtained sufficiently before January 1, 2000, in order for the manufacturer to have sufficient time to plan for compliance with the Tier 0 standards under the other options described above.

EPA believes that approach outlined in the previous two paragraphs addresses the concerns of all who commented on the lead time issue. The locomotive manufacturers support this option. This approach is also consistent with MPI's request for three years lead time for the Tier 0 standards. Finally, this approach gives CILAS the two years additional lead time it requested, since the bulk of the locomotives that CILAS member companies are involved with are pre-1990 models. Although this approach does not delay the Tier 0 standards for two years beyond the implementation of the Tier 1 standards, as CILAS requested, it will give CILAS one to two years to gain experience with the locomotive manufacturers' approach to the Tier 0 standards.

Additional analysis of the locomotive manufacturer's comments on lead time and feasibility is contained in Appendices A and B.

## **B.2. Tier 1 NO<sub>x</sub> and PM Emission Standards**

### Summary of the Proposal:

EPA proposed Tier 1 emission standards for locomotives originally manufactured from 2000 through 2004 applicable at the time of original manufacture, and also at the time of each subsequent remanufacture. The Tier 1 NO<sub>x</sub> standards were intended to generate NO<sub>x</sub> reductions of about half of uncontrolled levels. The Tier 1 PM standards were proposed to be more stringent than the Tier 0 levels, but still at levels above the uncontrolled baseline. As with the

Tier 0 PM standards, the Agency requested comment on whether it should set the Tier 1 PM standards at more stringent levels to assure that no Tier 1 locomotives had PM levels above the uncontrolled baseline. EPA proposed two years of lead time for the Tier 1 standards because the technology required for compliance is well understood and because the manufacturers have known the approximate levels of the standards that EPA was considering for quite some time.

#### Summary of the Comments:

In general the comments received on the proposed Tier 1 standards tended to mirror those received in response to the proposed Tier 0 standards. The locomotive manufacturers to argued that the proposed levels of the standards are feasible, but that more lead time is required to assure reliability. In contrast, the state, environmental and emission control manufacturer groups argued that, not only is compliance with the Tier 1 standards by 2000 feasible, the standards should be set at much more stringent levels. Each of these views is discussed in more detail in the following paragraphs.

EMA commented that, for the same reasons as outlined in the comments on Tier 0 lead time, locomotive manufacturers will need four years lead time to comply with the Tier 1 standards. EMA also stated that manufacturers will need for Tier 1 compliance much of the technology that EPA suggested might be used to comply with the Tier 2 standards. Thus, GETS commented in support of the Tier 1 standards as the outer limit of what is currently technologically feasible for locomotives, but added that design for Tier 1 will take at least a year, followed by two years for reliability testing.

Several entities commented in support of the proposed Tier 1 standards or in favor of more stringent standards. STAPPA/ALAPCO and NESCAUM both stated that the standards as proposed are feasible, with NESCAUM pointing out that the required technologies are already being used on trucks. NRDC argues that a 5.0 g/bhp-hr NO<sub>x</sub> standard for diesel locomotives is feasible in 2000 using improved injection, injection timing retard and enhanced charge air cooling, but did not submit any data or analysis in support of this claim. The use of selective catalytic reduction (SCR) to achieve lower NO<sub>x</sub> levels than the proposed Tier 1 levels was suggested by ICAC and MECA. ICAC suggested that the use of SCR would allow EPA to set a Tier 1 NO<sub>x</sub> standard at 4.1 g/bhp-hr.

As with its comments on the level of Tier 0 standards, CILAS argued that EPA should not increase the stringency of the Tier 1 PM standards since Tier 1 NO<sub>x</sub> reductions will result in increased fuel consumption, as well as higher emissions of HC, CO and PM.

#### Analysis of the Comments:

EPA believes that it is appropriate to provide four years lead time for the Tier 1 standards (*i.e.*, January 1, 2002 effective date) for two reasons. First, while for Tier 0, manufacturers are merely modifying existing designs, both of the major locomotive manufacturers are currently in the process of developing completely new engine models which will coincide with the Tier 1 standards. It is more difficult to optimize completely new models for emission performance than it is to optimize existing models. Moreover, since the Tier 1 standards are more stringent than the Tier 0 standards, they will require further optimization of emissions beyond that required of the Tier 0 standards. Second, EPA believes that requiring simultaneous compliance with the Tier 0 and Tier 1 standards does create a resource burden. Given that most of the early emission reductions from the locomotive emission standards will come from remanufacturing the current

fleet in compliance with the Tier 0 standards, EPA believes that it is more important to concentrate efforts on Tier 0 compliance initially.

EPA does not believe that more stringent levels than those proposed for Tier 1 are feasible in the time frame considered. EPA's detailed analysis of the availability of technology and likely compliance strategies for the Tier 1 standards is contained in the RSD. NRDC's suggestion that Tier 2 levels are achievable in 2000 is not supported by any analysis or data. While EPA sees some potential for SCR to provide dramatic emission reductions in the future, much development work remains to be done before SCR can be commercially available for use on locomotives, especially given the durability requirements of locomotive technology. SCR systems will require a certain amount of work on sizing and packaging in order to properly fit within a locomotive's size, weight, and weight distribution requirements. These packaging constraints would need to be addressed before the 18 to 24 month durability testing can begin. EPA believes that there is some potential for SCR technology to be ready for application in the time frame of the Tier 2 standards.

Additional analysis of the locomotive manufacturer's comments on lead time and feasibility is contained in Appendices A and B.

### **B.3. Tier 2 NO<sub>x</sub> and PM Emission Standards**

#### Summary of the Proposal:

EPA proposed Tier 2 standards applicable to all locomotives originally manufactured in 2005 and later. The proposed standards included standards intended to generate 60 to 65 percent NO<sub>x</sub> reductions, and 50 percent PM and HC reductions from uncontrolled levels. EPA proposed that these levels could be achieved through continued improvements in charge air cooling beyond those required for Tier 1 compliance, fuel management (including the introduction of injection rate shaping), combustion chamber improvements, and electronic control systems. EPA also suggested that exhaust gas recirculation (EGR) or reduced oil consumption might be needed. The Agency requested comment on whether it would be more appropriate to require greater Tier 2 NO<sub>x</sub> reductions (70 to 75 percent) coupled with lower (30 percent as opposed to 50 percent) or no PM reductions.

#### Summary of the Comments:

In general, the locomotive manufacturers argued that the proposed Tier 2 standards are not feasible using known technology. In contrast, the state, environmental, and emission control manufacturing organizations argued that the standards are feasible in the time frame proposed. Some commented that the Tier 2 standards could be much more stringent. Each of the comments is discussed further in the following paragraphs.

AAR expressed general support for the Tier 2 standard levels and timing, but expressed concerns about the feasibility concerns of the locomotive manufacturers. NESCAUM expressed general support for the Tier 2 standards as both reasonable and feasible.

Several commenters suggested the availability of SCR would make more stringent Tier 2 standards feasible. ICAC argued that NO<sub>x</sub> reductions of up to 90 percent could be available for Tier 2. Siemens suggested that 70 to 80 percent NO<sub>x</sub> reductions could be achieved in that time frame. In contrast to these claims, AAR argued that SCR is not feasible for use on locomotives. AAR suggested that the SCR equipment would be too expensive for railroads. In addition to

cost, AAR argued that there are many technical hurdles to overcome before SCR could be used on locomotives. These include catalyst blockage or poisoning problems (which may require the development of new lubricant additive packages), increased exhaust back pressure, general safety and reliability, and the ability of the SCR equipment to withstand the mechanical shocks and vibration of a locomotive environment. Also, AAR pointed out as a major concern the limited space available for the SCR components, as well as concerns about the weight of those components and how that weight can be safely accommodated in locomotives that are near their per-axle weight limits or locomotives where the SCR equipment would result in a top heavy configuration with no practical option for redistributing the weight.

ATA argued that the proposed Tier 2 levels are too lenient and fail to require achievable standards consistent with current diesel technology. ATA's reasoning was largely based on the issue of fairness, arguing that the locomotive standards should be of comparable stringency with upcoming on-highway truck standards. ATA stated that it took EPA 27 years to gain the authority to regulate locomotives, and that it will be 15 years after that before any locomotive PM benefits appear. Thus, ATA argued, EPA must set more stringent emission standards now for locomotives since the PM benefits will not show up for 15 to 30 years.

The locomotive manufacturers argued that the proposed Tier 2 emission standards are not feasible using technology that can reasonably be expected to be available by 2005. The manufacturers also argued that EPA failed to demonstrate the feasibility of the proposed Tier 2 standards, as required by the Act. EMA stated that the manufacturers would support 2005 as an applicable date for Tier 2 standards provided that EPA revised those standards to reflect the technology that will be feasible and available by 2005. In general, the manufacturers argued that the technologies that EPA proposed could be used to comply with the Tier 2 standards will actually be needed for Tier 1 compliance. Further refinement of these Tier 1 technologies will achieve additional reductions beyond the Tier 1 levels, but will not be sufficient for Tier 2 compliance. The other technologies that EPA projected could possibly be used for Tier 2 compliance will not be ready in 2005, if they are feasible for locomotives at all. Thus, the manufacturers argued, new technology must be invented to comply with the proposed Tier 2 standards. These arguments are discussed more fully in the following paragraphs.

GETS stated that much of the technology discussed for potential use on Tier 2 locomotives is on-highway diesel truck technology that may not be transferrable to locomotives. This is due to the different operating characteristics of truck and locomotive engines. While truck engines tend to operate at 1800 to 2200 rpm, locomotives engines operate at roughly half that speed. This results in significantly longer residence times of the combustion products in a locomotive combustion chamber as compared to truck combustion residence times. Also, locomotive engines operate at a significantly higher power density than truck engines, resulting in higher locomotive combustion temperatures. Since NO<sub>x</sub> production in the combustion chamber increases exponentially as a function of temperature and linearly as a function of time, GETS commented, locomotive engines have inherently higher and more difficult to control NO<sub>x</sub> emissions than trucks. It also means that technologies used on trucks may not be as effective when used on locomotives.

The only technology that EPA proposed as a Tier 2 technology that the manufacturers do not expect to use for Tier 1 compliance is injection rate shaping. The manufacturers stated that rate shaping is not likely to have a significant effect on NO<sub>x</sub> emissions, but that its benefit would be primarily PM control. GETS pointed out that this will be especially important since smoke emissions are expected to rise as NO<sub>x</sub> levels are decrease below the Tier 1 levels. GM pointed

out that the experience with rate shaping thus far indicates that its effectiveness is very dependent of the specific engine it is used on.

The manufacturers argued that the ability to improve charge air cooling significantly beyond what will be used for Tier 1 compliance is limited for three reasons. First, the size and weight constraints of the locomotive environment would make it difficult to find the space for additional heat exchangers for additional cooling capacity. Second, GM argued that a significant fuel economy penalty appears with cooling the charge air much beyond the level of cooling expected to be used for Tier 1 compliance. Finally, locomotive space constraints and operating environments preclude the use of air to air aftercooling, which is a more effective form of aftercooling than water to air, which is currently used on locomotives. Thus, the manufacturers stated that continued improvements in charge air cooling can lead to some NO<sub>x</sub> reductions beyond those achieved for Tier 1, but are not expected to allow compliance with the Tier 2 NO<sub>x</sub> standards.

Given that EMA believes additional charge air cooling and injection rate shaping will not allow compliance with the Tier 2 standards, manufacturers must look at technologies such as EGR, LNG and exhaust aftertreatment. The most likely candidate seemed to be EGR. GM pointed to several items it believed need to be addressed before EGR could be used on a locomotive. These included the development of the necessary control strategies, potential fouling of the turbocharger by particulate-laden exhaust and the need for filtration or pumps to introduce the exhaust downstream of the turbocharger, and the need for additional heat exchangers if cooled EGR is utilized. GETS argued that EPA did not consider the likely high costs of EGR in the proposal and should not finalize a Tier 2 requirement based on the need for EGR.

GETS commented that the proposed Tier 2 standards may require a serious look at LNG technology. The spark ignition approach to using natural gas results in too great a loss in power as compared to a similar diesel engine. GETS stated that the only way to achieve diesel power and fuel economy when using natural gas is the high pressure, late cycle injection method. However, this approach results in fairly high combustion temperatures and NO<sub>x</sub> emissions, and is not capable of meeting the Tier 2 standards as a result.

GM mentioned several technologies that it believed may have some potential in the long term, but whose current state of development precludes their use for Tier 2 compliance. These technologies included SCR, oxidation catalysts, trap oxidizers, use of water in combustion, ceramics/low heat rejection and turbocompounding. GM gave specific reasons why each of these technologies is not expected to be feasible by 2005. In the case of SCR, GM pointed to poor transient load response, the need to refill the reagent tank, the low exhaust temperatures and the size and weight constraints of locomotives as reasons why this technology cannot be developed by 2005.

The manufacturers argued against the regulation of PM, HC and CO in the Tier 2 standards. They pointed out that many technologies that reduce NO<sub>x</sub> tend to increase HC, CO and PM. Since locomotives contribute such a tiny percentage of the total inventory of these pollutants they should not be regulated as that may interfere with the real goal of NO<sub>x</sub> reductions. EMA suggested that, at a minimum, the Tier 2 PM standards should only hold PM at or below current, unregulated levels.

EMA argued that EPA first assumed levels of emission reductions it wanted from

locomotives and selected the Tier 2 standards according to these desired reductions, rather than examining the potential for technology to reduce emissions and setting standards based on technological feasibility. EMA also pointed out that EPA had worked with the railroads and the state of California to develop a program for the South Coast area of California which was negotiated with the understanding that Tier 2 locomotives would be available beginning in 2005. EMA argued that the existence of the South Coast agreement cannot be used to justify the Tier 2 standards, and that EPA must set standards which it can show are technologically feasible.

Three commenters suggested that EPA should consider a third tier of standards. CARB commented that EPA should adopt a Tier 3 standard for freshly manufactured locomotives to take effect in 2015. CARB argued that the Tier 3 standard could be, depending on what is most appropriate in the future, a NO<sub>x</sub> reduction of 75 to 85 percent from uncontrolled levels or a more stringent PM standard with NO<sub>x</sub> held at the Tier 2 level. CARB stated that these reductions could be achievable by 2015, and that the use of natural gas may make them feasible in the near term. STAPPA/ALAPCO argued that, since the Tier 2 locomotive standards will not be as stringent as those for heavy-duty trucks in the same time frame, EPA should consider a third tier of locomotive standards to make locomotive standards as stringent as truck standards. Finally, Siemens suggested that any Tier 3 rule EPA considers should have at its heart a railroad fleet average program. This, Siemens argued, would be a more effective method of regulating railroad pollution than EPA's proposed approach of regulating locomotive manufacturers and remanufacturers.

#### Analysis of the Comments:

EPA believes that the Tier 2 standards as proposed are feasible. As discussed at length Chapters 3 and 4 in the RSD, EPA expects that a variety of technologies and technology mixes will be available for Tier 2 compliance without the use of alternative fuels or exhaust aftertreatment. In addition to the technologies that EPA expects to be used for Tier 2 compliance, the Agency believes that there is a chance that SCR, LNG or EGR may be available for use on locomotives by 2005. EPA is providing seven years lead time to comply with the Tier 2 standards, and it is simply too early to conclude that these technologies will not work, especially considering that little or no work has been done to date to adapt these technologies for use on locomotives. In addition, EPA is making changes to several aspects of the proposed rule which would serve to improve the feasibility of all tiers of the locomotive standards. These areas include the humidity correction factor, the useful life period, the ABT program, compliance at high altitude, and certification notch caps, as discussed elsewhere in this document.

As described in the RSD, EPA has determined that the Tier 2 emissions standards for new locomotives and new engines used in locomotives achieve the greatest degree of emissions reductions achievable through the use of technology that EPA has determined will be available for application in 2005, taking into consideration cost and other factors. Comments from engine manufacturers expressed strong concern about the technology forcing nature of the Tier 2 standards and about their ability to identify, develop, and apply the technologies that will be needed to locomotive engines by 2005. EPA's detailed response to the engine manufacturers' comments can be found in Chapters 3 and 4 of the RSD, and Appendices A and B of this document. EPA is confident that manufacturers will be able to comply with the Tier 2 standards in a cost-effective manner by 2005, but recognizes that these are technology forcing standards which will require significant effort to achieve.

EPA disagrees with EMA with respect to how EPA arrived at the proposed Tier 2

standards. First, it is important to note that EPA has extensive experience in regard to the application of emission controls to diesel engines. Prior to conducting a detailed analysis, EPA roughly estimated the potential for NO<sub>x</sub> emission reductions from diesel powered locomotives to be in the range of 50 to 75 percent from baseline, which it then estimated at 13.5 g/bhp-hr. EPA chose to include a Tier 2 NO<sub>x</sub> standard of 5.5 g/bhp-hr in its proposal to represent roughly the midpoint of this range.

EPA does not agree with ATA or STAPPA/ALAPCO that the on-highway truck emission standards should be used as a basis for determining ultimate emission reductions from locomotives. While there are many similarities between on-highway trucks and locomotives, the space constraints and operating modes of locomotives effectively preclude the use of air-to-air aftercooling on locomotives. Air-to-air aftercooling is widely used for on-highway truck compliance.

Finally, EPA does not believe that it is appropriate to consider Tier 3 standards at this time. The Agency believes that the Tier 2 standards represent EPA's determination of the greatest emission reductions achievable considering such factors as cost and lead time. While EPA believes that further emission reductions from locomotives may ultimately be feasible beyond those required of the Tier 2 standards, accurate information is not available at this time regarding the availability, emission reduction potential and cost of the technologies that could be used. Thus, EPA believes it appropriate to limit the current rulemaking to the standards proposed. EPA will monitor the industries compliance efforts, the status of technology development in the future, and air quality trends to determine at some future time whether Tier 3 emission standards for locomotive are appropriate.

Additional analysis of the locomotive manufacturer's comments on lead time and feasibility is contained in Appendices A and B.

#### **B.4. Compliance Margins**

##### Summary of the Proposal:

As discussed in the previous and following sections, EPA proposed various standards for the emissions of gaseous pollutants from locomotives and locomotive engines. EPA used expected compliance margins in calculating the expected emission benefits from the proposed standards. A compliance margin is the "margin of safety" that a manufacturer or remanufacturer is expected to incorporate into its design. It takes the form of a difference between the emission level of a locomotive and the applicable standard in order to assure compliance both at certification and in-use.

##### Summary of the Comments:

NRDC commented that EPA should set the NO<sub>x</sub> emission standards for all three tiers at levels which reflect the emission benefits that EPA projected to result from those standards. In other words, NRDC stated that, rather than including a compliance margin in its calculation of benefits, EPA should set the standards at the levels it assumes locomotives will emit at. Thus, for example, NRDC stated that EPA should set the Tier 0 line-haul duty-cycle NO<sub>x</sub> standard at around 8 g/bhp-hr, rather than the proposed level of 9.5 g/bhp-hr, since the lower level is what EPA assumed would be achieved for purposes of emission benefits calculations.

### Analysis of the Comments:

EPA disagrees with NRDC that the use of compliance margins is inappropriate in calculating expected emission benefits resulting from emission standards. The proposed locomotive compliance programs were designed such that an engine family would be considered in nonconformance with the standards even if only a small number of locomotives or locomotive engines failed a test. Due to such things as manufacturing variability, locomotives, as with all mobile sources, are expected to have emission levels that vary somewhat from one unit to the next. Thus, in order to assure compliance with the emission standards of every unit, a manufacturer or remanufacturer must design its engine families such that the average emission level of all units in that family is below the applicable standard. This has historically been the case for other mobile source categories. Further information on compliance margins can be found in the RSD for this rule.

### **C. Other Standards**

#### **C.1. HC and CO Emission Standards**

### Summary of the Proposal:

EPA proposed HC and CO standards for all three tiers. For Tier 0 and Tier 1 these standards were essentially loose caps on those emissions, with the intent of not allowing significant increases in HC and CO as locomotives met the Tier 0 and Tier 1 NO<sub>x</sub> and PM standards. For Tier 2, EPA proposed standards which would generate approximately 50 percent HC reductions compared to uncontrolled baseline levels. The proposed Tier 2 CO standards would essentially act as caps on CO to prevent increases over uncontrolled levels, similar to the proposed Tier 0 and Tier 1 CO standards.

### Summary of the Comments:

EMA commented that EPA should eliminate any HC and CO standards for locomotives. Since locomotive emissions of HC and CO represent an insignificant contribution to the total national inventories of these pollutants, EMA argued, their inclusion in the emission standards for locomotives is not crucial to the improvement in air quality. EMA stated that the inclusion of HC and CO standards presents design constraints for manufacturers attempting to comply with the NO<sub>x</sub> standards, and add cost and complexity to emissions compliance efforts. Further, EMA argued, efforts to comply with the HC and CO standards could divert resources away from NO<sub>x</sub> compliance efforts, and could conflict with those efforts. EMA stated that technologies used to reduce NO<sub>x</sub> emissions often lead to increases in HC and CO emissions. CILAS commented similarly to EMA, stating that if NO<sub>x</sub> is EPA's focus, there should be no HC and CO standards because NO<sub>x</sub> reduction technology tends to increase emissions of these pollutants. EMA suggested that as an alternative to eliminating the HC and CO standards, EPA adopt loose caps for all tiers of 2.0 g/bhp-hr for HC and 10.0 g/bhp-hr for CO. In contrast to the EMA and CILAS position, NRDC commented that it is essential for EPA to retain the proposed HC and CO standards.

### Analysis of the Comments:

EPA believes it is both necessary and appropriate to control the emissions of HC and CO from locomotives. While HC and CO emissions are not the primary focus of the locomotive regulations, their control is nonetheless important for ozone control, especially in certain areas of



the country. With the exception of the Tier 2 HC standard, the HC and CO standards would merely act as caps intended to prevent significant increases in those pollutants over uncontrolled baseline levels. In contrast, the caps that EMA proposed would allow those emissions to quadruple or more over uncontrolled levels. EPA also believes that it is appropriate to require HC reductions for Tier 2 locomotives for two reasons. First, many areas of the U.S. are in need of HC reductions in order to achieve compliance with the national ambient air quality standards, and EPA is pursuing HC reductions in other mobile source categories as well. It would not be appropriate to allow locomotive HC emissions to increase significantly, and potentially affect other efforts. Second, the Tier 2 HC reductions are consistent with the Tier 2 PM reductions, and technologies used to reduce PM emissions also tend to reduce HC emissions. While EPA does not disagree with EMA that HC and CO emission standards present a design constraint with respect to compliance with the NOx standards, EPA believes that HC and CO standards are justified for reasons discussed in this paragraph. Further, EPA considered the feasibility of all of the standards together, rather than assessing the feasibility of the NOx standards in isolation. The Agency has determined that, while the HC and CO standards may present a design constraint with respect to NOx compliance, they do not make NOx compliance infeasible. Thus, EPA agrees with NRDC that HC and CO standards are essential.

## **C.2. Alternative Fuel and Optional Alternative Standards**

### Summary of the Proposal:

EPA proposed emission standards applicable to new locomotives and locomotive engines running on alternative fuels such as natural gas and alcohol that were the same as those proposed for new diesel locomotives and locomotive engines. EPA also proposed an alternate set of PM and CO standards for all three tiers which were primarily intended to address new locomotives and locomotive engines which operate on alternative fuels such as natural gas. The alternate standards would allow higher CO emissions than the proposed diesel locomotive standards, but would require lower PM emissions. Although these alternate standards were primarily intended to address alternative fueled locomotives and locomotive engines, EPA proposed that they be an available option for any locomotive.

### Summary of the Comments:

NESCAUM commented in support of the proposed alternate standards, stating that more stringent PM standards and less stringent CO standards than the diesel standards is an appropriate tradeoff. CILAS also commented in favor of adopting the alternate standards in the final rule. AAR suggested that EPA adopt the NOx and PM standards for alternative fuels, and leave the other pollutants unregulated for those fuels. AAR expressed concerns about the feasibility of natural gas locomotives meeting the alternate standards, especially the alternate CO standards. AAR stated that there is interest among the railroads in developing natural gas-powered locomotives, and that setting emissions standards for them at this time may discourage experimentation with natural gas. EMA argued, like AAR, that setting emissions standards now for natural gas locomotives could restrict their development. EMA stated that there is no supporting data for the levels of the proposed alternate standards, and no demonstration of their feasibility. Thus, EMA recommended that EPA defer emissions standards for alternative fuels altogether until the technologies are much better understood. NRDC commented that EPA's emission standards for locomotives and locomotive engines should promote a shift to alternative fuels, such as liquefied natural gas (LNG).

### Analysis of the Comments:

As discussed in the RSD, data on natural gas locomotives shows that the proposed alternate standards are largely feasible at this time. Thus, EPA disagrees that the proposed alternate standards are infeasible. The Agency recognizes EMA and AAR's concerns that setting emission standards for alternative-fueled locomotives now may constrain their development. Since the standards are feasible and will not deter experimental development, EPA believes it is appropriate to promulgate emissions regulations for alternative-fueled locomotives at this time. EPA wants to ensure that alternative fuel technology that is developed is clean, and having standards is a way to do that. As with many other Agency mobile source programs, manufacturers and remanufacturers can seek from EPA an experimental waiver from compliance with the applicable emissions standards. This waiver allows experimental locomotives which are under development to be sold into actual service without being certified as complying with the applicable emissions standards. The availability of this waiver addresses concerns about the potential the alternate standards would have to restrict experimentation and development of alternative-fueled locomotives.

While EPA believes that it is appropriate to set emission standards for alternative fueled locomotives and locomotive engines in order to put them on a level playing field with diesel technology, it does not believe that it is appropriate to set standards that would more or less mandate a shift to alternative fuels. EPA believes the most appropriate approach to alternative fuels is to put them on a level playing field with diesel and let the marketplace determine the relative markets for each fuel. This policy of fuel neutrality is one which EPA has used in several of its other mobile source emission programs.

### **C.3. Smoke Standards**

#### **Summary of the Proposal:**

EPA proposed visible opacity, or smoke, standards for locomotives. These standards would require that the measured opacity for locomotive exhaust be below specified opacity limits that varied by exhaust stack dimensions and by averaging time. For example, the measured opacity of exhaust from a locomotive with a 12-inch diameter exhaust stack could not exceed 20 percent when the locomotive was operating at a "steady-state" condition, 35 percent during any continuous 30-second period, or 50 percent during any continuous 3-second period.

EPA also placed in the docket for public consideration a description of an alternate form of the standard.<sup>3</sup> Specifically, the alternate form would require that all smoke measurements be normalized using the Beer-Lambert law to be equivalent to measurements having a one-meter path length. The advantage of this form is that, instead of having different sets of smoke standards apply to locomotives with different exhaust duct configurations, there would be a single set of standards that would apply to all locomotives. EPA indicated that it believed that steady-state, 30-second peak, and 3-second peak smoke standards of 20, 30 and 40 percent opacity, respectively, for the normalized measurements would be roughly equivalent to the multiple sets of numerical smoke standards that were proposed.

#### **Summary of the Comments:**

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<sup>3</sup> Public docket A-94-31, item IV-B-5.

AAR and GETS supported the smoke standards proposed in the NPRM. EMA, NRDC, and NESCAUM supported the alternate form of the smoke standard. However, EMA opposed the levels discussed for the alternate form. They disagreed with EPA's statement in docket item IV-B-3 that normalized smoke standards of 20, 30, and 40 percent opacity would be equivalent to the standards that were proposed. Instead, EMA argued that the normalized standards would be more stringent than the standards that were proposed. AAR agreed with EMA in this regard. While NRDC and NESCAUM did not comment on the equivalency of the normalized smoke standards with the smoke standards proposed, they did argue for more stringent smoke standards. STAPPA/ALAPCO also argued for tighter smoke standards to ensure adequate control of in-use PM emissions. They expressed special concern about future locomotives, which they argued will be more capable of complying with stringent smoke standards in use. EPA received no comments challenging the feasibility of the proposed smoke standards.

#### Analysis of the Comments:

In response to the generally supportive comments that were received, EPA is finalizing smoke standards based on normalized opacity measurements. Such standards are expected to achieve more uniform control for all locomotive designs than the relatively complicated series of standards that were proposed.

EPA agrees with EMA and AAR that the normalized smoke standards described in docket item IV-B-3 would be more stringent than the smoke standards that were proposed. As discussed in the Notice of Data Availability, EPA intended to finalize smoke standards based on normalized opacity measurements equivalent to the proposed levels of the variable measurements. After reconsideration, the Agency concludes that normalized smoke standards of 30, 40, and 50 percent for allowable steady-state, 30-second peak, and 3-second peak smoke levels would be most equivalent to the standards proposed. These values are very similar to the values proposed for locomotives with a single exhaust stack greater than 12 inches in diameter (i.e., 30, 40, and 55 percent opacity).

EPA also recognizes the concerns of the other commenters that the proposed smoke standards are not sufficiently stringent. However, the Agency agrees with the suggestion by STAPPA/ALAPCO that smoke standards for existing locomotives should be considered separately from those for future locomotives. For Tier 0, EPA is finalizing smoke standards equivalent to those that were proposed. More precisely, EPA is finalizing the equivalent normalized smoke standards of 30, 40, and 50 percent for steady-state, 30-second peak, and 3-second peak smoke levels. More stringent smoke standards could prevent remanufacturers from using injection timing retard, which is expected to be the most cost-effective means of reducing NOx emissions from many existing locomotives. Therefore, setting more stringent smoke standards for Tier 0 locomotives would require relaxation of the proposed Tier 0 NOx standards. As described in the preamble for this rule, the focus of EPA's locomotive emission standards is NOx emissions.

For 30-second peak and 3-second peak smoke levels from Tier 1 and Tier 2 locomotives, EPA is finalizing the same smoke standards as for Tier 0 locomotives. However, it is finalizing more stringent smoke steady-state smoke standards. EPA is setting the steady-state smoke standard at 25 percent opacity for Tier 1 locomotives, and 20 percent opacity for Tier 2 locomotives. EPA's smoke test data indicates that steady-state smoke levels for newer locomotives are often below 10 percent opacity with proper maintenance. Thus, these revised

smoke standards should be feasible, even with a significant in-use compliance margin and/or some slight smoke increase due to adjustments made to injection timing for NOx emission control.

#### **C.4. High Baseline Tier 0 Locomotives**

##### Summary of the Proposal:

There are a small number of primarily older locomotives which, for various reasons, have fairly high uncontrolled NOx emissions. As a result it is more difficult to reduce their NOx emissions to the levels of the proposed Tier 0 standards than it is for most engine families covered under the Tier 0 standards. Due to concerns about the logistics surrounding the ability to remanufacture these locomotive under the proposed averaging, banking and trading (ABT) provisions, EPA proposed special provisions for these high baseline locomotives. Specifically, EPA proposed to allow a remanufacturer to certify such locomotives at NOx emission levels 33 percent below uncontrolled baseline levels, rather than require them to meet the Tier 0 NOx standards. EPA chose 33 percent as the NOx reduction required under this option because that is the overall NOx emission reduction expected from implementation of the Tier 0 NOx emission standards.

Under this provision, a remanufacturer would petition EPA to allow certification to a 33 percent NOx reduction, rather than the Tier 0 NOx standard. Such a petition would be granted if a petitioner showed infeasibility or excessive cost of meeting the Tier 0 NOx standard for a particular engine family. The applicable NOx standard under this provision would be determined by the emissions testing of five well maintained locomotives in the engine family. The average of those five tests would then be used to determine the applicable standard, which would be set at 33 percent below that measured average. The Tier 0 standards for all pollutants other than NOx would still apply.

EPA proposed that any engine families certified under the 33 percent reduction option not be allowed to participate in the proposed ABT program. Further, EPA proposed that any manufacturer or remanufacturer which certified a locomotive under this option be precluded from participating in the ABT program with any of its other engine families.

##### Summary of the Comments:

EPA received comments both in support of and in opposition to the proposed 33 percent NOx reduction option. EMA supported this option, stating that some engine families will be unable to meet the standards without it. CILAS also supported this option, but commented that the five tests required to establish the baseline are too burdensome. MPI supported the 33 percent option, but suggested that EPA provide public notice and opportunity for public comment as part of the petition process. Allowing public notice and opportunity to comment, MPI stated, would allow other entities to comment on claims of infeasibility, and give them an opportunity to come forward with technology which would allow the engine family at issue to comply with the Tier 0 standards in a cost effective manner. Further, MPI suggested that the exemption from the actual Tier 0 NOx standards under this option be limited to one year. Such a one year limit would provide incentive to continue development of systems which would allow those engine families to meet the Tier 0 standards. CARB opposed this option, except in very rare circumstances, since its widespread use could easily result in Tier 0 fleet NOx reduction of less than 33 percent. This could occur if those engine families with high baseline NOx emissions were certified according

to the 33 percent reduction option while engine families whose uncontrolled emissions are close to the Tier 0 NOx standards only certify in compliance with the Tier 0 NOx standards, resulting in less than 33 percent reductions for those engine families certified to the Tier 0 standards. CARB also pointed out that, while the preamble to the proposed rule discussed this option as something that must be petitioned for, the proposed regulatory text presented it as an option that a remanufacturer can elect to use without advance approval from EPA.

NRDC strongly opposed the 33 percent reduction option, stating that this provision would undermine Tier 0 standards, which it believes are already too lenient. STAPPA/ALAPCO commented that there is no reason to offer this option in light of the proposed ABT program, but did not specifically address the concerns EPA raised in the proposal about the ability of the ABT provisions to address high baseline locomotives.

EMA commented that Tier 0 locomotives certified under the 33 percent NOx reduction provisions should be allowed to participate in the ABT program. EMA further argued that precluding a manufacturer or remanufacturer from including any of its engine families in the ABT program if it certified an engine family according to the 33 percent provisions would create a disincentive to offer remanufacture systems for those high baseline engine families. AAR suggested that a manufacturer or remanufacturer should not be excluded from the ABT program if it exercises the 33 percent reduction option in some of its engine families. In practice, AAR argued, once an entity certified an engine family under the 33 percent reduction option it would be precluded from ever participating in the ABT program. AAR proposed to deal with this by allowing a manufacturer or remanufacturer to exercise the 33 percent reduction option only if it cannot certify to the Tier 0 standards using its existing credits. However, AAR also pointed out that this approach would not work unless EPA eliminated the proposed FEL ceilings.

#### Analysis of the Comments:

EPA shares CARB's concerns that the 33 percent NOx reduction option could result in Tier 0 fleetwide emission reductions lower than those projected in the proposal. Additionally, the Agency is confident that the more flexible ABT program adopted today addresses the concerns expressed in the proposal about the ABT program's ability to effectively allow for the certification of these high baseline locomotives. EPA is adopting ABT provisions that allow generation of credits prior to the effective date of the standards and cross-tier credit exchanges. In addition, EPA is not finalizing Tier 0 FEL ceilings, for reasons discussed in section E.2 of this chapter. These revisions to the proposed ABT program, in conjunction with the small number of locomotives that would likely be certified under this option, lead EPA to conclude that the 33 percent NOx reduction option is no longer necessary to assure compliance of all locomotives subject to the Tier 0 standards.

#### **D. Useful Life**

##### Summary of the Proposal:

EPA proposed that each locomotive and locomotive engine covered by these regulations be required to comply with the standards throughout its full useful life; where useful life would be defined as the typical period that such a locomotive or locomotive engine is expected to be properly functioning. The Agency decided to base its numerical definition of a locomotive engine family's useful life on the average period between remanufactures (or from remanufacture to scrappage) for that family, because it believes that this period is the most accurate

representation of the period during which a locomotive is designed to be properly functioning. However, because the average period between remanufactures varies from railroad to railroad for any given locomotive model, EPA proposed minimum (or default) useful life periods for each Tier of standards, measured in miles or megawatt hours (MW-hr), for Tier 0 locomotives, and measured in MW-hr for Tier 1 and Tier 2 locomotives and locomotive engines. The proposed default MW-hr useful life levels were expressed as a function of the rated power of a locomotive. Since the Agency expects that future locomotives will operate longer between remanufactures than current locomotives, EPA proposed that locomotive and locomotive engine manufacturers would be required to specify a longer useful life than the minimum if a longer interval between remanufactures is intended for the locomotive than the minimum useful life interval. EPA also proposed to allow manufacturers to petition for shorter useful lives in unusual circumstances where an individual engine family is not designed to achieve the minimum useful life in-use.

The Agency also requested comment on other aspects of the proposed useful life definition. Specifically, comment was requested on 1) whether MW-hrs and miles are the most appropriate measure of a locomotive's useful life, or whether other measures (e.g., fuel usage, years) should be considered and, if so, how they should be measured; 2) a separate useful life definition of 12 years for Tier 0 locomotives dedicated to switching operation; and 3) whether it should consider allowing different useful lives within a given engine family for locomotives which will be used in substantially different applications than other locomotives in the same engine family.

#### Summary of Comments:

EPA's useful life proposal was generally supported by the environmental community, which emphasized the importance of assuring that the period during which a manufacturer is liable for the emissions of a locomotives will continue to be at least as long as the typical remanufacturing interval. NRDC, argued that the minimum useful life periods specified by EPA for Tier 0 and Tier 1 are too short.

AAR suggested that EPA should set a single useful life value at 7.5 MW-hr/hp for all standards. They also argued that adjustments to this value, especially downward adjustments, should only be made through a notice and comment rulemaking process, to ensure that all parties potentially affected by any adjustment had a chance to comment on it before it was approved.

Manufacturers argued that EPA failed to justify the proposed useful life periods, and that these periods are too long. Specifically, GETS recommended that EPA set the useful life period at 7.5 MW-hr/hp for locomotives equipped with MW-hr meters, and 750,000 miles or 7.5 years for locomotives not equipped with such meters. GM argued that useful life should be no more than 4.0 MW-hr/hp. As discussed in Chapter 7, EMA (including GM) expressed support after the close of the comment period for a useful life value of 7.5 MW-hr/hp. The arguments put forward by manufacturers in support of shorter useful life periods were:

- 1) Remanufacture intervals in use are longer than design lives for locomotives because of extensive maintenance, and replacement of worn components within these intervals;
- 2) Long useful life periods are not necessary because deterioration is not a problem for diesel engines;
- 3) Long useful life periods expose manufacturers to unreasonable recall risk, and would

result in excessive compliance costs; and

4) EPA has no basis to assume that remanufacture intervals will increase in the future.

#### Analysis of Comments:

EPA does not agree with manufacturers that remanufacture intervals are an inherently inappropriate basis for setting useful life periods. Useful life periods in mobile source regulations have historically been based on average or median periods to scrappage or rebuild. Such an approach provides assurance that manufacturers will design their engines and vehicles to maintain emissions performance as long as power output and fuel consumption performance. The Agency does recognize that locomotives often undergo extensive maintenance between remanufactures, and that this needs to be accounted for in these regulations. For this reason, EPA is allowing manufacturers significant flexibility in specifying maintenance that will be required during the useful life (see "Maintenance"). EPA will also not require manufacturers to test improperly maintained locomotives for the in-use testing program (see "In-Use Testing").

The manufacturers' argument that in-use deterioration will not occur is refuted by their own argument that long useful life periods will lead to greater recall risk. Such additional recall exposure would only result from in-use emission failures for locomotives, which would generally only result where they had significant in-use deterioration. EPA does agree that longer useful life periods can increase the risk of in-use failures, but this is only because emissions from diesel engines, especially smoke and PM, often deteriorate in use. EPA understands the manufacturers' desire to avoid the risk associated with a long useful life period, but EPA's choice of a useful life period reflects the large amount of usage a locomotive sees prior to scrappage or remanufacture, and the need and ability to control emissions over this period.

EPA also believes that it is likely that locomotives of the future will have longer useful lives. Manufacturers have made numerous improvements over the years to significantly increase engine life, and railroads have been constantly improving maintenance practices. EPA expects that these trends will continue, resulting in marginal increases in median engine life each year. However, EPA does not believe that it would be appropriate to effectively require longer engine life periods. For these reasons, EPA believes that the most appropriate way to determine useful life is to set default values, and to allow variations from that default on a case-by-case basis. EPA agrees with the commenters that argued for a single useful life value, because the Agency does not believe it is appropriate to mandate longer design lives for locomotives. Thus, EPA is finalizing a single minimum useful life period.

Based on the comments received, EPA believes that the minimum useful life period in MW-hr should be equal to 7.5 times the rated horsepower of the engine, or ten years, whichever occurs first, for all tiers of standards. The MW-hr value is the one that EPA proposed for existing locomotives and is the value recommended by the locomotive manufacturers and the railroads. EPA is including the year specification for all Tiers of standards to account for switch locomotives, or other low-use locomotives. In selecting the minimum value, EPA sought a value that would generally be feasible for the current fleet, even if there are no future improvements in engine life, while ensuring the desired in-use control of emissions from future locomotives under the most likely engine life scenario. While the minimum value appears to be somewhat greater than the median remanufacture interval for the current fleet, EPA is confident that remanufacturers will be able to comply with the standards during this period. EPA also believes that this value will be reasonably close to the median remanufacturing interval that will be observed for Class 1 railroads during the early part of the next century, when these regulations

will be in effect.

As was proposed, because EPA expects that some future locomotives will be designed to be operated (and actually will be operated in the field) significantly beyond the minimum useful life values defined here, EPA is requiring that manufacturers and remanufacturers specify a useful life that is longer than the minimum value where appropriate. Generally, the useful life value should be at least as long as the median remanufacturing interval of those locomotives in use. However, the Agency does recognize that there could be cases in which the median remanufacturing interval would not be appropriate for the useful life because the railroads were actually using the locomotives beyond their legitimate design life. Such special cases would be indicated by very significant increases in fuel consumption and/or decreases in reliability or power output before the locomotives were remanufactured.

As is discussed in the "Repowering" section in Chapter 6, EPA will allow manufacturers of repower engines to petition for a shorter useful life in some cases.

Finally, EPA recognizes that some Tier 0 locomotives will not be equipped with megawatt-hour meters. For these locomotives, EPA has set the default useful life at 750,000 miles, or ten years, whichever occurs first. EPA is including the year specification to account for switch locomotives, or other low-use locomotives. In practice, EPA expects that most Tier 0 line-haul locomotives will reach the 750,000 mile point before ten years, while most Tier 0 switch locomotives will not. Moreover, EPA is not confident that mileage accumulation values would be meaningful for switch locomotives operating within a switchyard.

## **E. Averaging, Banking and Trading**

The proposed ABT provisions were intended to enable manufacturers and remanufacturers to meet standards that EPA believed might not otherwise be feasible for all families within the lead time provided. In response to comments, EPA has eliminated many of the proposed restrictions in the ABT program. The Agency has determined that these restrictions, which limited credit life, prevented cross-tier trading, segregated Tier 0 locomotives into multiple categories, and placed stringent ceilings on FELs for Tier 0 locomotives, imposed unnecessary limits on the use of credits, and would have greatly reduced the value of the ABT program with respect to enhancing feasibility of the proposed standards. The modifications to the proposed provisions are being included to ensure that the ABT program affords manufacturers and remanufacturers the level of flexibility in complying with the emissions standards that EPA intended to provide, in light of the stringency of the standards being adopted. Therefore, the Agency does not believe that these modifications would support more stringent emissions standards than those being adopted today, based on EPA's analysis under Section 213(a)(5). EPA's analysis of the technological feasibility of the final standards is described earlier in this chapter and in the RSD. In addition, EPA's cost analysis, also in the docket for this rulemaking, was developed in light of the modifications EPA is finalizing to the proposed ABT provisions.

### **E.1. General Approach**

#### Summary of the Proposal:

Consistent with other EPA mobile source regulatory programs, EPA proposed an emissions averaging, banking and trading (ABT) program for locomotives. The ABT program would allow certification of one or more engine families within a given manufacturer's or



remanufacturer's product line at levels above the emission standard, provided the increased emissions are offset by one or more families certified below the emissions standard. The result is that the average of all emissions for a given pollutant in a particular manufacturer's product line (weighted by horsepower, production volume and useful life) is at or below the level of the emission standard. In addition to the averaging provisions just described, the proposed ABT program would also allow a manufacturer or remanufacturer to generate "credits" and bank them for future use in the averaging program, or sell them to another manufacturer or remanufacturer. EPA's proposed locomotive ABT program was modeled after similar programs already in place for on-highway and nonroad engines.

EPA proposed the ABT program for several reasons. The ABT program allowed the Agency to propose and finalize a more stringent set of locomotive emission standards than might otherwise be appropriate under CAA section 213, since ABT reduces the cost and improves the technological feasibility of achieving the standards. An ABT program can enhance the technological feasibility and cost-effectiveness of emission standards, helping to assure that new standards may be attainable earlier than would otherwise be possible. Manufacturers gain flexibility in product planning and the opportunity for a more cost-effective introduction of product lines meeting the new standards. ABT also creates an incentive for early introduction of new technology which allows certain engine families to act as trail blazers for new technology. This can help provide valuable information to manufacturers on the technology prior to manufacturers needing to apply the technology throughout their product line. This further improves the feasibility of achieving the standards. This early introduction of clean technology can also provide valuable information for use in other regulatory programs that may benefit from similar technologies, (e.g., nonroad programs). EPA views the effect of the ABT program itself as environmentally neutral because the use of credits by some engine families is offset by the generation of credits by other engine families. However, when coupled with the new standards, the ABT program would be environmentally beneficial because it would allow the new standards to be implemented earlier than would otherwise be appropriate under the Act. In addition, to the extent any credits end up not being used then there is an additional environmental benefit.

#### Summary of Comments:

EPA received a variety of comments on its proposed locomotive ABT program. In general, the locomotive manufacturers and railroads supported a much more flexible program than EPA proposed, with far fewer restrictions on credit life, credit exchange limitations, etc. EMA stated that the proposed program was far too complex and would not provide flexibility or reduced costs. The locomotive aftermarket suppliers and remanufacturers tended to see the ABT program as an anti-competitive program that would benefit the locomotive manufacturers at the expense of the aftermarket. These companies tended to support further restrictions that would level the playing field. Finally, the states and environmentalists tended to view the proposed ABT program as a lenient program that would allow for the generation of credits which may not really exist, and tended to advocate such things as credit discounting in order to guarantee environmental benefits from locomotives certified under the provisions of the proposed ABT program.

#### Analysis of the Comments:

Each of the issues included in the preceding summaries is discussed in more detail in the following sections, along with EPA's analyses and conclusions regarding those issues.

## **E.2. FEL Ceilings**

### Summary of the Proposal:

EPA proposed that when a manufacturer or remanufacturer uses ABT it would be required to certify each participating engine family to a family emission limit (FEL) of its choosing. A separate FEL would be determined for each engine family and pollutant included in the ABT program. EPA proposed an FEL ceiling of 1.25 times the applicable standard, so that no engine family could be certified at an emissions level higher than 1.25 times the applicable standard. The purpose of the FEL ceilings is to assure that no locomotives have emissions substantially higher than the applicable standards.

### Summary of Comments:

Only EMA and AAR commented on the proposed FEL ceilings. Both favored eliminating the ceilings altogether, stating that they constrain flexibility. AAR stated that overall emissions from the locomotive fleet are what EPA should be concerned about, and that EPA should, at a minimum, raise the ceilings from what was proposed. AAR also stated that the proposed locomotive FEL ceilings are more stringent than those for other EPA programs. Finally, AAR commented that eliminating the FEL ceilings would aid in the compliance under the ABT program of those engine families that would otherwise be certified under the 33 percent NO<sub>x</sub> reduction option.

### Analysis of the Comments:

While EPA does not agree that the FEL ceilings as proposed for Tier 1 and Tier 2 locomotives would constrain flexibility unduly, it does see merit in relaxing those ceilings somewhat to provide additional compliance flexibility without undermining the environmental goals of the proposed emission standards. This additional compliance flexibility will allow for compliance with the Tier 1 and Tier 2 standards at a lower cost than would be incurred had EPA kept the proposed FEL ceilings. The Agency believes that it would be inappropriate to eliminate the FEL ceilings altogether for Tier 1 and Tier 2 locomotives because doing so may result in some locomotives with largely uncontrolled emissions well into the next century. EPA believes that the best approach to relaxing the Tier 1 and Tier 2 FELs would be to follow the precedent set in the ABT program for on-highway heavy-duty engines where the applicable FEL ceilings are set at the levels of the standards applicable to previous model years. In other words, the FEL ceilings for Tier 1 locomotives would be set at the levels of the Tier 0 standards. Likewise, the FEL ceilings for Tier 2 locomotives would be set at the levels of the Tier 1 standards.

As previously stated, EPA does not believe it would be appropriate to eliminate the Tier 1 and Tier 2 FEL ceilings altogether. However, EPA does believe that it would be appropriate to eliminate the Tier 0 FEL ceilings. As discussed in detail elsewhere in this document, EPA believes that the 33 percent NO<sub>x</sub> reduction option proposed for Tier 0 locomotives should not be finalized because it could allow the Tier 0 fleet average emissions to exceed the Tier 0 standards. In order to allow the locomotives that this option was proposed to address (i.e., “high baseline locomotives”) to be remanufactured under the Tier 0 standards the NO<sub>x</sub> FEL ceiling must be much higher than 1.25 times the Tier 0 NO<sub>x</sub> standard. Any FEL ceiling that EPA would adopt to allow these high baseline locomotives to be certified to the Tier 0 standards under the provisions of the ABT program would be largely irrelevant to all other Tier 0 locomotives. Thus, EPA believes that it would be most appropriate to eliminate FEL ceilings altogether for Tier 0

locomotives. This approach will likely result in slightly lower Tier 0 fleet average emissions than having Tier 0 FEL ceilings and keeping the 33 percent NOx reduction option.

### **E.3. Pollutants Included**

#### Summary of the Proposal:

EPA proposed that, consistent with other mobile source ABT programs, the locomotive ABT program be limited to NOx and PM. EPA did not believe that the proposed HC, CO or smoke standards were so stringent as to justify their inclusion in the ABT program. Further, EPA proposed that only duty cycle-weighted emissions be included in the ABT program, believing that the inclusion of notch emissions would result in a program that is too complex to be practical.

#### Summary of Comments:

EPA only received two comments concerning the appropriateness of limiting the locomotive ABT program to NOx and PM. CARB commented in support of limiting the program to NOx and PM, but did not give any reasons for that position. AAR commented in favor of expanding the locomotive ABT program to include HC, CO and smoke. AAR suggested that including these pollutants would help in compliance and reduce cost.

STAPPA/ALAPCO stated that the presence of ABT means that the proposed Tier 0 PM standards are too lenient. The Tier 0 PM standards were proposed at levels above the uncontrolled locomotive baselines in order to allow all Tier 0 locomotives the ability to meet them in light of the required NOx reductions, resulting in the ability of some engine families to actually increase PM emissions from uncontrolled levels and still generate PM credits for being well below the Tier 0 PM standards. STAPPA/ALAPCO did not suggest how to address this specifically, but the implication is that either the Tier 0 PM standards need to be more stringent or PM (at least for Tier 0) should be excluded from the locomotive ABT program. NRDC also strongly supported cross-tier PM credit restrictions, presumably with this issue in mind.

#### Analysis of the Comments:

EPA continues to believe that, for the reasons stated in the proposal, there is no reason to include HC, CO and smoke emissions in the locomotive ABT program. AAR, while supporting their inclusion, did not provide any compelling arguments for their inclusion. Thus, EPA believes that limiting the ABT program to NOx and PM emissions, as proposed, is appropriate.

EPA agrees with the concern expressed by STAPPA/ALAPCO that the level of the Tier 0 PM standards could result in a locomotive generating PM credits under the ABT program even if its PM level increased from its pre-control level. This is a situation which could also occur under the proposed Tier 1 PM standards. Clearly it would not be appropriate to allow credits to be generated for emissions reductions which do not really occur. However, excluding Tier 0 and Tier 1 PM emissions from the ABT program altogether would remove any incentive for the early introduction of locomotives with low PM emissions. Thus, EPA believes that it would be most appropriate to allow Tier 0 and Tier 1 locomotives to participate in the ABT program for PM emissions, but credits should only be allowed to be generated relative to the uncontrolled baseline PM levels, not the levels of the standards. Thus, for the line-haul duty-cycle standards, Tier 0 and Tier 1 PM credits could only be generated to the extent the FEL is below 0.32 g/bhp-

hr. Similarly, for the switch duty-cycle standards, Tier 0 and Tier 1 PM credits could only be generated to the extent the FEL is below 0.44 g/bhp-hr.

#### **E.4. Credit Use Restrictions**

##### Summary of the Proposal:

EPA proposed separate ABT programs for switch and line-haul duty cycle emissions, since it was proposed that each locomotive be required to meet both the switch and line-haul duty cycle emission standards. EPA proposed that line-haul credits could not be used to meet the switch standards, and vice versa. Further, the Agency requested comment on whether it should restrict the exchange of credits between locomotives above and below 2000 hp. The concern expressed by EPA was that, since ABT credits are weighted according to horsepower, a large number of switch locomotives could be brought into compliance under the ABT program using credits from a few high-powered line-haul locomotives. This may result in many switch locomotives, which operate largely in urban areas, being largely uncontrolled.

EPA proposed to limit the exchange of credits to locomotives subject to the same set of emission standards (*i.e.*, Tier 0, Tier 1 or Tier 2) out of concern that credits generated on a less stringent set of standards could be used to delay compliance with the more stringent standards. EPA requested comment on whether it should allow some exchange of credits between these groups. EPA also proposed to exclude any Tier 0 engine family certified under the 33 percent NO<sub>x</sub> reduction provisions from the ABT program, and further proposed that any manufacturer or remanufacturer which certifies an engine family under this provision be prohibited from including any of its other engine families in the ABT program as well.

##### Summary of the Comments:

EPA received a variety of comments concerning the proposed restrictions on the exchange of credits between switch and line-haul duty-cycle emissions; Tiers 0, 1 and 2 locomotives; horsepower restrictions; and restrictions on the exchange of credits between freshly manufactured and remanufactured locomotives. Both EMA and AAR opposed all of these restrictions, stating that they remove the flexibility that allows ABT programs to generate emission reductions at the lowest cost. EMA stated that the most valuable aspect of any ABT program is its ability to smooth the transition from one set of standards to a more stringent set of standards. This benefit of ABT would be lost if credit exchanges are restricted between Tier 1 and Tier 2 locomotives. NRDC supported both the duty-cycle and cross-tier restrictions, but did not provide specific reasons for that support. CILAS generally supported a more flexible program in terms of horsepower restrictions, but commented that EPA should restrict the exchange of credits between freshly manufactured and remanufactured locomotives. CILAS stated that allowing such credit exchange favors the locomotive manufacturers, who participate in both the freshly manufactured and remanufactured locomotive market, while leaving the aftermarket companies at a disadvantage because they can not generate credits from freshly manufactured locomotives. CILAS suggested that this competitiveness issue could be addressed through some kind of brokerage system which would allow the aftermarket access to credits generated from freshly manufactured locomotives. Finally, MPI commented that the horsepower restrictions should be more stringent than EPA proposed. MPI suggested that, in order to more accurately reflect the current locomotive distribution, EPA should restrict the exchange of credits between locomotives up to 2500 hp (switch), 2500 to 4000 hp (older line-haul) and above 4000 hp (newer and future line-haul). MPI stated that a locomotive manufacturer has more flexibility

to shift credits among its engine families because it has more engine families to work with. This would allow those established manufacturers a price advantage over new entrants to the market which would have, by necessity, fewer engine families. MPI stated that this problem would be made worse if EPA were to allow early generation of credits (i.e., prior to the effective date of the standards).

EMA commented that Tier 0 locomotives certified under the provisions allowing for a 33 percent NO<sub>x</sub> reduction from a baseline level (rather than meeting the Tier 0 NO<sub>x</sub> standard) should be allowed to participate in the ABT program. EMA further argued that precluding a manufacturer or remanufacturer from including any of its engine families in the ABT program if it certified an engine family according to the 33 percent provisions would create a disincentive to offer remanufacture systems for those high baseline engine families. STAPPA/ALAPCO commented that there is no need for the 33 percent reduction option in the presence of the ABT program, suggesting that any emissions shortfall produced by the high baseline families could be made up through credits generated from other engine families. AAR suggested that a manufacturer or remanufacturer should not be excluded from the ABT program if it exercises the 33 percent reduction option in some of its engine families. In practice, once an entity certified an engine family under the 33 percent reduction option it would be precluded from ever participating in the ABT program. AAR proposed to deal with this by allowing a manufacturer or remanufacturer to exercise the 33 percent reduction option only if it cannot certify to the Tier 0 standards using its existing credits. AAR pointed out that this approach would not work unless EPA eliminated the proposed FEL ceilings.

#### Analysis of the Comments:

EPA agrees that a more flexible ABT program is desirable in that it has the potential to allow emission reductions at a lower cost. While a reduction in cost could be considered to be a reason for making the standards more stringent, EPA believes that the emission standards are the most stringent feasible given the expected availability of technology. Thus EPA believes that having fewer credit exchange restrictions than proposed is appropriate, both for reasons of lower cost and because EPA believes that one of the most important aspects of an ABT program is the incentive it provides for the introduction of cleaner technology earlier than otherwise anticipated. However, EPA also believes that it is important to structure the ABT program in such a way to prevent its use to delay the practical implementation of new technology. With these guidelines in mind, EPA believes the best approach to credit exchange restrictions in the locomotive ABT program is to have generally unlimited credit exchange between Tier 0, Tier 1 and Tier 2 locomotives, with no horsepower restrictions. However, EPA believes that Tier 2 technology will be significantly more advanced than Tier 0 and Tier 1 technology, and that imposing some restrictions on Tier 2 compliance with respect to the ABT program is important to assure that ABT is not used to delay Tier 2 compliance. Thus, only 75 percent of a given manufacturer's production of freshly manufactured locomotives in 2005 and 2006 will be allowed to be certified to NO<sub>x</sub> FELs greater than the applicable Tier 2 NO<sub>x</sub> standards. In 2007 and later, only 50 percent of a given manufacturer's new production will be allowed to be certified to NO<sub>x</sub> FELs greater than the applicable Tier 2 NO<sub>x</sub> standards. As is discussed later in the section on early generation of credits, EPA is restricting somewhat the use of credits generated on Tier 0 locomotives from 1999 through 2001.

EPA does not believe that a locomotive manufacturer will be in a position to "subsidize" its Tier 0 production with Tier 1 credits given the timing and stringency of the Tier 1 standards. Thus, EPA does not agree that allowing credit exchange between Tier 0 and Tier 1 locomotives

will result in the aftermarket being at a competitive disadvantage. Further, EPA is adopting several provisions in other areas of this rule in order to address the competitiveness concerns expressed by the aftermarket. The most notable of these provisions are in the area of compliance. The ABT program also contains such provisions in the way EPA is handling the early generation of credits.

As discussed elsewhere in this document, EPA does not believe it is appropriate to adopt the 33 percent NO<sub>x</sub> reduction option it proposed for Tier 0 locomotives. Thus, no response to the comments about how such locomotives should be handled in the ABT program is necessary.

#### **E.5. Treatment of Remanufactured Locomotives**

##### Summary of the Proposal:

EPA proposed that remanufactured locomotives be allowed to participate in the ABT program. It was proposed that, for purposes of credit generation and usage, the point of reference for a remanufactured locomotive be the FELs it was previously certified as meeting, rather than the original standards. EPA requested comment on whether it should ignore any previous FELs and calculate credits for remanufactured locomotives based only on the applicable standards. EPA also requested comment on whether it should restrict the exchange of credits between manufacturers and remanufacturers.

##### Summary of the Comments:

EPA received several comments in support of allowing subsequent remanufactures to participate in the ABT program, although the comments varied in how this should be done. CARB expressed concerns that once experience with in-use locomotive emissions is gained remanufacturers would reduce their compliance margins. This would allow them to certify to lower FELs and generate additional credits, but not actually reduce emissions compared to the previous remanufacture level. CARB suggested that EPA should either base FELs on production line testing results, or only allow a new FEL if it were an unspecified percent below the old FEL. CILAS commented that all subsequent remanufactures should be judged relative to the applicable standards, not the previous FELs. This approach would simplify things for an entity that is performing a remanufacture on a locomotive that it did not perform the previous remanufacture on. AAR stated that all subsequent remanufactures should be judged relative to the previous FELs, pointing out that it may be difficult for locomotives to comply if their previous FELs were above the applicable standards.

##### Analysis of the Comments:

EPA agrees that subsequent remanufactures should be included in the ABT program in order to encourage further emission reductions from locomotives which are already in compliance with the standards. EPA understands and sees merit in CILAS's position that remanufactures should be judged relative to the original emission standards in order to make it easier for an entity to perform a remanufacture on a locomotive it did not previously remanufacture. However, EPA sees greater merit in AAR's comment that it may be difficult for locomotives to comply if their previous FELs were above the applicable standards. Given that there are good arguments for both approaches, EPA believes that the practical implementation aspects of each approach should be considered in determining the best approach to take. If a locomotive were to be judged relative to the standards every time it were remanufactured, it

would need to be included in the ABT credit calculation each time it was remanufactured to FELs other than the standards, even if it were remanufactured to the same FELs as during its previous remanufacture. EPA believes that many locomotives will be remanufactured in the same configuration over and over again, and that requiring them to be included in the ABT calculation at each remanufacture would create an excessive paperwork and record keeping burden. Thus, EPA believes it would be best to judge remanufactures based on the previous FELs they were certified as meeting.

Using the approach just discussed, once a locomotive is remanufactured to FELs other than the standards it would be required to be remanufactured in compliance with those FELs at all subsequent remanufactures. Its ABT credits would be calculated based on the assumption that it would continue meeting the same FELs at all subsequent remanufactures. Thus, credits would be calculated based on the total emissions of that locomotive for its remaining service life. In order to allow these credits to be used for other locomotives it is necessary to prorate the emission credits based on the expected remaining service life. The approach EPA is finalizing to prorate emission credits is described in the RSD. EPA believes that the market for remanufactures will stabilize over time and that this approach will allow for a dramatically reduced paperwork burden as this stabilization occurs.

EPA believes that, even though it is requiring locomotives to be remanufactured in compliance with the previous FELs at subsequent remanufactures, it should allow subsequent remanufactures to again participate in the ABT program by being certified to FELs different than those it was previously certified as meeting. Under this provision, a locomotive's credits would be calculated in the same prorated basis as just discussed. The credits would be calculated relative to the FELs (or standards) that the locomotive was previously certified as meeting.

EPA does not agree with CARB that it should base FELs on production line testing or should only allow a new FEL for a remanufactured locomotive if it were some percentage below the old FEL. The purpose of the production line testing program is to assure that production locomotives are accurate reflections of the one used for certification. Should this not prove to be the case, EPA would take enforcement action, as discussed in the section on production line testing in Chapter 3. If a remanufacturer adjusts its FEL downward in response to increased confidence that its locomotives will always meet the emission standards (*i.e.*, the manufacturer reduces its compliance margins), it will, in essence, be getting credits for emission reductions that had been occurring all along. EPA sees no good reason for denying a remanufacturer legitimate credits because of increased confidence in its ability to maintain compliance. A remanufacturer will still be held liable for the emission performance of its locomotives relative to any new FELs during in-use testing.

## **E.6. Calculation of Tier 0 Credits**

### **Summary of the Proposal:**

Since ABT credits are weighted according to useful life, and Tier 0 useful life was proposed to be measured in MW-hr (if equipped with a MW-hr meter) or miles (if not equipped with a MW-hr meter), EPA proposed separate ABT programs for Tier 0 locomotives, depending on which measure of useful life they have, in order to deal with the issue of incompatible credits. The Agency also requested comment on other options for dealing with this issue.

#### Summary of the Comments:

AAR provided the only comments on the issue of the two different measures of useful life proposed for Tier 0 locomotives, and how that should be handled in the ABT program. AAR pointed out that the useful life of all Tier 0 locomotives is expected to be the same, regardless of whether or not they have MW-hr meters, and that the different measures of useful life were a practical matter related to the presence or absence of such meters. Thus, AAR proposed that all Tier 0 ABT credits be calculated based on the MW-hr definition of useful life on the assumption that the actual emissions would be the same for locomotives with and without MW-hr meters. This approach would allow for a single Tier 0 class for ABT purposes.

#### Analysis of the Comments:

EPA agrees with AAR's assertion that all Tier 0 locomotives are expected to have the same useful life regardless of whether or not they have MW-hr meters. This being the case, it does not make sense to restrict credit exchange between Tier 0 locomotives with and without the meters. Thus, EPA believes it is appropriate to calculate Tier 0 ABT credits according to the MW-hr definition of useful life, regardless of whether a Tier 0 locomotive has a MW-hr meter or not, and allow credits to be exchanged between locomotives with and without MW-hr meters. In the case of Tier 0 locomotives without MW-hr meters which are certified using a lower useful life value than the default, EPA will prorate the credits for that locomotive based on the ratio of actual certification useful life and the default useful life. This ratio will then be applied to the default useful life in MW-hr to determine useful life for the purposes of ABT credit calculations.

### **E.7. Early Generation of Credits**

#### Summary of the Proposal:

EPA proposed to allow early generation of credits by allowing both freshly manufactured and remanufactured locomotives to be certified in 1999 to the standards that were proposed to take effect in 2000. It was proposed that credits generated through such early certification would be calculated based on the difference between a locomotive's FELs and the standards it would have to meet if it were certified in 2000. However, EPA requested comment on whether it should allow credits for locomotives certified in compliance with the Tier 1 standards in 1999 to generate credits relative to the Tier 0 standards.

#### Summary of the Comments:

Both EMA and AAR supported the ability to generate credits prior to the effective date of the standards. They also suggested that such early banking should not be limited to one year prior to the effective date, but should be available upon finalization of the rule. EMA suggested that, for NO<sub>x</sub> credits, early banking should be based on a certification level below a trigger level set at 25 percent above the applicable standards. This comment suggests that EMA supports generation of credits relative to the uncontrolled locomotive baseline level. Both CILAS and MPI opposed the early credit generation provisions. Both stated that allowing early credit generation favors the locomotive manufacturers over the aftermarket. They stated that the manufacturers are in a position to generate credits early, whereas the aftermarket is not. The manufacturers could then use these early credits to later sell remanufacture systems at higher emissions levels (and resulting lower cost) which would put the aftermarket remanufacturers at a disadvantage. Finally, MPI stated that early credits would provide a windfall for the



manufacturers based on their past behavior and that this would ultimately harm the environment.

#### Analysis of the Comments:

EPA believes that one of the most important aspects of any ABT program is the incentive it provides for the early introduction of cleaner vehicle technology. As discussed in the sections relating to the Tier 0 and Tier 1 standards earlier in this Chapter, EPA expects that a few locomotive engine families will be able to comply with the emission standards prior to the effective dates of the standards. Since there is a cost associated with compliance with the standards, EPA does not believe that early compliance, even if feasible, would happen absent the incentive of early credit generation availability. As such, EPA believes that it should provide that incentive in the locomotive rule. However, EPA also agrees with CILAS and MPI that the early generation of credits could give the locomotive manufacturers a competitive advantage over the aftermarket. Past market practices of the locomotive manufacturers, such as predatory pricing, have given EPA reason to believe that, given the opportunity, they would drive the aftermarket suppliers from the market. Thus, EPA believes that the concerns stated by CILAS are real and should be addressed. EPA does not desire to create a market shift from the aftermarket to the locomotive manufacturers by creating an incentive for the early introduction of cleaner technology. EPA believes the best approach to dealing with the conflicting desires to provide incentives for cleaner technology and to minimize disruption to current market dynamics is to allow for the early generation of credits beginning in 1999, as proposed, but restrict how such Tier 0 credits can be used in the early years of the program. Thus, beginning in 2002, any credits generated on Tier 0 locomotives from 1999 through 2001 that have been banked by the manufacturer can only be used for the compliance of Tier 1 or later locomotives. Alternately, such credits could be transferred to the locomotive owner and then used without restriction. This approach would both provide incentive for the early introduction of cleaner technology while allowing the aftermarket industry greater access, through the primary locomotive operator, to the credits generated, while limiting the ability of locomotive manufacturers to use Tier 0 credits generated in the early years of the program to gain a competitive advantage over the aftermarket industry. EPA believes that this approach would provide the aftermarket industry better access to the early credits because the railroads have an economic interest in maintaining the viability of the aftermarket industry.

EPA is concerned that some locomotives which are due to be remanufactured when the standards take effect may be remanufactured early in order to generate credits relative to the uncontrolled baseline, even though they may not meet the Tier 0 standards. Thus, EPA believes it is only appropriate to allow the early generation of credits for those locomotives which meet the Tier 0 standards. Also, while EPA's calculated fleet average line-haul weighted NO<sub>x</sub> emissions are approximately 13 g/bhp-hr, many locomotives currently emit well below that level. EPA is concerned that allowing credit generation relative to the fleet average would result in many locomotives being able to generate credits without actually reducing emissions. Thus, EPA believes it would be appropriate to use conservative baseline values of 10.5 g/bhp-hr for the line-haul duty--cycle and 14.0 g/bhp-hr for the switch duty-cycle standards for credit generation purposes in order to assure that such windfall credits cannot be generated. Similarly, EPA is including baseline values of 0.20 and 0.24 g/bhp-hr for the line-haul and switch PM standards, respectively. These are the values that credits would be calculated relative to for purposes of early credit generation. However, requiring these values to be used for all locomotives would result in locomotives whose baseline emissions are above these values not getting credits for actual reductions achieved. Therefore, EPA believes it would be best to use these values as default values, but allow a remanufacturer to use locomotive model-specific baseline values

based on actual testing data for that model.

As was previously discussed, credits for remanufactures will be prorated according to estimated remaining service life. However, in the case of credit generation associated with early compliance, credits will only be given for a single useful life period since any locomotive brought into compliance early would still be required to comply with the standards at its next remanufacture.

## **E.8. Treatment of Credits**

### Summary of the Proposal:

EPA proposed that credits should have a three year life with no annual discounting. Comments were requested on anywhere from a three year to infinite credit life, and discounting rates from zero to 20 percent annually. Also, EPA proposed that when credits are generated and traded in the same model year both the buyers and sellers of those credits be potentially liable for any credit shortfall at the end of the year, except in cases where fraud is involved.

### Summary of the Comments:

EMA, AAR and CILAS all commented in favor of an infinite credit life. AAR stated that a limited credit life is counter to the intent of the ABT program. NRDC supported EPA's proposed three year credit life. Further, NRDC suggested that the ABT program be terminated once the transition is made to the Tier 2 standards. Specifically, NRDC suggested that credits no longer be allowed to be generated after 2005. In the presence of a three year credit life this would mean that the ABT program would end in 2008. Also, both EMA and AAR argued against any credit discounting. EMA and AAR's positions opposing credit life limits and credit discounting were based on the idea that a ton of emissions is a ton of emissions, regardless of when it is produced. NRDC stated that there must be credit discounting in the ABT program, and that undiscounted credits sacrifice the ability to capture environmental benefits from the early introduction of cleaner technologies.

Only EMA and AAR commented on the proposed provision to hold both buyers and sellers of credits liable for any year end credit shortfalls. EMA stated that the credit buyers should be held liable for shortfalls. AAR did not specifically recommend how to address the issue of liability, but stated that the liability provisions need to be revised since one entity can not be held liable for the other's actions, and holding both liable would discourage the use of the trading provisions.

EMA commented that credits should be calculated using the average power of an engine family. EPA, in its existing ABT programs, requires that credits be calculated using the lowest horsepower rating in an engine family generating the credits. When credits are being used the usage must be calculated based on the highest horsepower rating in the engine family using the credits. EMA stated that EPA is eliminating this "buy high, sell low" approach in its upcoming on-highway rulemaking.

AAR suggested that railroads should be allowed to hold ABT credits. If a railroad were allowed to purchase any credits generated by a locomotive it purchased or had remanufactured, AAR argued, it could then use those credits to assist the aftermarket in producing remanufacture systems. This approach would allow the railroads to help keep the aftermarket companies

competitive with the locomotive manufacturers.

#### Analysis of the Comments:

EPA agrees with AAR, CILAS and EMA that the best approach to ABT credits is to have an unlimited credit life and no discounting. This approach will improve the feasibility of the standards by providing additional flexibility in compliance, and as a result will also reduce the cost of compliance. This is the approach that EPA is moving towards in some other mobile source programs, such as the new regulations for on-highway heavy-duty diesel engines.<sup>4</sup> With respect to credit life, EPA believes that having a finite credit life creates an incentive to use credits which may otherwise go unused. EPA does not believe that, in the case of locomotives, it makes sense to include credit discounting, as NRDC suggested. EPA structured its emission standards based on the inclusion of the ABT program, and the feasibility of the standards was determined based on the ABT program as proposed. While EPA is making some changes to the proposed ABT program, as discussed in this section, it believes that including credit discounting would diminish the feasibility of the standards.

EPA continues to believe that it is appropriate to hold both the buyers and sellers of credits liable for any year end credit shortfalls, except in cases where fraud is involved. However, a buyer of credits which are shown later to not exist will only be required to make up the credit shortfall. There will be no penalty associated with the unknowing purchase of nonexistent credits. EPA believes that the proposed provision that both not be held liable in cases of fraud should be sufficient to address concerns expressed by AAR and EMA.

EPA agrees with EMA that it would be most appropriate to calculate credits both generated and used based on the average horsepower of the participating engine family. However, in order to accurately calculate credits, the average horsepower must be calculated on a sales-weighted average. Thus, credits will be calculated on an average engine family horsepower basis, determined through a sales-weighted average of all configurations in the participating engine family.

EPA agrees with AAR that the railroads should be allowed to hold emission credits generated under the ABT program. This rule is the first time that EPA has regulated the remanufacture of any mobile source on such a comprehensive scale, and this regulation of remanufactures presents unique circumstances to the railroad industry. The railroads have traditionally relied upon the aftermarket to provide competitive, low cost components for locomotive remanufacturing. This has aided in the ability of the railroad industry to remain a cost efficient mode of transportation. Allowing the railroads to own emission credits will put them in a good position to assure that the aftermarket industry will remain competitive. EPA also believes that it should expand upon AAR's request that the railroads can hold credits and, in the interest of fairness to other entities, will allow any entity, with the advance approval of EPA, to purchase and hold locomotive emission credits. This will allow an entity, for example, to purchase credits at the market value and hold them with the intent of not using them.

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<sup>4</sup> 62 FR 54694, October 21, 1997.

## **CHAPTER 3 COMPLIANCE**

EPA requested comment from stakeholders regarding the different administrative programs included in the proposed regulation. Specifically, the Agency requested comment on the certification, production line, and in-use testing programs.

### **A. Engine Family Definition**

#### **Summary of the Proposal:**

The Agency proposed to define engine family for locomotives using many of the same parameters which are currently used to define on-highway and nonroad engine families, plus some additional parameters. These parameters include aspects of both the physical design of the engine (*e.g.*, combustion chamber configuration, cylinder bore and stroke) as well as operating characteristics (*e.g.*, fuel injection pressure and rate, turbocharger and inlet air cooling characteristics). A complete list of the parameters is included in section 92.204 of the proposed regulations. Overall the definition proposed for locomotives is more narrowly drawn than for on-highway and other nonroad engines.

#### **Summary of the Comments:**

CILAS recommended that the parameters for the designation of an engine family should include only similar emission characteristics and not the physical design of the engine. Caterpillar and GETS commented that the proposed engine family definition was too burdensome and recommended that the definition follow the engine family definition for other nonroad equipment contained in 40 CFR part 89. EMA and AAR commented that the proposed definition is too narrow and will cause a proliferation of locomotive engine families. Both EMA and AAR suggested that EPA adopt for locomotives the same engine family definition for nonroad engines over 37 kW contained in 40 CFR part 89.

#### **Analysis of the Comments:**

EPA is adopting regulatory definitions of engine family very similar to those proposed for Tier 0, Tier 1, and Tier 2 locomotives. The final definitions are, however, somewhat more flexible than the proposed definitions, and are somewhat narrower than the engine family criteria used in 40 CFR Part 89. EPA believes these somewhat narrower criteria are more appropriate for grouping locomotive engines with similar emissions characteristics than the Part 89 criteria, and strike an appropriate balance between manufacturers' desire for broad criteria, and EPA's concerns that engines that may have different emissions characteristics should not be grouped in a single engine family. For all tiers, the conceptual definition of engine family is "a group of locomotives that are expected to have similar emission characteristics for their useful lives." The regulations also contain specifications for certain locomotive engine parameters that determine whether various locomotives can be grouped into the same engine family. For example, locomotive engines must have the same bore and stroke, and use the same fuel to be grouped into the same engine family. While the proposed definitions would have required locomotives be identical with respect to nearly all of these engine family parameters, the final definitions allow some reasonable deviations for many of the parameters. Given the complexity of bringing a variety of existing locomotive models into compliance, the regulations provide additional flexibility for Tier 0 locomotives by specifying fewer engine family parameters than are specified for Tiers 1 and 2. As is noted elsewhere, if any configuration within a family fails

to comply during in-use testing, then the entire family would be presumed to be in noncompliance unless proven otherwise. Thus, manufacturers and remanufacturers will have a very strong incentive to ensure that only locomotives with similar emission performance are grouped together in the same family.

### **A.1. Combining Small Tier 0 Engine Families into One Family**

#### Summary of the Proposal:

EPA requested comment on whether it should allow manufacturers to combine small volume Tier 0 engine families into a single engine family in order to reduce testing burden.

#### Summary of the Comments:

The CILAS commented that the certificate holder should determine which engine types their systems will bring into compliance. EMA commented that there should be no pre-determined criteria for defining a Tier 0 engine family. The AAR suggested that, for Tier 0 engine families, EPA should avoid specifying the characteristics that engines must share to be grouped in the same engine family and allow the certificate holder to specify the engine models for which a system is appropriate.

#### Analysis of the Comments:

As was previously discussed, an engine family is a group of locomotives expected to have similar emission characteristics throughout their useful lives. EPA is allowing more leeway in defining Tier 0 engine families as compared to Tier 1 and Tier 2 engine families, but it believes that engine families must ultimately be defined on the basis of similar emission characteristics. While EPA is defining engine family criteria for all three tiers of standards, it is allowing some variation from these criteria for all tiers in order to allow a manufacturer or remanufacturer to combine different configurations into the same engine family if they can be shown to have similar emission characteristics.

## **B. Certification**

### **B.1. Locomotive or Engine Certification**

#### Summary of the Proposal:

EPA proposed in the NPRM preamble that locomotives (rather than engines), in a particular engine family, be certified with respect to compliance with the applicable emissions standards. EPA also proposed provisions that would allow test data from a development engine to be used for certification, rather than requiring testing of a pre-production prototype locomotive. Nevertheless, it is the actual locomotive, not the engine, in an engine family for which a certificate of conformity was proposed to be issued.

#### Summary of the Comments:

Manufacturers opposed EPA's proposal to certify locomotives rather than locomotive engines. They argued that the proposal is inconsistent with EPA's engine certification programs for other heavy-duty mobile sources. They also argued that a locomotive-based testing program

would pose significant facility and operational problems for both engine-only and fully integrated manufacturers (*i.e.*, those that make both the engine and the entire locomotive). GETS stated that while an engine-only manufacturer need only perform certification testing, a locomotive manufacturer not only will need to devote personnel, time, and equipment to certification testing of engines, but also will have to spend additional time and money on equipment, training and testing for the locomotive itself. Caterpillar commented that certificates should not only be issued for locomotives, but also for locomotive engines. NESCAUM commented that EPA should not allow test data from a development engine to be submitted for certification. Comments from CILAS supported an engine-based testing program as a less costly means of collecting test data.

#### Analysis of the Comments:

For reasons discussed in the NPRM, EPA believes that the most appropriate approach to regulating locomotive emissions is to measure the emissions under conditions representative of actual locomotive in-use operation. As was previously discussed, EPA is requiring the certification of engine families. In order to assure that the measured emissions of an engine family are representative of actual locomotive operation a manufacturer or remanufacturer must either specify actual locomotive models for that engine family or specify the parameters that affect locomotive engine emissions (*e.g.*, engine and intake air cooling specifications, parasitic loads on the engine) as part of the application for engine family certification. The lack of such specifications will be assumed to mean that the engine family is to be certified for use in any locomotive application. Using this approach to the certification of engine families, EPA is confident that measured emission levels will be representative of in-use locomotive emissions whether it is a locomotive or a locomotive engine which is tested. This rule contains provisions for both locomotive and engine testing. The engine testing procedures contain provisions which assure that engine testing results represent actual locomotive emissions by accounting for such things as parasitic engine loads and alternator efficiency. This approach to certification and testing means that engine and locomotive testing are interchangeable. While it is desirable, from a cost perspective, to test engines rather than locomotives during certification and production line testing, it is impractical to remove a locomotive engine from the locomotive for in-use testing purposes, and in-use testing will be done on actual locomotives. This approach to engine family certification will allow for engine testing in some cases, and locomotive testing for in-use testing purposes. For the reasons discussed in the NPRM, EPA is allowing engine testing on a development engine to be done for certification. Also, as discussed later in this chapter, EPA is allowing engine testing to be done for production line testing as well. All of the arguments in favor of engine testing concern the cost of doing locomotive testing, and EPA believes that this approach to engine family certification, with allowances for engine testing for certification and production line compliance address those economic concerns while assuring that measured emissions are representative of actual locomotive operation, and that enforcement actions can be taken based on either locomotive or engine testing.

The Agency agrees that this is not the approach that it has taken with its regulation of other heavy-duty engines. However, the reasons why those engines are certified as engines rather than vehicles do not apply to locomotives. More specifically, it is practical to perform emission testing in locomotives, and locomotive engines are not used as broadly in different applications as other heavy-duty engines. EPA does not believe that it should only certify locomotive engines simply because this is the approach it has taken in regulating other classes of heavy-duty engines.

## **B.2. Certification Durability Requirement**

### Summary of the Proposal:

The Agency proposed no durability demonstration be required for certification. However, a manufacturer or remanufacturer must still estimate in-use emissions deterioration as part of the certification process (through engineering evaluation or other means), but need not do so by operating a locomotive for its entire useful life. EPA proposed manufacturers and remanufacturers specify deterioration factors (DFs) at the time of certification to account for in-use emission deterioration (i.e., increases in emissions caused by such things as component wear). The DF is a factor that is multiplied by the emission rates that are measured from a low-mileage locomotive or locomotive engine to project in-use emissions at the end of useful life. In cases where no emissions deterioration is expected, manufacturers and remanufacturers could specify a DF of one.

### Summary of the Comments:

EMA commented in support of the absence of a durability demonstration requirement in EPA's proposal. EMA stated that the demonstration would impose an unnecessary cost burden on manufacturers. EMA also commented that the requirement for manufacturers and remanufacturers to estimate deterioration factors (DFs) should be postponed until they have obtained additional data over time that indicates proper levels of deterioration. CILAS commented that the proposal to require manufacturers to estimate DFs is not technically sound and is not cost efficient. NESCAUM commented that EPA should develop optional assigned DFs based on the initial results of the in-use testing program.

MPI stated they believed that EPA's requirement for DFs was inappropriate. They argued that the proposed approach incorrectly implies a gradual and predictable deterioration of emissions performance. MPI argued, instead, that in-use emission increases result from problems that are preventable with proper maintenance such as faulty aftercoolers, worn injectors, or inlet port carboning. Moreover, they argued that remanufacturers might be unable to determine DFs where the emission deterioration is caused by factors which they do not control. CILAS argued that estimation of in-use deterioration will be very difficult for small supply companies.

### Analysis of the Comments:

Under EPA's current motor vehicle program, the certification process includes an up-front showing of emissions durability. This is done through an emissions durability vehicle which is operated more or less continually to accumulate mileage representative of in-use operation. Thus, a motor vehicle's ability to meet the emission standards throughout its useful life is demonstrated as part of the initial certification process. With locomotives, which are built to operate continually and have very long useful lives, this type of accelerated usage is not feasible. Such a demonstration would take several years to complete, compared to several months for on-highway passenger cars, and could require more than \$1 million in fuel. Thus, including a durability showing in the initial certification process is not appropriate in light of the cost and time involved in making such a showing.

The Agency is not disputing MPI's argument that most emission deterioration for in-use diesel engines could be prevented by ensuring that proper maintenance is performed. That is why the regulations require that railroads perform emission-related maintenance. However, there

remains a potential for emissions to increase due to general wear of the engine. This is especially true for PM emissions. Thus, EPA is finalizing the proposed DF requirement.

EPA has historically included DFs in its mobile source regulations, and believes that they are equally appropriate in these regulations. In the past, EPA has allowed manufacturers to specify DF values of one for those cases in which they can reasonably demonstrate that there will be no deterioration, and EPA will also allow them to do so for locomotives as appropriate. Thus, manufacturers and remanufacturers of locomotives with very durable emission performance could, in effect, choose to not use a DF. However, if the results of the in-use testing show that significant deterioration is occurring, then EPA could reject future certification applications that did not account for the expected in-use deterioration.

The results of the in-use testing program could not be used initially to assign DFs in this case because, with the long useful lives of locomotives, the results will not be received for several years into the program. As information becomes available, EPA will consider the development of optional assigned DFs.

### **B.3. Use of Carry-over Test Data**

#### Summary of the Proposal:

EPA proposed that when no significant changes to an engine family occur from one model year to the next, manufacturers and remanufacturers may submit emission test data used to certify the engine family in previous years in lieu of actual testing for current year certification. This can be done to certify an engine family which is the same as, or substantially similar to (as determined by the Administrator), the previously certified engine family, provided these data show that the test engine would comply with the applicable regulations. This allows manufacturers the ability to "carry over" test data from the same engine family from one model year to another.

#### Summary of the Comments:

Comments received from EMA supported EPA's proposal to provide manufacturers and remanufacturers the ability to carry-over certification test data from one model year to the next when no significant changes to the engine family occur.

#### Analysis of the Comments:

EPA is finalizing the proposed provision for the reasons identified in the NPRM.

### **B.4. Simplified Certification Reporting Burden**

#### Summary of the Proposal:

EPA proposed to reduce the reporting burden associated with the application for certification. EPA believes that it is appropriate to require manufacturers and remanufacturers to collect and maintain certification application information, but that it should not be necessary for them to submit this information unless specifically requested. EPA could modify the information that must be submitted and maintained, allowing EPA to exercise some flexibility in designing and implementing the certification process for locomotives and locomotive engines.



#### Summary of the Comments:

Comments from EMA supported the reduced certification reporting procedures. NJ Transit commented in support of simplifying the certification and enforcement process.

#### Analysis of the Comments:

EPA is finalizing the proposed provision to reduce the reporting burden associated with the application for certification, with no changes from the proposed requirements. If the Agency modifies the information submission requirements, it will provide manufacturers and remanufacturers with a guidance document, similar to the manufacturer guidance issued under the on-highway program, that explains the modification(s). These modifications to the information submission requirements will in no way change the actual requirements of the regulations in terms of the emissions standards, test procedures, etc. Manufacturers and remanufacturers must retain records supporting the certification application whether or not EPA requires that all such records be submitted to the Agency at the time of certification. The Administrator retains the right to review records at any time and at any place he or she designates.

### **B.5. Maintenance**

#### Summary of the Proposal:

EPA proposed a schedule of minimum maintenance intervals that a certificate holder would be allowed to specify for certain critical emission-related engine components. EPA proposed that certificate holders were to provide maintenance instructions for their products, and that operators would be required to perform such maintenance. EPA proposed that a locomotive owner which knowingly fails to properly maintain a locomotive would be considered to have tampered with that locomotive.

#### Summary of the Comments:

EMA stated that maintenance intervals should be market-driven, rather than set by EPA. EMA argued that railroads exert enough economic pressure to prevent manufacturers from specifying more maintenance than that necessary for economical operation of the locomotive. Moreover, they argued limiting allowable maintenance would prevent the application of beneficial new technology to locomotives, *e.g.*, air filter design, which had been earlier drastically revamped to be cheaper and more effective. EMA also stated that many railroads are applying reliability centered maintenance measures, based on inspection and monitoring, rather than fixed periods, which would be "derailed," at least in part, by the proposed regulations. EMA further stated that EPA's proposed intervals conflict with current maintenance practices, which are based primarily on 92 day Federal Railway Administration (FRA) safety inspections, or on longer time intervals (*e.g.*, fuel injectors at 2 or 3 year intervals), not mileage points. EMA recommended that EPA specify maintenance intervals using current railroad practice, usually in multiples of 92 day FRA intervals.

EMA also stated that EPA excluded some emissions-critical items from its list of emission-related components, *i.e.*, aftercooler and radiator cleaning. EMA also recommended a much shorter interval (92 days) for cleaning EGR filters, rather than the 150,000 mile EPA

specification.

GETS agreed that it was unnecessary for EPA to specify maintenance requirements; market forces would be sufficient to assure that optimum maintenance would be performed, due to the strong market position of the railroads.

AAR agreed that reasonable maintenance must be performed on locomotives to ensure proper emissions performance, but objected to the proposed requirements allowing the certificate holder to specify the required maintenance. AAR argued that this would provide certificate holders with incentives to specify unnecessary and costly maintenance requirements. AAR also objected to EPA specifying components and replacement intervals, on the grounds that maintenance intervals and the components that must be maintained will vary from application to application. AAR stated that EPA should only impose a general requirement for maintenance that would reasonably be expected to maintain the emissions performance of a locomotive.

#### Analysis of the Comments:

EPA believes that the manufacturer or remanufacturer is generally in the best position to determine how locomotives should be properly maintained, and that the market forces involved should be sufficient to ensure that manufacturers will not specify excessive maintenance for liability or other purposes. EPA will therefore allow manufacturers and remanufacturers to specify reasonable maintenance procedures. However, EPA will retain the authority to disapprove maintenance specifications which it has reason to believe are excessive, or would not be performed in-use. EPA will require that maintenance instructions present a clear picture of specific requirements to the extent possible, rather than imposing ambiguous general requirements. This is necessary to ensure that properly-maintained locomotives are selected for in-use testing, which would not be possible with the type of vague general specifications that AAR has requested. Locomotive owners, in turn, will be required to perform the required maintenance, or its equivalent, or be subject to the tampering penalties provided in this rulemaking. The determination of equivalence will generally be based on whether the alternate maintenance practice maintained emission compliance to the same extent as the specified maintenance.

### **C. Production Line Testing Program**

#### **C.1. Appropriateness of a Production Line Testing Program**

##### Summary of the Proposal:

EPA proposed a Production Line Testing (PLT) Program in which manufacturers and, in some cases, remanufacturers of locomotives perform production line testing of newly manufactured and remanufactured locomotives. This program would require manufacturers to test locomotives as they leave the production line for emission compliance. The objective of the PLT program is to allow manufacturers, remanufacturers and EPA to determine, with reasonable certainty, whether certification designs have been translated into production locomotives that meet applicable standards and/or FELs from the beginning, and before excess emissions are generated in-use.

##### Summary of the Comments:

EMA commented that EPA has failed to demonstrate any need for a production line test program and question the rationale EPA used to justify the need for this program. EMA, GETS and GM commented that a production line testing program is unnecessary and would impose enormous burden. Comments in support of production line testing were received from the San Diego Air Pollution Control District and the CARB. Carol Tino also commented in support of a production line testing program, but suggested that it would be more appropriate for EPA to select which engines are to be tested.

#### Analysis of the Comments:

EPA has determined that the PLT program is an appropriate testing activity which can detect whether a manufacturer has failed to translate a locomotive's design successfully into mass production before the locomotives and locomotive engines are put into use.<sup>5</sup> This program offers the manufacturer the opportunity to correct emission related problems early in a locomotive's life, thus reducing a manufacturer's in-use liability.

EPA believes that a PLT program is necessary to verify that new locomotives and new locomotive engines comply with applicable regulations. This program is especially important given that EPA is allowing certification of freshly manufactured locomotives and locomotive engines based on data from a development engine, rather than a pre-production prototype locomotive. In other mobile source regulations EPA requires the pre-production prototype vehicle/engine to be tested for certification.

The finalized PLT program also will serve the following additional purposes: 1) ensure that manufacturers follow precisely the required emissions test procedures, and 2) ensure that production locomotives are in conformity with applicable federal emission requirements as they come off the production line and that individual locomotives tested conform to applicable family emission limits.

PLT is especially important for a rule where certification is built around an averaging, banking, and trading program. Manufacturers will be producing locomotives which generate emission credits that can be bought or sold or used to offset other families produced by the same manufacturer. It is important to ascertain that actual production locomotives achieve certification family emission limits to ensure that credits are bona fide and real.

EPA has taken a different approach in the locomotive production line testing program than in other mobile source regulations: this program implements a more flexibly organized testing regime that acts as a quality control method that manufacturers and remanufacturers will utilize and monitor to assure compliance. Manufacturers will continue to take steps to produce engines within statistical tolerances and assure compliance aided by the quality control data generated by PLT which will identify poor quality in real time. Under this program, manufacturers will randomly select locomotive engines for testing. EPA has the right to reject any locomotive engines selected by the manufacturer if it determines that such locomotive

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<sup>5</sup> This discussion uses the term "manufacturer" because the emission testing-based PLT program is primarily intended for freshly manufactured locomotives. Under some circumstances a remanufacturer may be required to perform testing in accordance with the manufacturer PLT program discussed here.

engines are not representative of actual production.

## **C.2. Locomotive or Engine Testing**

### Summary of the Proposal:

EPA proposed that manufacturers test locomotives, rather than engines, for the PLT program.

### Summary of the Comments:

EMA commented that a locomotive-based testing program would pose significant facility and operational problems for both engine-only and fully integrated manufacturers (*i.e.*, those that make both the engine and the entire locomotive). GETS stated that while an engine-only manufacturer need only perform certification testing, a locomotive manufacturer not only will need to devote personnel, time, and equipment to certification testing of engines, but also will have to spend additional time and money on equipment, training and testing for the locomotive itself. Caterpillar commented that requiring engine-only manufacturers to conduct locomotive tests is extremely burdensome because they do not have the economic or the technical base to support such an activity. Comments from CILAS supported an engine-based testing program.

### Analysis of the Comments:

The Agency agrees with the locomotive industry comments regarding locomotive engine-only manufacturers but, as stated earlier, EPA believes that testing of locomotives is important to ensure compliance. EPA believes an emission test on a locomotive would much more accurately reflect real world locomotive operation than a test on a locomotive engine, but is finalizing provisions allowing locomotive or locomotive engine manufacturers to test locomotive engines in their PLT program in order to reduce the cost of PLT testing.

## **C.3. Production Line Test Procedure**

### Summary of the Proposal:

EPA has proposed that manufacturers test locomotives using the full Federal Test Procedure (FTP) for the Production Line Testing (PLT) Program.

### Summary of the Comments:

In response to the proposal, EMA recommended that the PLT program utilize an abbreviated test procedure. In their comments, EMA proposed their recommendation for a abbreviated test procedure.

### Analysis of the Comments:

The purpose of the PLT program is to ensure that manufacturers translate certification prototype engines into mass production engines that meet emission standards. The PLT program serves as a mechanism to evaluate the validity of certification credits. A full FTP is the best way to evaluate, with certainty, whether production engines meet emission standards and therefore whether the valuable emission credits produced, are valid.

EPA believes that the abbreviated test procedure that EMA has proposed is inadequate for the PLT program. For the certification program, EPA is adopting provisions that allow manufacturers to certify locomotives using a development engine. In other words, locomotive manufacturers and remanufacturers will conduct testing on a development engine for the purposes of obtaining a certificate of conformity. Therefore, under the PLT program, manufacturers and remanufacturers will conduct a full FTP on a locomotive for the first time. This full FTP is needed to determine that actual production locomotives and locomotive engines are being produced identical to the development engine and as specified in the certificate.

#### **C.4. Time Period for Suspension/Revocation of Certificates of Conformity**

##### Summary of the Proposal:

EPA proposed that the Administrator may suspend the certificate of conformity for an engine family that is found to be in noncompliance fifteen days after the failure is discovered.

##### Summary of the Comments:

The AAR commented that this time period is too short and cite the equivalent time period in the Statement of Principles for Phase II regulations of lawn and garden engines is 30 days. EMA suggests that EPA adopt a 60 day time period. CILAS commented that suspension of a certificate should only occur in cases of gross incompetence, tampering or fraud.

##### Analysis of the Comments:

In the PLT program, the Administrator could suspend or revoke the manufacturer's certificate of conformity in whole or in part after an EPA noncompliance determination for an engine family that fails the PLT, or if the locomotive manufacturer's submittal reveals that the PLT tests were not performed in accordance with the applicable testing procedure. EPA understands the commenter's argument and believes a longer time period should be established, especially in light of the less frequent nature of locomotive and locomotive engine production. EPA believes an appropriate time period would be 30 days.

EPA is finalizing provisions under which the Administrator may suspend or revoke the manufacturer's certificate of conformity in whole or in part 30 days after an EPA noncompliance determination for an engine family that fails the PLT, or if the manufacturer's submittal reveals that the PLT tests were not performed in accordance with the applicable testing procedure. During the 30 day period following a determination of noncompliance, EPA would coordinate with the manufacturer to facilitate the approval of the required production line remedy in order to eliminate the need to halt production, to the greatest extent possible. The manufacturer must then address (*i.e.*, bring into compliance, remove from service, etc.) the locomotives produced prior to the suspension or revocation of the certificate of conformity. EPA may reinstate the certificate of conformity subsequent to a suspension, or reissue one subsequent to a revocation, after the manufacturer demonstrates (through its PLT program) that improvements, modifications, or replacement had brought the engine family into compliance.

#### **C.5. Remanufacturer Production Line Testing Program**

##### Summary of the Proposal:

The Agency proposed a separate program for assuring the production quality of remanufactured locomotives. Under this proposed program, the certificate holder, as a condition of the certificate, would be required to audit its remanufacture of locomotives for the use of the proper parts, their proper installation, and all proper calibrations. The certificate holder would be required to perform these audits on five percent of its annual production.

#### Summary of the Comments:

CARB commented in support of the proposed program, but added that some confirmatory testing should be performed. Comments received from the AAR generally support the audit concept for this program, but recommend a lesser amount of audits per certificate holder per year. AAR also commented that only serious installation errors should constitute a failure. AAR states that the requirement to audit 5 percent of its annual production is excessive, especially for certificate holders that produce large numbers of systems per year. EMA commented that the number of potential remanufactured engine families is enormous and that EPA must recognize the PLT requirements for remanufacturers must account for the fact that there really is no production line for remanufacturing engines. EMA supported the proposed audit requirement for remanufacturers. CILAS commented in support of the audit concept and recommended that the auditing of remanufactured units be held to a maximum of 5 units per year. CILAS stated that all production line auditing should be performed using portable testing equipment.

#### Analysis of the Comments:

The Agency recognizes that there may be a large number of remanufactured engine families and that it may be difficult for a certificate holder to audit system installations from a variety of installers located throughout the country. As a result, EPA is adopting AAR's recommendation of requiring the certificate holder to audit five percent of the certificate holder's systems for each installer of the systems, with a maximum number for each installer of 10 systems per engine family. EPA believes that a maximum of five units per year per remanufacturer will not allow EPA to make a compliance decision for a particular engine family

EPA believes the remanufacturer is the best entity to decide how the actual auditing takes place. In other words, the remanufacturer may, in fact, employ portable testing equipment, per CILAS's suggestion, to determine if parts have been installed properly. A case of uninstalled, misinstalled, misadjusted or incorrect parts will constitute a failure, and additional locomotives will be required to be audited. Actions in the event of an audit failure will be determined on a case-by case basis, depending on whether the failure is considered tampering, causing of tampering, inappropriate parts in system, etc. EPA retains the right to order, on a case-by-case basis, a PLT testing program for remanufactured locomotives in the same manner as the PLT program for freshly manufactured locomotives if in-use testing or system audits showed evidence of noncompliance.

### **D. Locomotive Manufacturer and Remanufacturer In-use Testing Program**

#### **D.1. Authority**

##### Summary of the Proposal:

EPA proposed to adopt an in-use testing program pursuant to the Agency's authority to implement and enforce the locomotive emissions standards, and pursuant to its authority to collect information from entities subject to the Act's requirements.

#### Summary of the Comments:

EMA commented that EPA does not have the authority under the Clean Air Act to impose an in-use test program on manufacturers. EMA stated that section 208 only permits EPA to require testing that is not otherwise reasonably available and that in-use testing is otherwise reasonably available to EPA because the Agency has long maintained that it has authority under the CAA to conduct in-use testing of mobile sources. EMA also noted that EPA's authority to charge fees for in-use compliance tests, upheld in EMA v. EPA 20 F.3d. 1177 (DC Cir 1994), establishes a means by which EPA can obtain in-use emissions data. EMA cited to the legislative history of the 1990 amendments to the CAA to support its position. EMA also commented that the proposed program would require manufacturers to do the impossible - obtain locomotives for testing from railroads. NRDC commented in support of the Agency's authority to implement and enforce an in-use test program. NESCAUM and STAPPA/ALAPCO commented in support of EPA's interpretation of the Act allowing EPA to require manufacturers to test locomotives. The ATA and CILAS commented in support of EPA's authority to require manufacturers to perform an in-use testing program.

#### Analysis of the Comments:

EPA is finalizing the proposed manufacturer and remanufacturer in-use testing requirements, with the changes noted below, for the reasons described in, and pursuant to the authority cited in, the NPRM. The in-use testing requirements adopted today are designed to ensure that locomotives and engines comply with EPA's emissions standards for the full extent of their useful lives. EPA disagrees with EMA's statement that EPA lacks authority to adopt in-use testing requirements for manufacturers because such testing is otherwise reasonably available to EPA. They stated that, because EPA could charge fees for in-use compliance tests under Section 217 of the CAA, in-use testing of locomotives and locomotive engines is otherwise reasonably available to EPA, and therefore cannot be required. EPA disagrees that in-use testing such as that required by the in-use testing program adopted today for manufacturers of new locomotives and new locomotive engines is otherwise reasonably available. While EPA does have a facility in which it can test motor vehicles, the Agency does not have any test facilities in which it could test locomotive emissions. Even if EPA were to allocate funds to construct such a facility, which it does not currently anticipate doing by the time implementation of the locomotive standards begins, the cost to build the facility would be more than \$500,000 per year. Assuming that most locomotives passed the tests, the costs of such testing would be at least twice the expected cost for the manufacturer and remanufacturer in-use testing requirements. Moreover, unlike EPA, the manufacturers and remanufacturers already have the infrastructure and practical expertise to efficiently manage such a program for locomotives; thus, they will be much more able to minimize disruptions to the railroads. The Agency rejects the argument that the manufacturers and remanufacturers will be unable to obtain locomotives for testing. Where necessary, they can make contractual arrangements with their customers at the time of sale.

In promulgating the motor vehicle certification fees schedule, EPA described its interpretation of testing that is "not otherwise reasonably available." EPA stated that "testing is considered not otherwise reasonably available if the Agency determines that additional testing is

necessary beyond the base program that is not covered by fees.” In addition, EPA clarified in that rulemaking action that “in keeping with Section 217(d) of the CAA, as amended, nothing in the fees regulations will restrict the Administrator’s authority to require testing. The Administrator retains authority to require testing under all provisions of the CAA ... As Section 217(d) makes clear, the fee program in Section 217 does not limit EPA’s authority to require manufacturer testing ...” 57 FR 30046 (July 7, 1992).

EPA agrees that it has the authority under Section 217 to collect fees for any in-use compliance tests. However, to view this fees authority as automatically resulting in in-use testing being otherwise reasonably available would render the provision of the Act requiring manufacturers to perform tests a nullity. If EPA could not require in-use testing for any vehicle category for which it can charge fees under Section 217 for compliance testing, the Act’s authorization for EPA to require manufacturers to perform tests would be meaningless. EPA does not believe that Congress intended for EPA’s authority to require in-use testing by vehicle and engine manufacturers to be voided by the Agency’s ability to charge fees for in-use compliance testing conducted by EPA. EPA also disagrees that the promulgation of a railroad in-use testing program in today’s rule means that in-use testing is “otherwise reasonably available,” since the railroad testing requirements apply at or beyond the end of useful life, compared to the manufacturer testing requirements, which apply earlier in the useful life. The two in-use testing programs are designed differently, and are intended to obtain different information regarding in-use compliance with standards.

Finally, it is important to note that the in-use testing requirements that were proposed do not represent a significantly greater relative economic burden than the current pre-production durability requirements of 40 CFR Part 86. The Agency considered adopting a similar pre-production durability requirement for locomotives, but determined that such an approach would be unnecessarily expensive. The in-use testing requirements will be much less expensive. In fact, one of the reasons that EPA proposed the in-use testing requirements is that the pre-production emission durability data that is typically available for mobile sources would not otherwise be available for locomotives.

## **D.2. Appropriateness of In-use Testing Program**

### **Summary of the Proposal:**

EPA proposed an in-use testing program requiring manufacturers and remanufacturers to test locomotive engine families in-use. EPA stated that the proposed in-use testing program would be a critical element in the success of the proposed locomotive program by ensuring that manufacturers and remanufacturers produce new locomotives that continue to meet emission standards beyond certification and production stages, during actual use.

### **Summary of the Comments:**

STAPPA/ALAPCO commented that ensuring locomotives continue to meet emission standards in-use is critical to the overall success and integrity of the locomotive program. NRDC commented in support of the in-use program by stating that they believe an in-use testing program is a key factor in ensuring that the final rule’s in-use emission reductions are actually achieved, especially in the absence of an up-front durability demonstration. CARB commented that the proposed in-use program is not stringent enough to insure the emissions reductions



needed to meet the final rule standards are achieved. EMA stated that the proposed in-use testing program is unnecessary, costly, and has no potential to provide measurable air quality benefits. EMA suggested adopting a one time cooperative in-use data collection program to determine in-use performance. Comments from the ATA state that EPA must establish an in-use testing program to assure compliance with the emission standards.

#### Analysis of the Comments:

EPA agrees with commenters who stated that in-use compliance is essential to the success of the locomotive emission control program. EPA believes the in-use testing program does, in fact, provide an air quality benefit, because the best way to ensure that the in-use emissions reductions expected to result from implementation of the proposed standards are actually achieved is to perform in-use testing on a significant number of locomotives every year. This is especially important in the absence of an up-front durability showing demonstrating how a locomotive deteriorates in-use before a certificate of conformity would be issued.

The in-use testing program is designed to minimize the burden on industry, while providing a strong incentive for manufacturers and remanufacturers to build locomotives and locomotive engines that meet standards beyond the certification and production stages, when in actual use. Under the in-use testing program, each manufacturer and remanufacturer will be required to test in-use locomotives from one engine family per year, using the full FTP. The Agency is finalizing the requirement to test one engine family per year in order to limit the testing burden on manufacturers and remanufacturers.

### **D.3. Maintenance and Use History of In-use Locomotives**

#### Summary of the Proposal:

EPA proposed that in-use test locomotives would be required to be randomly selected and to have a maintenance and use history representative of a properly maintained and operated locomotive.

#### Summary of the Comments:

GM suggested that EPA revise the regulations to clarify that in-use compliance determinations shall not be based on locomotives which have had significant maintenance or repair work performed using either uncertified components, or procedures which are not in accordance with the manufacturer's recommended practices. EMA commented that any in-use locomotives tested under this program must be properly maintained and used. EMA stated that the proposed regulations do not explain this requirement.

#### Analysis of the Comments:

EPA clearly stated in the NPRM preamble that any in-use locomotive tested must be properly maintained and operated and the final version of the regulations include a provision clarifying this. To comply with this requirement, a manufacturer or remanufacturer would question the end user regarding the accumulated usage, maintenance and operating conditions of the test locomotive. EPA may allow manufacturers and remanufacturers to delete locomotives from their test sample and replace them with others if abuse or malmaintenance is shown to

occur that might significantly affect emissions durability. The manufacturer or remanufacturer would document reasons for deletion in its test report to EPA.

#### **D.4. Sample Size**

##### Summary of the Proposal:

EPA proposed that each manufacturer and remanufacturer test one in-use engine family per year. EPA proposed that a minimum of two locomotives per year, within the subject engine family, be tested provided that no locomotive fails any standard. For each failing locomotive, EPA proposed that two more locomotives would be tested up to a maximum of ten.

##### Summary of the Comments:

EMA commented that the proposed test program is not based on a statistically valid sample and that manufacturers would incur greater costs because they will test more engines to avoid false failures. CARB commented that the test program should require testing of a larger sample of the locomotives produced each year to assure reliable test results. CARB also stated that EPA should focus on locomotives certified using carryover data.

##### Analysis of the Comments:

To achieve the Agency's goal of establishing a strong enforcement program while minimizing the burden on manufacturers, EPA proposed a sampling process for the selection of locomotives for in-use testing which is designed to provide adequate data for the Agency to use as a basis for compliance decisions, while expediting testing of engine families found to meet the standards. Under Section 207(c) of the CAA, in order to make a determination of nonconformity, the Agency must determine that a substantial number of locomotives or locomotive engines do not conform to the applicable emission standard or FEL during their regulatory useful life. This provision applies to locomotives and locomotive engines as provided in section 213(d). A sample size of ten has proved capable in the past, in other mobile source programs, to provide confidence as to whether a substantial number fail to conform. Over the years, in EPA's light-duty vehicle in-use testing program, the sample size of ten has been a good indicator for EPA to make a compliance determination for an engine family. A manufacturer or remanufacturer could test more locomotives than the minimum described in the regulation or could concede that the engine family failed to comply with applicable standards before reaching locomotive number ten. EPA would consider failure rates, average emission levels, and the existence of any defects in tested locomotives, among other things in determining whether to pursue remedial action.

#### **D.5. Time Period for In-use Testing**

##### Summary of the Proposal:

The Agency proposed that all locomotives tested under the manufacturer and remanufacturer in-use testing program will have reached at least 75 percent of their useful lives. While testing of locomotives will be limited to between 75 and 100 percent of their useful lives, actual repair in the event of a determination of noncompliance under section 207(c) of the Act, however, would not be limited to locomotives and engines within their useful life.

##### Summary of the Comments:

EMA commented that testing at or beyond 75 percent of useful life is far too late in the life of a locomotive engine and greatly increases potential recall liability. CILAS stated that the use of in-use programs to measure useful life is not appropriate. AAR commented that EPA should clarify when in-use testing of locomotives must take place. Carol Tino suggested that EPA alter the in-use testing time frames to test a locomotive somewhere past the midpoint of the useful life and once again near the end.

#### Analysis of the Comments:

The Agency is finalizing the provision that in-use testing of locomotives must take place between 50 and 75 percent of a locomotive's useful life. EPA believes that requiring testing an in-use locomotive more than once during its useful life is inappropriate because locomotive operators will not reasonably be able to supply locomotives for that amount of testing. If the locomotive must be tested numerous times during its useful life, the operator would have to take the locomotive out of service a number of times and lose the revenue generating service of the locomotive. EPA believes that one in-use test is appropriate and EPA has chosen between 50 and 75 percent of useful life in order to balance the need to accurately assess in-use emissions performance, which argues for testing late in the useful life, with the desire to maximize the benefits of any remedial action in the event of an in-use failure, which argues for testing earlier in useful life, and the desire to allow for flexible scheduling of in-use tests. The in-use test program is intended to assess in-use emissions deterioration, not production quality (which is assessed in the production line testing program). Thus, it is most appropriate to test later in a locomotive's useful life, rather than earlier, to ensure that test results reflect actual in-use deterioration, which tends to increase with age. However, testing too late may present two problems. First, the later in useful life the testing is done, the more difficult it may be to find well-maintained locomotives to test, since many may be remanufactured before the end of useful life. Second, testing extremely late in useful life would minimize the benefits achieved from any remedial action taken in the event an in-use nonconformity is identified. Thus, EPA believes that testing between 50 and 75 percent of useful life strikes a balance between these different issues.

### **D.6. In-use Testing Burden**

#### Summary of the Proposal:

EPA proposed that manufacturers and remanufacturers perform testing on in-use locomotives for the in-use testing program.

#### Summary of the Comments:

EMA commented that EPA's proposed program imposes an inequitable burden on locomotive engine manufacturers that is not imposed on engine manufacturers in other industries. NRDC commented that the in-use testing program should be the responsibility of the manufacturer or railroad company, not EPA. GETS expressed their concern that, under EPA's proposal, parts-only manufacturers do not bear the costs of in-use tests, resulting in a potential competitive advantage. STAPPA/ALAPCO noted that the marine engine regulations also include an in-use testing program that requires testing to be performed by manufacturers.

#### Analysis of the Comments:

Requiring manufacturers and remanufacturers to perform in-use testing is consistent with

EPA's view that manufacturers and remanufacturers should take an active role in monitoring and assuring the in-use emissions performance of their products. Through its experience in the motor vehicle program, EPA has developed the view that manufacturers believe the test results and benefit the most when they are responsible for generating the test data. When testing their own locomotives, manufacturers and remanufacturers gain opportunities to investigate emission problems and to develop solutions on the very locomotive(s) that may have failed emissions testing.

EPA disagrees that this in-use testing requirement represents an inequitable burden relative to other mobile sources. While manufacturers of many other sources are not currently required to perform in-use testing, they are required to perform a pre-production durability demonstration. For locomotives, such a demonstration for each engine family would likely cost significantly more than the in-use testing program being established here.

EPA believes that in-use testing performed by manufacturers is particularly important in the context of the locomotive emission control program. Locomotive engine manufacturers can conduct certification testing on development engines under the regulation adopted today. In addition, the PLT program allows manufacturers and remanufacturers to conduct testing on engines themselves, rather than on locomotives. In other words, under the certification and PLT programs, manufacturers and remanufacturers may only conduct testing on locomotive engines. Because of these provisions, it is possible that testing pursuant to the manufacturer in-use testing requirements could be the first test, in the compliance scheme, actually conducted on a locomotive. Also, as was noted, the marine engine regulation contains an in-use testing program conducted by the engine manufacturers. EPA is also considering in-use testing requirements for manufacturers of other kinds of nonroad and on-highway engines and vehicles.

#### **D.7. Time Period for Procurement of In-use Locomotives**

##### Summary of the Proposal:

EPA proposed to allow manufacturers and remanufacturers to set their own schedule for in-use testing. EPA proposed to allow manufacturers and remanufacturers twelve months after the receipt of testing notification to complete the testing of an engine family.

##### Summary of the Comments:

The ATA commented that this proposal, coupled with the possibility of an extension, is unacceptable. The ATA stated that this time frame is overly lenient and that the testing should occur on an EPA determined schedule.

##### Analysis of the Comments:

EPA understands the commenter's statements but recognizes that locomotive manufacturers and remanufacturers may have difficulty procuring locomotives for in-use testing due to the fact that they are in revenue-generating service. This is particularly problematic for the locomotive industry because locomotives are typically in small fleets, and as a result, it would be much harder to replace a locomotive chosen for in-use testing on short notice. Therefore, EPA is finalizing the provision to allow manufacturers and remanufacturers twelve months after the receipt of testing notification to complete the testing of an engine family. (Testing by the Agency of an engine family in the motor vehicle program is usually completed within a three-

month period.) The Agency believes that providing manufacturers and remanufacturers with twelve months to complete this testing provides them the necessary flexibility in conducting their test programs and adequately addresses any difficulties which would arise during the locomotive procurement and testing.

## **E. Railroad In-Use Testing Program**

### **E.1. Number of Locomotives to be Tested and Test Procedure to be Used**

#### Summary of the Proposal:

EPA proposed a railroad in-use test program, as a screening program whereby a relatively large number of locomotives (10 percent of those locomotives in a railroad's fleet that are operating past the end of their useful life) would be tested. The locomotives tested would be randomly selected by the railroads. The testing, to be performed at all notches, would be done using field quality measurement equipment. NO<sub>x</sub>, CO, CO<sub>2</sub> and HC concentrations were proposed to be measured, as well as smoke opacity. These concentrations would be compared to the concentrations measured during certification testing. No requirement to measure fuel consumption or power output was proposed.

The Agency also considered an option under which the railroads would perform testing using the full FTP (with the exception of PM measurement) instead of the test procedure described above. However, tests would be performed at a much lower sampling rate. EPA also requested comment on a second alternative whereby only a smoke test would be used with the number of locomotives tested being much greater than the ten percent in the proposed railroad in-use testing program.

#### Summary of the Comments:

EPA received no comments opposing the establishment of in-use testing requirements for railroads. However, AAR argued that the specific program proposed by EPA was unnecessarily costly and inconsistent with the stated purpose of the program. They stated that the program would cost \$8 million each year, and that this was too much for a program that is intended for informational rather than enforcement purposes. They suggested an in-use testing program for railroads that would be similar to the one proposed for manufacturers and remanufacturers. Under such a program, each Class I railroad would be required to test at least two locomotives from a single engine family each year. The railroad could be required to test up to eight additional locomotives from that engine family, depending on the results of the testing. (Note: while not specifically mentioned in the written comments, the railroads indicated during discussions with EPA prior to the NPRM that they believe that such testing should not include measurement of particulate.)

AAR also stated in its comments that the railroads would support an optional program in which they tested 25 percent of their locomotives each year for smoke. However, this testing would be performed using a non-FTP test procedure designed to minimize testing time and fuel consumption.

Other commenters also supported the requirement that railroads perform in-use testing. The City of San Diego emphasized the importance of allowing flexibility for railroads in performing the testing. On the other hand, ATA argued for less flexibility and more oversight by EPA. They also argued that the railroad testing should be required both during and after the

useful life period. MPI argued that EPA should finalize an FTP-based test program for railroads. NRDC suggested that EPA should finalize an engine family-based railroad test program that requires testing of 25 percent of the specified engine family (which would require about 100 to 300 tests per year per railroad). The State of Utah argued that states should have authority to conduct in-use testing because such testing can be better targeted at the local level than at the national level.

#### Analysis of the Comments:

EPA agrees with AAR that the proposed railroad testing program could be more expensive than was estimated in the proposal. EPA believes that it underestimated railroad labor costs in the proposal. EPA also agrees that the most appropriate type of railroad testing program at this time is an FTP-based program involving fewer locomotives than proposed to balance the increased accuracy and costs of the testing. The Agency does not, however, agree that the railroad testing program should be structurally similar to the manufacturer program. Rather, because it is intended for informational and not enforcement purposes, it should require a fixed number of tests that is not based on any pass/fail criteria.

The program suggested by AAR would require that railroads test 20 to 100 locomotives each year. (Note: assuming a low failure rate the actual number of tests would be closer to 20 than to 100.) EPA agrees that this is the appropriate range for the test sample size. However, EPA believes that the number of tests required by a railroad should be proportional to the total number of locomotives operated by the railroad, rather than the same number of tests required for each railroad as AAR proposed, so that each railroad must test the same percentage of its fleet of locomotives. The number of tests proposed by AAR would be about 1.1 to 5.4 tests per thousand locomotives. EPA is finalizing a requirement that railroads test 1.5 locomotives for each thousand locomotives of that railroad's total average locomotive fleet size the previous year. The tests shall be done on locomotives which have reached the end of their useful lives for reasons stated in the proposal. If the number of locomotives in a given railroad's fleet which have reached the end of their useful lives is not large enough to fulfill the testing requirement, railroads are to test locomotives late in their useful lives, as described in the regulatory text. The test locomotives will be randomly selected by the railroad, unless otherwise specified by the Administrator, and must proportionally represent the railroad's fleet mix.

The Agency considered higher sampling rates such as that suggested by NRDC, but concluded that the cost of testing was not justified by the marginal value of the additional testing. Similarly, EPA continues to believe for the reasons discussed in the proposal, that given a fixed number of railroad tests, it is more appropriate to have them performed after the end of the manufacturer's or remanufacturer's liability for in-use emission performance. Moreover, manufacturers and remanufacturers will be providing test results for locomotives during their useful lives. Nevertheless, EPA will retain the flexibility to accept and/or require railroad testing conducted during a locomotive's useful life. EPA notes that section 114 of the CAA authorizes EPA to require railroads to test locomotive emissions on a one-time basis, and EPA may exercise such authority on a case-by-case basis as appropriate.

The Agency also believes that it will be necessary that the railroad testing include measurement of PM. This is especially true given the new NAAQS for PM that will require additional focus on PM emissions. EPA recognizes that this will have a significant impact of the cost of each test, but these impacts were considered in determining the appropriate number of tests required.

EPA continues to believe that railroads should be allowed significant flexibility in conducting in-use testing. While EPA is not finalizing any specific alternative testing programs, the regulations allow EPA to approve alternate test programs using different test procedures, sample size, or with modifications to other parameters of the test program. In determining whether to approve alternate in-use test programs, EPA will consider the need for such emission data (including the availability of data from other sources), the cost of such testing, and the results of previously provided emission data. In response to ATA's comment on the need for oversight, EPA recognizes that some oversight of railroad testing will be necessary, and will determine the proper amount of oversight needed.

Finally, EPA disagrees with the State of Utah regarding the relative value of national versus local emission testing for locomotives. (Note: states' authority to require in-use testing of locomotives is discussed in the "preemption" section.) The vast majority of railroad emissions come from locomotives that are used in interstate line-haul service. Thus, multiple state programs would be inefficient because multiple states would often be expending resources to monitor the emissions performance of the same locomotive. The same level of effort at a national level would result in much broader coverage of locomotives because it would be better able to avoid duplicative testing. Moreover, national railroad emission testing may be less burdensome to the railroads because they will not be required to monitor which locomotives were operated in each state at any given time.

## **E.2. Obligation to Supply Locomotives to EPA for Testing**

### Summary of the Proposal:

EPA proposed that any railroad or other entity subject to the provisions of subpart K shall supply for testing to EPA, upon request, a reasonable number of certified in-use locomotives or engines.

### Summary of the Comments:

AAR objected to this requirement that they must supply EPA with an undefined reasonable number of locomotives or engines for testing. AAR suggests EPA limit the number of locomotives it can request from a railroad to five per year. EMA opposed this requirement and suggested EPA remove it from the regulation.

### Analysis of the Comments:

EPA believes that manufacturers and remanufacturers of locomotives and locomotive engines must supply EPA with locomotives or locomotive engines, upon request. However, EPA understands the commenters' concern that, with the smaller sizes of the locomotive engine families compared to other industries, the requirement to supply to EPA a reasonable number of certified locomotives or locomotive engines may be burdensome. Therefore, EPA is finalizing the requirement that any railroad or other entity shall supply to EPA, upon request, a maximum number of five locomotives per year.

## **E.3. Time Period for Recordkeeping Requirements**

### Summary of the Proposal:

EPA proposed a recordkeeping retention period of twelve years for records created under the certification, averaging, banking & trading, defect reporting, voluntary recall and production line programs.

Summary of the Comments:

AAR commented that this time period is too long. AAR stated that this time period is longer than any other regulated industry's recordkeeping requirements and suggests that EPA adopt a period of eight years for each of the programs.

Analysis of the Comments:

EPA agrees with the commenter that a recordkeeping retention period of eight years for records created under the certification, averaging, banking & trading, defect reporting, voluntary recall and production line programs is an adequate time period to ensure that records will be available to EPA when necessary. EPA does not believe that a twelve year retention requirement will provide useful benefits compared to an eight year requirement. Therefore, EPA is finalizing a recordkeeping retention period of eight years.

**F. Recall Program**

**F.1. Appropriateness of Recall Program**

Summary of the Proposal:

In the NPRM the Agency stated that if an in-use nonconformity is found to occur in an engine family, EPA will work with the manufacturer or remanufacturer to implement a remedial action on a voluntary basis. If the manufacturer or remanufacturer does not implement a voluntary remedial action, the Administrator may order one pursuant to section 207(c) of the Act.

Summary of the Comments:

EMA commented that the recall liability should be eliminated, or at least minimized. EMA stated that recall is costly and is simply not necessary to assure that locomotive engines are performing in-use and that the decision to require a mandatory recall to address each potential emission exceedance must be consistent with the statutory criteria established for locomotive emission standards. Comments from EMA further question the need for conventional recall, pointing out that the Statement of Principles developed by EPA and engine manufacturers concerning a proposal to implement a second phase of emission reductions for small spark-ignition (SI) nonroad engines used in nonhandheld equipment do not include a mandatory recall program.

GETS commented that a recall is an inappropriate remedy for this industry. NRDC commented in support of the proposal to recall a locomotive fleet which fails to comply with the emission standards.

Analysis of the Comments:



Under section 207 of the Act, as applied to locomotives according to section 213(d), the Administrator has authority to require manufacturers and remanufacturers to submit a plan to remedy nonconforming locomotives and locomotive engines if EPA determines that a substantial number of a class or category of properly maintained and used locomotives or locomotive engines do not conform with the requirements prescribed under section 213 of the Act. Other requirements applicable in the event of a determination of nonconformity under section 207(c) of the Act include submittal of the manufacturer's remedial plan for EPA approval, procedures for notification of locomotive owners, submittal of quarterly reports on the progress of the recall campaign, and procedures to be followed in the event that the manufacturer requests a public hearing to contest the Administrator's finding of nonconformity. If a determination of nonconformity with the requirements of section 207(c) of the Act is made, the manufacturer or remanufacturer would not have the option of an alternate remedial action, and an actual recall would be required.

Based on its experience in the motor vehicle program, EPA views recalls as an extremely effective tool to induce manufacturers and remanufacturers to produce emission durable products. EPA believes that locomotives could be readily located for recall repairs and notes that most locomotives are centrally maintained and are subject to periodic inspection and maintenance which would facilitate their repair. EPA recognizes that the actual recall and repair of locomotives may prove to be burdensome and impose financial hardship on a manufacturer or remanufacturer if the necessary repair was extremely complex and expensive. The Agency also understands that an actual recall could also impact railroads when locomotives are required to be taken out of service for any repairs. As stated in the preamble to the NPRM, in such instances, and assuming that the Administrator had not yet rendered a determination of nonconformity, alternatives to traditional recall would be considered.

Today's final regulations contain provisions which allow EPA to make compliance determinations on the basis of in-use testing. EPA believes that given the tracking systems present in the vertically integrated locomotive industry and the fact that locomotives receive regularly scheduled maintenance and inspections, a recall (preferably voluntary) is an extremely feasible remedy for noncompliance.

## **F.2. Alternatives to Recall**

### **Summary of the Proposal:**

EPA proposed that, in the event of an in-use problem and, assuming the Administrator had not yet rendered a determination of nonconformity, alternatives to traditional recall would be considered, and requested comment regarding the circumstances under which alternatives to conventional recall should be considered.

### **Summary of the Comments:**

Comments received from EMA state the proposed recall regulations unnecessarily mandate recalls without considering other methods for reducing emission exceedances. EMA stated that alternatives to recall should be available regardless of hardship and claims that alternatives to recall will be less costly than an actual recall. EMA further stated that there are many other methods which have been or could be developed to address a potential emission exceedance. EMA commented that those methods should be allowed when a locomotive or locomotive engine manufacturer proposes a program which achieves emission reductions which

are at least equivalent and possibly superior (measured as a combination of costs and benefits) to those which would be achieved under the mandatory recall provisions.

EMA commented that EPA should include regulatory options in lieu of mandatory recall in the event of a nonconformity finding by the Agency. EMA noted that recalls may be particularly expensive for locomotives, because of the cost and time required to obtain locomotives from operators, and the high cost of replacement locomotives. EMA stated that EPA must consider the statutory criteria in Section 213(a)(5), including cost, in deciding whether to require a mandatory recall to address each potential emissions exceedance. EMA also noted that EPA's regulations for small spark ignition nonroad engines less than 19 kW do not include mandatory recall provisions.

#### Analysis of the Comments:

EPA contemplates that recall of locomotives will be the primary method for addressing in-use nonconformities. Recalls directly address the emission problem and, as discussed previously, EPA believes that such recalls provide substantial incentive to manufacturers and remanufacturers to produce emission durable locomotives. However, the Agency recognizes that in some cases, the actual recall and repair of locomotives could impose financial hardship on a manufacturer or remanufacturer if the necessary repair was extremely complex and expensive, and could also impact railroads when locomotives are required to be taken out of service for those repairs. In such cases, and assuming that the Administrator had not yet rendered a determination of nonconformity, alternatives to traditional recall would be considered. These alternatives would be required to have the same or greater environmental benefit as conventional recall and to provide equivalent incentives to manufacturers and remanufacturers to produce locomotives which durably and reliably control emissions. But, if a determination of nonconformity with the requirements of section 207(c) of the Act is made, the manufacturer or remanufacturer will no longer have the option of an alternate remedial action, and an actual recall would be required.

EPA is finalizing the proposed recall regulations, with changes noted in this section of the Summary and Analysis of Comments. EPA expects to consider alternatives to recall in the event of in-use emissions exceedances, prior to a finding of nonconformity. However, once a nonconformity finding is made, a recall action will be required. EPA notes that the regulations for small spark ignition nonroad engines less than 19 kW include no in-use standards, unlike the locomotive emissions standards which apply for the full useful life of the vehicle or engine. EPA intends to adopt full useful life standards in the second phase of standards for these small nonroad engines that will include provisions for mandatory recall.

### **F.3. Remedy Liability**

#### Summary of the Proposal:

EPA proposed that if a nonconformity is found to occur with the in-use test locomotives, then the entire engine family will be found to be in noncompliance. If the engine family contains more than one configuration, EPA proposed that the nonconformity be assumed to apply to all configurations in the engine family, not just the configuration that was tested.

#### Summary of the Comments:

EMA commented that in-use liability should be limited to the tested engine configuration rather than extending the liability to any configuration in the tested engine family. EMA stated that EPA would have no justification to automatically expand liability since the in-use test data would be limited to the tested configuration.

#### Analysis of the Comments:

The conceptual definition of engine family is a group of locomotive configurations which are expected to have similar emission characteristics throughout their useful lives. With this definition in mind, EPA believes that, as proposed, it is most appropriate to extend liability to all configurations in a given engine family in the event that any configuration in that engine family fails an in-use test. Since all configurations in an engine family have, by definition, similar emission characteristics, they would be expected to have similar emission failures. Thus, as the default, EPA will assume that an in-use nonconformity affects all configurations in the engine family. However, EPA can envision scenarios where an in-use failure could conceivably be limited to a particular configuration. Thus, in the event that the engine family is discovered to be in nonconformity, a manufacturer or remanufacturer may limit their liability for the nonconforming engine family by demonstrating to EPA that the reason for the nonconformance is limited to a certain engine configuration.

### **F.4. Extending Remedial Action to Carry-over Engine Families**

#### Summary of the Proposal:

EPA proposed that, in the event of a nonconformity, it may require any remedy to extend to locomotives of the same engine family, but different model years, that were certified using the certification carry over provisions. Such an extension of the remedy to other model years was proposed to be limited to two model years before and one model year after the model year of the nonconforming engine family.

#### Summary of the Comments:

Comments received from EMA stated that extending a recall remedy to locomotives or locomotive engines beyond the model year which was emission tested is inconsistent with the Act and with past Agency practice. EMA commented that EPA has no basis for assuming that an emissions exceedance in a locomotive engine will extend to all other engines with the same certification database.

#### Analysis of the Comments:

EPA proposed the requirement that, in the event of a nonconformity, any remedy needed extend to locomotives of the same engine family, but different model years, that were certified using the certification carry over provisions. EPA believed that such a provision would limit liability in the event of a nonconformity to four model years' production. However, the Agency understands the commenters' statements as outlined above and agrees that this provision is not consistent with past Agency practice. Therefore, EPA is not finalizing the proposed provision that any remedy extend to locomotives of the same engine family, but different model years.

### **G. Recordkeeping**

#### Summary of the Proposal:

The Agency proposed that a manufacturer's or remanufacturer's certificate of conformity may be voided for recordkeeping violations.

#### Summary of the Comments:

AAR commented that certificates should not be voided for recordkeeping violations. AAR stated that the voiding of certificates could result in power shortages and service disruptions. They further commented that because accurate recordkeeping is an essential component of the ABT program, manufacturers and remanufacturers already have sufficient incentive to keep records.

#### Analysis of the Comments:

EPA will evaluate a manufacturer's or remanufacturer's records and recordkeeping practices as part of the certification, production line and in-use testing programs in order to determine whether an engine family is in compliance with applicable emission standards or FELs. EPA agrees with the commenter that accurate recordkeeping is an essential component of the ABT program. The Agency believes that the potential voiding of a certificate of conformity for recordkeeping violations provides an added incentive for manufacturers and remanufacturers to keep detailed and accurate records for each engine family.

## CHAPTER 4 TEST PROCEDURE

### **Background**

EPA proposed test procedures for measuring emissions from locomotives and locomotive engines. These test procedures were based largely on test procedures for on-highway heavy-duty diesel engines in 40 CFR 86. After publication of the NPRM, EPA placed in the docket a slightly different version of locomotive test procedures, dated February 18, 1997. This section addresses comments received on both the proposed regulations and the February 18, 1997 version.

### **A. Separate Engine Test Procedures**

#### Summary of the Proposal:

While EPA focused its proposed test procedures on locomotive testing, it also included numerous provisions that applied only to engine testing. These engine testing provisions were integrated into the entire procedure.

#### Summary of the Comments:

EMA's Locomotive Industry Test Procedure Subcommittee (LITPS) commented that EPA should create separate test procedures for locomotive testing and engine testing.

#### Analysis of the Comments:

EPA disagrees with LITPS. The Agency believes that it is essential that the test procedures for locomotive and engine testing remain integrated. The overall objective of this rule is to reduce emissions from in-use locomotives. Thus, the test procedures are intended to measure the emissions of in-use locomotive. The engine procedures, which are included to provide manufacturers and remanufacturers with some compliance flexibility, are intended to produce the same measured results as the locomotive procedures.

EPA expects that it will likely develop, along with industry, better and more efficient ways to measure emissions in the future. If this occurs to any significant degree, then EPA will likely undertake a rulemaking to revise the test procedures adopted today. EPA is concerned that engine test procedures could evolve differently if they are separated from the locomotive test procedures. If this were allowed to happen, then it would be possible for testing of future locomotive engines to produce results that would not be representative of emissions from in-use locomotives. Therefore, EPA is not creating separate engine test procedures. EPA is clarifying the regulations, however, with respect to those provisions that apply only to locomotive testing or only to engine testing.

### **B. Test Sequence**

#### Summary of Proposal:

EPA proposed to use a steady-state test procedure to measure gaseous and particulate

emissions from locomotives; that is, a procedure wherein measurements of gaseous and particulate emissions are performed with the engine at a series of steady-state speed and load conditions. Measurement of smoke would be performed during both steady-state operations and during periods of engine accelerations between notches. At the beginning of the sequence, the engine would be started, if not already running, and warmed up to normal operating temperature in accordance with warm-up procedures for in-service locomotives as specified by the manufacturer. After the engine reached normal operating temperature, the engine would be operated at full power (i.e., highest power notch) for 5 minutes, then returned to idle, or low idle if so equipped. Measurement of exhaust emissions, fuel consumption, inlet and cooling air temperature, power output, etc. would then begin, and would continue through each higher power operating mode to maximum power. The minimum duration of the initial test point (idle or low idle), and each test point when power is being increased is 6 minutes, with the exception of the maximum power point, where the minimum duration of operation is 15 minutes.

EPA proposed that emission measurements could not be based on any measurement made after the end of the minimum sampling period. EPA also proposed steady-state stability provisions that would require integration of emission concentration measurements if certain stability criteria were not met.

#### Summary of the Comments:

Manufacturers commented that they should be allowed to measure emissions after a longer equilibration period in each notch (i.e., longer than six minutes). They argued that the six-minute period was not long enough to allow stable and repeatable emission measurements. For PM measurements, they commented that EPA should not require that PM sampling begin within ten seconds of the notch change, but should allow a three-minute delay. They argued that this longer delay is necessary to ensure a stable and repeatable measurement. Part of the reason for this is the time necessary to flush the transfer line of exhaust from the previous notch, which they stated was on the order of 20 to 30 seconds. They also suggested that engine power measurements be average values for the same time period as the steady-state emission measurements, and that fuel measurement should be delayed until three minutes after the notch change and continue as long as necessary to obtain a stable measurement.

Manufacturers also opposed the proposed stability criteria. They argued that it was overly complex and time consuming. They asked, if it is finalized would an "eyeball" determination be sufficient for compliance purposes? They also indicated that they had special concerns for CO and CO<sub>2</sub> because of instrument nonlinearity.

#### Analysis of the Comments:

EPA recognizes that the six-minute sampling period could have an effect on repeatability. However, based on testing conducted for EPA<sup>6</sup> the Agency believes that the effect will be relatively small, especially for gaseous emissions measurements. Moreover, given that in-use locomotives rarely are operated continuously in any one notch for more than six minutes, emission measurements made after six minutes would have little relevance to actual in-use

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<sup>6</sup> "Emission Measurements - Locomotives," Final Report, Southwest Research Institute Project No. 08-5374-024, August 1995.

emissions. In fact, the Agency is most concerned about the emissions that occur during the first three minutes after a notch change. The primary reason that EPA proposed a six-minute, rather than a three-minute, sampling period was to address concerns about repeatability, especially for particulates. (Note: the six-minute sampling period also reduces concerns about the potential for off-cycle emissions that would have been raised by a sampling period of only three minutes.) As is described in the RSD, EPA believes that equilibration periods beyond six minutes are not necessary to ensure adequate repeatability.

EPA proposed a ten-second delay for particulate sampling to address concerns such as the transfer time issue raised by the manufacturers. EPA believes that a longer delay could lead to misrepresentative measurements because of the potential for significant particulate spikes that can occur immediately after a notch changes, just as is observed with smoke emissions. While such spikes might result in substantial emissions, they typically last much less than one minute, and a three-minute delay would completely miss any particulate spikes associated with notch changes. EPA remains very concerned about this issue, and thus is specifying a ten-second delay for particulate sampling. However, EPA will allow manufacturers or remanufacturers to wait slightly longer if they demonstrate by engineering analysis that the time necessary to flush the sampling system is longer than ten seconds. EPA still believes, as is described in the RSD, that the six-minute sampling period is sufficiently long to minimize the potential impacts of any "nonequilibrium" effects in the sampling system. Moreover, EPA is convinced that it is more important to ensure that emission spikes are measured than to eliminate all nonequilibrium effects. Nevertheless, EPA would reconsider this decision in the future should it be shown that this approach significantly compromises the accuracy of the particulate measurement procedure.

EPA recognizes that this issue is most significant with respect to the in-use notch standards. With the weighted averages, most of the measurement variability is dampened by the averaging process (*i.e.*, some notches may be high, but others will be low, so that the average error should be minimal). However, there is no such dampening effect for the individual notch measurements. Therefore, EPA is making an allowance for this concern for particulate emissions in its interim provisions (§92.012). For model years 2000 through 2006, EPA will set the notch standards using a 20 percent margin (plus the compliance margin) for particulate measurements to account for variability, instead of the 10 percent that applies in all other cases.

EPA proposed the steady-state stability criteria primarily to address concerns about the potential for NO<sub>x</sub> emissions to be higher shortly after a notch change than at the "steady-state" conditions, especially where the difference is due to different fueling rates or injection timing. Emission measurements from current locomotives generally show a small spike when the locomotive is switched to a higher notch. These observed spikes, however, are sufficiently small that they do not significantly impact in-use emissions. The purpose of these criteria is to ensure that any large emission spikes that manufacturers or remanufacturers may design into future locomotives are accounted for in the emission measurements. For example, in the absence of such constraints, a manufacturer could design an electronically-controlled locomotive to have retarded injection timing at "steady-state" operation, but have timing optimized for minimum fuel consumption during the first two or three minutes after the notch change. In such a case, NO<sub>x</sub> emissions would be significantly higher during those first two or three minutes, which is where most in-use operation actually occurs, than would be measured at "steady-state".

The criteria that are being finalized have been modified in order to minimize the burden for testers. First, the criteria are only being finalized for NO<sub>x</sub> and HC emissions. EPA agrees with the manufacturers that application of these criteria to CO and CO<sub>2</sub> measurements could be

problematic because the instruments used for these measurements are not linear. In addition, EPA is also clarifying in the regulations that visual determination of compliance with the criteria is acceptable for small peaks. Thus, since EPA expects that observed peaks will be sufficiently small in essentially all cases to allow a visual determination, this requirement should not result in a significant burden for manufacturers or remanufacturers.

### **C. Test Conditions**

#### Summary of the Proposal:

EPA proposed that test conditions such as ambient test temperature and pressure be fully representative of in-use conditions. Specifically, the Agency proposed that locomotives comply with emissions standards when tested at temperatures from 45°F to 105°F and at both sea level and high altitude conditions (i.e., up to 7,000 feet above sea level). This temperature range is significantly broader than the test temperature range used for other mobile sources. The Agency did not propose specific correction factors that could be used to account for the effects of ambient test conditions, such as temperature or humidity, on emission rate, because it did not believe that the available corrections factors were adequate. It did request comments on the need for any correction factors.

#### Summary of the Comments:

Manufacturers opposed EPA's proposed broad range of test conditions. They argued that EPA must adopt correction factors if it finalizes the broad range of test conditions, because test conditions can significantly affect emission rates. EMA suggested that EPA adopt the correction factors used in 40 CFR 89, and that it should narrow the range of test pressures to 31 to 28 inches of mercury. They argued that the test conditions need to be consistent with the conditions under which the manufacturers generated the data that EPA is relying upon for its estimated baseline emission rates (75 grains moisture per pound dry air, 85°F, barometric pressure representative of sea level). MPI argued that EPA should conduct a study to develop correction factors. They also implied that EPA should not allow manufacturers to generate their own correction factors because this would give OEMs an advantage over smaller competitors.

#### Analysis of the Comments:

EPA agrees that NO<sub>x</sub> emission rates should be corrected to account for the effect of ambient humidity. However EPA does not agree that the NO<sub>x</sub>-humidity correction factor that is currently being used for highway and general nonroad diesel engines (40 CFR 86 and 89) would be appropriate for these regulations. EPA continues to have concerns about the applicability of data from older uncontrolled highway engines to current and future locomotives that incorporate NO<sub>x</sub>-reduction technologies. More importantly, however, the data is inappropriate as a basis for such correction factors for locomotives because the range of test conditions being proposed for locomotives is much broader than was used in the collection of that data. EPA has developed revised correction factors to correct emission rates to typical ambient summer conditions of 86°F and 75 grains of water per pound of dry air. With these correction factors, EPA sees no need to finalize a narrower range of allowable test temperatures. In fact, EPA continues to believe that it is important allow a fairly broad range of test temperatures to allow for outdoor testing in various parts of the country.

Since the effects of humidity and temperature on NO<sub>x</sub> emissions from locomotives are



not fully understood at this time, EPA has decided to include conservative default correction factors in the final rule (i.e. factors that are more likely to overestimate emissions rather than underestimate emissions), but to allow manufacturers and remanufacturers to use their own correction factors, where they are appropriate for their specific locomotives. The Agency recognizes that the correction factors being established in these regulations may not be appropriate for the long term, but believes that they are appropriate at this time. During the first several years of this program, EPA expects that nearly all manufacturers and remanufacturers will perform engine testing rather than locomotive testing, and will therefore be able to perform all testing under controlled conditions where the effect of the correction factors will be small (i.e., near 86°F and 75 grains). Moreover, where the manufacturer or remanufacturer believes that the default correction factors penalizes them, they will be able to develop and use their correction factors. Nevertheless, EPA expects to refine these correction factors in the future when better information becomes available.

With respect to allowable barometric pressures for emission testing, EPA agrees that the proposed range of 31 to 24 inches of mercury is too broad. More specifically, EPA agrees that the lower value of 24 is too low. It would be very difficult for manufacturers or remanufacturers to conduct testing over this entire range of pressures. To do this, manufacturers and remanufacturers would need to either develop complex air handling systems to control the pressure of the intake air and exhaust, or locate multiple testing facilities in different areas of the country; neither of which are practical. EPA is setting the lower limit for test pressure at 26 inches of mercury, which is representative of the typical ambient pressure at an elevation of 4,000 feet above sea level. This will allow all expected certificate holders to conduct testing at its normal ambient pressure. This includes MPI, which is located in Boise, Idaho at an elevation of about 2,700 feet above sea level, with a typical ambient pressure of about 27 inches of mercury). While EPA is not requiring that manufacturers or remanufacturers demonstrate compliance during testing at barometric pressures below 26 inches of mercury, it will require that they perform an engineering analysis to demonstrate that the locomotive would be able to comply with the emission standards at pressures as low as 24 inches of mercury. Moreover, they will also be required to use similar smoke control measures at all lower pressures. For example, if a manufacturer designs its locomotive to comply with the smoke standards during use at a pressure of 24 inches of mercury by limiting the fuel rate, then it would be required to limit the fuel rate to the same rate or lower at lower pressures.

#### **D. Particulate Measurement**

##### Summary of the Proposal:

EPA proposed a particulate sampling procedure that calls for a sample of the exhaust to be diluted, and a fraction of the diluted exhaust to be sampled for particulates. This procedure is essentially the same as the procedure described in 40 CFR 86 for on-highway diesel engines, except that the on-highway procedure calls for dilution of the entire exhaust stream, rather than a fractional sample.

##### Summary of the Comments:

Manufacturers commented that they support EPA adopting a "partial flow fractional sampler" system as the reference system for particulate measurement. However, they also suggested that EPA establish more specific provisions for approving alternate sampling systems, especially for "partial-flow, total sampler" systems.

#### Analysis of the Comments:

EPA agrees with the manufacturers suggestions for provisions for alternate sampling systems, and is adopting specific provisions for determining equivalency. It should be emphasized, however, that the Agency believes that it is important that it retains authority to judge alternate system on a case-by-case basis. Thus, the provisions being finalized are guidelines for determining equivalency, which are contained in a regulatory appendix.

#### **E. Test Fuel Specifications**

##### Summary of the Proposal:

The Agency proposed test fuel specifications for compliance testing (certification, PLT and manufacturer/remanufacturer in-use testing) which are consistent with test fuel specifications for on-highway heavy-duty engine certification testing, with the exception of the sulfur specification. In the case of the sulfur specification, EPA proposed a lower limit of 0.3 weight percent, without an upper bound. This was intended to approximate worst case in-use conditions.

##### Summary of the Comments:

Manufacturers opposed EPA's proposed sulfur specification, and suggested that EPA adopt the sulfur specification used in 40 CFR 89, which allows the use of low sulfur fuel. They argued that test fuel with more than 0.3 percent sulfur is not currently available, and that the proposed specification would result in an unnecessary burden.

#### Analysis of the Comments:

EPA agrees that the proposed lower limit for sulfur is too high, and that such fuel may not be commercially available in the future. However, EPA does not agree that the fuel specifications of 40 CFR 89 should be adopted. Those specifications were incorporated to allow manufacturers to use the same test data for federal certification and California certification. There is no such need for locomotives. Instead, EPA is finalizing a sulfur specification of 0.2 to 0.4 weight percent. This is generally consistent with the fuels used by manufacturers to perform their baseline emission data testing. It is also reasonably consistent with current in-use locomotive fuels. (Locomotives currently use both low sulfur and high sulfur fuel in use, depending on availability.) It is important to note that manufacturers and remanufacturers could use test fuel with lower sulfur content, provided that they can demonstrate that the locomotive model being tested will only use that type of fuel in use.

#### **F. Differences Between FTP and Test Procedures Used by Manufacturers to Generate Baseline Emission Data**

##### Summary of the Proposal

EPA proposed specific federal test procedures (FTP) to determine compliance with the proposed emission standards. These procedures are not identical to test procedures used by manufacturers to generate emission data that was provided to EPA, and that was used during the development of the proposed regulations.

### Summary of the Comments:

EMD stated in its comments that EPA's proposed FTP is fundamentally different from the procedures used by manufacturers to generate much of the data that EPA is relying upon for this rulemaking. Specifically, they argued that the FTP does not allow sufficient time for the locomotive (or engine) to reach level conditions (i.e., constant horsepower, fuel rate, temperatures, etc) at each notch. EMD stated that it could take 30 to 60 minutes to stabilize the engine at each notch, while EPA specified only a six-minute sampling period for each notch. They argued further that EPA cannot base its emission standards on the data provided by the manufacturers because of differences in the test procedures.

EMD and EMA also argued that EPA's test procedures for locomotives and locomotive engines have been constantly changing during the rulemaking development process, and that it is therefore disingenuous to expect manufacturers to have started intensive development to meet standards well before the rule is finalized.

### Analysis of the Comments:

EPA strongly disagrees with EMD's assertion that the FTP is fundamentally different from standard industry emission testing procedures. In fact, other than the engine stabilization issue (which was the only significant difference raised by EMD), the FTP is very similar to test procedures used by manufacturers and railroads. EPA's proposed test procedures are very consistent with SwRI's standard test procedures<sup>7</sup>, which have been used for a substantial amount of emission testing for the railroads. Moreover, as is described in the RSD, the available evidence indicates that the six-minute sampling period allows for adequate stabilization of the engine from an emissions measurement perspective. EMD provided no data to dispute this. Therefore, there is no reason to believe that the FTP being established in this rule is inconsistent with the general procedures used by industry to measure emissions from locomotives, or that it would be inappropriate to use the emission data generated by the manufactures for determining baseline emission rates in support of EPA's emission standards.

There are also important reasons for limiting the sampling time to six minutes. First, locomotives very rarely operate in any single notch for more than six minutes. Thus, allowing long equilibration periods would be completely unrepresentative of in-use operation. The six-minute sampling period also minimizes testing time and fuel consumption during testing. Both of these serve to minimize testing costs.

EPA agrees that its test procedures have been evolving over the past several years.<sup>8</sup> However, EPA disagrees with the manufacturers' implication that these changes fundamentally affect the feasibility of the standards. The vast majority of changes that have been made will have a negligible effect on the stringency of the standards. Moreover, any changes that might have an effect on the stringency of the standards are being made in response to comments from the manufacturers or railroads, and should only serve to make the standards more feasible.

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<sup>7</sup> Ibid.

<sup>8</sup> Note: Changes made to the calculations to address the effect of ambient humidity and temperature on NOx emissions are considered separately.

Overall, the test procedures being finalized are essentially equivalent to the test procedures used by SwRI to perform locomotive emission testing for EPA in 1994 and 1995.

Finally, it should be noted that issues affecting the appropriate amount of lead time for compliance with the emission standards were considered together (see previous lead time discussion in Chapter 2). EPA is adopting final regulations that allow for adequate lead time considering test procedures, as well as the stringency of the standards and other issues.

## **G. Other Issues<sup>9</sup>**

### **G.1. Measurement of Horsepower**

#### Summary of the Proposal:

EPA proposed that brake horsepower be calculated during testing from measurements of the traction alternator output power, reported alternator efficiency curves, and reported accessory loads.

#### Summary of the Comments:

MPI had several comments on the measurement of engine horsepower. First, they argued that onboard computer displays should not be relied upon to brake horsepower. These computers, they stated, can be off by more than one percent, unless calibrated using a separate current shunt. They also stated that EPA should require that accessory loads be measured during testing, to the extent possible, rather than allowing reported values to be used. They argued that this was necessary because the loads from the fans and blowers will vary with ambient conditions. They went further to say that EPA should require that accessories be turned off as is specified by AAR fuel consumption measurement procedures.

#### Analysis of the Comments:

EPA agrees with MPI that power estimates from onboard computers could potentially be inaccurate. Therefore, EPA will only allow them to measure power where they have been shown to have the same accuracy and precision of EPA's recommended method. EPA disagrees with MPI, with respect to the need to measure accessory loads. Admittedly, it would be preferable to measure these loads; however, such measurements would not be practical for all accessories. EPA will allow accessory loads to be measured, but will not required. EPA does not believe that using reported values will significantly affect test accuracy or repeatability. Should it become more practical in the future to measure accessory loads, EPA will reconsider requiring such measurements.

### **G.2. Multiple Exhaust Stacks**

#### Summary of the Proposal:

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<sup>9</sup> EPA received numerous specific comments from LITPS on the technical details of the test procedures, most of which have been incorporated. (See docket items #A-94-31-IV-D-36 and #A-94-31-IV-E-2.) This subsection only addresses those comments from LITPS that were not incorporated.

For locomotives with multiple exhaust stacks, EPA's proposed test procedures called for the stacks to be ducted together during testing, which would allow for a single sample to be collected for measurement. In the cover letter for the February 18, 1997 test procedures, EPA indicated that it was considering allowing measurements to be made from a single stack, provided that the exhaust from different stacks were similar (e.g., had similar CO<sub>2</sub> concentrations).

#### Summary of the Comments:

LITPS commented that EPA should allow, but not require that multiple exhaust stacks be ducted together. They also stated that EPA should allow teed samples to be collected, provided that the CO<sub>2</sub> measurements from each stack were within 5 percent of one another. They also suggested that EPA only require that a single exhaust stack be used for smoke measurements. Under such an approach, where differences in smoke emissions could be determined visually, testers would be required to test the stack with the highest observed smoke levels.

#### Analysis of the Comments:

EPA agrees that it is not necessary to duct exhaust stacks together where CO<sub>2</sub> concentrations do not vary by more than 5 percent among any of the stacks. Thus, EPA will allow the options suggested by LITPS. Under this approach, testers will be required to measure CO<sub>2</sub> concentrations in each stack for each notch, either during the test sequence or prior to beginning the test sequence. Where the concentrations do not vary by more than 5 percent, then testers will be allowed to collect teed samples for gaseous and particulate measurements. They will also be allowed to smoke test a single stack for smoke, provided that they select the highest emitting stack where there is a visual difference. Also, where any measured smoke level exceeds three-quarters of the level allowed by the standard, then all stacks must be tested.

### **G.3. Dynamic Brake**

#### Summary of the Proposal:

EPA proposed that emissions be measured at dynamic brake (DB), but did not specify how to determine which DB setting to test, where there are multiple DB settings.

#### Summary of the Comments:

LITPS commented that EPA need to state how to select a dynamic brake setting.

#### Analysis of the Comments:

EPA is finalizing the testing provisions to require that the DB notch nearest to 75 percent of the maximum power use during dynamic braking be used for testing. This test point will be used in all calculations in order to make the test more standardized.

### **G.4. Required Information (Timing Curves)**

#### Summary of the Proposal:

EPA proposed that manufacturers and remanufacturers provide to EPA engine parameter information, including injection timing curves.

Summary of the Comments:

LITPS argued that timing curve information is not generally available outside of the manufacturers, and that EPA should not require that it be provided. They stated that they were concerned about the release of this proprietary information.

Analysis of the Comments:

EPA recognizes the proprietary nature of timing curves, and therefore will only require that it be provided to EPA upon request in the application for certification. Also EPA will treat this information in the same manner as other confidential business information as prescribed in the regulations.

## **CHAPTER 5 ECONOMIC IMPACT**

### **A. Economic Impact of Compliance**

EPA requested comment from manufacturers and remanufacturers regarding the potential costs of compliance with the proposed regulations. Since the proposal, EPA has contracted with ICF, Incorporated, with its subcontractors, Acurex Environmental Corporation and Engine, Fuel, and Emissions Engineering, Incorporated, to update the economic analysis. The results of this study, which will hereafter be referred to as the cost study, can be found in the Public Docket.

#### **A.1. Subsequent Remanufacturing Costs and Maintenance Costs**

##### **Summary of the Proposal:**

EPA estimated additional costs of approximately \$1,000 would be incurred for each subsequent remanufacture of a locomotive that had been brought up to Tier 0 standards, as a result of the improved parts necessary to meet the emission standards. The NPRM did not contain any estimated increases in maintenance costs for Tier 0.

##### **Summary of the Comments:**

EMD argued that the EPA estimate of \$1,000 per subsequent remanufacture of engines previously remanufactured to Tier 0 standards was not consistent with information which the locomotive manufacturers had provided to EPA. EMD stated that electronic injectors would have to be replaced with each subsequent rebuild, at a cost of between \$12,000 and \$24,000, depending on whether the injectors were rebuilt or new. EMD projected a 25 percent "fallout rate," presumably whereby the remanufacturer would have to use new injectors rather than remanufactured ones, which would increase the cost to about \$15,000. In addition, EMD stated that the injector wiring harnesses would have to be replaced at a cost of approximately \$2,000, and that components such as aftercoolers might have to be replaced with more costly components, e.g., a 2-pass aftercooler would be replaced with a 4-pass aftercooler, at a marginal cost of about \$400. EMD estimated the marginal cost of a subsequent rebuild at about \$18,000.

EMD also stated that EPA did not take into consideration the difference in maintenance costs between an uncontrolled and a Tier 0 or Tier 1 engine in its NPRM cost estimates. EMD stated that the recommended replacement interval for fuel injectors on their engines was three years, at an incremental cost of \$11,840. However, since the new electronic injectors were as yet relatively unproven, the replacement interval might have to be shortened to 2 years. This would require an additional \$11,840 parts cost plus labor costs of \$320 (8 hrs @ \$40/hr) or a total additional cost of \$18,000. These costs applied to both Tier 0 and Tier 1 locomotives.

##### **Analysis of the Comments:**

With respect to Tier 0 subsequent remanufacturing costs, EMD appears to assume the full cost of an electronic injector, rather than the marginal cost difference between an electronic and a mechanical injector in arriving at their stated cost. The above-mentioned cost study indicates that new electronic injectors (no unit exchange, or trade-in) would cost between \$1,000 and \$1,500 each, or \$16,000-24,000 for a 16-cylinder engine. Discounted for manufacturer markup (at a conservative 20 percent) this would cost the manufacturer \$13,000-19,000 for a completely new

system, which is what EMD claimed it would cost for a rebuilt system. The contractor also estimated that it will cost approximately \$70 more to rebuild an electronic injector (unit exchange) than it would to rebuild a mechanical injector, or a total of about \$1,100 for a 16-cylinder engine, which EPA believes is closer to the actual marginal cost for rebuilding the injectors. EPA also believes that EMD's "fallout rate" of 25 percent is greatly overstated, since the customer could presumably specify whether it wanted rebuilt or new injectors. Furthermore, the cost study indicates that electronic injectors may not in fact even be required to meet the Tier 0 standards on certain locomotive models. Thus, locomotive operators may not consider it to be a cost-effective option for some of the lighter-usage locomotives, where fuel economy issues are not as great a concern as with the heavier usage locomotives. In such cases, improved mechanical injectors with lower sac volume could be used to meet the standards, at an incremental cost of about \$50 per injector, or a total of \$800 for a 16-cylinder engine. The replacement interval for these injectors would also not be significantly shorter than for current mechanical injectors. Thus, even allowing \$400 for replacement of a 2-pass aftercooler with a 4-pass aftercooler places the total cost at \$1,200 to \$1,500, which is considerably less than the \$18,000 estimated by EMD. This same differential also carries through with respect to the maintenance costs for Tier 1 standards.

Regarding the question of more frequent replacement of electronic injectors, for an engine where mechanical injectors were replaced with electronic units, the difference in replacement intervals, assuming an average remaining Tier 0 service life of 21 years, would be 3 additional injector replacements at a total cost of \$3,300 (3 x \$1,100), rather than \$54,000 for the same period (\$18,000 x 3), as claimed by EMD.

## **A.2. Tier 2 Compliance Costs**

### Summary of the Proposal:

EPA estimated compliance costs per locomotive at \$266,484. This estimate consisted of initial equipment costs of \$200,000, remanufacture costs of \$18,000 (\$3,000 X 6 remanufactures), fuel costs of \$42,500, and testing costs of \$5,984.

### Summary of the Comments:

EMD claimed that it was unaware of any evidence to support EPA's initial estimate of compliance costs for Tier 2 (\$200,000). EMD further stated that EPA's estimate of \$3,000 per engine for Tier 2 remanufacturing costs appeared low, given the sophisticated technology that would likely be required for compliance. EMD gave a marginal cost estimate of \$20,000, but provided no basis for this estimate, other than the statement that the newer power assemblies would be more expensive than the \$4,400 current cost of EMD 710 units. EMD also stated that maintenance costs for Tier 2 could run in excess of the Tier 1 marginal costs for maintenance, but did not provide any supporting detail, except for some possible estimated EGR maintenance.

### Analysis of the Comments:

The above-mentioned cost study based its estimates of costs for compliance with the Tier 2 standards on modifications to the new generation of locomotive engines that are currently in advanced stages of development by EMD and GETS. These engines are being developed at the request of the railroads for performance and fuel economy purposes, as well as for lower emissions. The cost study estimated that these engines would be capable of meeting the Tier 2



standards if they were equipped with fuel injection systems having rate shaping capability and low temperature charge air coolers. The incremental costs for meeting the standards for these engines were estimated at \$35,000 in manufacturing costs and \$152,000 in operating costs (including about \$500 every 2 years for incremental maintenance costs), for a total incremental cost per locomotive of approximately \$187,000. Power assemblies would need to be replaced whether there were emission standards or not, so any discussion of cost differences would be irrelevant. EPA also believes that if manufacturers experiment with any types of EGR, it will be of the "internal" type, achieved through valve timing, rather than through any external hardware additions. Further information on the expected cost of compliance with the Tier 2 standards can be found in the RSD.

### **A.3. Tier 2 Fuel Economy Penalty**

#### Summary of the Proposal:

EPA estimated a total lifetime fuel economy cost for Tier 2 locomotives of approximately \$42,500, based on a possible 1 percent decrease due to the Tier 2 standards.

#### Summary of the Comments:

EMD argued that EPA had underestimated the fuel economy penalty associated with compliance with the Tier 2 standards. EMD projected a 5-10 percent penalty, rather than the 1 percent estimated by EPA, based on the experience of others in the use of EGR, the likely technology of choice for meeting the Tier 2 standards. EMD also stated that the cost of a 1 percent fuel economy penalty could be more like \$2,275 per year, rather than the \$1,062 projected by EPA. This was because the typical new line haul locomotive in 2005 would likely be 6,000 hp and consume 350,000 gallons of fuel per year. Thus, a 1 percent fuel economy penalty would be \$2,275 at an assumed cost of \$0.65 per gallon. A 7 percent fuel economy penalty would then equal almost \$24,000 per year for a 6,000hp locomotive.

#### Analysis of the Comments:

EPA believes that EMD grossly overestimated the fuel economy decrease associated with meeting these standards. EMD appears to assume that EGR will be required on every engine in order to meet the Tier 2 standards. EPA does not believe that this will be the case, since economic forces will tend to argue against its use. EPA believes that EGR will remain the technology of last resort, and that if used at all, only moderate EGR rates will be employed, which should not result in the magnitude of fuel economy decrease envisioned by EMD. As what EPA believes is a worst case, the cost study projected a 4 percent fuel economy decrease, due to injection timing retard, for the new engines when optimized for low emissions, as opposed to best possible fuel economy. However, it should be emphasized that the resulting fuel economy will still be relatively better than with current engines. Assuming that EMD's fuel consumption estimate of 350,000 gallons of fuel per year is accurate, the cost of a 4 percent fuel economy penalty would be 14,000 gallons, or \$9,100 at a cost per gallon of \$0.65, rather than the \$24,000 estimated by EMD. It should be noted that the cost-effectiveness analysis contained in the RSD is based on total fuel costs, not per locomotive fuel costs.

### **A.4. Compliance Testing Costs**

#### Summary of the Proposal:

EPA estimated a cost of approximately \$10,000 per locomotive test, including amortization of fixed equipment costs of \$400,000 per test site for three test sites.

#### Summary of the Comments:

EMD stated that EPA greatly underestimated the cost of compliance testing for locomotives. EMD stated that the proposed rule would require EMD to build a test facility at each of its 4 or 5 locomotive assembly plants, or alternatively to ship the completed locomotives to a central location for testing. This latter alternative would be unacceptable because of the 6-8 week delay between completion of the engine and the completion of the locomotive. This could expose the builder to remedial action on any engines built during the intervening period, in the event of a failure. EMD estimated the cost of building a certification-quality test facility at each locomotive plant at \$1 million for the facility and \$400,000 for the test equipment, or a total cost of \$7 million for all 5 locomotive plants. In addition, the 6 existing engine facility test cells would have to be upgraded to be able to run the EPA smoke test, at a cost of \$100,000 each, or a total cost of \$600,000.

CILAS also stated that EPA had considered the cost of test equipment, but not of test facilities necessary to house the equipment and conduct testing. CILAS argued that such costs would be disproportionately burdensome for small remanufacturers and, potentially, parts suppliers, because smaller amortization bases would result in significantly greater costs to the smaller entities. Alternatively, if the testing were done by contract, per-test costs could reach \$125,000 per engine for those without their own test facilities, not \$10,000 as estimated by EPA.

#### Analysis of the Comments:

Although the NPRM contained no estimate for construction of a test facility, EPA agrees that some facility costs may be incurred. However, the Agency believes that the primary engine producers have existing facilities that could be upgraded for the purpose, so that major new construction expenditures would not be necessary. EPA believes these costs will be considerably less than even the EMD estimate. The cost study estimated that each of the two major manufacturers would need to construct one additional development test cell, at a cost of approximately \$2 million each (including equipment), which would add an additional \$200,000 annually to the Tier 0 fixed costs. However, EPA believes that this cost should be amortized over a 20 (rather than 10) year time frame and added to the other test cell equipment expenditures. This would in turn add to the annualized cost per test used for calculating fixed costs for developing the hardware necessary for compliance with the various standards. Using the estimated 200 tests per year from the cost study, this would add about \$1,088 per test.

Since no dynamometer is required for locomotive certification testing, and since there are no tight temperature and humidity specifications to be met (requiring expensive air handling systems) EPA continues to believe that the main cost of equipping a testing facility is the cost of the exhaust sampling and analysis equipment, which the industry originally estimated at \$400,000 and which the cost study at \$340,000 plus \$185,000 for additional facility-wide equipment such as a gas handling system, which could serve more than one test site. A dynamometer may be necessary for an additional test cell, and this is included in the estimates contained in the cost study. Despite EMD's stated liability concerns due to the delay between engine completion and locomotive completion, EPA believes that the manufacturers will not find it cost-effective to build additional test facilities at satellite assembly plants, since the estimated

utilization for the primary facilities would likely be on the order of 33 percent (about a 200 (or less) test per year requirement, out of a total available capacity of approximately 600 tests). EPA envisions that possibly one independent manufacturer/remanufacturer and one or two railroads are likely to develop a testing capability, which could also serve the needs of some of the smaller independent remanufacturers. EPA also believes that the abovementioned \$2 million facility cost for the 2 OEMs would also serve as a reasonable estimate for the capital expenditures necessary for these latter entities.

The Agency also believes that the testing costs quoted by CILAS for a different type of test than will be required for certification or in-use testing. Southwest Research Institute (SwRI), currently the only contract laboratory with a locomotive testing capability, charges approximately \$20,000 to \$30,000 per locomotive test, depending on the number of tests to be run, which includes setup costs. The SwRI costs quoted by CILAS are for removing the engine from the locomotive and testing it on an engine dynamometer, which would not only be unnecessary, but would not be in compliance with the provisions of the current rulemaking. As mentioned above, the cost study also estimated an in-house cost per test of \$10,237, based on a volume of 200 tests per year. EPA believes the actual testing volume is likely to be more like half of this latter figure, which would place the cost per test in the same general range as the SwRI cost, factoring in the additional facility cost mentioned above.

#### **A.5. Number of Engine Families**

##### Summary of the Proposal:

EPA estimated in the NPRM that there would be approximately 30 Tier 0 engine families for the entire industry and no more than 3 to 5 engine families per manufacturer for Tier 1 and Tier 2.

##### Summary of the Comments:

EMD argued that EPA had underestimated certification costs, due to its underestimation of the number of engine families that would result from the family definition criteria in the proposal. EMD estimated Tier 0 costs of \$3.6 million, based on 29 engine families and costs of \$1.25 million for Tier 1 and Tier 2. EMD also stated that carryover data would not reduce certification costs for Tier 1 after the first year, as EPA had suggested, since EMD would likely have to bear the burden of 2 new certifications per year, due to changes to improve reliability and normal design changes, which EMD estimated at 1 per year. This would add \$250,000 per year to the certification costs.

##### Analysis of the Comments:

Regarding the number of engine families, EPA does not intend for its engine family definition to result in an unnecessary proliferation of locomotive engine families. Consequently, in response to a number of comments, the Agency is finalizing an engine family definition requirement somewhat less restrictive than. The Agency believes this will have the effect of limiting the total number of engine families to the 3-5 estimated in the NPRM, rather than the 29 estimated by EMD. It should be noted that certification costs are only a small part of the total cost of the locomotive emission standards. The largest costs are fuel and hardware costs.

## **A.6. Cost of Production Line Testing**

### **Summary of the Proposal:**

EPA estimated the costs of Tier 1 and Tier 2 production line testing (PLT) at between \$150 and \$280 per locomotive produced, based on testing an average of 11 to 13 tests per year, respectively, for 3 to 5 engine families per year, at an estimated cost of \$10,000 per test.

### **Summary of the Comments:**

EMD stated that Tier 1 & Tier 2 PLT would cost \$150,000 per year, based on 15 tests at \$10,000 per test, since 3 of its 10 families were large families and would require more than 1 test each, plus 2 for QC purposes. EMD also stated that SwRI charges \$15-20,000 per test, higher than EPA's estimate of \$10,000 per test.

### **Analysis of the Comments:**

EMD has not allocated the cost of PLT over the entire year's production, which would result in a cost of \$231 per engine using EMD's testing costs and a production level of 650 locomotives per year. EPA also sees no relevance in quoting the contractor testing price, when it appears likely that manufacturers will have more than enough testing capacity for PLT, and the likely cost per test will be only slightly higher than the original EPA estimate, assuming the number of tests estimated in the cost study. EPA's complete analysis of testing costs can be found in Chapter 7 of the RSD.

## **A.7. Cost of In-Use Testing**

### **Summary of the Proposal:**

For Tier 1 and Tier 2 locomotives, EPA proposed an in-use testing requirement for manufacturers, consisting of two tests on each of two locomotives in one engine family/per year/per manufacturer. If a failure occurred, two additional locomotives would be selected for each failed locomotive, up to a maximum of 10. EPA estimated Tier 1 and Tier 2 costs of \$207 to \$389 for the projected 4 tests, including opportunity costs for lost service for the locomotive being tested. When amortized over the entire locomotive fleet, this amounted to \$6 to \$10 per locomotive per year.

EPA also proposed an in-use testing requirement for the railroads. The Agency estimated that no more than 5 percent of the fleet would be tested each year, or a total of about 1,100 tests per year, at a cost of \$1,848. This estimate assumed the railroads would use the optional short test provided, and included the cost of equipping test sites for each of the Class I railroads, at \$30,000 for each site. This estimate also included opportunity costs of \$848 per locomotive for the time lost from service.

EPA calculated the opportunity costs for both manufacturers and railroads by calculating the hourly revenue per locomotive and multiplying by the estimated lost time.

### **Summary of the Comments:**

EMD stated that EPA had underestimated the cost of in-use testing. EMD projected that

at least 10 tests would be required to make an emission performance determination, which would equate to a cost of \$150-200,000 per year, using SwRI prices as a reasonable estimate of testing cost.

AAR stated that EPA underestimated the cost of end-of-useful life testing for locomotives by a factor of 4. AAR stated that the proposed rule would require it to build a test facility (capable of testing 2 locomotives at the same time) at a cost of \$3.2 million, plus an estimated \$400,000 for the test equipment necessary. This would result in an annualized cost of \$568,000, assuming an interest rate of 13.5 percent and amortization periods of 20 years and 7 years, respectively, for the facility and equipment costs.

AAR estimated test facility operating costs of \$1.2 million per year, based on personnel sufficient to run 2 shifts for 5 days plus 2 days per week for facility and equipment maintenance, at a cost of \$1,075,000; test fuel cost of \$112,000, based on 400 gallons per locomotive for 4.5 hours of testing; and \$240,000 for other consumables, repairs, etc.

EMD stated that EPA should have used commercial lease rates in calculating the cost of taking a locomotive out of service for testing purposes. EMD gave a cost of \$825 per day for a 4,000 hp locomotive; proportionally more for the larger 6,000 hp units. EMD also stated that EPA's estimate of 48 hours for shipment to the test site was much too low--EMD estimated it would take about a week, due to the need to move through yards and interchange from railroad to railroad. Total out-of-service time would then be 17 days: two weeks for shipping to and from the test facility and 3 days for testing, or \$14,025 per test, not the \$6,000 estimated by EPA. EMD also projected shipping costs of \$3,150 per test, based on shipping two locomotives 400 miles at a deadheading cost of \$750 plus \$3 per mile.

AAR placed the cost of taking a locomotive out of service at \$6,000 based on a daily lease cost of \$750/day for 8 days. The total cost for testing 1,100 locomotives would then amount to \$6.6M. AAR stated that the total testing cost would then amount to approximately \$8.6M, almost 4 times the EPA estimate of \$2,065,800.

EMA submitted comments raising essentially the same points as the above EMD comments regarding costs of compliance.

#### Analysis of the Comments:

EPA sees no reason why the increased number of tests projected by EMD would be necessary if reasonable compliance margins are maintained. Only two tests will be required unless there is a failure. EPA believes that its method, which has been used successfully for other PLT programs, provides an acceptable degree of confidence without an unnecessary increase in testing requirements. EMD also failed to elaborate on the reason for basing its cost estimates on the purported cost per test for a contractor, SwRI, rather than on in-house testing costs. Given the likely excess testing capacity in the primary testing facilities, EPA doubts that the manufacturers will find it cost-effective to contract in-use testing with outside vendors.

There also appears to be a wide disparity between the EMD and AAR estimates for constructing a testing facility. EMD estimates a cost of \$1 million for a certification-quality test site while AAR estimates a cost of \$3 million for a presumably less advanced in-use testing site. As stated above, EPA believes that two railroads may develop test facilities, and that the \$2 million mentioned above is a reasonable estimate of the costs involved, since no dynamometers

or sophisticated environmental controls will be required for the test site. Also, the Agency has decreased the number of in-use tests that a railroad would be required to perform from approximately 1,100 per year to approximately 30 per year, so there should be no necessity for testing two locomotives simultaneously or for running two testing shifts.

The EMD estimate of 17 days loss of service for in-use testing appears high. Railroads are already accustomed to having locomotives out of service for 92-day FRA inspections and apparently have developed ways of minimizing the out-of-service time, as evidenced by the AAR estimate of 8 days, rather than 17, for in-use testing. AAR also estimated the lease cost for a replacement locomotive at \$750 per day, rather than the \$875 estimated by EMD. Based on the experience of the railroads in this area, EPA believes these are more reasonable estimates than those presented by EMD. With respect to shipping charges, EMD presented its projected shipping costs as if every test locomotive would have to deadhead 400 miles to the test site, with no real basis for these assumptions.

## **B. Small Business Impact**

### **B.1. Small Business Exemption From Tier 0 Standards**

#### Summary of the Proposal:

EPA proposed to exempt Class II & III railroads with fewer than 500 employees from the Tier 0 emission requirements, unless the locomotive was owned by a company having more than 500 employees.

#### Summary of the Comments:

ASLRA stated that the cutpoint for the Tier 0 exemption should be increased to locomotives and engines operated by Class II and III railroads with fewer than 1,500 employees<sup>10</sup>. ASLRA maintained that the Surface Transportation Board (STB) required all railroads to be independently managed and operated, and so each railroad is responsible for showing a profit regardless of the ultimate owner. Moreover, ASLRA argued the EPA cutpoint was not consistent with the Small Business Administration (SBA) small business guidelines, i.e., 1,500 employees for line-haul railroads and 500 employees for switching and terminal railroads and that EPA had not advanced an alternative definition. ASLRA found that locomotives and engines operated by some 21 of its member railroads, having a total of 560 locomotives and consuming a total of 44.5 million gallons of fuel annually, were not exempted by the EPA criterion. ASLRA argued these numbers were small in comparison with those evidenced by the rest of the industry, and that their inclusion in the exemption from the requirements would not significantly reduce the effectiveness of the final rule.

NRDC opposed the Tier 0 exemption for small railroads. NRDC stated that if EPA allowed this exemption, it should at least not preempt individual state's rights to regulate or exempt locomotives and engines.

CILAS supported the proposed exemption, but argued that it would be more appropriate

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Transtar, Incorporated submitted a comment in support of ASLRA's comments, but submitted no additional comments. Thus, Transtar will not be specifically mentioned hereafter.

to base the exemption on fuel usage, rather than number of employees, since fuel usage would correlate more directly to emissions produced.

WCL stated that the proposed exemption should apply to all non-Class I railroads. They further argued that the EPA criteria should be consistent with those of the STB (the primary regulator of railroads), which classifies railroads based on their annual income, rather than number of employees. WCL stated that annual income would correlate better with ton-miles of freight carried and would avoid the administrative burden that would be imposed by two sets of criteria. WCL also pointed out that many non-Class I railroads have reclaimed track abandoned by the Class I railroads, thus providing service to communities which otherwise would have none. This required hiring large numbers of seasonal employees to restore such track. Thus, an individual non-Class I railroad might have more than 500 employees during the summer months and less than 500 during the remainder of the year. Finally, Wisconsin Central pointed to the disparity between the number of locomotives owned by non-Class I railroads (approx. 4,200) and the number of locomotives owned by Class I railroads (approx. 18,500) as an indication that the exemption of all non-Class I railroads would have little practical effect on emissions.

ISC requested an exemption from virtually all locomotive standards for in-plant industrial and switching railroads, on the grounds that (1) their emissions comprise a very small percentage of all locomotive emissions, and (2) that any disruption of their operation (as a result of EPA regulatory action) could severely affect production and might result in a modal shift to trucks, which could increase overall emissions. ISC stated that locomotives meeting the standards would eventually be placed into service in industrial operations in any event, as a result of sale of locomotives from Class I railroads to the manufacturing sector. ISC also requested exemption from the recall provisions as well as initial compliance.

NJT proposed that the small business exemption also be applied to publicly-owned commuter railroads with a fleet of less than 100 diesel locomotives which served highly-congested urban areas. NJT argued that this was justified by the resultant reduction in personal automobile usage by the ridership.

TUSI stated that it operates 7 locomotives of 2000-2300 hp, transporting lignite coal for power plant fuel in east Texas. TUSI claimed that it is a short haul operation in primarily rural areas. TUSI requested an exemption from compliance with the requirements because the cost of meeting the Tier 0 requirements would be too expensive overall (\$550,000- \$1,800,000), and also claimed that some (unspecified) control devices would not function on their locomotives and engines, since TUSI engines do not reach optimum operating temperatures due to light loads and short hauls involved.

Amtrak and AAR requested that the small business provisions in the proposal also be extended to Amtrak and 17 other commuter rail transit agencies. Amtrak stated that its 315 diesel locomotives comprised only about 1.5 percent of the total locomotives in this country, so this exemption should have only minimal impact on emissions. Moreover, Amtrak also said that it operates some 65 all-electric locomotives, which emit no exhaust emissions, in the Northeast Corridor, which would in effect compensate for the emissions generated by the diesel locomotives. Amtrak stated that although it was classified as a Class I railroad by the STB, its financial position was much worse than any of the other Class I railroads, and that it could not afford the costs of compliance. Amtrak also stated a concern about the applicability of Tier 0 line-haul locomotive technology to passenger locomotives. Weight and space restrictions are much more severe on a passenger locomotive, Amtrak stated, than on a line-haul locomotive

using the same engine for propulsion. Amtrak's concern is that the Tier 0 systems used for a line-haul locomotive may not be directly applicable to a passenger locomotive using the same engine. Given the small number of passenger locomotives in service, Amtrak is concerned that any Tier 0 system required to be developed specifically for a passenger locomotive would be much more costly than a similar system developed for a line-haul locomotive, resulting in costs for Amtrak which could be disproportionately higher than for the other Class I railroads.

#### Analysis of the Comments:

EPA recognizes that some of the smaller railroads may face financial or other difficulties in complying with the proposed Tier 0 regulations, and is committed to minimizing the economic impact of the regulations on small business entities. The Agency has decided to address the concerns of the small railroads by providing an exemption for small railroads (as defined by the Small Business Administration) from the Tier 0 remanufacturing requirements. However, EPA also agrees with NRDC regarding preemption for these locomotives. Since the exempted locomotives are not considered new, they will not be covered by the preemption of state and local regulation afforded to new locomotives and engines. Also, if a small railroad purchases and subsequently remanufactures a previously-certified Tier 0 locomotive, it must be remanufactured to Tier 0 standards or be subject to the tampering provisions of this rule. EPA believes that this approach is reasonable and is justified by the small air quality impact, incremental to the proposed exemption, and the relatively small number of post-1972 locomotives that would be involved (about 1/6 of the current small railroad fleet).

The Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA) and the Regulatory Flexibility Act (RFA) require EPA to take steps to identify the regulatory burden of proposed regulations on small business entities. This was the primary reason EPA proposed to exempt the smaller railroads from the Tier 0 provisions. However, AMTRAK is not considered a small business and does not qualify under the generally accepted small-business definition promulgated by the SBA. EPA therefore does not believe it is appropriate to completely exempt AMTRAK from the Tier 0 provisions.

EPA understands Amtrak's concerns about the applicability of line-haul locomotive Tier 0 remanufacture systems to passenger locomotives. If remanufacturers had to develop for passenger locomotives different than for line-haul locomotives, economies of scale may result in a passenger locomotive system that is more expensive than its line-haul counterpart. However, based on confidential business information submitted to EPA by a locomotive manufacturer, EPA believes that the retrofit of existing passenger locomotives to comply with Tier 0 standards is both feasible and cost effective. Thus, EPA does not believe that it is necessary to provide any special exemptions for passenger locomotives with respect to the Tier 0 standards in the long term. It does, however, believe that a delay of the Tier 0 requirements for passenger locomotives until January 1, 2007 is appropriate for two reasons. First, it will allow passenger railroads, which usually receive public funding, more time to prepare for the expenditures associated with Tier 0 compliance. Second, it will allow locomotive remanufacturers to focus their initial development efforts on higher volume engine families at the start of the program, as discussed in Chapter 2. EPA may also be considering some form of credit in the future for pure electric locomotives, which should assist Amtrak in compliance.

### **B.2. Small Business Impact of Tier 0 Remanufacturing Requirements.**

#### Summary of the Proposal:



EPA proposed certification requirements for remanufacture systems that allowed any remanufacturers, including railroads, aftermarket rebuilders and installers to be certificate holders for the systems. The Agency proposed that remanufacturers demonstrate compliance with the applicable standards through emissions testing of the locomotive, and requested comments as to whether it should require testing for systems that were equivalent to previously certified systems, and if not, whether such pro forma certification should be delayed for 5 years, to allow the original certificate holder time to recover its testing cost investment. EPA also requested comment on any other provisions that should be established to minimize the burden on small business entities.

#### Summary of the Comments:

CILAS stated that the proposed certification requirements were anti-competitive, because they failed to understand the true nature of the aftermarket parts market. They argued that testing and other certification costs would have a severe adverse impact on small parts suppliers. CILAS feared that the certified system concept would allow OEMs to employ predatory pricing and other tactics to drive the smaller independent parts suppliers out of business.

CILAS also felt that a 2-year phase-in of Tier 0 requirements for small aftermarket suppliers would allow time for development of additional compliance technologies, and that the small parts suppliers should be afforded a 5-year grace period for R&D purposes, so that a rebuild system could be certified without the need for certification or in-use testing.

CILAS argued that EPA should certify a generic Tier 0 "template" system using currently available control technology, that would bring emissions close to the standards. Under this scheme there would be no certificate holder, but each supplier of a system identical to the generic system would be responsible for the performance of its own components and the installer would be responsible for proper installation.

EMD stated that equivalency in rebuild systems could not be determined without emissions testing. EMD argued that copying the physical dimensions of a certified system was insufficient to assure equivalency, citing an example where a minor difference in the position of a weld in an aftermarket turbocharger resulted in a difference in the emissions and life of the component. Stating that it had no control over the replacement parts used by locomotive owners, EMD also argued that allowing systems to be certified without testing would create an economic disincentive for developing and certifying such systems, by denying the manufacturer the opportunity to recover its investment. EMD stated that aftermarket suppliers had inherent competitive advantages such as low overhead, the ability to choose market niche, low initial component costs and an aging locomotive fleet which discourages investment in more durable components. EMD therefore objected to any additional preferential treatment of aftermarket suppliers.

MPI also stated that it would not be possible to determine whether an alternate system was truly equivalent without actual test data. MPI stated that to allow a certifier to use someone else's data would be to give a "free ride" to "copy-cat" certifiers. MPI recommended a 17 year period of exclusive rights to test data, similar to the period allowed under the patent system. MPI stated that a certifier should, however, be free to allow another entity to use its data upon payment of "fair compensation."

GETS stated that all participants in the remanufacturing process should be treated equally, rather than affording special treatment to some segments, e.g., that parts manufacturers should be included in the definition of "manufacturer" in section 92.202, that imported parts should be subject to the same requirements as domestic parts, that parts-only manufacturers should have to provide the same warranties as the engine manufacturers, and that parts manufacturers should be subject to the defect reporting requirements of section 92.405.

#### Analysis of the Comments:

The Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA) and the Regulatory Flexibility Act (RFA) require EPA to take steps to identify the regulatory burden of proposed regulations on small business entities and to involve them in the regulatory process. Toward this end, EPA requested comment on a number of measures designed to ease the regulatory burden on small locomotive rebuilders and parts suppliers, and has taken from them comments on this aspect of the regulation. In this final rule, EPA has attempted address these comments and to minimize the economic burden of compliance on small business entities wherever possible.

EPA is therefore delaying compliance with the Tier 0 standards until 2002 for the segment of the market represented by these small business entities, as requested by CILAS. EPA recognizes the concerns of the small aftermarket rebuilders and suppliers regarding the potential cost impacts of the emissions testing requirements, since these costs can have a greater economic impact on small business entities than on larger concerns. EPA will therefore provide FTP testing exemptions for a 5-year initial period for business entities meeting the SBA definition of a small business. EPA cannot take on the responsibility of developing generic rebuild systems for commercial locomotives. However, for these small business entities, EPA will allow certification of remanufacturing systems based on a modified version of the FTP, rather than on full FTP emissions testing, and will exempt the small remanufacturers and suppliers from PLT audits and in-use testing requirements during that period. As noted previously, testing costs are a small part of the total cost. Small remanufacturers will still need to do development work. Finally, if small business concerns are not adequately resolved through operation of the market within that time frame, EPA intends to revisit the small business impact issues 5 years after promulgation of the Final Rule. In spite of their protests to the contrary, the Agency believes that these provisions will not provide any significant competitive advantage to small remanufacturers, and thus it should not have a significant adverse impact on the larger business entities.

## **CHAPTER 6 OTHER ISSUES**

### **A. Liability for Remanufactured Locomotives**

#### **Summary of the Proposal:**

The Agency proposed that any entity “engaged in the manufacturing or assembling” of a remanufactured locomotive or locomotive engine would be considered a remanufacturer of such locomotive or locomotive engine. EPA proposed that the remanufactured locomotive or locomotive engine, because it is a new vehicle or engine, must be covered by a certificate of conformity before being introduced into commerce. For purposes of maintaining a competitive aftermarket industry, EPA also requested comment on a provision requiring the locomotive owners/operators to be the certificate holders for remanufactured locomotives.

#### **Summary of the Comments:**

CILAS commented that if the primary manufacturer fails to obtain a certificate of conformity, all manufacturers involved in the remanufacturing process should not be liable. They commented that this action may impose an undue burden and unnecessary liability on a component part manufacturer or remanufacturer in the remanufacturing system. AAR commented that the certificate holder should be held liable for compliance, and that railroads should not be required to be certificate holders.

#### **Analysis of the Comments:**

Section 206 of the Act, which applies to locomotives pursuant to section 213(d), states that the Administrator shall determine compliance with applicable emissions standards and shall issue a certificate of conformity if the vehicle or engine conforms to EPA regulations. Section 203(a)(1) prohibits manufacturers from introducing into commerce new vehicles and engines that are not covered by a certificate of conformity issued by EPA. Because section 213(d) states that EPA’s locomotive emissions standards shall be enforced in the same manner as the federal motor vehicle emission standards, it is appropriate to apply the prohibition against introduction into commerce without a valid certificate to manufacturers of new locomotives and new engines used in locomotives.

Section 216 defines “manufacturer” of a new motor vehicle as any person engaged in the manufacturing or assembling of new nonroad vehicles or new nonroad engines. This definition envisions manufacturing of a new vehicle or engine, at least in some cases, as being something other than simply assembling the new vehicle or engine. EPA has considered the remanufacturing process for locomotives and engines to determine which entity or entities should be considered a manufacturer for purposes of compliance with emissions standards. For remanufactured locomotives and engines, several different entities may typically be “engaged in the manufacturing or assembling” of the new locomotive or engine, potentially resulting in multiple manufacturers of a remanufactured locomotive or engine.

A railroad company may remanufacture its locomotives or engines itself. A railroad may otherwise play a significant role in the process of design, production, or installation of parts in the remanufacturing process. A third party may install the remanufacturing system. Such systems, in turn, could be produced by a different entity. All of these parties are involved in the remanufacturing process to some extent, and can therefore be considered to be “engaged in the

manufacturing or assembling” of the resulting new locomotive or engine. This is significantly different from the motor vehicle industry, in that no single entity conducts the entire process of manufacturing a new vehicle or engine.

The entity that makes the remanufacturing system, containing parts used to remanufacture locomotives or engines, can be considered a manufacturer of the new locomotive or engine because such entity actually produces the components that will constitute the remanufactured locomotive or engine. The installer of the remanufacturing system, who may or may not be a different entity, can be considered a manufacturer of the remanufactured locomotive or engine because such entity performs the installation of the remanufacturing system to result in a new locomotive or engine. Finally, the railroad company that remanufactures its own engine, or is otherwise involved to any significant degree in the remanufacturing process, such as by hiring another entity to install a remanufacturing system according to the railroad’s specifications, can be considered a manufacturer of the resulting new locomotive or engine, because the railroad plays a significant role in determining the specific manner in which the locomotive or engine will be remanufactured. Because any of these entities could be considered the remanufacturer, the Agency is finalizing that any of them could hold the certificate of conformity. EPA, however, is not requiring any of them in particular to hold the certificate of conformity.

As just discussed, any entity which is “engaged in the manufacturing or assembling” of a remanufactured locomotive is potentially liable for that locomotive’s emissions performance. In general, EPA would expect to begin enforcement action against the certificate holder, since it is the entity that has the most control over all aspects of the design, certification and installation of a remanufacture system. However, in cases where the certificate holder is clearly not primarily responsible for a nonconformance, EPA would expect to hold the primarily responsible party liable in any enforcement action. For example, if locomotives were remanufactured under a certificate of conformity and were found to be in nonconformance in-use, EPA would pursue enforcement action against the certificate holder. If the remanufacture system were installed by an entity other than the certificate holder and the nonconformity was determined to be caused by improper installation, EPA would pursue enforcement action against the installer rather than the certificate holder, provided the certificate holder provided adequate system installation instructions with the system. Likewise, if an entity were to remanufacture a locomotive into a configuration not covered by a certificate of conformity, EPA would pursue enforcement action against that entity, rather than a different entity that may have simply supplied components for the remanufacture. Having authority to pursue enforcement action against any entity “engaged in the manufacturing or assembling” of a remanufactured locomotive allows EPA to directly pursue action against the entity most responsible for the problem. EPA would not use this authority to hold an entity liable for actions for which the Agency believes that it clearly has no knowledge of or control over.

## **B. Defect Reporting**

### Summary of the Proposal:

EPA proposed that a manufacturer or remanufacturer of locomotives or locomotive engines be required to file a defect information report whenever the manufacturer or remanufacturer identifies the existence of a specific emission-related defect in a locomotive, or locomotive engine. No report would be required if the defect was corrected prior to the sale of the affected locomotives or locomotive engines.

### Summary of the Comments:

Comments received from EMA as well as AAR opposed the proposed defect reporting provisions, stating that using one engine as the trigger would be too burdensome. GETS suggested that the defect reporting requirement be eliminated entirely. AAR suggested that a defect report be filed only when a defect is discovered in 25 engines, similar to the requirements found in the on-highway and nonroad over 37 kW programs for compression ignition engines.<sup>11</sup>

### Analysis of the Comments:

As described in the preamble for the NPRM, there are three reasons why a threshold of less than 25 is appropriate for locomotives. First, since reliability is a very critical concern for locomotive purchasers, locomotives and locomotive engines tend to be very carefully manufactured. As such, the number of emission-related defects that would actually occur is expected to be small. Second, the number of locomotives produced under a single certificate will be much smaller for locomotives than for most on-highway or nonroad engine families. While 25 would be a very small fraction of a light-duty engine family of 100,000 vehicles, it could be one-quarter or more of the annual production volume of a locomotive engine family. Finally, given the size of locomotive engines (30 to 40 times the horsepower of a typical light-duty vehicle), and their long service lives (up to one million miles between rebuilds), the environmental impact of high emissions from even a single defective engine could easily be much more significant than 25 defective light-duty vehicles. However, EPA agrees with commenters who state that a threshold of a single defective locomotive will trigger a report to EPA is too burdensome, given the low production volumes in the locomotive industry. However, EPA believes that since locomotive production volumes are so low, it would not be appropriate to use a level of 25 defective locomotives as a trigger for reporting. Therefore, EPA is finalizing a threshold of 10 locomotives or locomotive engines. In other words, a manufacturer or remanufacturer of locomotives or locomotive engines must file a defect information report whenever the manufacturer or remanufacturer identifies the existence of a specific emission-related defect in ten locomotives, or locomotive engines. EPA believes that this number of locomotives is more appropriate for the locomotive industry and could constitute a significant percentage of the annual production volume of a locomotive engine family. Furthermore, if a manufacturer finds and remedies a defect prior to sale of the locomotive or locomotive engine to the ultimate purchaser, no defect report to the Agency is required.

## **C. Imports**

### **C.1 Exemption for Locomotives or Locomotive Engines Greater than 20 Years Old**

#### Summary of the Proposal:

EPA did not propose an exemption for imported locomotives and locomotive engines greater than 20 years old. EPA requested comment on the need for an exemption for imported locomotives and locomotive engines greater than 20 yrs old.

#### Summary of the Comments:

Comments received on this issue supported EPA's proposal to have no exemption for imported locomotives and locomotive engines that are greater than 20 years old.

#### Analysis of the Comments:

The final regulations will not include an exemption for importing locomotives and locomotive engines that are greater than 20 years old for the reasons described in the NPRM.

### **C.2. Exemption for Locomotives or Locomotive Engines That Are Identical to a Certified Version**

#### Summary of the Proposal:

The Agency proposed an exemption for locomotives and locomotive engines, shown to be identical, in all material respects, to their corresponding United States certified versions.

#### Summary of the Comments:

The California Air Resources Board (CARB) commented that this exemption would imply that these locomotives and locomotive engines would not have to comply with the various requirements of the rule and seems to be unwarranted, creating inequities and potential abuse.

#### Analysis of the Comments:

EPA believes that there is no need to provide an exemption for imported locomotives which are identical, in all material respects, to their United States certified versions. EPA agrees with CARB that such an exemption would create an inequity between locomotives manufactured in compliance with the standards and those that are merely the same in all material respects to certified versions. Since the production line and in-use testing portions of the locomotive emission standards are important and integral parts of the program as a whole, EPA sees no good reason to exempt imported locomotives from these compliance measures. Such locomotives can always be remanufactured in compliance with the standards.

### **D. Tampering**

#### Summary of the Proposal:

EPA proposed provisions that would prohibit any person from tampering with any locomotive or locomotive engine emission-related component or system installed on or in a locomotive or locomotive engine in accordance with EPA regulations. These provisions would help ensure that in-use locomotive engines remain in certified configurations and continue to comply with the applicable emission standards.

#### Summary of the Comments:

EMA commented in support of the proposal. EMA stated its support for prohibiting the adjustment of engine parameters beyond the specified ranges and for defining tampering as knowingly removing, disabling or failing to maintain emissions-critical components or installing

defeat devices. Comments from CARB supported the proposed tampering provisions.

#### Analysis of the Comments:

EPA is finalizing the proposed anti-tampering restrictions for the reasons described in the NPRM. The basic purpose of these restrictions is to prohibit any person from tampering with an emission related component on a locomotive or locomotive engine both prior to and after the sale to the ultimate purchaser.

### **E. Nonconformance Penalties (NCPs)**

#### Summary of the Proposal

Pursuant to section 206 (g)(1) of the Act, the on-highway heavy-duty vehicle and engine emission compliance program provides that, in certain cases, engine manufacturers whose engines cannot meet emissions standards may receive a certificate of conformity and continue to sell their engines provided they pay a previously specified nonconformance penalty (NCP). NCPs are designed to provide relief for manufacturers who are technology developing laggards in the emission control technology needed to meet technology-forcing standards. EPA concluded that there would be no technology developing laggards with respect to compliance with the proposed locomotive emission standards, and therefore did not propose the availability of NCPs for locomotives.

#### Summary of the Comments

EMA was the only entity that commented on the issue of NCPs. EMA stated that, even if EPA were to relax the levels of the proposed Tier 2 standards as EMA requested, those standards would still likely be technology-forcing. Thus, it is likely that some manufacturers and/or engine families would be unable to meet the Tier 2 standards. EMA stated that it is therefore essential to make NCPs available for the Tier 2 standards in order to assure that manufacturers are able to participate in the market. Further, EMA commented that such NCPs must be established well in advance of the Tier 2 implementation date if manufacturers are to effectively factor the availability of NCPs in their development programs.

#### Analysis of the Comments

While EPA agrees with EMA that the Tier 2 standards are technology forcing (in the sense that much development work remains, but not necessarily that new technology needs to be invented), the Agency believes that it is much too early to begin serious consideration of whether NCPs should be established. The criteria used to determine whether NCPs should be made available, and what the amount of the penalty should be, are fairly well defined. In general, EPA must find that the standards are technology forcing but feasible, and that one or more technological laggards will not be able to comply with the standards by their effective dates. With seven years to go before the applicable date for the Tier 2 standards, EPA believes that it is much too early to evaluate the appropriateness of NCPs for those standards, especially the identification of a technological laggard. However, EPA believes it appropriate to continually monitor the status of technology development for all the tiers of standards, and intends to investigate the appropriateness of NCPs for any of the standards in a timely fashion, if appropriate in the future. EPA disputes EMA's claim that NCPs must be made available well in advance of the applicable date of the standards they are intended for. The implication is that NCPs should be considered just another compliance tool, similar to the averaging, banking and

trading program. EPA believes that the purpose of NCPs is to assure that a manufacturer can continue selling its product even if its development efforts toward compliance with the standards fall short despite its best efforts at achieving compliance.

## **F. Emissions Warranty**

### Summary of the Proposal

Under section 207(a) of the Act EPA proposed an emission warranty period for all locomotive and locomotive engine parts which were not in common use prior to the effective date of the standards, and whose primary purpose is emission control. EPA proposed that this warranty be in effect for the full useful life of the locomotive or locomotive engine. Specifically, EPA proposed that a manufacturer or remanufacturer must warrant that the locomotive, locomotive engine, or remanufacture system is designed, built and equipped to conform with all applicable emission regulations, and that it is free from defects which would cause nonconformity in-use. The warranty was not proposed to cover normal maintenance. EPA stated that a warranty period equivalent to the full useful life would provide proper incentive for manufacturers and remanufacturers to design and build durable emission control equipment.

### Summary of the Comments

Both EMA and AAR requested that EPA promulgate a much shorter warranty period than proposed. They pointed out that the purpose of the 207(a) warranty provisions is to provide consumer protection to the purchasers of emissions certified vehicles. In the case of most mobile sources, an individual purchaser would have very little power over the manufacturer in a dispute over emissions technology defects, and thus should be provided protection under section 207(a) of the Act. However, in the case of the locomotive market there are very few customers (*i.e.*, railroads) of locomotive manufacturers and remanufacturers. Thus, a railroad has a great deal of power in the producer/purchaser relationship, and is able to effectively negotiate the warranty coverage it needs at the time of purchase. EMA and AAR argue that given the railroads' ability to protect themselves in this market there is no need for EPA to promulgate warranty provisions that are not needed and may interfere with the efficiency of the relationship between the railroads and the manufacturers and remanufacturers.

In contrast to the EMA/AAR position, NRDC commented in support of the proposed full useful life warranty period, stating that not having an emission warranty would provide a disincentive to railroads to get emission-related repairs done beyond the warranty period. CILAS commented that full useful life warranties are unrealistic because the useful life periods EPA proposed are unrealistic. Finally, CARB raised an issue with respect to maintenance of emission-related parts. CARB stated that EPA's proposed regulations require a locomotive owner to perform proper maintenance on parts that affect emissions but were in general use prior to the proposed effective date of the standards (*i.e.*, emission-related parts not covered under the emissions warranty). CARB suggested that the warranty regulations be revised to require locomotive owners to perform proper maintenance on all new technology which will require maintenance, not just technology that is in general use prior to 1999.

### Analysis of the Comments

EPA agrees with EMA and AAR that the major railroads are able to negotiate the warranty protection they need without long EPA-mandated warranty periods. The Agency also



believes that the in-use testing provisions and associated liability provide sufficient incentive for manufacturers and remanufacturers to design and build durable emission control equipment. However, EPA believes that some minimum warranty protection should be provided to the owners of freshly manufactured and remanufactured locomotives, especially the smaller railroads who may not have the same bargaining power to negotiate the kind of warranty coverage that the major railroads can. Thus, the Agency is promulgating an emission warranty period for locomotives that parallels that for the heaviest heavy-duty on-highway engines, and is a compromise between the full useful life warranty period it proposed, and the lack of a warranty requested by the manufacturers and railroads. Under those warranty provisions the current period of the warranty is roughly one third of useful life. Thus, for locomotives the warranty period will be 2.5 MW-hr per hp. This period is the minimum (default) warranty period. Consistent with EPA's emission warranty period for heavy-duty diesel engines, if a locomotive is covered by a mechanical warranty longer than this minimum, then the emission warranty will be required to be at least as long as the mechanical warranty. EPA does not believe that this shorter warranty period in any way compromises the effectiveness of its emission standards. Manufacturers and remanufacturers would still be subject to in-use testing, and any enforcement action taken by EPA would not be affected by the warranty period.

The purpose of requiring the owner of a locomotive to perform proper maintenance on emission-related parts not specifically covered by the emission warranty (*i.e.*, those covered by the warranty include parts whose primary function is emissions control and that were not in general use prior to the implementation of emission standards) is to assure that emission related parts not covered by the emission warranty are properly maintained. There are two reasons why EPA does not believe that it is necessary to include a requirement in the warranty provisions that a locomotive owner perform proper maintenance on parts that were not in general use prior to the effective date of the standards. The first reason is that any new emission related parts which were not in general use prior to the implementation of that standards would likely be parts whose primary function is emissions control. Thus, such parts would be covered by the emission warranty and would not fall into the category of the owner's responsibility. The second reason is that EPA is promulgating requirements that locomotive manufacturers and remanufacturers hold in-use liability for emissions performance of their emission-certified locomotives, consistent with its other mobile source programs. Also, EPA is requiring that locomotive owners be liable for tampering violations if they do not perform the specified maintenance (or similar) that is included in the recommended maintenance instructions provided by the manufacturer or remanufacturer. Given the liability for in-use emissions performance that the manufacturers and remanufacturers have, it is likely that they will include any required maintenance of non-warranted parts in the recommended maintenance instructions. Since failure to perform such maintenance will constitute a tampering violation, to include similar maintenance requirements in the warranty provisions would be redundant.

The comment that full useful warranty is unrealistic because the proposed useful life periods are unrealistic is really an issue about useful life. Comments on the feasibility of the proposed useful life periods are being addressed in the section on useful life elsewhere in this document.

## **G. Locomotives from Canada and Mexico**

### Summary of the Proposal:

In the NPRM, the Agency expressed concern about the possibility of nonconforming

locomotives from Canada and/or Mexico operating extensively within the U.S., under the ownership of either a U.S. or foreign railroad. EPA requested comment on EPA's legal authority to limit such activity, and whether EPA should limit export exemptions of nonconforming locomotives, since locomotives used in Canada and Mexico are often produced in the U.S.

#### Summary of the Comments:

NRDC supported limits on export exemptions as an incentive for Canadian railroads to comply with the U.S. emission standards. CILAS commented that export exemptions should be limited to locomotives that are not operated within the U.S. other than for cross-border transit operations. AAR, EMA, and the Railway Association of Canada (RAC) all expressed opposition to any attempt by EPA to limit the export of nonconforming locomotives to Mexico or Canada. AAR and RAC emphasized the importance of traffic across the U.S. - Canadian border, and suggested specific clarifications to the proposed import regulations. EMA argued that EPA lacks the authority to limit exports to Canada or Mexico. RAC also argued that there is no need for EPA to be concerned about adverse emissions impacts from Canadian locomotives because:

- 1) Such locomotives do not operate extensively within the U.S.;
- 2) Canadian railroads already have an agreement with the Canadian government to limit emissions from their locomotives; and
- 3) Canadian railroads are likely to purchase the same low emission locomotives as the U.S. railroads because of market forces.

RAC further argued that cross-border traffic is not importing.

#### Analysis of the Comments:

EPA agrees with the railroads clarifications regarding the import regulations. EPA believes it is appropriate to exempt locomotives that do not operate extensively in the United States from compliance with EPA's emissions standards, and has included such an exemption in the final rule. Most locomotives operated by Canadian and Mexican railroads do not operate extensively in the United States. This approach ensures that significant emissions from Canadian and Mexican railroads do not occur in the U.S., which could particularly pose a problem in border areas, but does not require manufacturers and remanufacturers of such railroads to incur the costs of compliance with the standards for minimal operation in the United States. Moreover, requiring compliance for such minimal operation could result in completely stopping rail traffic from Canada and Mexico into the U.S., which could have an adverse effect on businesses and individuals that rely on these routes. However, if a locomotive does operate extensively in the U.S., it must comply with applicable emissions standards.

EPA is finalizing the proposed regulations to allow export exemptions, with some modifications, to exempt U.S. manufacturers and remanufacturers from compliance with the emissions standards for locomotives that are exported, including exports sold to Canadian and Mexican railroads. The modifications to the proposed provision clarify EPA's intent with respect to certain issues, including clarifying that locomotive engines manufactured in the United States by EMD for use by U.S. railroads are not exempt from the standards, even though installation of such engines into locomotives may occur in Canada.

## **H. Aftermarket Parts**

### Summary of the Proposal:

EPA proposed an approach to locomotive aftermarket parts that parallels its current approach for on-highway vehicle aftermarket parts. Specifically, EPA proposed to allow voluntary certification of such parts under the provisions of 40 CFR Part 85, Subpart V. For those parts not voluntarily certified under these provisions, EPA stated its intent to apply the principles of EPA Mobile Source Enforcement Memorandum No. 1A, which outlines the Agency position on tampering with respect to the use of replacement components on certified vehicles and engines.<sup>12</sup>

EPA requested comment on whether it should establish provisions which would allow aftermarket part suppliers to sell some emissions related parts for locomotive manufacturing without being a part of a certified remanufacture system. Finally, EPA requested comment on whether it should allow the streamlined certification for modified remanufacture systems (*i.e.*, systems that are largely versions of previously certified systems but that utilize aftermarket parts).

### Summary of the Comments:

CILAS was the only commenter on the issue of aftermarket parts certification. CILAS pointed out the importance of allowing aftermarket part suppliers to remain active in the locomotive market. Thus, CILAS supported the establishment of a voluntary aftermarket parts certification program. However, CILAS stated that the testing and durability requirements of 40 CFR Part 85, Subpart V are too burdensome for the small aftermarket companies to bear. CILAS urged EPA to adopt an aftermarket parts certification program which is tailored to, and more appropriate for, the locomotive market. CILAS supported the inclusion of provisions allowing aftermarket part suppliers to sell some emissions related parts for locomotive manufacturing without being a part of a certified remanufacture system. Finally, while CILAS thought that streamlined certification for modified systems is conceptually appropriate, it stated that any certification program would impose excess burdens on small aftermarket parts suppliers.

### Analysis of the Comments:

In general, EPA is finalizing the approach it proposed. However, the Agency does agree with CILAS that the provisions of 40 CFR Part 85, Subpart V are inappropriate for the locomotive industry since those provisions are intended to apply to on-highway vehicles and engines. Thus, rather than adopt provisions for locomotives like those in 40 CFR Part 85, Subpart V, EPA will simply allow aftermarket parts suppliers to petition the Agency for advance approval of parts under the tampering policy as outlined in EPA Enforcement Memorandum 1A. Such an approval would not constitute a formal certification, but would merely show that, based on an engineering analysis and/or emissions test data, that the part is identical in all material respects to the original. This advance approval, which amounts to an exemption to the user from the tampering prohibition, would provide some assurance to entities which use the part that they

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<sup>12</sup> June 25, 1974. Available in the public docket for this rulemaking.

will not be subject to enforcement action under the tampering prohibition for using that part. However, the entity which manufactures and offers the part for sale will be held liable for any in-use nonconformities attributable to that part.

EPA believes that the aftermarket parts provision just discussed addresses the needs of the aftermarket parts industry by providing a mechanism to sell parts outside the context of a certified remanufacture system, and that there is no need to adopt provisions allowing aftermarket part suppliers to sell some emissions related parts for locomotive manufacturing without being a part of a certified remanufacture system. Also, EPA's response to CILAS's stated needs for a streamlined certification program are addressed in Chapter 5 in the section dealing with the economic impacts of the Tier 0 remanufacture requirements.

## **I. Onboard Diagnostics (OBD)**

### Summary of the Proposal

Onboard diagnostic systems indicate to a vehicle operator any occurrence of specific emission control failures. EPA currently has OBD requirements in place for light-duty on-highway vehicles. The Agency did not propose any specific OBD requirements for locomotives, but requested comment on the appropriateness and feasibility of applying OBD systems to freshly manufactured locomotives (*i.e.*, Tier 1 and 2 locomotives), which are already expected to have advanced onboard computer displays for other purposes.

### Summary of the Comments

EMA commented that OBD systems are not needed for emissions compliance and the EPA should not finalize any OBD requirements for locomotives. AAR also opposed the adoption of OBD requirements for several reasons. First, AAR stated that such a requirement for locomotives would be inconsistent with EPA's regulations for all other nonroad categories, for which EPA has no OBD requirements. Second, AAR stated that OBD represents a consumer protection that the railroads do not believe they need, stating that they are capable of negotiating any diagnostics needs they have as part of the purchase agreement. Finally, AAR stated that there are currently no locomotive emissions OBD systems available, and that their technical feasibility has not been demonstrated. NRDC commented that EPA should require OBD systems on all Tier 2 locomotives, stating that these locomotives will already have onboard computers, resulting in OBD systems that have no real cost associated with them.

### Analysis of the Comments

EPA agrees that it is not appropriate to require OBD systems on locomotives at this time. EPA believes that AAR's argument about the use of OBD for other categories is not relevant here. EPA must decide this issue based on the costs and benefits associated with OBD in locomotive applications. While EPA agrees with NRDC that many of the components needed for an effective OBD systems (*e.g.*, an onboard computer and various operating parameter sensors) will be on freshly manufactured locomotives in the 2005 time frame, OBD systems do have some additional costs associated with them. Such costs include additional sensors to measure parameters not already measured for other purposes, as well as research and development costs associated with developing appropriate software. The Agency expects that during the early years of locomotive regulation much information will be collected regarding the relationship between measured parameters such as manifold air and exhaust temperatures, and emissions. EPA expects

that this information will provide a good basis for evaluating the usefulness and need for OBD on future locomotives. The Agency expects to reconsider the issue of locomotive OBD requirements in the future. Finally, EPA does not agree with AAR that OBD is a consumer protection. EPA believes that OBD is potentially an effective means of promoting good locomotive maintenance practices by alerting the operator to potential emission-related problems.

## **J. Engines Used for Repowering Locomotives**

### Summary of the Proposal:

EPA proposed provisions to address the replacement of an existing tractive power locomotive engine (*i.e.*, repowering) with an engine generally used in equipment other than locomotives. Such engines are subject to EPA's standards for nonroad engines contained in 40 CFR Part 89, and only a small percentage of the total production of such engines would be used in locomotives.<sup>13</sup> EPA was concerned that it might be overly burdensome to require such engines to be certified to two different sets of federal standards (*i.e.*, the 40 CFR Part 89 provisions and the locomotive standards), especially given the small number expected to be used in locomotives. Thus, the Agency proposed to allow manufacturers to sell up to 25 of these nonroad engines each year for use in locomotives without specifically certifying to the locomotive standards. Such engines would be certified as meeting the 40 CFR Part 89 regulations. This allowance was proposed to be limited to engines under 2000 hp, which are typically used for repowering used locomotives for railroad switching operations. Also, as a condition of being allowed to sell such engines for use in locomotives, the Agency would retain the authority to require that testing done for certification to the 40 CFR Part 89 standards also include testing done at the locomotive power notch points. EPA would use this data to determine the validity of this provision from an environmental perspective. The Agency also requested comment on several aspects of this proposed provision for repowering, including, how should such engines be treated with respect to preemption, and whether EPA should extend this provision, or a similar one, to engine manufacturers for engines to be used in locomotives with freshly manufactured chassis.

EPA proposed that engines used for repowering of existing locomotives that are not eligible to use the provisions just discussed, because they exceed either the sales or horsepower limits, be certified as locomotive engines, not locomotives. Moreover, due to the logistical problems associated with pulling an engine from a locomotive to test it during in-use testing (discussed later), EPA proposed that in-use testing for these engines be done on locomotives. The engine manufacturer could choose, in the event of a failure of locomotives containing its engines during the in-use testing program, to either accept the results of the locomotive tests, or to test the actual engines.

### Summary of the Comments:

EMA and Caterpillar supported this allowance to use certified nonroad engines in

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EPA also proposed that the engines under 1000 hp, which are generally only used in in-plant locomotives for moving materials and equipment within industrial sites, not be defined as locomotive engines. They would therefore not be subject to the proposed regulations. Engines in such vehicles must be certified as meeting the 40 CFR Part 89 regulations.

locomotives, but argued that it should be modified. Specifically, they felt that there should be no restrictions on sales or horsepower, and that it should be broadened to include sales of engines for use in freshly manufactured locomotive chassis. They agreed with EPA that such engines will likely have emissions similar to engines used in certified locomotives, but opposed EPA having the authority to require manufacturers to provide test data with which the Agency could validate this supposition. They argued that for EPA to be able to require a manufacturer to provide such data would be an unreasonable burden, and that it would subject it to liability under the locomotives regulations. EMA and AAR also emphasized that such engines should also be covered by the proposed preemption provisions. Caterpillar also suggested that EPA finalize a shorter useful life for "nonroad type engines": 8000 hours, 300,000 miles, or 3.0 MW-hr/hp. Finally, Caterpillar argued that they should be allowed to develop Tier 0 retrofit systems using Part 89 test protocol for the less than 200 existing Caterpillar repower locomotive engines. In these cases, they argued that they should be allowed to demonstrate a 33 percent reduction from uncontrolled baseline levels.

EMA commented that EPA should allow the replacement of existing engines with identical engines under the repower provisions.

NRDC opposed this allowance, arguing that it was inconsistent with the goals of this rulemaking, and that it would delay emissions reductions. NESCAUM supported this allowance, but emphasized the importance of restricting sales to 25 engines per year. CARB commented that EPA will need a mechanism to track these engines. They also argued that these nonroad engines should be subject to the in-use testing requirements and should be required to maintain their emissions performance upon remanufacture.

#### Analysis of the Comments:

The Agency has concluded that it would be unreasonable to require locomotive certification for a small number of previously certified nonroad engines that are to be used to repower existing locomotives on the basis of cost. This is especially true for cases in which a given engine model is sold for repowering several different locomotive chassis. Clearly, if the number of engines sold is small, the per-engine cost of certification could represent a very large fraction of the total cost of the engine. For these same reasons, EPA does not believe that it is appropriate to require such engines to be in-use tested.

There are also compelling arguments why the proposed provisions for allowing some engines to be used in locomotives to be exempt from the locomotive standards (provided they are certified to the 40 CFR Part 89 standards) should not result in any significant adverse environmental impacts. Such engines are expected to have emissions levels similar to Tier 1 locomotive engines based on the percent NO<sub>x</sub> reductions from uncontrolled levels required by each regulation, but would most likely replace older locomotive engines which would otherwise remain uncontrolled (*i.e.*, those in pre- 1973 locomotives) or be remanufactured to the Tier 0 standards (*i.e.*, 1973-1999 locomotives). Thus, there could even be an emissions benefit from these engines relative to the engines they replace. Moreover, the fact that these engines are not expected to have useful lives as long as other locomotive engines, nor are they expected to be remanufactured as many times throughout their service lives would serve to minimize any unanticipated adverse effects of this provision. In order to assure that this exemption does not result in any adverse effects the Agency is making this exemption subject to EPA approval.

While EPA believes that the 40 CFR Part 89 regulations will generally provide similar

environmental benefits as do the proposed Tier 1 locomotive regulations, the Agency nonetheless shares the concerns of those commenters opposed to this allowance. EPA is most concerned about the differences between the test procedures proposed for locomotives and those that currently apply to other nonroad engines and the potential environmental impacts of those differences. Since the 40 CFR Part 89 regulations will not apply to engines in the 1000 to 2000 hp range until 2000, EPA currently has no way of evaluating those impacts because there are no engines meeting the 40 CFR Part 89 regulations which can be used to compare the results over the two test procedures. This is why EPA continues to believe it must retain the authority to require that testing done for certification to the 40 CFR Part 89 standards also include testing done at the locomotive power notch points, as a condition of allowing such engines to be used in locomotives. It is important to clarify, however, that EPA will use these data only for informational purposes, and that there would be no liability associated with such data.

At this time, given the lack of information about the precise impacts of such an allowance, the Agency believes that the most appropriate course is to limit the total annual sales to 25 for each manufacturer, as was proposed. EPA believes that this properly balances the environmental risks and the need to minimize the compliance burden. If a manufacturer sells more than 25 engines, then it should be able to adequately spread the additional costs of locomotive certification. However, EPA does agree with the manufacturers that there is no need for EPA to limit this allowance to only low-horsepower engines. The Agency believes that the current practice of repowering primarily low power, switch locomotives will continue, thus keeping the number of higher horsepower nonroad engines used for repowering to a minimum.

EPA also agrees with EMA that integrated engine/chassis manufacturers should also be allowed to sell engines under this provision. Thus, EPA is expanding this provision from what was proposed to include such manufacturers. However, this would only be allowed for an engine model for which sales for non-locomotive applications exceed sales for locomotive applications. To allow otherwise would be inappropriate because it would allow manufacturers to choose which standards were more favorable for its engines, even though there would be no compelling policy reason to allow such a choice.

The Agency agrees that any engines sold under this allowance should be treated the same as other locomotive engines with respect to preemption since they are “engines used in locomotives,” and therefore subject to the preemption provisions of the Act. EPA also agrees that engines not designed to be used primarily in locomotives may need shorter useful lives because they were not designed with the long service life of a locomotive in mind, but does not agree with Caterpillar's specific suggestion. EPA will instead allow manufacturers to petition for a shorter useful life. However, this will only be allowed if the engine was not designed for locomotive applications, and the manufacturer can demonstrate that it will actually have a shorter life in use than other locomotive engines. EPA agrees with CARB that these engines should be required to maintain their certified emissions performance upon remanufacture. However, the Agency believes that its tampering prohibitions are sufficient to address this, and that adding remanufacture provisions to 40 CFR part 89 would not be justified given the small number of engines allowed to be used in locomotives under these provisions.

While EPA does not believe that it would be appropriate to have a broad allowance for the use of 40 CFR Part 89 certified engines in freshly manufactured locomotives, the Agency does believe it appropriate to have a limited allowance for such nonroad engine use in order to reduce the certification burden associated with the occasional locomotive manufacturer practice of building very small numbers of switch locomotives using nonroad engines not normally used

in locomotives. Thus, EPA is allowing locomotive manufacturers to use a small number of engines certified to the standards in 40 CFR Part 89 in freshly manufactured switch locomotives. For a given locomotive manufacturer, this provision will be limited to 15 locomotives over any three year period. This limit will apply to the locomotive manufacturer, rather than the engine manufacturer, in cases where the engine manufacturer and locomotive manufacturer are different. Engines sold by an engine manufacturer for use in freshly manufactured locomotives under this provision will not be included in the sales limit for engines used for the repowering of existing locomotives discussed previously.

The Agency did not fully consider the issue of existing nonroad engines in locomotives with respect to the Tier 0 requirements. EPA agrees that retrofit systems for existing nonroad engines used in locomotives could be certified using Part 89 test protocol, but that they would otherwise have to comply with the locomotive remanufacturing provisions. This is appropriate because of the small number of engines involved, and because these engines are not expected to be remanufactured multiple times like other locomotive engines. These two factors would make it difficult for a nonroad engine manufacturer to recover the costs that would be associated with developing a locomotive test facility. However, given the uncertainty associated with the comparability of the two test procedures, EPA believes that the remanufacturer should be required to demonstrate a 40 percent reduction from uncontrolled levels, in order to assure that in-use it would achieve similar reductions as the Tier 0 standards.

EPA agrees that it is appropriate to allow the replacement of existing engines with identical engines under the repowering provisions has added to its proposed definition of “freshly manufactured locomotive” a provision stating that freshly manufactured locomotives do not contain more than 25 percent (by value) previously used parts. EPA is allowing 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. The Agency chose 25 percent as the cutoff because it believes that 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.

## **K. Upgrading**

### Summary of the Proposal:

EPA proposed a definition of remanufacture that included upgrading, which it proposed to define as a process by which a locomotive remanufacturer converts an older engine model so that it becomes functionally equivalent to a more recent model, both in terms of its performance and the expected remaining service life following the upgrade. EPA proposed that any pre- 1973 locomotives which are upgraded to post-1972 specifications be required to meet the same emissions standards as locomotives originally manufactured after 1972, at the time of upgrading and at subsequent remanufactures. The Agency also requested comment on whether this provision should be written to optionally (the remanufacturer's option) include any remanufactured pre-1973 locomotive that complies with the Tier 0 emission standards.

### Summary of the Comments:

EMA and AAR argued that the proposed definition of upgrading was too vague, and that



it should be replaced with a definition that would define upgrading as the process of bringing a pre-1973 locomotive into compliance with the Tier 0 standards. They also argued that compliance in these cases should be optional (at the remanufacturer's discretion). NESCAUM also supported allowing remanufacturers of pre-1973 locomotives to voluntarily comply with the Tier 0 standards.

#### Analysis of the Comments:

EPA agrees with EMA and AAR that the proposed definition is too vague to adequately determine what is and is not an upgrade. However, EPA believes that it is not possible to precisely define upgrade in such a manner that it would not include some locomotives that are not truly "new". Thus, the definition will be revised as suggested, and compliance for upgraded pre-1973 locomotives will be voluntary. The Agency does not believe that this will have any significant adverse impacts, because the number of locomotives that would have been forced to comply with the Tier 0 standards under the proposed definition of upgrade would have been very small (likely fewer than ten). Moreover, under this new definition of upgrade, railroads are more likely to voluntarily bring many more pre-1973 locomotives into compliance in order to have them covered by the preemption provisions of 40 CFR 85.

### **L. Idle Shutdown**

#### Summary of the Proposal:

The Agency requested comment as to whether it should provide an incentive for the development of an automatic shutdown mechanism that could shut off an engine automatically after some extended period of idling. One such approach that was identified in the proposal would be to reduce the weighting factor for the idle emission rate, for engines equipped with automatic shutdown mechanisms, but use the higher power weighting factor that is specified in the proposed regulations.

#### Summary of the Comments:

Manufacturers, remanufacturers and railroads supported the approach discussed in the proposal. NESCAUM also supported such an approach. CARB supported this approach, provided that the shutdown mechanism could not be disabled by the operator.

#### Analysis of the Comments:

EPA is finalizing the approach that was discussed in the proposal because it believes that it is appropriate to give credit for emissions that are prevented. EPA does not believe that CARB's concern is significant because the fuel savings associated with reduced idling time would provide railroads strong incentive to use a shutdown feature as much as possible. Further, any disabling of the shutdown mechanism would constitute a tampering violation.

### **M. Voluntary Low Emission Standard Programs**

#### Summary of the Proposal:

EPA did not propose any voluntary low emission standard programs, but did propose an averaging, banking and trading program (ABT) for NO<sub>x</sub> and PM that would provide credits for locomotives certified with emission rates below the applicable standards.

#### Summary of the Comments:

NESCAUM and MECA both argued that EPA should create provisions to encourage manufacturers and remanufacturers to certify below the levels of the applicable emission standards. Specifically, they want a program in which states and other interested parties could provide incentives for such compliance.

#### Analysis of the Comments:

EPA believes that the ABT program being adopted in these regulations already provides a mechanism by which states could provide incentives for cleaner locomotives. EPA agrees that a state, or any other interested party, should be able to obtain credits (or obtain agreement to retire credits) from a manufacturer or remanufacturer that certifies a locomotive with low emissions in exchange for whatever incentive it chose. The state would then be able to retire the credits so that they could not be used, and thus, ensure that the emission benefit is not reduced at some later time. Admittedly, under such a program, a state could not necessarily ensure that all of the emission reductions would occur within its boundaries. However, given the regional manner in which railroads typically operate, a regional organization could be reasonably confident that a very significant fraction of the reductions would occur within its boundaries by establishing a railroad-specific credit program. Therefore, the Agency is not establishing any additional credit programs in this rule.

### **N. Modal Shift**

#### Summary of the Proposal:

EPA stated that one consideration it had taken into account in developing new emission standards for locomotives and locomotive engines was the potential for a modal shift from one form of transportation to another, as a result of the new standards. If the new locomotive standards were too stringent and resulted in higher locomotive shipping costs, the potential for a modal shift from rail- to truck-based transportation could occur. This could prove detrimental to the environment, since trucks produce a great deal more pollutants per ton-mile of freight moved than locomotives, even at current emission levels.

#### Summary of the Comments:

ATA stated that EPA used the modal shift argument to justify too-lenient locomotive standards. ATA stated that EPA had based its findings regarding the negative emissions impact of a modal shift from rail- to truck-based transportation on a single inaccurate interoffice memorandum, which failed to take into account that final delivery of rail shipments had to be by truck or other mode. ATA further argued that if anything, trucks have been at a competitive disadvantage due to decades of EPA regulation.

#### Analysis of the Comments:

All of the information currently available to EPA indicates that truck-based movement of freight generates more pollutants per ton-mile of freight hauled than do the current, unregulated rail-based forms of freight movement. In addition to the preliminary in-house estimates referenced by ATA, statistics compiled by the Department of Energy (DOE) also indicate that

locomotives are on the order of three times cleaner than trucks on an emissions per ton-mile basis. HD trucks produce almost 2.5 times the quantity of NOx emissions as do railroads, but only account for 75 percent as many ton-miles of freight hauled.<sup>14</sup> This estimate is further reinforced by a report issued by the American Society of Mechanical Engineers.<sup>15</sup> EPA thus believes that the possibility of a negative modal shift in terms of emissions is a real consideration in determining the level of the final emission standards. Whether final delivery is made by truck or other mode is largely irrelevant, since the difference in emissions attributable to a modal shift occurs over the portion of the total mileage where competition does exist. The final delivery portion of the total trip would be made by truck in either case.

It is also important to note that while EPA did consider the potential for modal shifts, this major consideration did not have an effect on the Agency's final decisions in this rulemaking. The only significance of the consideration of modal shift was to underscore the importance of not placing unnecessary economic burdens on the railroads, since they could actually result in increased emissions.

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U.S. DOE, Transportation Energy Book, Edition 16 (1994), 1996.

<sup>15</sup> American Society of Mechanical Engineers, Task Force of the Internal Combustion Engine Division, Council of Engineering, "Statement on Surface Transportation of Intercity Freight," May 18, 1992.

## **CHAPTER 7 SUMMARY OF SUPPLEMENTAL COMMENTS**

EPA received several comments after the close of the public comment period, both in the form of submissions to EPA and in the context of meetings with the affected industries. The comments submitted and summaries of the meetings are contained in the public docket for this rule (docket A-94-31). This chapter presents a summary of the significant comments which impacted EPA's final decisions on issues discussed elsewhere in this document, or the regulatory support document.

### **A. Locomotive Manufacturer Comments**

As described in docket item IV-E-10 GM (EMD) stated that it could possibly make certified Tier 0 remanufacture systems available for approximately 50 percent of existing GM locomotive models on January 1, 2000. As described in docket item IV-E-12, EMA suggested that Tier 0 levels could be met by at least some new production locomotives beginning January 1, 2000, the date EPA proposed to require new production to comply with the Tier 1 standards. Finally, in docket item IV-E-17, EMA presented a proposal to EPA for model years 2000 through 2002 which included two options which a given manufacturer could choose from. Under one option, the Tier 0 standards would apply beginning January 1, 2001 for all new production as well as all post-1993 engine families when remanufactured. Under the second option, the Tier 0 standards would apply to a manufacturer's primary post-1994 engine family, as well as all new production of that engine family, beginning January 1, 2000. Under this option, any locomotives freshly manufactured in 2000 and 2001 and not included in the manufacturer's primary engine family would not be covered by regulations at the time of initial manufacture. Under both options the Tier 1 standards would take effect for new production on January 1, 2002. Also, under both options the Tier 0 standards would apply to all post-1973 locomotives when remanufactured beginning January 1, 2002. In that same docket item, EMA (including EMD) indicated its support for a useful life value of 7.5 MW-hrs per hp.

Caterpillar submitted a letter describing the expected useful life for its 3100, 3400, 3500, and 3600 series engines (docket item IV-G-2). Based on this information, Caterpillar recommended that EPA specify a useful life value of 4.1 MW-hrs per hp for "nonroad engines used for powering locomotives."

On November 26, 1997, GETS submitted a package of confidential business information that supported their claim that they needed more lead time for Tiers 0 and 1. The package included descriptions of the current status of their development for Tiers 0 and 1. The information provided does not support the feasibility of EPA's proposed January 1, 2000 effective date for all Tier 0 and Tier 1 locomotives, but does support the feasibility of the phase-in schedule which EPA is finalizing for Tier 0 and 1. The information also provides more detail with respect to their concern about the potential for reliability problems with any new engine feature.

On December 12, 1997 GM submitted a package of confidential business information that further explained GM's comments concerning the lead time proposed for the Tier 0 and Tier 1 standards.

### **B. Railroad Comments**

As described in docket item IV-E-13, EPA met with AAR on August 7, 1997. At that

meeting, railroad representatives indicated that they were likely to not remanufacture their Dash-7 or SD-45 locomotives for compliance with the Tier 0 standards, but instead would sell them, probably for use in Mexico. They also clarified at that meeting that while most switchers are less than 2000 hp, there are significant numbers of "road switchers" that are between 2000 and 2300 hp. They stated that these road switchers were expected to have duty-cycles very similar to the smaller switchers. They also indicated that they believed that Tier 2 locomotives would be able to comply with a 20 percent opacity standard for steady-state smoke emissions. At a later meeting, on October 6, 1997 (docket item IV-E-16), AAR suggested that if EPA were to force railroads to use certified systems in 2000 and 2001, then there should be some cost cap on such a requirement; that is that they should not be required to use systems that exceeded some reasonable cost limit. They emphasized that the expected cost of increased fuel use and maintenance also needed to be considered. They also requested that EPA make allowances for in-use modifications to certified locomotives where they are necessary to maintain adequate reliability.

In a fax to EPA dated November 3, 1997 (docket item IV-G-8), AAR submitted new data on locomotive remanufacture intervals from three Class I railroads. This data showed a distinct bimodal distribution in remanufacture intervals, with the first peak centered around 30,000 MW-hr and the second peak centered around 50,000 MW-hr. A graph from this docket item which shows the data is contained in Appendix C. The data showed that the 95th percentile is at 50,577 MW-hr, suggesting that a preemption period of 1.69 times useful life would cover 95 percent of locomotives before they are remanufactured.

### **C. Aftermarket Comments**

As described in docket items IV-E-4 and IV-B-5, EPA met with CILAS on April 29, 1997. At that meeting, CILAS emphasized their need for a transition period that would allow them to gradually adjust to the new market structures. Specifically, they indicated that they most needed relief from the proposed testing requirements. They also indicated that the vast majority of the locomotives that they deal with during remanufacture were originally manufactured before 1990.

EPA met again with CILAS on November 14, 1997, as is described in docket item IV-E-25. At that meeting, EPA explained the small business provisions that it expected to finalize, and CILAS indicated that those provisions would resolve most of their concerns. CILAS reiterated a concern at that meeting about the potential for its members to be at a competitive disadvantage if EPA were to allow GETS and EMD to use early emission credits from engines remanufactured before 2002 for compliance with later Tier 0 standards, but that such a concern would not exist if the railroads controlled the credits.

## APPENDIX A -- Additional Analysis of Locomotive Manufacturer Comments on Lead Time

### Tier 0 and Tier 1 Lead Time

GETS and EMD each provided estimates for various steps in their expected design, certification and production process for Tier 0 and Tier 1 compliance. GETS estimated the design period to be at least 12 months, the reliability testing to require 11 to 25 months, and the certification to take 6 months. EMD estimated the design period to be 24 months, the reliability testing to require 12 to 18 months, and preproduction efforts (including certification) to take 12 months. Based on the available information, including these inputs, EPA is projecting the lead time shown in Table A-1 as being necessary.

Table A-1				
Necessary Lead Time for Compliance (months)				
	Certify One Tier 0 Engine Family	Certify All Tier 0 Engine Families	Certify All Tier 1 Engine Families	Manufacturer Estimate (Tiers 0&1)
Design	4	18	18	12-24
Reliability Testing	12	18	18	11-25
Certification	3	3	3	6-9
PreProduction	4	6	6	3-9
Total	23	45	45	35-54*
Leadtime Allowed	36	48	48	

\* Manufacturer totals calculated independently for each manufacturer.

The First column represents the lead time EPA expects to be needed to bring a locomotive manufacturer's primary locomotive model into compliance. Both locomotive manufacturers have a good idea of how they will meet the Tier 0 standards on their current primary locomotive models, and EPA's projection of the needed development time is reflected in this column. EPA also believes that reliability testing required for the single Tier 0 engine family scenario will be at the low end of the manufacturers' range of estimates. This is because manufacturers have indicated in confidential business information their current work towards compliance with the Tier 0 and Tier 1 standards. Furthermore, since EPA is finalizing options for compliance with the standards in 2000 and 2001, manufacturers will have broad flexibility in optimizing their resource use strategies, particularly in the early years of the program. In all columns EPA estimated the time needed for actual certification to be three months: one month to do the certification testing, one month to complete and submit the application for certification, and one month for EPA to act on the application. Finally, for pre-production EPA estimated the

time required to be at the mid point of the manufacturers' range, except for the single Tier 0 engine family scenario, where EPA estimated four months based on the fact that the manufacturers already know how they will comply under this scenario and that they will be able to focus resources on a single engine family.

### Tier 2 Lead Time

Comment: Both GM and GETS expressed concern about meeting the Tier 2 standards while maintaining the same reliability and durability they achieve on current locomotives.

Response: EPA understands and is sensitive to the manufacturers' need to provide the railroads with reliable and durable locomotives. The technologies EPA expects for Tier 2 are identified and discussed in chapters 3 and 4 of the RSD. There is nothing about any of these technologies which should inherently raise problems with reliability and durability and the commenters provided no additional data specific to their concerns. Nonetheless, these are technology forcing standards and manufacturers have had problems in the past with what should have been relatively straightforward technology changes.

Normal industry practice to implement new technology involves several steps, many of which can be iterative. These include concept development, application engineering, reliability verification testing (both bench and in-use testing), certification, and pre-production readiness, and manufacturing. For Tier 1, GM estimates this process will take 48 months assuming all goes well, while GETS estimates 36-48 months for a similar process. The rule provides 84 months of lead time for Tier 2, a full three years more than the industry estimates is needed for Tier 1. Using the industry estimate for Tier 1, which may pose a bigger challenge than Tier 2 since it requires a larger incremental reduction, there appears to be ample lead time.

Thus, even if manufacturers encounter unanticipated problems in reliability testing and the need for iterations, industry has ample time for several iterations, including time to make the appropriate changes and recommence reliability testing. In fact, based on industry comments, there is adequate time to do a full additional cycle of reliability testing if needed (1-2 years).

Alternatively, manufacturers could delay Tier 2 development until Tier 1 reliability testing is underway, although EPA does not expect manufacturers to take this approach because it would reduce the time available to meet the Tier 2 standards while ensuring the desired reliability and durability. EPA expects that manufacturers will conduct their Tier 1 and Tier 2 development programs simultaneously if they have concerns about the reliability and durability of technology used for the Tier 2 standards. EPA expects simultaneous technology development and assessment for each of the manufacturer's potential Tier 2 locomotive families, as well as the possible simultaneous evaluation of competing control strategies if there are concerns about reliability/durability for any technique(s). Seven full years lead time should be sufficient to do this, including allowing time for unanticipated problems.

The industry comments indicate that they have a clear idea of the process needed to meet the Tier 2 standards with the necessary reliability and durability, and the comments from manufacturers describing their typical product development process indicate that ample lead time is available even if technology iterations and improvements are necessary. Furthermore, the rule provides the industry with additional flexibility by allowing use of credits from averaging, banking, and trading to assist in their compliance efforts during the transition years from Tier 1 to Tier 2. Thus, not every locomotive family must meet the Tier 2 standard in 2005. In addition,

manufacturers can use credits to gain additional time for engine families with which they encounter unanticipated problems in reliability and durability testing of emission reduction technologies.



## APPENDIX B -- Additional Analysis of Locomotive Manufacturer Comments on Feasibility

This appendix includes additional analysis of the locomotive manufacturer comments on feasibility. The appendix is divided into three sections: Tier 0/Tier 1, Tier 2, and general (which includes all comments which could generally apply to any or all of the tiers of standards).

### Tier 0/Tier 1

Comment: EMA commented that their member companies would need at least 4 years to meet Tier 1 standards. This is because substantial design changes will be needed and special attention will be needed to ensure reliability. Delay of Tier 1 won't materially affect emissions reductions of program.

Response: As presented in Appendix B, EPA agrees that approximately four years of leadtime is needed to provide the manufacturers opportunity to design, develop, prove out, and certify all of their locomotive models for Tier 1, even considering the availability of averaging, banking, and trading programs. The Tier 1 requirement must be met beginning January 1, 2002.

Comment: EMA commented that EPA failed to provide adequate lead time for Tier 0 and Tier 1. If EPA had adopted standards in 1995, as per Section 213(a)(5), there would have been sufficient lead time. EPA hasn't identified requisite technology and hasn't accounted for costs of meeting Tier 0 and Tier 1 standards in 2 years. Also, EPA set Tier 2 levels without any data to support achievability.

Response: EPA has adjusted the timing and applicability of the Tier 0 and Tier 1 standards to provide the manufacturers and remanufacturers adequate leadtime. EPA's analysis for costs of compliance for Tier 0 and Tier 1 and EPA's technical analysis on the Tier 2 standards is presented in the RSD.

Comment: GM stated that many of the same technologies will be used for Tier 0 and Tier 1; although there will be some limitations because of need to economically fit onto existing locomotives (*e.g.*, four-pass aftercoolers are the only practical cooling enhancement for Tier 0). GM locomotives with normally aspirated engines used primarily for switching and branch lines might have difficulty meeting Tier 0 standards; they have low in-cylinder air/fuel ratios and high NO<sub>x</sub> emissions.

Response: EPA recognizes manufacturers' concerns regarding switch locomotives, and is not requiring that such locomotives meet the line-haul duty-cycle standards. (Switch duty-cycle standards only require a 28% NO<sub>x</sub> reduction as compared to a 34% reduction for the line-haul standards.) EPA has also increased the flexibility of the ABT program for Tier 0 compliance by eliminating many proposed restrictions on the use of credits.

Comment: GETS stated that EPA needs to recognize the unique characteristics of locomotives, and expressed concern that primary emission reduction techniques for Tier 0 and Tier 1 standards may not work on locomotives because of design limits such as peak firing pressure, mechanical stress limits, and available cooling capacity. Significant research and development will be required to overcome these constraints.

Response: In other comments, GETS stated that compliance with Tier 0 and Tier 1 standards was technically feasible provided the proposed lead time period was extended. EPA is providing

additional lead time beyond that proposed for both Tier 0 and Tier 1 standards in the final rule. With respect to the comments on firing pressure, mechanical stress and availability of cooling capacity, a primary emission reduction technique, injection timing delay, tends to reduce peak firing pressure and mechanical stress limits while a form of additional cooling, split cooling is already being built into locomotives.

Comment: GM said that EPA does not address two technical constraints pertaining to charge air cooling (packaging limitations and the tradeoff between charge cooling and fuel consumption). GM stated that they can not use air to air aftercooling because of packaging constraints of locomotives, and that ram air is not available. GM also provided comments on the fuel efficiency loss associated with charge air cooling systems that it stated must be considered in the cost-effectiveness analysis. EPA has not discussed the charge air cooling system used by GM. GM can't use aftercooling of any sort in some locomotives (*e.g.*, GM two-stroke engines with Roots blower instead of turbocharger) because the intake air heating in compression process is negligible.

Response: EPA recognized in its proposal that ram air effects as available on cars and trucks would not be available on locomotives and that the application to locomotives of air to air charge air cooling would be more difficult than its application to trucks or cars. The effect of charge air cooling on fuel consumption was not addressed because effects, while positive, are very small and vary between engine designs. There could be fuel economy benefits associated with charge air cooling, as the manufacturers recognized in their comments, and EPA expects that GM will make every effort to maximize any fuel economy benefit associated with enhanced charge air cooling while complying with emission standards. The purpose of using a charge air cooler is to lower the temperature of intake air after the air is heated by compression as in a turbocharger or supercharger. Since the purpose of the Roots blower is to move air into the cylinders of the two-stroke engine with little or no compression and little or no associated heating, the use of a charge air cooler would be pointless on Roots blown two stroke engines made by GM. EPA considered that charge air cooling could not be used on these engines, and also recognized that the vast majority of post-1972 Roots blown engines are found in switch locomotives and accounted for these factors in setting the switch locomotive standards.

Comment: GM stated that while many of the same technologies would be employed in complying with Tier 0 as with Tier 1, some limitations would be present because of the need to economically fit onto existing locomotive, (*e.g.*, four-pass aftercoolers are the only practical cooling enhancement). GM locomotives with normally aspirated engines (Roots blown) used primarily for switching and branch lines might have difficulty meeting Tier 0 standards because of low in-cylinder air/fuel ratios which result in high NO<sub>x</sub> emissions, and aftercooling not applicable.

Response: EPA agrees that there will be significant overlap in the technologies used in complying with Tier 0 and Tier 1 standards. As was discussed in response to the comment above, charge air cooling will not be used as an emissions reduction technology for engines where little or no charge air heating occurs (Roots blown two stroke engines). Data collected by Southwest Research Institute on in-use Roots blown two stroke GM locomotives for AAR showed that some of those locomotives were essentially in compliance with the Tier 0 standards without modification. Slight modification to these locomotives may result in emissions levels below the Tier 0 standards, and would provide credits which can be applied to other locomotives under the ABT program.

## Tier 2

Comment: For Tier 2, GETS commented that EPA's draft RSD does not support the view that the technologies listed in the RSD can be applied to locomotive engines in the time frame of the Tier 2 standards in a cost-effective manner. EPA needs to quantify the effectiveness of each technology, and the feasibility of fitting hardware onto locomotives in light of limited space.

Response: The Tier 2 standards are not effective until January 1, 2005, providing the manufacturers 7 years (84 months) of leadtime. As discussed in Appendix B, GETS has projected that about 43 months would be needed to fully comply with the Tier 0 and Tier 1 requirements. With 84 months of leadtime for Tier 2, there appears to be sufficient time to design, develop, prove out, and refine these technologies. In addition, the RSD contains an analysis which quantifies within ranges, the emission control effectiveness of these various technologies. Obviously, the effectiveness of these technologies will vary from one locomotive/engine to another, but the analysis indicates that the required percent reductions are within reach. None of the technologies listed in the chart raise unique packaging issues, and all are used to varying degrees in current locomotives.

Comment: For Tier 2, GETS commented that very recent locomotives have split cooling systems to lower intake manifold air temp via intercooler, but provide minimal NO<sub>x</sub> reductions. They will need lower intake air temp for Tier 1, and even more for Tier 2. GETS estimated an additional 30 degrees F reduction by using separate cooling system for intercoolers, but that will not be enough to meet Tier 2 standards, and will not work when ambient temperatures are high. It could also result in locomotives needing to be longer, which will mean higher costs because may have to offset increased weight.

Response: NO<sub>x</sub> reductions associated with the current use of charge air cooling have been coincidental to the use of such technology designed for optimum performance and fuel economy. Manufacturers have not thus far been required to achieve NO<sub>x</sub> emissions reductions through the use of available technology, nor to expend resources to develop emissions reduction technology. EPA agrees that ideally further inlet temperature reductions will be needed to achieve further NO<sub>x</sub> reductions. However, GETS has not yet attempted to optimize current systems or develop and evaluate enhancements for the future. Thus, the true potential for charge air cooling in reducing NO<sub>x</sub> remains untapped. EPA agrees that the effectiveness of the charge air cooling is dependent on ambient temperature, so manufacturers will need to design for these conditions, just as they have always designed locomotives to perform well under a range of ambient temperatures. Finally, GETS suggested the possibility of longer locomotives, presumably to develop a larger heat exchanger. Such decisions rest with the manufacturer, but EPA believes that more practical approaches to enhance the performance of the heat exchanger are available such as segmented coolers or metals/fluids with improved heat transfer properties.

Comment: For Tier 2, GETS commented that they have no direct test experience with aftertreatment or EGR on locomotive engines, and would have to limit EGR to 15% because of increased PM that results. Both aftertreatment and EGR will require costly additions to locomotive (gas pumps, exhaust gas coolers, reactors and/or ammonia injection systems) and will take up space. EPA has not evaluated potential impacts of aftertreatment and EGR use to justify concluding technology will be available.

Response: As indicated in the RSD, EPA does not believe that either EGR or any form of aftertreatment will need to be used to meet the Tier 2 standards. The Tier 2 standards were not

established based on the expected availability of EGR or aftertreatment for use in 2005. Certainly, the aftertreatment approaches include the regulatory and practical problems discussed in the RSD, and these would have to be addressed if manufacturers choose to use aftertreatment technology. While EPA has not based the Tier 2 standards on a determination that EGR will be available for use in 2005, EPA believes that EGR presents fewer issues than aftertreatment. It could be used in light load as suggested by the commenter or at varying rates depending on the notch (higher rates in the lower notches and lower rates or none in the higher notches). Cooling of the EGR would make it even more effective. EGR has been demonstrated in several large bore diesel engines and is expected to be in widespread use by 2004. Such technology is transferable to diesel locomotives if necessary.

Comment: For Tier 2, GETS commented that EPA has not provided a reasoned basis for believing technologies will become available and will achieve required levels of reduction. EPA's approach emphasizes rate shaping as primary approach to meet standards -- but there is no discussion in the record supporting rate shaping as an approach that will actually be available, or how it or other technologies would be applied to achieve the level of the standards. Also, cost analysis is cursory and does not provide adequate information to evaluate EPA's reasoning behind its decisions.

Response: EPA is projecting the availability of the technology for the Tier 2 standards based on the availability or development of similar technology for large truck diesel engines. Such an extrapolation is a reasonable exercise of engineering judgment based on the similarity of locomotive and truck diesel engine technology and 20 years of experience in the transportation sector which consistently shows that emission control technology for similar types of engines can be and is often successfully extrapolated. One need only examine the evolution of passenger car, light truck, and heavy-duty truck/bus emission controls as evidence of this practice. Thus, EPA's conclusion that rate shaping and other currently used diesel technologies can and will be applied to locomotive diesels is not only reasonable but is reasonable based on industry practice. In the RSD EPA has projected how effective these technologies will be in reducing the pollutants for Tier 2. Chapter 7 of the RSD contains an analysis showing the costs for each of the technology packages EPA expects to be used.

Comment: EMA commented that manufacturers expect to use technologies EPA has identified for Tier 2 for Tier 1 compliance (electronic controls, rate shaping, injection timing, low temperature charge air cooling, combustion chamber modifications, and oil consumption reduction).

Response: EPA is pleased that the manufacturers agree that the technologies identified in the RSD are those that they will use to seek NO<sub>x</sub> reductions. The locomotive emission standards are performance standards, not design standards, and it is the manufacturer's option to select its compliance strategies for each locomotive model and to demonstrate compliance with the emission standards. As is presented in the RSD, EPA projects a range of effectiveness for the these controls strategies, and lists others as well. If the manufacturers use all of these strategies for Tier 1, they may well be able to certify locomotives to emissions levels below the Tier 1 standards, and generate credits that could be used towards compliance with the Tier 2 standards.

Comment: EMA commented that manufacturers will need to develop and test new and unknown emission control technologies to meet the Tier 2 standards, since they will be using what EPA identified for Tier 2 to meet Tier 1 standards.

Response: At this point such an assertion is speculative. Manufacturers are at this point only in

the earliest stages of developing Tier 1 designs and have provided EPA no data which supports this assertion. Based on success in truck engines, EPA believes that the technologies expected to be available for use in 2005 will be capable of meeting Tier 2 levels.

Comment: EMA commented that the technologies EPA has identified for Tier 2 all have negative aspects, which raise questions about their viability.

Response: Controlling emissions while maintaining desirable characteristics of performance often involves the need to identify and balance trade-offs in areas such as emissions and fuel consumption. However, EPA believes that the lead time and emission control technology available provide the tools necessary for the manufacturers to meet the standards with minimal and perhaps only a short-term impact on these characteristics. In addition, manufacturers could use credits generated from certification of locomotives to levels below Tier 0 and Tier 1 towards compliance with the Tier 2 standards for at least some engine families.

Comment: EMA commented that EPA hasn't provided rational support for available use and effective application of technologies on locomotive engines for Tier 2..

Response: The Tier 2 standards are technology forcing for diesel locomotives. Manufacturers will have to do substantial work to meet these standards. Nonetheless, as presented in the RSD, EPA believes that with seven years leadtime and the battery of emission control technologies available, manufacturers can meet the Tier 2 standards. Such technologies have been successful in providing emission reductions of at least the same magnitude on other large diesel engines.

Comment: EMA commented that the draft South Coast agreement doesn't justify the level of the Tier 2 standards.

Response: EPA established the Tier 2 emissions standards based on the Agency's determination of the greatest achievable emissions reductions achievable through the use of technology EPA determined will be available for use in 2005, taking cost and other factors into consideration. EPA agrees that the South Coast agreement would not justify the level of the Tier 2 standards, and has not relied in any way on the South Coast agreement as a basis for the Tier 2 standards.

Comment: GM commented that it is counterproductive to increase the stringency of PM, CO, and HC standards from Tier 1 to Tier 2, because of the tradeoff with NOx reductions. GM stated that EPA should not even regulate HC and CO from locomotives.

Response: The HC, CO, and PM standards for Tier 1 are essentially caps and do not provide significant reductions from uncontrolled levels. For some control strategies such as simple injection timing retard there are often NOx vs HC and NOx vs PM trade-offs. This is indeed part of the engineering job a manufacturer must take on if these strategies are used. Any consideration of not regulating HC and CO emissions from locomotives is questionable from an air quality perspective. This is especially true for HC, since the NOx vs HC tradeoff which accompanies some technologies could lead to increases in HC they are not controlled.

Comment: Except for rate shaping, GM plans to explore all technologies EPA identifies for Tier 2, plus EGR.

Response: EPA is pleased that GM is considering the technologies identified in the RSD to achieve the required reductions for Tier 2. The locomotive emission standards are performance standards, not design standards, and it is the manufacturer's option to select its compliance

strategies for each locomotive model and to demonstrate compliance with the emission standards. As is presented in the RSD, EPA thinks that rate shaping has emission reduction potential as well and agrees that EGR is an option, although the level of the Tier 2 standards is not based on the availability of EGR for use in 2005.

Comment: GM commented that additional aftercooling (beyond that discussed for Tier 1) -- will result in increased fuel consumption. Presumably this is because a larger heat exchanger will be required. Heat exchanger volume is an issue (because of radiator size, which is limited by packaging constraints).

Response: EPA agrees that a larger heat exchanger with more cooling surface area will provide greater temperature reductions for inlet air. However, this early in the process it is unclear whether the concern posited by GM will really be an issue. Indeed, there are other means to increase cooling effectiveness without increasing the size of the heat exchanger, and EPA believes manufacturers will consider these options as well.

Comment: EMA said that the proposed PM reductions are not justified given the minor contribution of locomotives to ambient PM levels, and adverse impact of PM controls on NO<sub>x</sub> emissions. EMA also said that EPA should set Tier 2 PM standards at 0.30g/bhp-hr for line haul freight, and 0.40g/bhp-hr for switchers, to achieve greatest degree of reduction in NO<sub>x</sub> emissions.

Response: Although locomotive PM emissions are a very small part of the PM-10 inventory, they are much larger part of the PM-2.5 inventory. This is particularly important given the new National Ambient Air Quality Standard for PM 2.5 finalized in July 1997. It is also important to note that EPA considered the NO<sub>x</sub>/PM tradeoff in determining feasibility; if PM standards were relaxed, the NO<sub>x</sub> standards would need to be tightened. EPA's approach balances the NO<sub>x</sub>/PM tradeoff by achieving significant NO<sub>x</sub> reductions in addition to meaningful PM-2.5 reductions. States and environmental groups submitted comments supporting the PM standards.

Comment: GETS stated that differences between locomotive and truck engines make reductions to Tier 2 levels improbable (slower engine speed, twice the power density levels leads to higher temperature, and size and weight constraints limit aftertreatment feasibility). GETS went on to state that one primary concern is that EPA expects transferability of truck technology to locomotive engines. EPA cannot assume such transferability, and the same level of effectiveness, due to different operating conditions and the different nature of locomotive and truck engines.

Response: As was stated in the response to another comment by GETS, EPA considered such factors as engine speed, power density and the transferability of technology between truck and locomotive engines in the deliberations which led to the Tier 2 NO<sub>x</sub> standard. Consideration of these factors is reflected in the lower percent reduction required of locomotive engines than that required of truck engines (62% reduction from uncontrolled levels for locomotives versus an 81% reduction in 2004 from the 1988 standard for heavy-duty engines). With respect to the comment on size and weight of aftertreatment technologies, EPA's conclusion on the feasibility of Tier 2 standards was based on achievable control of engine out emissions. Discussion of aftertreatment technologies was simply for the purpose of presenting technologies that have some potential for reducing locomotive emissions. EPA did not rely on the expected availability of aftertreatment for use in 2005 as a basis for setting the Tier 2 standards. If EPA had determined that these technologies would be available for use in 2005, the Tier 2 standards

would reflect emission reductions greater than those required.

Locomotive engines are fundamentally similar to other diesel engines. They use the same fuel and combustion cycle, and have similar general emission characteristics relative to non-diesel engines (i.e., high NO<sub>x</sub> and PM, low HC and CO). It is true that locomotives operate at somewhat lower engine speeds, and that the lower engine speed can cause higher NO<sub>x</sub> emissions. However, this higher level of NO<sub>x</sub> emissions applies to both engines without emissions control devices, and to engines using the types of controls described in the RSD. In developing the standards, EPA started with the level of NO<sub>x</sub> emissions from uncontrolled locomotive engines, and applied an appropriate percent reduction based on the use of technologies described in the RSD. As described in the RSD, the percent reduction expected from these technologies should be generally similar regardless of engine speed, although EPA accounted for other factors unique to locomotives and locomotive engines, such as space constraints, differences in duty cycles compared to on-highway diesel engines (i.e., predominance of steady-state operation compared to transient operation, and differences in weighting of components of the cycle to reflect differences in operation), and differences in reliability requirements for locomotive operation compared to truck operation. EPA therefore accounted for the higher magnitude of NO<sub>x</sub> emissions due to lower engine speed in setting the standards.

In addition, the data provided by Southwest Research Institute in support of the correction factors, which can be found in the docket, shows a very similar proportional dependence of NO<sub>x</sub> emissions on temperature and humidity in on-highway diesel engines and locomotives. In general, the technologies described in the RSD to control NO<sub>x</sub> emissions, such as timing retard and charge air cooling, will decrease peak combustion temperatures in both on-highway diesel engines and in locomotive engines. The percent reduction achieved for both locomotives and on-highway diesel engines is based on the level of combustion temperature decrease expected. For locomotives, EPA's standards reflect the degree to which factors such as space constraints may limit the ability of manufacturers to achieve reductions in peak combustion temperature. Therefore, it is reasonable to expect that manufacturers will achieve the level of NO<sub>x</sub> emissions reductions called for by the locomotive standards using technologies that are currently in use, or will be applied, on on-highway diesel engines.

Comment: Comments questioning the feasibility of liquefied natural gas (LNG) were provided by GETS. GETS stated that work that they have performed with high pressure direct injection of natural gas resulted in power output and fuel efficiency similar to diesel fuel, but with higher NO<sub>x</sub> than reported for spark ignited (SI) low pressure natural gas engines. Also, SI LNG engines have lower horsepower than diesel engines, which leads to more emissions because more locomotives are required to do the same amount of work. High pressure direct injection LNG engines will not be able to achieve Tier 2 level reductions by 2005, based on GETS's work. EPA's record does not support finding that this technology will be available for meeting Tier 2 standards. Also, need to develop new approach to combustion process to meet requirements of full horsepower operation on diesel and LNG (i.e., dual fueled). A late cycle, high pressure gas injection system using diesel pilot fuel may be possible, but will not get emissions reductions. Also could see higher HC emissions with methane gas.

Response: As was the case with aftertreatment technologies, EPA's discussion of LNG was provided for the purpose of presenting a technology that has some potential for reducing emissions. EPA did not rely on the availability of LNG technology for use in locomotives by 2005 as a basis for setting the Tier 2 standards. The linkage between relatively high power

density and relatively high NO<sub>x</sub> is recognized, as is that between relatively low power density and relatively low NO<sub>x</sub>. Also recognized is the relative undesirability of the use in line haul operations of a locomotive with a low power density engine. Through use of the technologies described in the RSD, manufacturers should be able to meet the Tier 2 standards without having to shift to LNG technology.

### General

Comment: GE commented that air to air cooling is ineffective on locomotives, because high temperature operation in long tunnels requires water cooling for engine operation. NO<sub>x</sub> reduction through approaches requiring additional cooling to achieve reductions of manifold air inlet temperature raises problems because locomotives have increased in power and pulling capacity, which makes it harder to “package” engine and related systems into locomotive.

Response: As discussed in the RSD, air-to air aftercooling is just one of several approaches EPA expects manufacturers will consider in optimizing their charge air cooling strategies. There are clearly designs and applications where an air-to-air aftercooler will provide be the optimum charge air cooling strategy. In other situations an air-to water approach may be more practical. This approach is being used to a lesser degree on some recently manufactured locomotives today. EPA recognizes that there are practical packaging constraints on how new or redesigned emission hardware can be effectively incorporated into locomotives. Such constraints exist in other applications such as heavy-duty diesel trucks, but ultimately have not been an obstacle to the introduction of these technologies.

Comment: GE urged EPA to accommodate design constraints of locomotives, not just transfer regulatory requirements for trucks to locomotives without careful consideration of unique factors.

Response: EPA understands the differences between locomotive and truck diesel engine design and application. As discussed in the RSD, in some situations the advanced technology used on trucks may not be as effective on locomotives, in others it will meet or exceed the effectiveness on trucks. Nonetheless, it is very important to note that locomotives have never been subject to emission controls before this rule, and all previous experience with diesels and in fact the variations in the uncontrolled levels of new engines indicates reductions are relatively easily within reach. Furthermore, the notch design of locomotive throttles and the steady-state nature of locomotive operation provides inherent advantages in the application and effectiveness of various control strategies relative to the variable nature of truck throttles and transient nature of truck operation. It is generally much easier to control emissions under steady-state than transient conditions, because the absence of transient operation creates predictable combustion conditions which helps to allow easier emissions optimization of combustion events

Comment: GE commented that the use of ram air to aid in charge air cooling is not available for locomotives.

Response: EPA concurs that direct ram air may not be available on all locomotives in-use, depending on locomotive design, train configuration (single/multiple locomotives) and locomotive orientation on the train (forward/backward). As discussed in the RSD however, this does not necessarily preclude the use of ambient air as a cooling mechanism. Ambient air can be directed to the heat exchanger through vents, ducts and fans which can be designed to provide cooling air in the same way as if the heat exchanger received air directly in the front of a forward



facing locomotive. This presents unique design issues for locomotives, but since some form of charge air cooling is being used on locomotives today, in the absence of any emissions standards, it is reasonable to conclude that there is room for the development, enhancement, and application of this technology within the lead time available.

Comment: GETS provided comments questioning the feasibility of EGR, even though EPA doesn't contemplate EGR will be needed to meet standards. They expressed concerns regarding durability and charge density, and cost, life, and maintenance of component parts. They commented that the amount of recirculation required will depend on effectiveness of other techniques used, and will affect fuel economy, durability, maintenance requirements, and life cycle costs. Because of modal shift that could result from higher costs, EGR could ultimately result in more NOx emissions overall

Response: EPA does not disagree with GETS comments regarding EGR. Such concerns would have to be considered in development of an EGR strategy. Nonetheless, given the flexibility available with electronic controls and the steady state test, EPA believes EGR may potentially be used, and that if a manufacturer can use EGR, such a strategy could have cost advantages relative to other options, as well as creating the potential to eliminate the need to consider other options. Even so, the Tier 2 standards were not established based on the availability of EGR for use on locomotives in 2005. Moreover, EPA does not believe the costs of compliance for this rule will lead to a modal shift. The costs of compliance are only a small fraction of either initial purchase or operating costs. Further, trucks will be implementing a more stringent NOx standard in the same time frame.

Comment: EMA commented that EPA should establish nonconformance penalties (NCPs) for Tier 2 to ensure manufacturers can participate in market.

Response: EPA may consider establishing NCPs in the future. Under 40 CFR 86.1103-87, there are three criteria which must be met: 1) there must be a new or revised emission standard, 2) it must require substantial work to meet, and 3) it must be likely that a technological laggard will exist. At this time EPA cannot make the finding that a laggard will exist. If appropriate, EPA will consider establishing NCPs in the future.

Comment: EMA commented that EPA hasn't provided data on which to base its projections of technology, and has acknowledged that additional invention, research, and development will be needed.

Response: EPA is projecting the availability of the technology for the Tier 2 standards based on the current availability or development of similar technology for large truck diesel engines, and the expectation that such technologies can be applied to locomotives. The successful use of such technology is well documented in the public record. While it clearly will require additional work, extrapolation of the successful application of these technologies to locomotives is a reasonable exercise of engineering judgment, based on the similarity of locomotive and truck diesel engine technology. Twenty years of experience in the transportation sector consistently shows that emission control technology for similar types of engines can be and is usually successfully extrapolated. One need only examine the evolution of passenger car, light truck, and heavy-duty truck/bus emission controls as evidence of this practice. Thus, an EPA assertion that current and future diesel technologies can and will be applied to locomotive diesels is not only reasonable but is a common industry practice. In the RSD EPA has quantified the effectiveness of these technologies in reducing the regulated pollutants for Tiers 0, 1, and 2.

Comment: GM provided comments regarding reducing lubricating oil consumption. About half of PM mass is from lubricating oil. GM has major concerns with reducing consumption. This leads to a potential increase in piston ring and cylinder bore wear because thinner oil film. Potential implications include shorter overhaul interval and higher costs to railroads. Also, probable increase in piston, ring, and liner scuffing for the same reason. Evaluation of increased wear and scuffing would be a major part of 12-18 month reliability testing. Also, engines may require scheduled engine oil changes, which are not currently required on GM engines. Oil chemistry advances EPA suggests may be needed may be costly (synthetic oil is more expensive than petroleum oils).

Response: Improved oil control is one way to reduce the mass of PM emissions, and this strategy has been used successfully on many diesel truck engines. Assertions of potential problems with piston ring and cylinder wear are speculative. In fact, diesel fuel itself provides significant lubricity, and this could be enhanced by a fuel additive if necessary. In addition, if the manufacturer has a concern, it can apply one or more of the other PM strategies presented in the RSD. While EPA recognizes there are differences between locomotive and truck diesels, it is worth noting that the improvement in oil control resulted in no problems for diesel trucks, and in fact their durability improved over this period.

Comment: With regard to injection rate shaping, GM commented that EPA failed to consider possible increases in PM, CO, and HC. Also, the benefits, tradeoffs, and specific degree of reductions that can be achieved are not clear. GM also raised specific concerns regarding use of split injection (could use multiple injectors per cylinder instead, but adds cost and mechanical complexity).

Response: Contrary to GM's perspective, EPA believes that injection rate shaping provides the potential for improvements in NO<sub>x</sub> levels with a modest benefit in HC, CO, and PM. This is especially the case since locomotive operation is largely steady state, and electronic control of the injection system provide great potential for optimization. The actual emission control strategy used by GM is at their discretion, however, since the locomotive emission standards are performance, not design standards. Rate shaping technology could be available in 2005, and its benefits are discussed in the RSD.

Comment: GM commented that the use of EGR involves effort to work out benefits and tradeoffs on a notch-by-notch basis, effort to develop a design recirculation control algorithm, and work to overcome mechanical and combustion limitations. This effort will require that cost, fuel economy, and maintenance requirements to be considered.

Response: EPA agrees. If EGR is to be used, these considerations will need to be worked out. The level of effort involved will depend on the degree to which the manufacturer relies on EGR and uses electronics to optimize its control.

Comment: EMA said HC and CO emissions from locomotives are insignificant portions of the total inventory, and regulation of HC and CO from locomotives is not crucial to air quality. They also said that the proposed standards are potential design constraints in attempting to meet NO<sub>x</sub> standards, and just add complexity and cost. EMA suggested a 2.0g/bhp-hr cap for HC and 10.0g/bhp-hr cap for CO for all 3 tiers.

Response: EPA's HC and CO emission standards will not typically require any emission control

technology not already required for PM control. Any modifications of PM controls necessary to comply with the HC or CO standards should be minor adjustments, and not add significantly to the cost of compliance. Thus, even small emission reductions are cost-effective.

Comment: GM stated that emission benefits from using electronic injection control (EIC) for trucks appear to come largely from management of transients, which is not available on locomotives because of their primarily steady-state operation, and that testing shows electronic system to be no better than mechanical system in terms of emissions and performance. They stated that, due to steady-state operation, EIC can't achieve the same levels of emissions and fuel economy benefits with locomotives as from trucks. GM did agree that there would be greater flexibility in injection timing retard for EIC compared to mechanical systems (*i.e.*, larger degree of retard might be possible at steady-state, with less in transient modes), to control NO<sub>x</sub> but retain acceptable smoke levels. They stated that the challenges are controlling PM effects and durability testing. They suggested that EIC for locomotives has been major challenge for injector manufacturers, with cavitation erosion still partly unresolved.

Response: EIC has been in use in locomotives for years; so durability challenges will be minor. EPA is not expecting the same percent emission reductions from EIC for locomotives as was seen with trucks, because of the steady-state nature of locomotive operation, but does expect significant emission reductions. EPA recognizes that much of this reduction could be obtained with more sophisticated mechanical controls, but believes that electronic controls will be more practical. NOTE: additional information was provided in the form of confidential business information.

Comment: GM raised many questions about the viability of some technologies in the draft RSD (SCR, Oxidation Catalysts, particulate traps, water injection and turbocompounding).

Response: EPA agrees that there are significant obstacles in the way of using these technologies for locomotives. However, EPA did not base the Tier 2 standards on the expected availability of these technologies; rather, EPA presented its analysis of these technologies as having some potential for reducing locomotive emissions. EPA expects that if these technologies were actually available, then emission reductions beyond the level of the Tier 2 standards would be feasible by 2005.

Comment: GETS stated that the slower speed of locomotive engines as compared to truck engines provides for longer residence time, and as a result higher NO<sub>x</sub> formation with similar technology.

Response: Factors such as those mentioned in the comment were considered by EPA in developing the standards for locomotives. Tier 0, Tier 1 and Tier 2 NO<sub>x</sub> standards for locomotives represent 34%, 49% and 62% reductions respectively from uncontrolled levels. Present standards for heavy-duty engines used in trucks require 63% reduction from 1988 standard level, which had required significant reduction from uncontrolled levels. The 2004 standard anticipated for heavy-duty engines requires 81% reduction from 1988 standard.

Comment: Combustion chamber modifications that GM said that it expects to employ would consist of changes in compression ratio to optimize operation with retarded timing and increased aftercooling, possibly changes in crevice volume which would require rerouting of coolant passages to maintain required cylinder liner bore wall temperatures for ring lubrication. GM believes that adoption of "squish lip" piston design as EPA suggests would require major design

program, with no assurance of success. Generally, combustion chamber modifications will be limited by overriding need for durability and reliability.

Response: Changes to engine design which EPA identified are those that have proven to be beneficial in other applications. Reentrant chamber, “squish lip”, designs have proven to be beneficial in engines used in trucks.

Comment: GETS said that they do not see much advantage in combustion chamber redesign to reduce NO<sub>x</sub>, and only minor changes to reduce PM and smoke. They may need to use rate shaping to control smoke, but does not expect the injection process to have much effect in lowering NO<sub>x</sub> emissions at this time.

Response: Technologies which provide substantial reductions in NO<sub>x</sub> (*e.g.* injection timing retard and charge air cooling) tend to increase PM and smoke emissions. Since GETS sees combustion chamber redesign and rate shaping as technologies most suitable for the control of PM and smoke rather than for the control of NO<sub>x</sub>, it is likely that combustion chamber redesign and/or rate shaping could be used to control increases in PM and smoke resulting from other technologies used to control NO<sub>x</sub> directly.

APPENDIX C -- Graph from Railroad Comments on Remanufacture Intervals

