United States
Environmental Protection
Agency

Air and Radiation

EPA420-R-05-004
November 2005

Emission Standards and Test Procedures for Aircraft and Aircraft Engines

Summary and Analysis of Comments

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Assessment and Standards Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

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Introduction

On September 30, 2003, we published a Notice of Proposed Rulemaking (NPRM) for proposed amendments to existing emission standards for oxides of nitrogen (NO_x) for newly certified commercial aircraft gas turbine engines with rated thrust greater than 26.7 kilonewtons (kN). These proposed standards are equivalent to the existing (effective in 2004) NO_x standards of the United Nations International Civil Aviation Organization (ICAO), and thereby bring the United States emission standards into alignment with the internationally adopted standards. The NPRM also proposed to amend the test procedures for gaseous exhaust emissions to correspond to recent amendments to the ICAO test procedures for these emissions. In addition, we also took comment on applying the proposed NO_x standards to newly manufactured engines of already certified models (a production cut-off).

We held a public hearing on the NPRM in Washington, D.C. on November 13, 2003. At that hearing, oral comments on the NPRM were received and recorded. A written comment period remained open until December 15, 2003. A complete list of organizations and individuals that provided comments on the NPRM is contained in the following table. Abbreviations for the organization names are also included.

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

List of Commenters with Acronyms and EDOCKET Reference Numbers

Commenter	Acronym
Aerospace Industries Association of America, Inc. (OAR-2002-0030-0113)	AIA
Air Transport Association of America, Inc. (OAR-2002-0030-0100)	ATA
Air Transport Association of America, Inc. (OAR-2002-0030-0109)	ATA
Airports Council International - North America; and the American Assoc. of Airport Executives (OAR-2002-0030-0119)	ACI-NA&AAAE
Alliance of Residents Concerning O'Hare (OAR-2002-0030-0099)	AReCO
Anonymous (OAR-2002-0030-0024)	--
Anonymous (OAR-2002-0030-0065)	--
Anonymous (OAR-2002-0030-0066)	--
Anonymous (OAR-2002-0030-0069)	--
Anonymous (OAR-2002-0030-0103)	--
Bluewater Network (OAR-2002-0030-0096)	Bluewater Network
California Air Resources Board (OAR-2002-0030-0123)	CARB
Center for Clean Air Policy (OAR-2002-0030-0098)	CCAP
Center for Clean Air Policy (OAR-2002-0030-0122)	CCAP
Clark, Bonnie (OAR-2002-0030-0068)	--
Delta Air Lines, Inc. (OAR-2002-0030-0114)	Delta
Environmental Defense (OAR-2002-0030-0097)	ED
Environmental Defense (OAR-2002-0030-0111)	ED
Geiser, Kathleen (OAR-2002-0030-0067)	--
Georgia Department of Natural Resources (OAR-2002-0030-0112)	GA DNR
Golden Gate University School of Law (on behalf of Bluewater Network) (OAR-2002-0030-0106)	Bluewater Network
Golden Gate University School of Law (on behalf of Bluewater Network) (OAR-2002-0030-0107) -- Attachment to above comment	Bluewater Network
New York State Dept. of Environmental Conservation (OAR-2002-0030-0115)	NYSDEC
Pederson, Holger (OAR-2002-0030-0062)	--
Sachau, B. (OAR-2002-0030-0063)	--
Sachau, B. (OAR-2002-0030-0094)	--
South Coast Air Quality Mgt. District (OAR-2002-0030-0104)	SCAQMD
STAPPA/ALAPCO (OAR-2002-0030-0095)	STAPPA/ALAPCO
STAPPA/ALAPCO (OAR-2002-0030-0116)	STAPPA/ALAPCO
Starr, Seti (OAR-2002-0030-0064)	--
State of New Jersey Dept. of Environmental Protection (OAR-2002-0030-0101)	NJDEP
Texas Commission on Environmental Quality (OAR-2002-0030-0120)	TCEQ

Public Hearing Testimony (OAR-2002-0030-0121) (November 13, 2003, Washington, D.C.)

Air Transport Association of America, Inc.
Alliance of Residents Concerning O'Hare
Bluewater Network
Center for Clean Air Policy
Environmental Defense
STAPPA/ALAPCO

1. Aircraft Engine NO_x Standards

What We Proposed:

The comments in this section correspond to Sections II and IV of the NPRM, and therefore are targeted at issues dealing with the proposed aircraft engine NO_x standards. A summary of the comments received, as well as our responses to those comments are located below. For the full text of comments summarized here, please refer to the public record for this rulemaking.

1.1 Engine NO_x Standard Levels and Stringency

What Commenters Said:

We received a number of comments from state and local governments and environmental groups stating that the proposed NO_x standards should be technology-forcing standards (a performance level that is beyond what sources are currently achieving). Emission standards should "point the way" and decrease emissions comparable to other sources. The California Air Resources Board (CARB) urged EPA to finalize the proposed rule, but they suggested at the same time that "it does not represent an advancement in emission control technology." Commenters noted that the proposed standards merely establish consistency with international and U.S. standards. They stated that the standards are not technology forcing since 94 percent of all engine models currently in production already meet the proposed standards (85 percent did in 1999 when the ICAO adopted the standards). Furthermore, STAPPA/ALAPCO expressed that the combined effect of the proposed standards with the previously promulgated NO_x standards (which also were not technology forcing) will only be about a 40 to 50 percent reduction in NO_x emissions from new engine models relative to uncontrolled levels of emissions. In comparison, all other sources are "controlled to well over 50 percent and some as high as 95 percent." The New York State Department of Environmental Conservation (NYSDEC) stated that EPA has already promulgated aggressive NO_x regulations for many mobile sources (resulting in over 90 percent NO_x reductions in respective categories), including Tier 2 light-duty vehicle standards, 2007 heavy-duty diesel standards, and recent heavy-duty nonroad standards. In addition, the Alliance of Residents Concerning O'Hare (AReCO) urged us to set aircraft NO_x standards at a level in which "90% of existing fleet engines could not meet it."

State and local governments and environmental groups expressed that since the proposed standards are not technology-forcing and most engines already meet the standards, aircraft engine NO_x will increase. Furthermore, aircraft emissions will increase (without technology-forcing standards) because the standards are rate-based, and the projected growth in aircraft operations (despite the temporary setback in activity following the tragic events of September 11, 2001) outpaces the rate of improvement in emissions-intensity of the standards. The proposed standards apply only to newly designed or certified engines, and since aircraft operate in the fleet for a long time (long life/slow turnover of fleet), "the new standards will have a limited impact on overall emission levels for quite some time" (weak standards will have a long

lasting impact on air quality since aircraft engines typically last 30 years). Also, commenters expressed concern the many states are facing air quality challenges with implementation of the new 8-hour ozone standard and fine particulate matter ($PM_{2.5}$) national ambient air quality standards (NAAQS). Decreases in ozone and $PM_{2.5}$ precursors, including NO_x, require control of emissions from all sectors, in addition to controls already implemented for 1-hour ozone NAAQS. For nonattainment areas, aircraft emissions are problematic, and the proposed standards will not reduce aircraft emissions or address aircraft NO_x pollution. Furthermore, emission reductions from other sources are hard to find. Increasingly stringent standards for other sources are reducing their pollution, but aircraft NO_x continues to increase in lieu of constraining standards. Commenters urged EPA to not miss an opportunity to establish strong standards for aircraft when there is a great need for reductions. The Environmental Defense (ED) suggested that EPA conduct a thorough technology and control strategy review of aircraft engines prior to establishing standards for these major sources of pollution. The resulting standards from such a review should lead to downward trend in aircraft emissions.

Bluewater Network expressed that EPA has the authority to adopt technology-forcing standards according to section 231 of the Clean Air Act (CAA), because section 231 states that EPA is required to issue standards with sufficient lead time "to permit the development and application of the requisite technology." In addition, states and local governments and environmental groups indicated that EPA's failure to propose technology forcing standards is unfortunate since only EPA (and not states) can effectively regulate aircraft emissions based on section 233 of the CAA. States are dependent on EPA and the Federal Aviation Administration (FAA) to control growing aircraft emissions. The Texas Commission on Environmental Quality (TCEQ) expressed that the fraction of emissions from federal sources has significantly increased as states adopt control strategies on other sources, and thus, the challenge that states encounter in creating 8-hour ozone implementation plans substantially increases. ED indicated that the meager proposed standard will only make it more difficult for states to develop clean air plans. The limited state authority highlights the necessity of rigorous federal standards.

In addition, Bluewater Network suggested that technology-forcing standards are long overdue. In 1997, when EPA last revised aircraft emission standards, "EPA adopted standards that most or all of the engines were already meeting. Compounding the problem, EPA's adoption of the standards came after ten years of inaction." Now six years later, EPA is again proposing to adopt standards "that most engines already meet." With many Americans forced to breathe unhealthy air, "it is time EPA changed its course to adopt technology-forcing standards that Congress authorized in section 231 of the Act."

Engine and airframe manufacturers and air carriers supported the proposed standards and opposed the concept of technology-forcing standards. The Air Transport Association of America, Inc. (ATA) indicated that the proposed rulemaking would codify aircraft emission standards determined to be technologically feasible. In addition, ATA expressed that technology-forcing standards would be contrary to the CAA. Aircraft engine emission standards adopted according section 231 of the CAA must be based on what is technologically feasible, and the standards cannot be amended if the change would significantly increase noise or

adversely affect safety. ATA suggested that a technology-forcing NO_x standard could adversely affect noise and safety. In addition, they indicated that section 231 of the Act is different from other sections of the CAA that call for technology-forcing standards. ATA expressed that section 231 requires that standards already be technologically feasible and not compromise noise and safety.

ATA indicated that technology-forcing standards would be based on the promise of developing technology, and such technology would not have been through rigorous certification testing that ensures safe flight. Manufacturers may have to compromise performance factors that implicate safety to meet technology-forcing standards. A technology review would not avert this risk since, with or without such a review, the technology will ultimately have to be certified to safety standards of the FAA. Any technology that does not meet those standards with sufficient margin may eventually come across regulatory roadblocks.

Also, ATA suggested that due to high development costs and the inherent uncertainty of technological development, there is not a guarantee that even promising technology can become a certified product. Technology-forcing standards would create market distortions in manufacturing, which would lead to a diminished choice of products being available for airlines to serve a range of required missions and raising the cost of products that are available.

In addition, ATA expressed that whether a "standard is technologically feasible depends not just on whether it can be achieved in a laboratory setting, but whether it can be achieved on a range of actual aircraft engine and airframe combinations that are certified as airworthy, safe, and fully operable under flight conditions. Moreover, such demonstrated technology must be available for application over a sufficient range of newly certificated aircraft, not just on a few airframe/engine combinations."

Aerospace Industries Association of America, Inc. (AIA) stated that "[m]arket forces and reasonable standards, based on best available certification technology, will encourage the development and introduction of this technology into service." Attempting to change this process by introducing standards that require unproven technologies will have an adverse environmental impact. "Introduction of new technology will be delayed until it can become technologically feasible, certifiable and cost effective. Investments in technology development may actually decrease because of projected small markets and increased failure risks, further delaying its introduction." Also, AIA suggested that the current (or ICAO) process has been shown to work, and it will continue to encourage the development of new technology in the future.

Our Response:

We refer to sections 231(a)(2)(B) and (b) of the CAA. Section 231(b) requires that any emission standards "take effect after such period as the Administrator finds necessary (after consultation with the Secretary of Transportation) to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance during such

period." 42 U.S.C. §7571(b). Section 231(a)(2)(B) provides that the Administrator shall consult with the Administrator of the FAA on standards, and "shall not change the aircraft engine emission standards if such change would significantly increase noise and adversely affect safety." 42 U.S.C. §7571(a)(2)(B). Future aircraft emission standards will involve appropriate consultations between EPA and the FAA in applying these provisions of the CAA.

EPA also needs to have a technical basis for expecting the standards will be achievable in a specific period of time. While the statutory language of section 231 is not identical to other provisions in title II of the CAA that direct EPA to establish technology-based standards for various types of engines, EPA interprets its authority under section 231 to be somewhat similar to those provisions that require us to identify a reasonable balance of specified emissions reduction, cost, safety, noise, and other factors. See, e.g., Husqvarna AB v. EPA, 254 F.3d 195 (D.C. Cir. 2001) (upholding EPA's promulgation of technology-based standards for small non-road engines under section 213(a)(3) of the CAA). However, we are not compelled under section 231 to obtain the "greatest degree of emission reduction achievable" as per sections 213 and 202 of the CAA, and so EPA does not interpret the Act as requiring the agency to give subordinate status to factors such as cost and safety and noise in determining what standards are reasonable for aircraft engines. Rather, EPA has greater flexibility under section 231 in determining what standard is most reasonable for aircraft engines, and is not required to achieve a "technology-forcing" result. The fact that most engines already meet standards would not in itself mean that the standard is inappropriate, provided the agency has a reasonable basis after considering all the relevant factors for setting the standard (with an appropriate period of lead time for that standard) at a level that results in no actual emissions reduction from the baseline.

By the same token, EPA does not agree that a technology-forcing standard would be precluded by section 231, in light of section 231(b)'s forward-looking language. Nor would EPA have to demonstrate that a technology is currently available universally or over a broad range of aircraft in order to base a standard on the emissions performance of such technology – the agency is not limited in identifying what is "technologically feasible" as what is already technologically achieved. However, EPA would, after consultation with the Secretary of Transportation, need to provide manufacturers sufficient lead time to develop and implement requisite technology. As section 231 conveys, there is an added emphasis on the consideration of safety (see, e.g., sections 231(a)(2)(B)(ii) ("The Administrator shall not change the aircraft engine emission standards if such change would [. . .] adversely affect safety") and 231(c) ("Any regulations in effect under this section [. . .] shall not apply if disapproved by the President, after notice and opportunity for public hearing, on the basis of a finding by the Secretary of Transportation that any such regulation would create a hazard to aircraft safety"). Therefore, it is reasonable for EPA to give greater weight to considerations of safety in this context than it might in balancing emissions reduction, cost, and energy factors under other title II provisions.

In regard to the comments that technology-forcing standards would create market distortions in manufacturing (and lead to cost increases of available products) and potentially decrease investments in technology development, we are not in a position to respond since the commenters did not submit data or information to support these comments.

In addition, EPA has authority to under section 231(a)(2)(A) to revise emission standards from "time to time." Since we have already gone past the implementation date of standards adopted at the fourth meeting of ICAO's Committee on Aviation Environmental Protection (CAEP/4) – implementation date of December 31, 2003 -- and that are equivalent to the proposed standards, there is not sufficient lead time to require more stringent emission standards in the very near term. EPA intends to address more stringent emission standards requiring more lead time in a future rulemaking (see later discussion on future standards in section 1.5). Thus, EPA will promulgate the proposed standards in this final rulemaking. CAEP/6, which occurred in February 2004, adopted more stringent international consensus NO_x emission standards for aircraft engines (implementation date of after December 31, 2007), and earlier this year the ICAO Council approved these standards.[1,2] Such standards will be a central consideration in a future EPA regulation of aircraft engine emissions. We believe this ongoing phased approach is the most appropriate means to address emissions from aircraft engines.

Moreover, this final rule to promulgate aircraft engine NO_x standards equivalent to CAEP/4 standards is an interim measure that is in accordance with U.S. obligations under ICAO. By issuing standards that meet or exceed the minimum stringency levels of ICAO CAEP/4 standards, we satisfy these obligations (see section 1.3, *Alignment with ICAO Standards*, for further discussion of this issue). As indicated above, the implementation date, December 31, 2003, has already occurred for the CAEP/4 standards, and we need to promulgate the proposed standards soon to meet our obligations for the CAEP/4 standards. In addition, we would not be able to quickly adopt a more stringent standard. However, as described earlier, we intend to consider further stringency in a future rulemaking. In addition, as discussed later in our response in section 1.5 (*Future Standards*), we have not yet assessed the costs (and emission benefits) of more stringent standards, but we anticipate doing so in the future for such standards.

EPA is aware that many states face air quality challenges in light of the new ozone and $PM_{2.5}$ NAAQS, and since section 233 of the CAA vests authority only in EPA to set aircraft emission standards, we understand their perspective regarding the importance of setting more stringent NO_x standards in the future. For these future standards, we expect to adopt standards developed through the CAEP process in ICAO. Further, federal agencies plan on working through the environmental Integrated Product Team for the Next Generation Air Transportation System (NGATS), to conduct a review of technology for aircraft engines and the resulting trend in aircraft emissions as well as interrelationships with noise (e.g., standards effect on projected aircraft emissions growth and expected effects on noise).

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[1]The CAEP/6 NO_x standards generally represent about a 12 percent increase in stringency from the standards promulgated in this final rule.

[2]ICAO News Release, "ICAO Council Adopts New Standards for Aircraft Emissions," PIO 03/05, March 2, 2005. Copies of this document can be obtained at the ICAO website located at www.icao.int.

1.2 Implementation Timeline

What Commenters Said:

States and local governments and environmental groups expressed that since ICAO adopted equivalent standards in 1999, engine manufacturers have been designing engines to meet the proposed standards for four years. There was plenty of time to meet the standards. Adopting these standards at this late date will not impact engine designs, and thus, expected aircraft emissions. If EPA had acted sooner, the Agency could have enacted standards by January 2004 that provided critically needed emissions reductions. Yet, because of the inexplicable delay, EPA is accurate to state that "at this time, there is not sufficient lead time to require more stringent emission standards ... by January 2004."

ATA indicated that while they support the proposed rule to adopt NO_x standards equivalent to ICAO standards, they believe it would have been better if it had occurred sooner. Given market forces, upon the adoption of the standards by ICAO in 1999, manufacturers began in earnest to comply with the standard, even though the standards were not implemented until January 1, 2004. To show a commitment to ICAO standards and more orderly progress for U.S. standards, EPA should have taken steps to adopt the ICAO standards immediately.

Our Response:

We agree with the view expressed by commenters that it would have been preferable to adopt standards sooner. However, as discussed above there is currently not enough lead time to mandate more stringent standards requiring near-term compliance, and thus, EPA plans to address more stringent standards in a future rule. Moreover, our adoption of standards equivalent to CAEP/4 standards at this point in time has not resulted in any appreciable loss of aircraft emissions reduction, given that manufacturers are already voluntarily complying with CAEP/4 requirements.

1.3 Alignment with ICAO Standards

What Commenters Said:

Bluewater Network urged EPA to take independent action as envisioned by Congress to set technology-forcing standards, instead of merely adopting the ICAO standards. If Congress had intended for the international standards to be the ceiling, Congress would have explicitly stated that in the CAA. Furthermore, because Congress was concerned about FAA regulating aircraft emissions, they explicitly gave that authority to EPA. However, by adopting ICAO's CAEP standards, in which the official representative from the U.S. is the FAA, EPA is doing exactly the opposite of what Congress had intended.

NJ suggested that by simply matching CAEP emission standards, the Agency is missing an important opportunity to tighten restrictions more, thus allowing the U.S. to be a leader in

improving emissions from aircraft. CARB expressed that U.S. should take a leadership role in advancing cleaner engine technology. EPA and FAA should advocate for NO_x emission controls that meet NASA's 70 percent reduction target at CAEP/6. In addition, STAPPA/ALAPCO indicated that since it is EPA's responsibility to make certain appropriate measures are taken to protect human health from environmental harm, EPA must also play a stronger role in setting the U.S. position on environmental matters within ICAO.

ATA expressed that the proposed rule to adopt CAEP/4 standards recognizes the imperative for preserving consistency in international aircraft emission standards as established through ICAO procedures, which account for safety matters unique to aviation. It also is a proper use of EPA's standard-setting role provided under the CAA. The proposed rule follows the Agency's "precedent of supporting international consistency while advancing environmental goals." Delta Air Lines, Inc. (Delta) also supports the proposed rule to align U.S. emission standards and test procedures with ICAO. Airports Council International - North America and the American Association of Airport Executives (ACI-NA&AAAE) suggested that the proposed alignment of U.S. standards with ICAO standards is one essential element in their efforts to reduce emissions at airports. AIA commented that they support the ICAO/CAEP process for setting recommendations for emission standards.

ATA stated that since aviation is a global industry, it is necessary that it function "under uniform, internationally recognized standards and procedures." If a country does not adopt an ICAO standard and files a notification of difference, the activity of aircraft certified by that country may be affected in nations where the ICAO standard does apply. Based on its obligations under the Chicago Convention, the U.S. needs to follow the ICAO standards in order that U.S. registered air carriers will be allowed to operate internationally without unnecessary and inconsistent restriction by other nations. Even though the proposed rule pertains to a NO_x standard only, the ongoing viability of an established United Nations organization, ICAO, to set global "consensus standards on safety, security, environmental, air traffic, and other parameters that allow international aviation to function" is at stake.

In addition, ATA commented that standards that have come from the rigorous CAEP and ICAO review process of the CAEP/4 standards are the only proper reference point for the EPA to use its standard setting authority under section 231 of the CAA. Even though CAEP functions under a wider mandate compared to any agency's statutory authority, CAEP's deliberations covered the factors that the CAA requires EPA and FAA to evaluate when setting emission standards for aircraft engines. If the U.S. differs from CAEP/4 emission standards, after participating in its development and supporting its adoption at ICAO, such a course of action would undermine ICAO and its ability to set needed emission standards. Any diversion from CAEP/4, would also undermine U.S. national interest by allowing conflicting agendas for standard setting, which could weaken the competitiveness of U.S. technology. Moreover, ACI-NA&AAAE expressed that to make sure U.S.-manufactured aircraft engines are not at a disadvantage, all engines should be made to meet the international standards from ICAO.

In addition, Delta Air Lines, Inc. suggested that a nation that chooses not to adopt CAEP standards is at risk of other member nations deciding not to recognize their air carriers' airworthiness certificates. Issuing standards that are not aligned with ICAO/CAEP undermines the mission of ICAO/CAEP and could effect international activity of Delta and other airlines based in the U.S. Further stringency beyond CAEP standards would result in an additional economic burden to Delta and other domestic airlines not applicable to other international air carriers.

Also, ATA indicated that the ICAO/CAEP standard setting process establishes the basis for the adoption of standards by EPA. ICAO/CAEP has approved four terms of reference for setting aircraft emission standards: technologically feasible, economically reasonable, environmentally beneficial, and balanced to account for interrelationships between emissions and noise. CAEP's assessment of each of these criteria is directly related to the deliberations that EPA and FAA must make when establishing aircraft emission standards under section 231 of the CAA. ATA commented that EPA and FAA contributed actively to the technical-feasibility analysis that CAEP's emissions technical-issues workgroup (WG3) undertook for CAEP/4 standards, and the recommendations by WG3 were accepted by the U.S., CAEP, and the ICAO Council.

In addition, Delta Air Lines, Inc. and ACI-NA&AAAE commented that the CAEP/4 standards were developed based on thorough consideration of technical feasibility, economic reasonableness, and environmental benefit by ICAO/CAEP. ACI-NA&AAAE also suggested that these criteria make certain that there is a successful program of emission reductions for nearly all sources, and such criteria are consistent with section 231 of the CAA. AIA commented that the ICAO/CAEP process has proven to be effective since it considers these three principles, and it "encourages technology development and the safe introduction of that technology into manufactured products in a cost effective and environmentally responsible matter."

In regard to economic reasonableness, ATA expressed that an extensive cost/benefit analysis was conducted for the CAEP/4 standards, and the CAEP workgroup that performed the analysis concluded that the standard was economically reasonable. CAEP and the ICAO Council concurred. As a legal matter such a finding by CAEP is important because the CAA directs EPA and FAA to account for the cost of aircraft standards.

As for environmental benefits and interrelationships, ATA indicated that CAEP/4 found that the recommended further stringency was the most beneficial NO_x reduction that could be attained without risking CO_2 increases. The CAEP/4 standard set a floor for NO_x levels of future production engines, without worsening the concerns about the potential climate change impacts of CO_2. ATA stated that it would be unsound policy for EPA to deal with aircraft NO_x in isolation, an approach inconsistent with international standards.

Our Response:

The Chicago Convention does not require all Contracting States to adopt identical airworthiness standards. Although the Convention urges a high degree of uniformity, it is expected that States will adopt their own airworthiness standards, and it is anticipated that some states may adopt standards that are more stringent than those agreed upon by ICAO. However, because any State can ban use within its airspace of any aircraft that does not meet ICAO standards, States that wish to use aircraft in international air transportation have agreed to adopt standards that meet or exceed the stringency levels of ICAO standards.[3] Because States are required to recognize certificates of any State whose standards meet or exceed ICAO standards, a State is assured its aircraft will be permitted to operate in any other Contracting State if its standards meet or exceed the minimum stringency levels of ICAO standards.

As long as a participating nation of ICAO adopts aircraft emission standards that are equal to or more stringent than ICAO's standards, the certificates of airworthiness for such nations are valid. Thus, aircraft belonging to countries with more stringent standards are permitted to travel through the airspace of other countries without any restriction. To ensure operation internationally without constraints, a participating nation which elects to adopt more stringent standards is obligated to notify ICAO of the differences between its standards and ICAO standards.[4] However, if a nation sets tighter standards than ICAO, air carriers not based in that nation (foreign-flag carriers) would only be required to comply with the ICAO standards.

Section 231 of the CAA directs EPA, from time to time, to propose aircraft engine emission standards for any air pollutant that may reasonably be anticipated to endanger public health and welfare. In addition, EPA is required to make certain such standards' effective dates permit the development of necessary technology, giving appropriate consideration to compliance cost. We must adhere to section 231, and nothing in the Chicago Convention or ICAO/CAEP

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[3] *Text of Article 33 of Chicago Convention:*
Certificates of airworthiness and certificates of competency and licenses issued or rendered valid by the contracting State in which the aircraft is registered, shall be recognized as valid by the other contracting States, provided that the requirements under which such certificates or licenses were issued or rendered valid are equal to or above the minimum standards which may be established from time to time pursuant to this Convention.

[4] *Text of Article 38 of Chicago Convention:*
Any State which finds it impracticable to comply in all respects with any such international standard or procedure, or to bring its own regulations or practices into full accord with any international standard or procedure after amendment of the latter, or which deems it necessary to adopt regulations or practices differing in any particular respect from those established by an international standard, shall give immediate notification to the International Civil Aviation Organization of the differences between its own practice and that established by the international standard . . . . In any such case, the Council shall make immediate notification to all other states of the difference which exists between one or more features of an international standard and the corresponding national practice of that State.

terms of reference for setting aircraft emission standards would supercede these CAA responsibilities. It is therefore permissible for the U.S. to adopt standards that differ from ICAO standards. Although it is not our intent at this time, it is plausible that we could in the future adopt an aircraft emission standard that is tighter than the ICAO standards due to the possible unique environmental and health concerns found in the U.S. If this was the case, we understand that domestic air carriers could be at a disadvantage to other international carriers since they would have to comply with such a standard and other carriers would not. However, before proposing such a standard we would, of course, give appropriate consideration to cost according to the CAA. It is important to note that according to 1999 data foreign flag carriers only made up about 3 percent of major carrier operations in the U.S.,[5] and thus, it would seem that the environmental benefit in the U.S. from more stringent standards could outweigh any potential competitive issues with foreign carriers. In addition, there might not be competitive issues between manufacturers since domestic and foreign manufacturers would have to meet the same requirements to sell compliant engines to U.S. registered air carriers.

As we stated in the proposed rule because aircraft and aircraft engines are international commodities, there is commercial benefit to consistency between U.S. and international emission standards. Manufacturers would only have to design to one emission standard globally, and air carriers would only need to be concerned with making sure the engines installed on their aircraft meet one standard. Such harmonization has economic and record keeping (and reporting) benefits. Moreover, since aircraft and their engines operate throughout the world on a daily basis, one standard may be the most efficient mechanism for meeting international environmental goals. Before issuing these aircraft engine NO_x standards, we have taken into account compliance costs (according to the CAA), which includes consideration of economic effects pertaining to consistency with international standards. However, alignment with international standards was not the sole consideration (we also evaluated technology development, safety, etc.). As stated above, we anticipate setting tighter NO_x standards in the future since there is currently not enough lead time to do so. For this ongoing phased approach in establishing standards, we will adhere to our CAA mandate and consider all criteria specified in section 231 to address aircraft engine emissions.

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[5]Data Base Products Inc. compiled and summarized information from the below data sets. Domestic carrier data: U.S. DOT, Bureau of Transportation Statistics, "Airport Activity Statistics of Certificated Air Carriers," Twelve Months Ending December 31, 1999. Foreign-flag carrier data: Total departures, foreign carriers, all U.S. airports combined, CY 1999, T-100 data from DOT.

1.4 Past Progress of Aircraft Engine Emissions

What Commenters Said:

The Georgia Department of Natural Resources (GA DNR) expressed that the proposed standards were adopted at ICAO's CAEP/4, and ICAO's standards historically follow aviation technology (85 percent of engines already met the CAEP/4 standards when then were approved in 1999 and today 94 percent of engines meet the CAEP/4 standards). The South Coast Air Quality Management District (SCAQMD) suggested that "aircraft emission standards have not been adequately developed and implemented by EPA to address the growing impact of aircraft emissions on air quality and historically aircraft have been under-regulated as compared to other sources."

ED indicated that the General Accounting Office's (GAO) February 2003 report, *Aviation and the Environment: Strategic Framework Needed to Address Challenges Posed by Aircraft Emissions*, showed that even though new aircraft engines are more fuel efficient and emit less carbon monoxide (CO), they emit more NO_x than older engine models. EPA needs to reconcile this finding with the statements in the NPRM that 94 percent of in-production engines already meet or perform better than the proposed NO_x standards. ED questioned whether these new standards would have an impact "on newer aircraft engines that are in some cases much dirtier than older engines." At a minimum, the rulemaking needs to explain this apparent discrepancy.

AIA expressed that "[h]istorically, the aircraft industry has responded favorably to standards based on best available technology that has demonstrated safety and airworthiness." A look back at past standards will show that by the time a new standard is implemented industry has taken voluntary action, where technologically feasible, to meet those standards, in most cases, many years ahead of the implementation date. "The same can be said for the CAEP/4 standard." In 1998, four engine families in-production and three new type engine families did not meet the standard, and as of December 2003, only two in-production engines will not meet this standard. "For one of those engines, a technology has been identified to meet the standard, and market forces will dictate its introduction into service." This shows that the proposed standard allows development of the necessary technology while giving appropriate consideration to the cost of compliance.

ATA suggested that while manufacturers have continued to improve NO_x, they have also attained marked improvements in fuel efficiency – 125 percent since 1975 according to FAA statistics (with corresponding carbon dioxide emission reductions). In the same time frame, the U.S. has decreased the population exposed to significant levels of aircraft noise from over 7 million to fewer than 500,000, while enplanements have tripled. In addition, there have been continued decreases in carbon monoxide, hydrocarbons, and smoke. Moreover, Delta Air Lines, Inc. indicated that the international air carrier industry holistically has demonstrated continued proactive behavior in decreasing pollution (both air and noise) from aviation. Because of the proactiveness of industry, 94 percent of the in-production engines already meet or perform better

than the proposed NO_x standards. Delta Air Lines, Inc. commented that "[t]hese achievements, and ongoing work within ICAO, show the industry's commitment to reducing pollution without the need for further burdensome regulations."

Our Response:

We would agree that historically aircraft standards have not had the tighter stringency that some other sources have had. As stated earlier, section 231(b) permits EPA to set aircraft emission standards at a level that is currently not achieved in practice if we provide sufficient lead time for development of technology before such standards must be met. However, we are not compelled under section 231 to obtain the "greatest degree of emission reduction achievable" as per section 213 (nonroad standards) and 202 (on-highway standards) of the CAA.

In regard to the finding in the GAO report that new aircraft engines emit more NO_x than older engines models (but emit less carbon monoxide and are more fuel efficient), we believe some additional context is needed. As pointed out in the report, there are engine technologies that manufacturers have developed for some newer engines now in service such as Pratt and Whitney's Technology for Affordable Low NO_x (TALON) that reduce NO_x. Also, the 1999 Intergovernmental Panel on Climate Change report entitled, *Aviation and the Global Atmosphere* stated that "[t]here is no single relationship between NO_x and CO_2 that holds for all engine types. However, for the best current aircraft engine and combustor design, there is a direct link between the emissions of NO_x and CO_2. As the temperatures and pressures in the combustors are increased to obtain better fuel efficiency, emissions of NO_x increase, unless there is also a change in combustor technology."[6] In addition, it is difficult to compare old and new aircraft due to the many differences (e.g., range, number of passengers, fuel and structural weight, performance, etc.) between otherwise similar aircraft. For instance, similar aircraft of the same series could carry almost an identical number of passengers; however, the newest aircraft may have twice the range of the older aircraft. There would likely be an increase in emissions from the newest aircraft for carrying the additional fuel and structural weight, but there may be benefits as well. For a mission well suited to the newest aircraft, the older aircraft might need an intermediate stop (and/or additional landing and takeoff), which may lead to more emissions that affect local air quality. Also, when comparing older and similar aircraft of the same series, which used the same engine, nearly identical emissions could be reported even though one of the older aircraft may be able to carry substantially more passengers. Such results may be due to

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[6]Reference provided in IPCC report: ICCAIA, *Emissions Technology Review*, Working Paper 3/11 presented at the 3rd meeting of ICAO/CAEP Working Group 3 (Emissions-Technical Issues), Savannah, GA, May 1997.

Intergovernmental Panel on Climate Change (IPCC), "Aviation and the Global Atmosphere," J.E. Penner, D.H. Lister, D.J. Griggs, D.J. Dokken, and M. McFarland, editors. Cambridge University Press, 1999.

model limitations, and it may not be a valid comparison of the two aircraft. Overall, an engine to engine comparison would probably show less of a NO_x increase from old to new.

As for the effect the standards will have on newer engines, it is important to note that the levels of the proposed and previous NO_x standards increases as the engine pressure ratio increases (the NO_x standard varies with and is a function of an engines pressure ratio), and based on available information some new engines will have low and medium engine pressure ratios (less than or equal to 30) and others will have high pressure ratios (greater than 30). These new engines are not expected to be all high pressure ratio engines, and thus the effect of the standards will vary. Also, regardless of the engine pressure ratio, the proposed (and promulgated) standards are never less stringent than the previous standards. In addition, as stated in the NPRM and the preamble of the final rule, we will codify current practice (NO_x standards will ensure that new engine designs incorporate the existing combustor technology), with no significant lead time, as a near-term approach, and we intend to address more stringent emission standards requiring more lead time in a future rulemaking

Even with the overall growth in aviation emissions (continued increases in aviation activity are directly related), we recognize that since the 1970's industry has made continued improvements in the pollution emitted from the aircraft technology. However, as described in section 3 below (*Environmental Need for Control)* and section II of the preamble for the final rulemaking, many areas in U.S. have air quality problems and will have a difficult time meeting the new 8-hour ozone and $PM_{2.5}$ NAAQS without decreasing aircraft emissions, which continue to grow. As previously discussed, today's standards will lead to minimal emission reductions, and thus, we intend to address more stringent NO_x standards in the future. We believe this ongoing phased approach is the most appropriate way to address aircraft engine emissions at this time.

1.5 Future Standards

What Commenters Said:

States and local governments expressed that EPA "has an obligation to immediately follow this rulemaking with further, more aggressive action, taking into consideration the deliberations of CAEP/6 in 2004...." It is vital that EPA take a more aggressive role in setting standards in time to meet the CAA deadlines for air quality attainment. In addition, they would like future standards to control aircraft emissions in a manner equal with emission control strategies from other sources. CAEP/6 standards would be "a step in the right direction, but even stronger, forward looking, technology-forcing standards are also absolutely necessary," otherwise emissions will continue to increase in the future. EPA acknowledged in the proposed rule that many engines already perform better than the CAEP/4 or proposed standards. However, the Agency should set future standards "that reflect the emission reductions that technologies will deliver at the future implementation date."

Also, state and local governments and environmental groups suggested that ongoing progress in the development of technology provides a reasonable expectation that significant emissions reductions from aircraft are attainable in the relatively near term. Currently, the National Aeronautic and Space Administration's (NASA) Ultra-Efficient Engine Technology (UEET) program aims to achieve 70 percent reduction (from CAEP/2) in NO_x levels within the next 10 years without adversely affecting noise or fuel burn. This NASA "stretch" goal seems to be a sensible starting point for a technology-based standard for aircraft. CARB believes future standards consistent with the NASA 70 percent reduction target are achievable and necessary "to meet air quality and public health goals," and EPA should immediately begin work with FAA to set more effective standards for implementation beginning in 2010 (so states can start realizing benefits in time to comply with air quality attainment deadlines for the 1-hour ozone, 8-hour ozone, and $PM_{2.5}$ NAAQS). In addition, state and local governments and environmental groups expressed that due to the promising technological developments taking place with aircraft aerodynamic design and materials (lighter and stronger), there is great promise in the future for more fuel-efficient and lower-emitting aircraft (which could lead to substantial reductions in emissions). The Agency should consider regulating emissions from the aircraft instead of the engine in order encourage the continuing development and application of new technology for airframes. STAPPA/ALAPCO urges EPA to promptly develop future aircraft emission standards according to a forward-looking approach that will get the most out of such technological advancement. GA DNR indicated that considering the engine and airframe technology for future standards will benefit the aircraft industry and the federal, state, and local officials responsible for managing the nation's air resources.

In addition, for assessments of future standards, STAPPA/ALAPCO urged EPA to calculate not only the costs, but also the emission benefits, over the full useful life of aircraft engines. The cost results provided at CAEP/6 were not calculated in such a way.

Delta Air Lines, Inc. expressed that EPA has been premature in bringing up the issue of further NO_x stringency beyond the proposed (or CAEP/4) standards and prior to a complete assessment by CAEP. It may set expectations on standards or their implementation date that are not consistent with the conclusions and recommendations of the CAEP/6 meeting. The Agency should align new standards "with ICAO and refrain from independently pursuing more stringent regulations that would place U.S.-based airlines at an economic disadvantage in the global marketplace." Delta suggested that since aircraft emissions account for a small percentage of the total NO_x from mobile sources (only 1 percent), the potential for actual NO_x reductions from aircraft is limited. It is not clear that additional reductions from aircraft would provide a substantial benefit to assist states with air quality attainment. The need for pursuing additional decreases in aircraft emissions should be based upon regional ozone modeling protocols, not the relative contributions.

ACI-NA&AAAE suggested that the U.S. continue to press for further NO_x stringency at CAEP/6 and beyond, accounting for economic considerations consistent with the CAA.

Our Response:

As stated earlier in section 1.1 of this document (*Engine NO_x Standard Levels and Stringency*), section 231(b) of the CAA allows EPA to establish aircraft emission standards at a level that is currently not achieved in practice, provided we give sufficient lead time to develop necessary technology before such standards must be met. However, we are not compelled under section 231 to obtain the "greatest degree of emission reduction achievable" as per sections 213 and 202 of the CAA. EPA has more flexibility under section 231 in determining what aircraft emission standard is most sensible. Expectations for the NASA UEET program could be the basis for future standards similar to a 70 percent NO_x reduction (from CAEP/2). A commenter urged us to set future standards similar to NASA targets for implementation in 2010, but it is premature to determine whether this is sufficient lead time since we have not undertaken an assessment of future standards, the technologies that could be used to meet them, or the costs or safety considerations of this goal. For such future standards, lead time would be a central consideration. In addition, we would need to appropriately evaluate the costs to meet stringency levels comparable to NASA targets, including after the NASA research ends and the industry begins applying the technology to their products. We anticipate setting more stringent NO_x standards in the future, and the Agency would assess the costs (and emission benefits) of any future standards regardless of stringency level. However, we have yet to conduct such an assessment of future standards.

In regard to the comment that for analysis of future standards EPA should calculate the emission benefits over the full useful life of aircraft engines, we would agree. It is normal EPA practice to do so for our regulatory impact analysis of rulemakings (which are typically conducted when the regulated entities are not already voluntarily complying with requirements – as is the case with today's action). But since today's standards will not compel a reduction in emissions beyond the current baseline, it was not necessary for us to calculate emission benefits for them.

We agree with the view expressed by commenters that it may make more sense as a practical matter to regulate emissions from the entire aircraft instead of only the engine. However, it may take many years to develop new procedures or methods for assessing aircraft and engine emissions together. Thus, the benefits of any such standards requested by some commenters would not be realized in the near term. For the sake of meeting the specific mandate of section 231, we believe it is more appropriate at this time to continue focusing standards on the aircraft engine. However, we will take the suggestions provided on regulating the entire aircraft under consideration in the setting of future standards.

We do not agree with the comment that it was premature to discuss further NO_x stringency beyond the proposed standards before a CAEP assessment. We believe a ongoing phased approach is the most appropriate means to address emissions: codify current practice (with no significant lead time) as a near-term approach and address more stringent emission standards requiring more lead time in a future rulemaking. Due to our intention to explore more stringent standards in the future, it was appropriate to raise this issue for public consideration in the proposal. In regard to consistency with ICAO standards, see our response on this issue in section 1.3 of this document (*Alignment with ICAO Standards*).

We disagree with the comment questioning whether additional reductions from aircraft would provide a substantial benefit to help states with attainment. Although aircraft NO_x emissions are a relatively smaller part of the national emissions inventory, they clearly contribute to the overall quality of air throughout the nation. In addition, as described later in our response to comments in section 3.2 (*Aircraft Emissions Contribution*) and in the proposed rulemaking, growth in commercial aircraft emissions is expected to occur (even with the temporary set back due to the tragic events of September 11, 2001) when other significant sources are drastically reducing emissions, thereby accentuating the growth in aircraft emissions. For instance, from a local/regional perspective the 1999 EPA study (*Evaluation of Air Pollutant Emissions from Subsonic Commercial Jet Aircraft)* showed that as an average for the for ten cities analyzed, commercial aircraft's contribution to regional mobile source NO_x emissions was anticipated to increase from about 2 percent in 1990 to 5 percent in 2010.

Aircraft NO_x emissions contribute to ground level ozone and secondary particulate matter ($PM_{2.5}$). As indicated in our response to comments in section 3.1 of this document (*Overall Air Quality Need*), there are approximately 159 million people living in areas that either do not meet the 8-hour ozone NAAQS or contribute to violations in other counties as noted in EPA's recent nonattainment designations for part or all of 474 counties. In addition, approximately 88 million people live in 208 full and partial counties where air quality measurements violate the $PM_{2.5}$ NAAQS (a map of the current areas violating the ozone and $PM_{2.5}$ NAAQS and a list of affected counties can be found in Docket No. OAR-2002-0030, Document No. OAR-2002-0030-0209). Aircraft operate nationwide, including in these nonattainment areas.

While we have not modeled the impacts on ozone and $PM_{2.5}$ levels due to the future aircraft standards, such future standards would result in NO_x emission reductions throughout the nation. Because NO_x is a precursor to ozone and $PM_{2.5}$, these reductions may be especially helpful for those areas that are in nonattainment of the ozone and $PM_{2.5}$ NAAQS. Federal, state and local governments will need to reduce emissions from many different sources of ozone and $PM_{2.5}$ precursors to achieve the reductions needed to meet the NAAQS. Most of these sources are not by themselves large contributors to the percentages of ozone and $PM_{2.5}$ precursors in the air. However, taken together they represent a large source of potential emission reductions that can reduce the number and severity of ozone exceedances. Neither EPA nor other governments can effectively and cost-effectively reduce emissions by regulating only a few large sources or source categories. Getting further emissions from sources that are already well regulated can often be much less cost-effective than reducing emissions from those sources that have not been as well regulated in the past.

1.6 Long-Term Technology Goals

What Commenters Said:

AIA expressed that the long-term technology goal program considered at CAEP/6 offers a medium to ensure the development of appropriate breakthrough technologies to further decrease aircraft engine emissions. "Certification standards are not the appropriate means to achieve these ends. The proposed standard is a certification standard whereby aircraft engines must be demonstrated as airworthy to enter service in order to remain in service. Design of an engine must allow for differing thrust requirements and for uncertainty in specification of safety and environmental regulations. This is by nature a conservative process . Technologies used in engine design are rarely breakthrough technologies; rather, they are improvements to existing technologies and/or application of newly developed technologies to the combustor. Certification standards are appropriate to evolutionary technology developments; long term technology goals are appropriate to progressing breakthrough technologies. Long term technology goals coupled with its standards setting prerogative will ensure continued progress toward meeting Clean Air Act requirements." Also, AIA strongly supports working with CAEP on their future work program on non-binding long-term technology goals.

ATA suggested that CAEP's goal review process provides the forward-looking viewpoint that will facilitate the development of technology. At the CAEP/6 meeting in February 2004, CAEP will consider a new process to setting long-term and medium-term technology goals. Long-term goals will comprise technology under development by research agencies. Medium term goals will cover technology at a more advanced stage that is being further developed by manufacturers. The goal review panel will consist of experts from research establishments and manufacturers, plus other stakeholders and independent experts. The panel will meet on a schedule consistent with the CAEP cycle, and it will provide CAEP with a comprehensive assessment of the goals being pursued by governments and industry globally. In addition, ATA indicated that the panel will check the progress toward existing goals, and decide whether technological innovations substantiate raising the goals. This review procedure will facilitate lower-emission technology development in a way consistent with the safety and airworthiness requirements. Also, ATA stated that "[w]hen technology progresses to a certification-ready stage, it can then be considered for future standards."

In addition, ATA expressed that while recognizing the fact that standards and goals must remain separate, the goal procedure will give CAEP a forward-looking focus on developing technology. "Though CAEP is not itself a research body, it can facilitate the efforts of researchers at all stages by bringing a comprehensive approach to technological development under the aegis of CAEP."

Our Response:

At CAEP/6, it was agreed that the future CAEP work program would continue efforts on developing long-term technology goals, including implementing a CAEP-approved process to set and review these goals.[7] We support this future work item and related process for establishing goals. However, this should not be interpreted as agreement on our part that the CAEP process is the exclusive appropriate process for setting aircraft emissions reduction goals or for encouraging the development of better performing technology. (For example, the Next Generation Air Transportation System (NGATS) plan was released in December 2004 - a Congressionally chartered and Administration endorsed activity to develop research and plans to transform the air transportation system. Efforts there will include assessment of various technological and operational procedures to reduce aircraft emissions, including NO_x, as well as a thorough assessment of interrelationships between noise and emissions and amongst emissions to enable maximizing environmental benefit derived from mitigating actions). In our long history of mobile source regulation, we have found that performance-based standards have been successfully used to stimulate technological development resulting in cleaner, cost-effective, and safe engines.

In regard to comments on setting aircraft engine standards or the basis for the level of standards, refer to our response to comments in sections 1.1 and 1.5 of this document (*Engine NO_x Standard Levels and Stringency* and *Future Standards*).

[7]ICAO, CAEP, Sixth Meeting, Montreal, Quebec, February 2-12, 2004, Report, Letter of Transmittal to the President of the Council From the Chairman of the Sixth Meeting of CAEP, CAEP/6-WP/57 (Report on Agenda Item 4). Copies of this document can be obtained from ICAO (www.icao.int). It can also be found in Docket No. OAR-2002-0030.

2. Applying the NO_x Standards to Newly Manufactured Engines of Already Certified Models (Production Cut-off)

What We Proposed:

The comments in this section correspond to Section IV of the aircraft engine NPRM, and therefore are targeted at issues of applying the CAEP/4-equivalent NO_x standards to newly manufactured engines of already certified models (i.e., a production cut-off date by which all new engines produced after that date must meet today's standards, rather than following CAEP/4 and merely applying today's standards to future engine designs and allowing currently produced engine models to meet the previous standards), which we requested comment on in the NPRM.[8,9] A summary of the comments received, as well as our responses to those comments are located below. For the full text of comments summarized here, please refer to the public record for this rulemaking.

What Commenters Said:

Bluewater Network expressed that EPA conceded in the proposed rule that it has historically applied aircraft emission standards to newly manufactured engines of already certified models and doing so this time would prohibit the indefinite continued production of aircraft engines that would meet only the previous standards. "EPA does not explain why it is proposing a sudden departure from the past practice of regulating already certified, newly manufactured engines - i.e., what is different about this particular rulemaking that justifies the exemption of such engines." Bluewater Network suggested that without a reasoned explanation, the Agency's proposal to exempt newly manufactured engines of already certified models from the new standards would be considered arbitrary and capricious, especially taking into account the harm of ozone pollution, the nonattainment problem throughout the country, and the aircraft emissions contribution to lo cal air quality problems. With the long life of aircraft engines and the availability of newly manufactured engines of already certified models in the future, there is a need to apply the proposed NO_x standards to this category of aircraft engines. In addition, with respect to an implementation date for such requirements (which we requested comment on in the

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[8]The provision of applying the standards to newly manufactured engines of already certified models does not mean the re-certification or retrofit of existing in-use engines. Instead the provision would require the ongoing production of engines that have already been certified to meet the new standards (i.e., those individual engines that are part of an already certified engine model, but are built after the effective date of the regulations for such engines and have never been in service).

[9]In the proposal, we referred to such engines as already certified, newly manufactured engines or already certified engines; however, this terminology may need some clarification for the final rulemaking (thus, we use the term "newly manufactured engines of already certified models").

NPRM), Bluewater Network expressed that the Agency should evaluate information on why such lead time would be needed and choose the shortest lead time. Also, in response to an NPRM request for comment on an averaging program for newly manufactured engines of already certified models, Bluewater Network indicated that an averaging program would create auditing and enforcement challenges that would necessitate considerable resources.

State and local governments recommended that the standards for newly manufactured engines of already certified models should be implemented one year after the effective date of the final rulemaking. At a minimum, EPA should have an implementation date that prohibits engine manufacturers from selling already certified engines unless the engines were recertified or redesigned to meet the proposed standards. STAPPA/ALAPCO commented that such a provision would be consistent with a stated objective of the rulemaking, which is to assure that progress in reducing aircraft engine emissions is not reversed in the future. Without such standards, high-emitting engines can continue to be produced and brought into service, further adding to the long-term growth in aircraft emissions that is anticipated without a more aggressive approach to regulating this source.

Also, STAPPA/ALAPCO commented that as EPA indicated in the NPRM, except for aircraft engines, all current CAA mobile source programs involving new emission standards apply to newly manufactured engines or vehicles based on the certification model year. STAPPA/ALAPCO questioned why the Agency did not pursue the same approach in the NPRM.

In addition, ED suggested that whether or not the proposed NO_x standards should be applied to newly manufactured engines of already certified models is almost moot because the standards have no real effect. If the Agency issued a technology-forcing standard that ultimately reduced emissions, then it may make sense to provide some period of time (2-4 years) prior to applying the standard to such engines.

ATA commented that as the NPRM acknowledges, market incentives lead manufacturers to bring their engines to the levels of the CAEP/4 NO_x standards as soon as possible once the standards take effect. Air carriers investing in costly, long-lasting assets prefer to buy engines that meet the latest standards, and demand engines that perform better than the standard without regulatory intervention of a production cut-off (applying standards to newly manufactured engines of already certified models). Such market forces together with EPA's four-year delay in proposing to adopt the CAEP/4 NO_x standards, account for the fact that 94 percent of in-production engines already meet the standard.

Also, ATA indicated that at CAEP/6 in February 2004 a decision will be made on whether to apply the CAEP/4 standards to newly manufactured engines of already certified models. CAEP's Forecasting and Economic Analysis Support Group (FESG) has assessed the costs and benefits of such a provision. If CAEP adopts a this provision, it will also recommend an implementation date.

In addition, ATA and Delta Air Lines, Inc. expressed that for the same reasons that the Agency should generally align with ICAO standards, it should be consistent with ICAO on whether to apply CAEP/4 standards to newly manufactured engines of already certified models. If EPA differed from ICAO on this provision, there would be the very inconsistency between domestic and international practice that aligning with ICAO requirements avoids. Furthermore, if EPA adopts such a provision prior to ICAO, such action would potentially place U.S. manufacturers and air carriers at a competitive disadvantage for what EPA acknowledges to be minimal environmental benefit.

Delta Air Lines, Inc. commented that application of the new standards to newly manufactured engines of already certified models is unwarranted. According to the Clean Air Act, EPA must give "appropriate consideration" to the cost of compliance for new aircraft emission standards. Any further stringency (such as these provisions for newly manufactured engines of already certified models), beyond those set by ICAO will result in additional cost to Delta and other domestic air carriers. The cost EPA describes in the NPRM has not undergone an appropriate cost benefit assessment to find out the true effect on U.S. air carriers of applying the proposed standards to newly manufactured engines of already certified models. According to the commenter both the minimal environmental benefit acknowledged by EPA (with which Delta is in agreement) and the potential for competitive disadvantage for domestic carriers argue for the Agency to conduct such an analysis before further consideration of this issue.

In addition, of the four engine models that would be effected by applying the standards to newly manufactured engines of already certified models, Delta Air Lines, Inc. presently has the JT8D-219 engine on some of its commercial jets. Delta expressed that the NPRM indicated that the JT8D-219 would be used in supersonic business jets, which they do not operate; however, Delta (and maybe other domestic air carriers) operates this engine in its commercial aircraft fleet. Therefore, the implication of these provisions has not been fully investigated by EPA as mandated by the CAA.

Also, Delta Air Lines, Inc. stated that full consideration must be given to the overall environmental benefit of such a provision. Changes to engine design parameters to decrease emissions of one pollutant not only affects engine performance, but it can and does increase emissions of other pollutants and/or noise. The interrelationships between aircraft engine performance, emissions of different pollutants, and noise are complex and bring about the need to consider trade-offs related to changing engine design. "These interrelationships must be fully evaluated and understood, and balanced against one another to effectively address all issues associated with aircraft engine operations."

AReCO suggested that today's standards should also be applied retroactively to all existing fleet aircraft (an existing in-use engine standard), with a phase-in period of linearly increasing stringency for the next 20 years. ATA stated that they strongly oppose any measure that retroactively applies to the existing fleet.

Our Response:

It is important to mention that, as indicated in the preamble of the final rulemaking, CAEP/6 did not adopt provisions to apply the CAEP/4 NO_x standards to newly manufactured engines of already certified models. CAEP/6 noted the industry view that market forces are the primary drivers of the development and incorporation of new technology (asserting voluntary compliance would suffice), and an understanding at CAEP/4 that a production cut-off would not be introduced in the future. CAEP/6, after reviewing that commitment, decided that "...this should not be interpreted as meaning that production cut-offs would not be introduced in the future if the situation so warranted."[10,11]

As an update to the status of engines discussed in the proposed rulemaking, nearly all engines that did not meet the CAEP/4 NO_x standard in 1998 now comply, except for the JT8D-200 engine family.[12] The PW4090 family of engines, which was described as not meeting the proposed standards in the NPRM, now has the means to eventually meet the standards (utilizing technology that would meet the lower ranges of stringency options for the NO_x standards considered at CAEP/6), although the manufacturer has projected it would be some years before it expects to meet CAEP/6 levels (the manufacturer has not provided us with a projected necessary lead-time to meet CAEP/4).

The JT8D-200 engine powers the MD-80 aircraft, which is no longer in production. Yet, the JT8D-200 engine (JT8D-217C and JT8D-219 in-production engines) could potentially apply to future supersonic business jets. As stated in the NPRM, the resulting NO_x emission benefits of applying the standards to the JT8D-200 (for these possible supersonic business jets) would be expected to be very small, and the costs would also likely be relatively small on an industry wide basis, although as discussed further below we do not feel we have a sufficient record at this point – nor have we presented it for public comment – to state our definitive views on these issues.

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[10]ICAO, CAEP, Sixth Meeting, Montreal, Quebec, February 2-12, 2004, Report, Letter of Transmittal to the President of the Council From the Chairman of the Sixth Meeting of CAEP, CAEP/6-WP/57 (Report on Agenda Item 1). Copies of this document can be obtained from ICAO (www.icao.int). It can also be found in Docket No. OAR-2002-0030.

[11]CAEP/6 noted that industry "pointed out that introduction of a production cut-off now would cause the manufacturer to modify engines to meet the CAEP/4 standards, whereas if no cut-off were imposed it was likely that they could be modified to meet the new standards agreed at this meeting." (ICAO, CAEP, Sixth Meeting, Montreal, Quebec, February 2-12, 2004, Report, Letter of Transmittal to the President of the Council From the Chairman of the Sixth Meeting of CAEP, CAEP/6-WP/57, Report on Agenda Item 1, page 1-13.)

[12]ICAO, CAEP/6, Working Paper 34, "NO_x Production Cut-off Consideration," Presented by the International Coordinating Council of Aerospace Industries Associations (ICCAIA), January 6, 2004. A copy of this document can be found in Docket No. OAR-2002-0030.

However, the direct (development) costs would most likely be borne by one engine manufacturer.[13]

As indicated earlier, the implementation date applicable to newly designed and certified engines under CAEP/4, December 31, 2003, has already occurred for the CAEP/4 standards, and at this late date to promulgate a provision to apply today's standards to newly manufactured engines of already certified models (a production cut-off) could be disruptive to the production planning of engine manufacturers. EPA and ICAO (as we mentioned in the proposal and as one commenter noted in its comments) have historically adopted production cut-offs for previous standards, but in today's unique case the lateness of the rule may not provide manufacturers enough lead time for such planning. However, as we discussed earlier in section 1, we intend to consider more stringent NO_x standards in a future rulemaking, and similar to CAEP/6's future plans described above, we also intend to consider applying more stringent standards to newly manufactured engines of already certified models for such a future rulemaking. This provision is an important issue that we expect to fully consider for future standards.

While we solicited comment on extending the CAEP/4 standards to newly manufactured engines of already certified models, we did not develop a record that fully analyzes the emissions benefits (if any) and the implementation costs of going beyond CAEP in this manner. Therefore, the public has not been provided an opportunity to analyze and comment upon these important factors. We believe that our analysis of these factors would need to be weighed through a notice-and-comment process in determining whether a production cut-off, with a specific lead-time period, would be appropriate under CAA section 231 in this case. Particularly regarding the cost of compliance within necessary lead-time issue, we are concerned that there is insufficient data that specifically addresses the appropriate lead time for subjecting the few remaining in-production engine models to the CAEP/4 standards, and that our selection of a production cut-off date could therefore be viewed as arbitrarily chosen.

Since we have not yet provided that opportunity for public comment on our analysis of this issue, and since attempting to do so now would in our view unacceptably slow down this rulemaking, in the interests of expediency and of bringing U.S. domestic law into conformity with our obligations under the Chicago Convention (albeit tardily), we have decided that the most appropriate course for now, under CAA section 231 (a), is to simply update our regulations to track CAEP/4 in terms of both stringency levels and scope of applicability. Similarly, without having developed the necessary record and analysis, at this time we are unable to respond to the substantive comments offered by commenters regarding the production-cutoff issue, and our decision today should in no way be viewed as either endorsing or rejecting the concept of a

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[13]ICAO, CAEP/6, Information Paper 28 - Appendix B, "FESG Economic Assessment of Applying a Production Cut-off to the CAEP/4 NO_x Standard" Presented by the FESG Rapporteur, January 29, 2004 (Same as CAEP-SG20031-IP/9, which was presented at June 10, 2003 CAEP Steering Group Meeting). A copy of this document can be found in Docket No. OAR-2002-0030.

production cut-off. Given the need to quickly promulgate standards that are at least as stringent as CAEP/4, we must decline to resolve the numerous issues raised either in favor of or in opposition to applying the CAEP/4 standards to newly manufactured engines of already certified models.

In response to the comment that an emission averaging program would generate enforcement (and/or administrative) challenges that would necessitate substantial resources, we would agree that such a program would require more than a trivial amount of resources to implement; however, we would not anticipate the need for any more resources than is currently provided for other CAA mobile source programs. Such an averaging program would be enforced by FAA, who is responsible for the enforcement of aircraft emission standards according to section 232 of the Act, and we believe that we could work with FAA to set up a program that would be supported with a reasonable amount of resources. On the other hand, because we did not receive any comments supporting an averaging program and nearly all in-production engines meet the standards, we have decided to not move forward with such a provision in today's rulemaking. It may be more productive to revisit the concept of an averaging program in a future rulemaking for tighter standards, where there would likely be a better opportunity to flesh out the details of such a program and submit them for public comment.

As for the comment on applying today's standards retroactively to existing fleet aircraft (or existing in-use engine standards), such requirements are not within the scope of this rulemaking. In the NPRM, we requested comment on applying the NO_x standards to newly manufactured engines of already certified models (or newly manufactured engines within existing engine models), but not to existing fleet or in-use aircraft engines. Moreover, we did not ask for comment on the retroactive application of such a standard, and therefore do not believe we could take final action to retroactively impose such standards in this rulemaking. As is the case with applying a production cut-off, we believe we would need to develop a record and analysis for this issue and submit that for public comment before we consider adopting such an approach. The need for us to adopt today's standards quickly precludes our ability to further consider that issue in this rulemaking.

3. Environmental Need for Control

What We Proposed:

The comments in this section correspond to Section III of the aircraft engine NPRM, and therefore are targeted at environmental need issues for the proposal. A summary of the comments received, as well as our responses to those comments are located below. For the full text of comments summarized here, please refer to the public record for this rulemaking.

3.1 Overall Air Quality Need

What Commenters Said:

Bluewater Network expressed that many urban areas are currently not in attainment with the 1-hour ozone standard and won't be with the upcoming 8-hour ozone standard. Bluewater Network stated that according to data from 1999 to 2001, "EPA expects 111 million people will live in nonattainment areas where they will be forced to breathe unhealthful air." Based on non-EPA data, 2002 was the worst smog year in history, with 41 states and the District of Columbia exceeding the 8-hour ozone standards nearly 9,000 times, a 90% increase over 2001 data.[14] Also in 2002, twenty-nine states and the District of Columbia did not meet the one-hour ozone standard over 800 times. For these nonattainment regions, aircraft emissions are a problem, and to highlight this concern these regions are currently indicating that reductions from stationary sources are more and more difficult to find.

In addition, the Center for Clean Air Policy (CCAP) expressed that an EPA analysis shows the a wide number of areas are expected to be designated as nonattainment for the 8-hour ozone and $PM_{2.5}$ standards. Specifically, EPA currently estimates that 290 counties throughout the nation are projected to be in nonattainment with the 8-hour ozone standard and 129 counties for $PM_{2.5}$. (ED suggested that nationwide monitoring indicates that 175 million people in 628 counties are exposed to ozone levels that exceed the NAAQS.) CCAP commented that since most of these counties include major urban areas, there will be some form of air travel in these nonattainment areas. However, these proposed standards "will not provide significant benefits to the environment, human-health, and communities working to come into attainment for the 8-hour ozone and fine particulate standards." Also, CARB expressed that over 100 million residents of the U.S. live in areas with unhealthy ozone or $PM_{2.5}$ levels, and Californians experience the highest levels in the nation. Moreover, SCAQMD recently adopted 2003 Air Quality Management Plan to comply with 1-hour ozone and PM_{10} NAAQS, and significant reductions in emissions are required to meet these standards by 2010. GA DNR suggested that reductions of ozone and $PM_{2.5}$ and their precursors necessitates control of emissions from every sector, in addition to reductions already applied to attain the 1-hour ozone standards.

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[14]U.S. PIRG Education Fund, "Danger in the Air: Unhealthy Levels of Smog in 2002," August 3, 2003.

STAPPA/ALAPCO suggested that "NO_x is a major contributor to multiple environmental problems including ozone, fine particles, acid rain, regional haze, and the nitrification of water bodies. ED indicated that elevated ozone concentrations have a number of adverse health effects including reduced lung function (especially in children active outdoors), hospital admissions and emergency room visits for respiratory causes (among children and adults with pre-existing respiratory disease such as asthma), inflammation of the lungs, and possible long-term lung damage. Considerable additional reductions in NO_x emissions are needed to effectively address these problems and balance the anticipated growth in activity from sources that account for most NO_x emissions. STAPPA/ALAPCO expressed that nationwide NO_x emissions from all sources increased by 2 percent between 1989 and 1998. To tackle this problem, STAPPA/ALAPCO and GA DNR commented that the U.S. will apply stringent new standard for some of the most significant sources of NO_x. For instance, with Tier 2 motor vehicle standards, light-duty vehicle NO_x emissions will be 99 percent less than NO_x from the uncontrolled vehicle of the 1960s. In addition, the standards for heavy-duty highway vehicles that will be implemented in 2007 require a 90 percent reduction in NO_x emissions from today's levels, and the recent regulations for heavy-duty nonroad diesel engines will also decrease NO_x by 90 percent from today's levels by 2011 (similar controls already or will apply to power plants as well). Moreover, due to federal transportation conformity, major cities' ground transportation programs will encounter considerable pressure to reduce NO_x.

In addition, one commenter indicated that "as a breather of common air (as we all are), I believe it is in everyone's best interests to reduce the pollution from aircraft and their engines as much as possible."

Our Response:

Nationwide, there are approximately 159 million people living in 126 areas that are designated as not attaining the 8-hour ozone NAAQS based upon the monitored data from 2001-2003 and other factors.[15] All or part of 474 counties are designated as non-attainment for the 8-hour ozone NAAQS. In addition, approximately 88 million people live in 39 areas and 208 full and partial counties that are designated as not attaining the $PM_{2.5}$ NAAQS (a map of the current areas violating the ozone and $PM_{2.5}$ NAAQS and a list of affected counties can be found in Docket No. OAR-2002-0030, Document No. OAR-2002-0030-0209). These numbers do not include the tens of millions of people living in areas where there is a significant future risk of failing to maintain or achieve the ozone or $PM_{2.5}$ NAAQS. Federal, state, and local governments are working to bring ozone and PM levels into compliance with the NAAQS.

[15]U.S. EPA, "Air Quality Designations and Classifications for the 8-hour Ozone National Ambient Air Quality Standards; Early Action Compact Areas With Deferred Effective Dates," Final Rule, 69 FR 23858 (April 30, 2004). On June 15, 2004, the 8-hour ozone nonattainment designations became effective.

From air quality modeling performed for the recent Clean Air Interstate Rule (CAIR),[16] we anticipate that without emission reductions beyond those already required under promulgated regulation and approved State Implementation Plans (SIPs), ozone nonattainment will likely persist into the future. With reductions from programs already in place, including the CAIR, the number of counties in the eastern U.S. violating the ozone 8-hour standard is expected to decrease in 2015 to 16 counties where 12 million people are projected to live. Furthermore, for $PM_{2.5}$, air quality modeling performed recently in connection with our CAIR rule, suggests that elevated $PM_{2.5}$ levels are likely to continue to exist in the future in many areas in the absence of additional emission controls.[17] For example in the eastern U.S. in 2015, based on emission controls currently adopted, we project that 16 million people will live in 18 counties with average $PM_{2.5}$ levels above 15 ug/m^3. See Section II of the preamble of today's final rulemaking for further discussion on air quality need.

As discussed above in our response, we have updated information on the number of people and counties exceeding the 8-hour ozone and $PM_{2.5}$ NAAQS, and we would agree that many urban areas are currently not in attainment with the ozone and $PM_{2.5}$ standards. In addition, we agree that NO_x is a significant contributor to a number of environmental problems including ozone, fine particles, and visibility. We also would agree that NO_x reductions in addition to those expected from recent new standards issued by EPA for other sources are needed to address these problems. Moreover, we realize that reductions from other significant mobile and stationary sources are becoming tougher to find since they are (or have) already greatly reducing their emissions. We understand that many areas will have a difficult time meeting the NAAQS without decreasing aircraft emissions, which continue to grow. In addition, we acknowledged in the NPRM that the proposed standards would have minimal air quality benefit. Therefore, as stated earlier we have promulgated the proposed standards, and we anticipate establishing more stringent NO_x standards in the future. We consider this ongoing phased approach to be the most appropriate way to address aircraft engine emissions.

3.2 Aircraft Emissions Contribution

What Commenters Said:

STAPPA/ALAPCO and GA DNR expressed that in contrast to other sources aircraft NO_x is projected to rise at a rapid rate. STAPPA/ALAPCO also stated that "[f]or most states and localities with major airports and seaports, aircraft and international marine vessels are the only

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[16]U.S. EPA, "Rule To Reduce Interstate Transport of Fine Particulate Matter and Ozone (Clean Air Interstate Rule); Revisions to Acid Rain Program; Revisions to the NO_x SIP Call," Final Rule, 70 FR 25162, May 12, 2005.

[17]U.S. EPA, "Rule To Reduce Interstate Transport of Fine Particulate Matter and Ozone (Clean Air Interstate Rule); Revisions to Acid Rain Program; Revisions to the NO_x SIP Call," Final Rule, 70 FR 25162, May 12, 2005.

two source sectors where emissions are projected to increase in the future." Moreover, STAPPA/ALAPCO and GA DNR commented that based on recent FAA growth projections, aircraft emissions are estimated to double by 2030, despite the effects of the tragic events of September 11, 2001. Georgia DNR indicated that NO_x emissions from Harstfield-Jackson Atlanta International Airport increased substantially in the 1990's, and from 1990 to 2002 NO_x emissions grew from 1 to 3.2 percent of all NO_x emissions in the Atlanta nonattainment area. Airport-related NO_x at this airport is projected to grow by 26 to 42 percent by 2010, and emissions growth is expected well in the future due to increases in operations (activity increase projected by FAA-approved airport layout plan). In addition, NY suggested that aircraft NO_x are projected to grow rapidly in the future, and even with effects of 9/11, aircraft emissions are expected to grow by 100 percent in the next 30 years. Bluewater Network also commented that aircraft operations are projected to grow even despite the temporary setback in aircraft activity after the tragic events of September 11, 2001. At airports in ten major cities, NO_x emissions will likely grow by about 15,000 tons per year from 1990 levels. GA DNR commented that for states and local air agencies to meet the NAAQS, they will have to control major sources further in order to offset the increase in aircraft emissions – if the aviation sector is not required to flatten the growth curve and start to return emissions to some baseline, e.g. 1990 emission levels. CARB commented that they can not meet their goals for health protection without tackling the continued growth in aircraft emissions.

CCAP stated that aircraft NO_x is projected to grow with the proposed standard. The NO_x stringency analysis conducted by the Environmental Consulting Group, LLC for EPA in 2003 demonstrates the directional emissions effect of the proposed standards. Based on this assessment, in 2015 aircraft NO_x throughout the nation are estimated to be 46 percent above 2000 NO_x levels. This time frame corresponds with the time period that many communities will need to decrease NO_x to meet the 8-hour ozone standard. In addition, over a longer time frame (2000 to 2040) aircraft NO_x is estimated to increase by an even greater amount (159 percent) with the proposed rule.

SCAQMD expressed that aircraft remain a significant and growing emissions source in the South Coast Air Basin (Basin) since passenger and cargo carrier activity are projected to double by 2030 (compared to 2002 levels). Standards for aircraft emissions have not been adequately developed to tackle the increasing effect of these emissions on air quality. Even though EPA acknowledges aircraft's environmental effects, the proposed rule does nothing to address these effects. Also, SCAQMD commented that the Basin has a tough challenge to achieve attainment of the 1-hour ozone standard by 2010, and to meet its goal, emissions from all sources including those under federal jurisdiction such as aircraft will be necessary. Thus, SCAQMD strongly believes that EPA should make every effort to do its fair share in obtaining all feasible aircraft reductions, thereby assisting their region in complying with the federal NAAQS. Without sufficient control on emission sources such as aircraft, the burden for reductions would shift unfairly towards other mobile and stationary sources, which have been heavily regulated for many years.

In addition, CCAP indicated that the 2003 Northeast States for Coordinated Air Use Management (NESCAUM) and CCAP study at three airports in the Northeast shows that airport emission sources such as aircraft, ground service equipment (e.g., baggage tugs), and auxiliary power units are significant sources of emissions in comparison to other emission sources in their respective regions. The assessment also showed that aircraft contribute about 85 percent of emissions from these airport sources. While aircraft may contribute a little different fraction of emissions at each airport, it is correct to expect that aircraft are one of the (if not) most dominant sources of on-airport emissions at airports nationwide. In addition, the study showed that future aircraft emissions at the airports evaluated could become as large as major stationary sources in the region. ED expressed that this assessment indicated inventories for aircraft emissions were seriously under reported (typically 50 percent lower) in State Implementation Plans (SIPs), and this further emphasizes the necessity from effective federal measures for aircraft emissions. Even with this under reporting, there are numerous airports in areas with ozone problems. In 2001, nationwide there were 132 airports in one-hour ozone nonattainment and maintenance areas, and 22 of the largest 31 airports in the nation are located in ozone nonattainment areas. Also, in accordance with the air quality monitoring data for 1997 - 1999, there were 137 airports in potential 8-hour ozone nonattainment areas, and there will probably be several more areas added to the list in more recent years.

In addition, STAPPA/ALAPCO suggested that at this time, NO_x emitted from major airports is greater than NO_x from large stationary sources such as refineries and electrical generating facilities. NY has a growing concern with the substantial number of unregulated emissions from aviation activity. Also, ED expressed that airports are a significant source of ozone-forming pollution in many ozone nonattainment areas. ED suggested that "[s]tate and local governments need rigorous federal clean air measures to lower smog-forming pollutants and to restore healthy air quality to vast areas of the country." AReCO indicated that Chicago's O'Hare Airport (with all its related aircraft operations) is not only one of the worst polluters in the state of Illinois, but it may be the worst polluter in the nation. Based on their data, AReCO claims that the emissions of criteria pollutants at O'Hare Airport are "off the charts." A new O'Hare/Peotone study shows that the health of 8.3 million people is affected by O'Hare operations (5.5 million people are affected significantly).

ACI-NA&AAAE commented that their "members who operate and manage the nation's airports are greatly concerned with the quantity of criteria pollutants emitted from airport sources." The ability of their members to develop critically needed airport facilities that will provide the capacity for the air transport industry to grow and attain future air travel demand is seriously and negatively affected by rising public concerns over pollutants impacting air quality in the vicinity of airports. For these reasons, our members have voluntarily undertaken considerable steps to decrease emissions from sources under their control at U.S. airports. In addition, ACI-NA&AAAE expressed that activities at U.S. airports are expected to increase well into the future, "potentially doubling over the next 20 years." This rise in air traffic will be in direct response to the U.S. economic growth. The proposed NO_x standards are needed to ensure that air travel does not negatively impact local air quality, while also allowing for the economic viability of the aviation industry.

ATA expressed that aviation has always contributed a small fraction of national NO_x emissions even before September 11. The Bureau of Transportation and Statistics data indicates that in 2001 aircraft contributed only 0.75 percent of NO_x from transportation sources, in comparison to 77 percent for highway vehicles and 11.5 percent for railroads.

In addition, Delta Air Lines, Inc. suggested that for the most adversely affected cities evaluated by EPA (1999 EPA study, *Evaluation of Air Pollutant Emissions from Subsonic Commercial Jet Aircraft*), the Agency indicated that by 2010 aircraft NO_x are projected to contribute up to 10 percent of the NO_x from mobile sources. What is not clearly conveyed with this result is that part of the relative increase is because of the actual reduction of emissions from other more substantial mobile sources. The EPA estimates were published in 1999 and do not consider the downturn in air transportation from a variety of long- and short-term effects of such events as September 11, SARS, and the Iraq War. Also, these estimates do not seem to account for emission reductions due to operations resulting from aircraft fleet renewal and airport expansion and renewal.

Our Response:

We agree with the comments on aircraft emissions growth. As we stated in the proposed rulemaking and the preamble of the final rule, commercial aircraft emissions are projected to be a growing segment of the transportation sector's emission inventory (in spite of the temporary set back due to the tragic events of September 11, 2001). This growth in commercial aircraft emissions is expected to occur at a time when other significant mobile and stationary sources are drastically reducing emissions, thereby accentuating the growth in aircraft emissions. Furthermore, we would agree that aircraft NO_x will continue to grow even with today's standard or the recently adopted CAEP/6 standard. In addition, airports are an important source of emissions in nonattainment areas, and aircraft are one of the main sources of emissions at airports. In addition, we would agree with the comment that states and localities may have to control other sources further if aviation emissions do not stop growing. Therefore, we are in agreement with the comments that there needs to be effective controls for aircraft emissions.

As we have already stated, we anticipate establishing more stringent NO_x standards in the future. We believe this ongoing phased approach is the proper way to address aircraft engine emissions. As we also discussed earlier, the CAEP/6 standards will be a central consideration in future EPA regulations for aircraft engine emissions. We realize that if we adopted standards in the future which were equivalent to the CAEP/6 standard, aircraft NO_x would continue to grow. Therefore, such information will be evaluated as we consider the stringency level of future standards.

In regard to the comments from ATA on the fraction of national NO_x emissions from aircraft, we do not disagree with the national numbers they report. However, from a local/regional perspective, as described in the proposed rule, the 1999 EPA study (*Evaluation of Air Pollutant Emissions from Subsonic Commercial Jet Aircraft)* showed that in 2010 commercial aircraft are projected to contribute as much as 10 percent of total regional mobile

source NO_x emissions in at least two of the cities studied. Thus, aircraft are an important and growing source of emissions regionally and locally, especially for nonattainment areas.

As for Delta Air Lines, Inc. comments that the 1999 EPA study does not make clear that part of the relative increase is due to the actual reduction of emissions from other more substantial mobile sources, we would disagree. Specifically, on page 4-1 of this study we state that "[w]hile emissions from most transportation sources such as NO_x from automobiles are predicted to stabilize and, in many cases, decrease from 1990 through 2010, ground level emissions from commercial jet aircraft are expected to continue rising." We also elaborate further on this point in other parts of the study. In addition, as described earlier, we stated in the NPRM that "[t]his growth in commercial aircraft emissions is expected to occur at a time when other significant mobile and stationary sources are drastically reducing emissions, thereby accentuating the growth in aircraft emissions" (see discussion in the NPRM preceding the mention of the 1999 EPA study). Also, this study accounted for aircraft fleet turnover (activity of removed or retired aircraft was assigned the emissions of an "average future" aircraft), and it actually acknowledged the comments from industry on this approach. Yet, we would agree with Delta that the 1999 EPA estimates did not consider the effects of events such as September 11, SARS, and the Iraq War. However, as discussed in the NPRM and the preamble of the final rule, FAA expects the demand for air travel to recover, and then continue a long-term trend of annual growth in the nation (though from a lower base and a slower rate in the United States).

4. Approaches to Additional Aviation Emission Reductions

What We Proposed:

The comments in this section correspond to Section VI of the aircraft engine NPRM, and therefore are targeted at possible other approaches for future aviation emission reductions, which we requested comment on in the NPRM. A summary of the comments received, as well as our responses to those comments are located below. For the full text of comments summarized here, please refer to the public record for this rulemaking.

What Commenters Said:

The CCAP expressed that the combination of current and projected future emission levels, the need for emission reductions by 2010-2015 for most communities to meet the 8-hour ozone and $PM_{2.5}$ NAAQS, and the new NO_x standards proposed by ICAO (NO_x emissions growth is estimated to decline slightly due to new ICAO standards), emphasize the need for a new approach to addressing aircraft emissions. The 2003 NESCAUM and CCAP study assessed a number of market-based approaches, such as emissions "bubbles" and emissions-based landing fees, that could be useful models for alternative approaches for the aviation sector.[18] CCAP suggested that "[i]n addition to an airport-by-airport approach (e.g., an airport bubble), EPA may want to consider a national emissions trading program for aircraft." An absolute emissions (e.g., the Acid Rain Trading Program) or rate-based (e.g., NO_x emissions per landing and take-off) reduction could be the basis for either of the above approaches.

Also, ED recommended that the Agency quickly develop national policy guidelines to help states establish enforceable, declining NO_x pollution caps for airports in ozone nonattainment areas, as well as information about appropriate SIP credit. Approaches such as "cap-and-trade" or airport bubbles have the potential to limit airport-related emissions, give flexibility in achieving reductions, and encourage the utilization and development of cleaner technologies. "Boston's Logan Airport has a cap on airport emissions where any emissions increases that result from airport activity must be offset by on-airport emission reductions, reductions near the airport, or by purchasing emission credits." ED suggests that "airport emissions caps can encourage the introduction of control technologies such as gate electrification, less polluting aircraft engines, and alternative fuel ground service equipment and ground access vehicles."

In addition, SCAQMD suggested that in lieu of more stringent national emission standards for aircraft, and due to the fact that by 2010 such standards would have limited emission benefit, the Agency should assess and create other innovative aircraft programs. Particularly, EPA should think about the development of a mitigation fee program for aircraft to

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[18]NESCAUM and CCAP, "Controlling Airport-Related Air Pollution," 2003, available at www.nescaum.org/workgroups/aircraftport.html.

attain equivalent reductions in emissions from other sources (e.g., nonroad equipment or on-highway vehicles), similar to the Mitigation Fee Program for Federal Sources control measure in SCAQMD's 2003 Air Quality Management Plan. "Under such a program, EPA would charge fees on aircraft or designate grant funds based on the emission contribution from aircraft (i.e., aircraft/engine type, number of operations, etc.)." Furthermore, SCAQMD expressed that the funding collected from this program would then be transferred to the localities affected considerably by aircraft emissions for putting into practice emission reduction projects that would attain equivalent or greater reductions. As an alternative, EPA could create an incentive-based program that facilitates and promotes the use of less polluting aircraft in the South Coast Air Basin. These kinds of approaches would make sure that federal sources such as aircraft would do their fair share toward helping attain the NAAQS.

AReCO also expressed that in the next action, EPA, FAA, and Congress should set airport based landing fees proportional to the quantity of pollutants emitted by aircraft at an airport. These fees should be of an amount guaranteed to prompt both air carriers and airports to decrease emissions. Such incentive fees should be put in a trust fund strictly for environmental improvements, which would be administered by EPA with oversight by an independent fund dispersal board (that includes considerable representation from environmental interests). In addition, ED indicated that airports with emission-based fee programs assess a greater charge to higher polluting aircraft, and such programs have been implemented at Switzerland's Zurich and Geneva Airports, and at nineteen airports in Sweden.

Also, ED commented that cost-effective measures exist for decreasing aircraft emissions, and such measures should be required by this rulemaking. "Near-term emission reduction options for aircraft include improving airlines' overall operational efficiency, reducing taxi time, and reducing power output during taxi, takeoff and landing." Optimizing the number of passengers per flight and maximizing the airlines' use of the cleanest aircraft are cost-effective methods for improving aircraft efficiency. Decreases in taxi time can be achieved through "dispatch towing," permitting aircraft to stay closer to runways between landing and takeoff, decreasing congestion on the ground and in the air by a variety of methods and technology improvements. The minimization of engine use can be accomplished by approaches such as engine taxi, decreased utilization of reverse thrust, and utilizing less that full power at takeoff.

In addition, ED indicated that "Heathrow Airport in the United Kingdom encourages pilots to shut down one or more engines during taxi." This practice is left to the pilots' discretion since shutting down some engines can reduce aircraft control and might not be feasible in particular situations or with particular aircraft. Also, National Airspace System improvements are being considered for the aircraft efficiency benefits. ED expressed that all of the above approaches cost little or nothing to implement and provide reductions in emissions and savings in fuel use. Moreover, ED commented that the 2003 NESCAUM and CCAP study found that the following practices decreased fuel costs and thus reduced emissions of NO_x, hydrocarbons (HC), and carbon monoxide (CO) to various degrees: dispatch towing, decentralized gates, measures to decrease ground congestion, reduced engine taxi, derated takeoff, and reduced reverse thrust. Also, ED suggested that the technology improvements that

decrease aircraft taxi and idling times by making the aircraft movement at the airport more efficient should be pursued further. "For example, advanced surface movement guidance, very high frequency (VHF) datalink, arrival and departure management systems, and automatic dependent surveillance broadcast systems are viable options for reducing emissions."

In addition, ED indicated that long-term aircraft improvements that will considerably decrease emissions include a blended-wing body configuration (which NASA is presently working on) that would decrease emissions and improve fuel efficiency (because of its more aerodynamic design compared to today's aircraft) and the utilization of liquid hydrogen as a replacement fuel.

SCAQMD expressed that the 2003 Proposed State and Federal Strategy for the California SIP calls for EPA to assess approaches for decreasing aircraft emissions, including engine retrofit kits and reformulation of jet fuel. Because of the slow turnover rate of aircraft engines, the Agency should assess the potential for existing engine retrofits and repowers of aircraft in use so that emissions from existing fleet aircraft could be decreased without compromising safety. Also, SCAQMD suggested that repowering could be applied to particular aircraft types which accommodate the utilization of several different types of engines where a lower polluting engine could replace an existing, more polluting engine. Fuel reformulations for aircraft might also be a subject that EPA should assess for feasible emission reductions. In addition, AReCO suggested that there are other solutions to addressing airport environmental issues such as creating new fuel sources, constructing new, environmentally friendly airport designs, etc.

ACI-NA&AAAE indicated that they are committed to working with EPA and other parties on creating and putting into practice balanced emissions reduction programs, for aircraft sources as well as other emission sources that their airport operators can control.

Delta Air Lines, Inc. commented that they agree "with EPA's recognition that aircraft engine emissions are but one part of the overall emissions associated with commercial aerospace operations." Also, Delta expressed that they appreciate the Agency's efforts to work with stakeholders to create a voluntary program to reduce emissions from other aerospace operations. They believe "that voluntarily addressing emissions from other aircraft-related operations will provide more near term environmental benefits than further regulating aircraft engine emissions. Additional reduction of aircraft emissions is a long-term approach that must incorporate additional study to fully understand emission interrelationships and economic impacts."

Our Response:

As described in the preamble of the NPRM and final rule, FAA and EPA participated in a national stakeholder initiative led by states and industry whose goal was to develop a voluntary program to reduce pollutants from aircraft and other aviation sources that contribute to local and regional air pollution in the United States. Initially, the discussions with stakeholders focused on the prospect of aircraft engine emission reduction retrofit kits, which might be applied to certain

existing aircraft engines.[19] However, as the initiative evolved, the focus was expanded by the stakeholders to identify strategies for various types of ground service equipment (GSE) in use at airports,[20] in addition to strategies to reduce aircraft emissions.[21] (At the same time, FAA developed a program, with Congressional approval, to fund conversion of airport infrastructure and ground support vehicles to alternative fuels technologies.[22]) Unfortunately, the state and industry stakeholders did not reach consensus on a national aviation emissions reduction program. The Agencies are currently contemplating next steps following from the national stakeholder initiative and discussions of potential voluntary programs, and the approaches suggested above by commenters will be taken under consideration.

In addition, the approaches or measures described above by commenters are not within the scope of this rulemaking since we only proposed new NO_x standards for aircraft main engines. Promulgating such approaches/measures would require another notice and comment rulemaking action. Moreover, we would need to develop a cost and emission benefit analysis for these approaches. Instead of slowing down the implementation of the aircraft engine NO_x standards promulgated in this final rule, we may consider such an analysis and the approaches/measures in the future.

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[19]Two engine models were indeed certificated with emissions retrofit kits, and a number of these engines have been purchased for aircraft with the retrofit kits installed in their stock configuration. However, retrofit kits have not to date provided widescale emissions improvements because it seems they may have limited applicability to certain engine types, small emission benefits, and cost issues.

[20]The stakeholders considered the impact, operation and design of GSE at airports, and whether to undertake projects at several airports to reduce overall emissions.

[21]Operational strategies, such as reducing the time in which aircraft are in idle and taxi modes and the impact of auxiliary power units (APUs) were also considered.

[22]The Vision 100-Century of Aviation Reauthorization Act, signed into law on December 12, 2003 (P.L. 108-176), directs the FAA to establish a national program to reduce airport ground emissions at commercial service airports located in air quality nonattainment and maintenance areas. The new Voluntary Airport Low Emissions (VALE) program will allow airport sponsors to use the Airport Improvement Program (AIP) and Passenger Facility Charges (PFCs) to finance low- emission vehicles, refueling and recharging stations, gate electrification, and other airport air quality improvements. See the FAA website located at www.faa.gov/arp/environmental/vale.

5. Other Issues

What We Proposed:

The items raised in the following comments were not specifically addressed in the NPRM, and therefore have no general corresponding NPRM section.

5.1 Environmental Justice

What Commenters Said:

Bluewater Network expressed that since EPA's proposed NO_x standards do not provide meaningful emission reductions, it results in environmental injustice for communities near some airports. Thus, EPA is not fulfilling it's obligation under the Executive Order on Environmental Justice (Executive Order 12898) and EPA's Policies on Environmental Justice. For example, in Atlanta, Georgia, Black or African-American residents are 81 percent of the population living close to the Hartsfield Atlanta International Airport (4 closest zip code areas), in comparison to about 32 percent in the urban area of Atlanta. The median household income in the same area close to the airport ranges from $28,155 to $39,141, in comparison to $52,512 in the Atlanta urban area. "Even in the absence of statistical testing, this demographic data strongly imply that people of color and low-income communities may experience increased exposure to air pollution from airports."

Our Response:

EPA supports implementing the Executive Order on Environmental Justice. However, its provisions are not relevant because like other technology-based or performance-based rules we adopt under the CAA, according to section 231 of the Act we have based the level of the standards promulgated in the rule on what we expect can be met after considering technology development, lead time, and costs of compliance (without consideration of the specific effect the standards have on air quality and meeting the NAAQS). Moreover, as we discussed earlier, EPA intends to address more stringent emission standards requiring more lead time in a future rulemaking (a ongoing phased approach to address aircraft emissions). In addition, as discussed in the preambles of the NPRM and final rule, air pollutants resulting from airport operations are emitted from several types of sources: aircraft main engines and auxiliary power units (APUs); ground service equipment (GSE); ground access vehicles (GAV), which include vehicles from off-site used by passengers, employees, freight operators, and other persons utilizing an airport. EPA's previous estimates show aircraft engines comprise approximately 45 percent of total air pollutant emissions from airport operations; GAV account for another 45 percent, and APUs and

GSE combined make up the remaining 10 percent.[23] As stated earlier, EPA has established stringent emission standards for GAVs and other on-highway motor vehicles (and new GSE and other nonroad equipment), and overall emissions from these vehicles (and equipment) will continue to decline for many years while the growth in commercial aircraft emissions is expected to continue. Even though aircraft are and/or will be the predominant source of emissions at airports, they are not the only source of emissions. Aircraft are one of several contributors (including stationary sources at airports as well) to emissions at or around airports. Therefore, EPA will continue to take a holistic approach to reducing emissions and improving air quality in and around airports (keep on focusing our efforts on all sources of emissions in and around airports).

5.2 General Aviation and Military Aircraft

What Commenters Said:

Bluewater Network suggested that the NPRM exempts all general aviation, air taxi, and military aircraft engines from EPA emission regulations. "Failure to regulate them would be arbitrary and capricious and inconsistent with the law, again in light of the harm of ozone pollution, the nonattainment problem nationwide, and the contribution of aircraft pollution to local air problems." In section 231 of the CAA, Congress required the Agency to issue emission standards from "any class or classes of aircraft or aircraft engines." The terms "aircraft" and "aircraft engines" are defined to comprise all types of aircraft and engines. These terms do not exclude general aviation and military aircraft engines (see section 234 of the CAA).

Also, the State of New Jersey Department of Environmental Protection (NJDEP) expressed that the proposed NO_x standards could also apply to engines with a rated output less than 26.7 kilonewtons, which would address smaller air taxis and business jets. Such action would enable the U.S. to obtain greater emission reductions and provide "the international community a more environmental friendly blueprint."

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[23]The California FIP, signed by the Administrator 2/14/95, is located in EPA Air Docket A-94-09, item number V-A-1. The FIP was vacated by an act of Congress before it became effective.

For comparison, the 1997 EPA Draft Final Report entitled, "Analysis of Techniques to Reduce Air Emission at Airports" (prepared by Energy and Environmental Analysis, Inc), it was estimated that for the four airports studied (which are large air traffic hubs) on average aircraft compromise approximately 35 percent of NO_x emissions from airport operations; GAV account for another 35 percent, and APUs and GSE contribute about 15 percent each for the remaining 30 percent. For NO_x and volatile organic compounds (VOC) together, aircraft contribute about 35 percent; GAV account for another 40 percent, and APUs and GSE combined make up the remaining 25 percent. This document can be found in Docket No. OAR-2002-0030.

In addition, Bluewater network indicated that the Agency has gone beyond its authority by excluding military aircraft and aircraft engines since only the President may provide such exemptions under section 118 of the CAA (Control of Pollution from Federal Facilities). This section directs federal agencies to comply with air pollution control requirements "in the same manner, and to the same extent as any nongovernmental entity." If exemptions for the military could be carried out at the rulemaking level, the necessity for a presidential exemption would become meaningless. Furthermore, Congress' intent that the military follow the same requirements that apply to non-governmental entities would be easily frustrated if EPA were permitted to exclude military in this rule.

Also, Bluewater Network commented that emissions from exempted aircraft engines – from 1 to 26 percent of emissions from all aircraft engines – are considerable; therefore, EPA has to explain its rationale for the exemption. In the NPRM, the Agency did not describe why these emissions would be exempted. "EPA's failure to regulate these sources is thus arbitrary and capricious."

In addition, as described earlier SCAQMD expressed that the 2003 Proposed State and Federal Strategy for the California SIP calls for EPA to assess options for decreasing aircraft emissions, including the application of standards for commercial aircraft engines to non-tactical military aircraft.

Our Response:

The promulgated NO_x standards apply to commercial aircraft engines of rated thrust greater than 26.7 kilonewtons, and general aviation and military aircraft can use commercial aircraft engines subject to these standards (e.g., small regional jet engines are also utilized in executive general aviation aircraft and larger commercial aircraft engines may also be used in military transport aircraft). In the NPRM, we stated that no general aviation or military engines are covered by the proposal. However, this statement may need some clarification (and was revised in the preamble of the final rule). For general aviation, EPA's 1982 aircraft final rule withdrew emission standards "for all gas turbine engines used only for general aviation applications" (and for all gas turbine engines of rated thrust less than or equal to 26.7 kilonewtons), but emission standards for aircraft gas turbine engines used for commercial transport by air carriers or commercial operators remained (although the standards were revised).[24] Currently, some engines used in commercial transport also power general aviation aircraft (e.g., business jets), and because such engines are used in commercial applications (and not merely general aviation operation), they must comply with EPA's aircraft engine emission standards – including the standards promulgated in this final rule. Therefore, it is more appropriate to state that the promulgated NO_x emission standards do not apply to aircraft engines used only for general aviation or military applications.

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[24]U.S. EPA, "Control of Air Pollution from Aircraft and Aircraft Engines; Emission Standards and Test Procedures," Final Rule, 47 FR 58462, December 30, 1982.

In regard to regulating general aviation aircraft engines, military aircraft engines, and aircraft engines with a rated output less than or equal to 26.7 kilonewtons, it is important to note that the scope of this rulemaking was limited to adopting NO_x standards equivalent to the CAEP/4 NO_x standards for commercial aircraft gas turbine engines of rated thrust greater than 26.7 kilonewtons. Such engines were the only type of aircraft engines we requested comment on in the NPRM for amending the NO_x standards, and thereby bringing the United States emissions standards into alignment with the internationally adopted standards. We may have mentioned other types of aircraft engines in the NPRM, but we did not invite comments on applying the new NO_x standards to these other types of aircraft engines. Thus, regulating these other types of aircraft engines is not within the scope of this rulemaking.

In addition, our record to support regulations for aircraft engines other than commercial aircraft engines greater than 26.7 kilonewtons was similarly limited. We did not assess costs, emission benefits, and the state of technology related to such engines for the NPRM, and we have yet to conduct such an assessment to support regulations for these engines. To finalize standards for these other types of aircraft engines, we believe this information would first need to have been put out for public comment. Also, there are a number of issues regarding enforcement mechanisms and legal authority that we would similarly need to address through a notice and comment process before adopting regulations for the other types of aircraft engines.

Currently, as described in the NPRM and the preamble of the final rule, nationwide aircraft emission estimates have limitations for military aircraft (and thus, a range of commercial aircraft's emissions contribution to nationwide aircraft NO_x was provided – see section II of the preamble for the final rule for further discussion of this range). The documentation for EPA's most recent national aircraft emission estimates identifies the areas of improvement to enhance the emissions estimates.[25] In particular, for military aircraft emissions we need to obtain better activity data for the diverse aircraft included in this category. In the future, EPA will be working to improve the data for military aircraft emissions.

5.3 Auxiliary Power Units

What Commenters Said:

The TCEQ expressed that EPA has failed to address aircraft auxiliary power units (APUs), which are a considerable source of NO_x emissions.

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[25]U.S. EPA, "Documentation for Aircraft, Commercial Marine Vessel, Locomotive, and other Nonroad Components of the National Emissions Inventory, Volume I - Methodology," Prepared for EPA by Eastern Research Group, Inc., October 7, 2003. A copy of this document can be found in Docket No. OAR-2002-0030.

Our Response:

APUs are not within the scope of this rulemaking since we only proposed new NO_x standards for aircraft main engines. New emission standards for APUs would require another notice and comment rulemaking action. For estimates of APUs' contribution to total emissions from airports, see the above discussion in the Environmental Justice section of this document (section 5.1).

5.4 Ground Service Equipment

What Commenters Said:

ED commented that a considerable amount of air pollution from airports is the result of ground service equipment (which include vehicles such as aircraft tugs, baggage tugs, fuel trucks, maintenance vehicles, and other miscellaneous vehicles used to support aircraft operations). EPA should quickly finalize the nonroad diesel emission standards proposed in April 2003 and expand the voluntary diesel retrofit program to achieve substantial, lasting reductions in these important sources of air pollution.

Our Response:

EPA finalized the new nonroad diesel emission standards on June 29, 2004 (69 FR 38958).[26] In addition, most GSE are powered by nonroad large spark-ignition engines, and EPA promulgated standards for these engines on November 8, 2002 (67 FR 68242).[27] In addition, see our response to comments in section 4 (*Approaches to Additional Aviation Emission Reductions*) for a discussion of the national stakeholder initiative and its relation to GSE. For estimates of GSE's contribution to total air pollutant emissions from airport operations, see the earlier discussion in the Environmental Justice section of this document (section 5.1).

5.5 Lead from Aviation Gasoline

What Commenters Said:

Bluewater Network stated that while the downward trend in mean blood-lead levels (since the 1970's) in children is encouraging, particular subpopulations are still exposed to lead. "For example, according to EPA, residents near "general aviation airports where leaded gasoline

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[26]U.S. EPA, "Control of Emissions of Air Pollution from Nonroad Diesel Engines and Fuel," Final Rule, 69 FR 38958, June 29, 2004.

[27]U.S. EPA, "Control of Emissions from Nonroad Large Spark-Ignition Engines, and Recreational Engines (Marine and Land-Based)" Final Rule, 67 FR 68242, November 8, 2002.

is still being used as fuel may have an increased risk of lead exposure.[28]" Lead from general aviation aircraft may also effect workers and maintenance employees, as well as aircraft passengers. Also, lead emissions can be deposited in wetlands and other ecologically sensitive areas next to airports.

In addition, Bluewater Network indicated that in 1970 Congress gave EPA the responsibility under section 231 of the CAA to determine whether emissions from aircraft endanger the public health or welfare. At the same time, Congress provided FAA with the authority to set standards for aircraft fuel and fuel additives to control or eliminate aircraft emissions that EPA "decides under section 231 of the Clean Air Act endangers public health or welfare" (49 U.S.C. § 44714). In a 1972 aircraft emissions study, EPA concluded that "the existing and potential air quality impact of sulfur oxides and lead is considered to be negligible in comparison to other sources of these two pollutants.[29]" Therefore, the Agency did not conduct any further analysis of the two pollutants.

Bluewater Network suggested that since 1972 two developments have undermined EPA's rationale for not studying lead pollution from aircraft further. First, nowadays lead is recognized as being much more toxic (previously safe blood level for children of 40 mcg/dL to current concentration of concern for lead paint of 10 mcg/dL). Second, because lead emissions from on-highway mobile sources have been practically eliminated, lead from pollution from general aviation aircraft now makes up a much greater fraction of total lead emissions. Also, Bluewater Network commented that EPA's 1999 National Emission Inventory indicated that aircraft emissions contribute about 16 percent of total lead emissions. Due to these developments and the health and environmental concerns near airports that Bluewater Network expressed earlier, they recommended that EPA make a determination that under section 231 of the Act aircraft lead emissions endanger public health and welfare. This step would prompt FAA's duty to control or eliminate aircraft lead emissions.

In addition, Bluewater Network commented that they are concerned that EPA's work with FAA on a voluntary process to remove lead from aviation gas will not result in a phase-out of lead in any reasonable time period. Without pressure from regulations, the goal of removing lead from aviation gas could be delayed for an indefinite period. "In fact, concern that voluntary measures were not accomplishing the air pollution control goals motivated Congress to add section 231 to the CAA in the first place."

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[28]U.S. EPA, Persistent, Bioaccumulative, and Toxic Pollutants (PBT) Alkyl-Lead Work Group, "Draft PBT National Action Plan for Alkyl-lead," May 8, 2000. A copy of this document can be found in Docket No. OAR-2002-0030.

[29]U.S. EPA, "Aircraft Emissions: Impact on Air Quality and Feasibility of Control," 1972. A copy of this document can be found in Docket No. OAR-2002-0030.

Our Response:

Based on EPA's 2003 *National Air Quality and Emission Trends Report*,[30] in 2000 nationwide lead emissions from aircraft were 545 tons per year, and total lead emissions from all sources were reported as 4,228 tons per year. Thus, based on the latest available information aircraft emissions represent about 13 percent of the total lead emissions, which is similar to the fraction provided by the commenter. In addition, for the remaining mobile sources emitting exhaust emissions of lead, aircraft are the most significant.

Currently, aviation gasoline is the only aviation fuel containing lead. Aviation gasoline is utilized in a relatively small number of aircraft (within the general aviation aircraft category), those with piston engines, which are generally used for personal transportation, sightseeing, crop dusting, and similar activities. (Lead is not used in jet fuel, the fuel utilized by most commercial aircraft.) Part of the lead additive package used to boost the octane of aviation gasoline keeps the lead volatile so that it does not deposit in the engine. Such deposits result in poorer performance and increased maintenance costs.

Because of our general concern for lead emissions in aviation gasoline, we have been encouraging FAA to develop an unleaded aviation gasoline. Research by FAA continues for unleaded aviation gasoline, but has yet to be successful. To ban lead emissions from aircraft, in the absence of an unleaded aviation gasoline, would ground the aircraft described above, resulting in severe economic penalties for the many small businesses which utilize them. Moreover, the 2000 EPA draft action plan for lead[31] discussed earlier was finalized in 2002, and the final plan stated (as did the draft plan) that the desire to find a no-lead gasoline substitute for aviation gasoline needs to be balanced with safety concerns.[32] The performance of an unleaded high-octane aviation gasoline in all possible and operational and atmospheric conditions must be thoroughly tested due to concerns pertaining to aircraft safety. High-performance piston aircraft engines need high-octane gasoline, and lead is extremely efficient at increasing the octane without creating any other undue performance effects.

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[30]U.S. EPA, "National Air Quality and Emissions Trends Report - 2003 Special Studies Edition," EPA 454/R-03-005. A copy of this document can be found in Docket No. OAR-2002-0030.

[31]U.S. EPA, Persistent, Bioaccumulative, and Toxic Pollutants (PBT) Alkyl-Lead Work Group, "Draft PBT National Action Plan for Alkyl-lead," May 8, 2000. A copy of this document can be found in Docket No. OAR-2002-0030.

[32]U.S. EPA, Persistent, Bioaccumulative, and Toxic Pollutants (PBT) Program, "PBT National Action Plan for Alkyl-lead," June, 2002. This document is available at www.epa.gov/pbt/pubs/alkyl_lead_action_plan_final.pdf A copy of this document can be found in Docket No. OAR-2002-0030.

We acknowledge that as aviation gasoline with lead is still utilized certain subpopulations may remain at risk. However, as indicated in the 2002 final EPA action plan for lead, there is insufficient information to evaluate whether the remaining uses of lead (including aviation gasoline) result in adverse public health or welfare effects. In particular, there is no information to determine whether there is increased risk to lead exposure to at-risk populations (especially children) living near general aviation airports, spectators at air shows, and fuel handlers (aviation crews). Therefore, we do not believe we currently have sufficient information that would enable us to make a determination whether aircraft lead emissions may reasonably be anticipated to endanger public health and welfare. Nevertheless, EPA will continue to pursue voluntary initiatives to the reduce the use of lead in aviation gasoline and collect information as possible.

5.6 Limits for Hydrocarbons, Particulate Matter, Air Toxics, and Sulfur Dioxide

What Commenters Said:

Bluewater Network indicated that EPA last regulated hydrocarbon emissions for aircraft engines back in 1982. Because hydrocarbons are precursors to ozone and many of the same reasons the Agency proposes to amend the aircraft engine NO_x standards apply to hydrocarbons, EPA should revisit the hydrocarbon requirements to make them stronger.

A few commenters expressed concerns with particulate matter, air toxics, and sulfur dioxide emitted from aircraft engines. CARB urged EPA to consider limits on $PM_{2.5}$ and air toxics in future aircraft rules to control the complete range of air pollutants that endanger our health. STAPPA/ALAPCO indicated that particulate matter and sulfur dioxide emissions from aircraft engines require a better understanding than is presently available. Moreover, STAPPA/ALAPCO stated that "EPA must be a leader in research in this area and set appropriate standards when sufficient data is available." In addition, AReCO suggested that new aircraft engine certifications should include measurements and characterization of PM_{10} and $PM_{2.5}$ starting in 2004, and this requirement should be expanded to all existing engines over the next three years. Also, AReCO expressed concerns with the health effects from air toxics emitted from aircraft and at airports.

Our Response:

Aircraft engine emissions of hydrocarbons (HC), particulate matter (PM), sulfur dioxide (SO2), and air toxics are not within the scope of this rulemaking since we only proposed new NO_x standards. In addition, we did not request comments on these other pollutants in the NPRM. New aircraft engines standards for pollutants other than NO_x would require another notice and comment rulemaking action. Therefore, we are not prepared in this final rule to either revise standards for hydrocarbon emissions or set standards for PM, SO2, or air toxics.

5.7 Interrelationships on Pollutants, Noise, and Performance

What Commenters Said:

A number of commenters expressed that in setting new standards (now and in the future) the EPA needed to consider the interrelationships with other pollutants, noise, and performance factors (including fuel efficiency and safety).

Our Response:

We agree that such interrelationships should be considered for today's and future standards. For today's standards these interrelationships were taken under consideration (as discussed earlier in this document), and for future standards we intend to do the same.

5.8 Regulations for Airports

What Commenters Said:

AReCO urged EPA to immediately amend regulations so all airports are considered to be consolidated sources of emissions. Such provisions "should include all fixed, mobile, and area sources of airport and aircraft related emissions, both on and off airport property as well as aircraft operations below 3,000 meters altitude." Also, AReCO expressed that from now on all airport expansion projects with an activity increase, should have environmental assessments and effective mitigation of consolidated airport activities that lead to exceedances in ambient air quality standards for particulate matter (at least $PM_{2.5}$).

In addition, AReCO suggested that they agree with the General Accounting Office[33] in their opposition to massive expansion of existing airports and their solutions to addressing long-term capacity needs. AReCO stated that these solutions are the following: "(1) take the issue away from the FAA and make this a transportation issue not just an aviation issue; (2) put back the airport operational and management controls, the removal of which started the massive airport delays we saw in 2000; (3) build a national Wayport system; and (4) build a world-class national and high-speed rail system."

Our Response:

Requirements for airports as one source of emissions and airport capacity are not within the scope of this rulemaking since we only proposed new NO_x standards for commercial aircraft engines. New regulations for airports would require another notice and comment rulemaking action.

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[33]U.S. General Accounting Office, "Long-Term Capacity Planning Needed Despite Recent Reduction in Flight Delays," GAO-02-185, December 2001.

5.9 Greenhouse Gases

What Commenters Said:

AReCO stated that the U.S. General Accounting Office (GAO) assessed the climate change issue and found that aviation emissions accounted for about three percent of the greenhouse gases and other emissions that contribute to global warming. Even though this percentage is relatively small, aviation emissions are potentially significant for a number of reasons:

"1. Jet aircraft emissions are deposited directly into the upper atmosphere and some of them have a greater warming effect than gases emitted closer to the surface, such as automobile exhaust.

2. The primary gas emitted by jet aircraft engines is carbon dioxide, which can survive in the atmosphere up to 100 years.

3. Carbon dioxide, combined with other exhaust gases and particulates emitted from jet engines could have two to four times as great an impact on the atmosphere as carbon dioxide emissions alone."

Also, AReCO indicated that the GAO report recommended additional research into the effect of jet aircraft emissions on the global atmosphere to help guide the development of new aircraft engine technology.

In addition, AReCO suggested that many new studies now "point to commercial jet aircraft as a major, if not the major cause of man-made climate change." One commenter also stated that aircraft emit "frightening" amounts of greenhouse gases and other pollutants.

Our Response:

EPA is promulgating amendments to the NO_x emission standard for aircraft engines in order to address the direct adverse impacts of NO_x emissions on public health, welfare and the environment, rather than to address climate change. Issues related to climate change are therefore beyond the scope of this rulemaking. Moreover, EPA has previously determined that it does not have authority under the CAA to regulate greenhouse gas (GHG) emissions to address global climate change. See 68 Fed. Reg. 52,922, 52,925 (September 8, 2003).

5.10 Altitude Where the Majority of Aircraft Emissions Occur

What Commenter Said:

AReCO stated "that airports and their operations are major local point or area emission sources, since over 90% of aircraft emissions are emitted at or relatively near the airport during the landing and take-off cycles."

Our Response:

We would agree that airports are significant sources of emissions (as discussed in section 3, *Environmental Need for Control* of this document), but we do not agree that over 90 percent of aircraft emissions are emitted during the landing and take-off cycles. NASA, in a 2001 report entitled, "Scheduled Civil Aircraft Emission Inventories for 1999: Data Base Development and Analysis," found that approximately 9 percent of aircraft NO_x emissions for the scheduled global fleet in May 1999, occurred at an altitude of 0 to1 kilometers (0 to 3,281 feet). (Typically, the landing and take-off cycle occurs up to an altitude of 3,000 feet, which is a default mixing height used for emission inventory calculations.[34]) In addition, approximately 58 percent of aircraft NO_x emissions occurred at altitudes ranging from 10 to 12 kilometers (32,808 to 39,370 feet), the typical cruise mode of operation.[35]

5.11 Contrails

What Commenters Said:

We received several comments from the general public expressing a concern about contrails produced by commercial and military aircraft. Commenters alleged that many contrails they observed were not "normal," but produced as a result of aircraft fitted with spraying devices, or direct injection into the engine(s) with compounds in order to disperse and spray a wide variety of chemicals or other harmful agents upon U.S. population centers. Some commenters claimed a number of health effects from these aircraft activities including, but not limited to colds, congestion, aches, respiratory, and skin problems.

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[34]U.S. EPA, *Evaluation of Air Pollutant Emissions from Subsonic Commercial Jet Aircraft*, Prepared for EPA by ICF Consulting Group. U.S. Environmental Protection Agency, April 1999, EPA-420-R-99-013. This document is available at www.epa.gov/otaq/aviation.htm. A copy of this document can also be found in Docket No. OAR-2002-0030.

[35]NASA, Donald J. Sutkus, Jr. et al., *Scheduled Civil Aircraft Emission Inventories for 1999: Database Development and Analysis*, October 2001, NASA/CR–2001-211216. This document is available at gltrs.grc.nasa.gov/cgi-bin/GLTRS/browse.pl?2001/CR-2001-211216.html. A copy of this document can also be found in Docket No. OAR-2002-0030.

A commenter stated that these spraying operations were intentionally carried out to produce cloudy sky conditions on what commenced as a clear day. Another commenter claimed observing a jetliner dumping jet fuel (apparently not for emergency purposes) through spray nozzles. Some commenters advanced the theory that persistent contrails are abnormal and offered this as evidence to support their allegations of chemical spraying, while another stated that this was a "secret" government program, its scope and purpose withheld from the general public.

Our Response:

EPA is unaware of any program to spray U.S. population centers with chemicals or other substances from jets or any another type of aircraft. What we can do is provide an explanation of how jet exhaust occasionally forms contrails.

Jet aircraft engines operating at high altitudes emit tiny particles that serve as condensation nuclei. High-altitude water vapor collects on these particles, crystallizes, and forms streaks of frozen water vapor otherwise known as contrails. Some contrails join with other contrails and expand into large, natural-looking clouds of cirrus characteristics that can cover large areas of the sky. (Cirrus clouds are wispy white, usually a natural phenomenon, consisting of minute ice crystals formed at high altitudes of 20,000 to 40,000 feet.) Research by the National Aeronautics and Space Administration (NASA) has recognized jet aircraft cloud formation as a potential problem for blocking sunlight, but not solar heat reaching the earth, thereby acting as a thermal blanket and perhaps contributing to global warming.

In September 2000, EPA published a document entitled, *Aircraft Contrails Factsheet*, EPA430-F-00-005, in conjunction with NASA, the National Oceanic and Atmospheric Administration (NOAA), and the Federal Aviation Administration (FAA). This fact sheet describes the formation, occurrence, and effects of "condensation trails" or contrails, and it is located on EPA's web site at: www.epa.gov/otaq/aviation.htm. Information from the Air Force about military aircraft and their atmospheric and environmental effects can be found at: http://www.af.mil/shared/media/document/AFD-051013-001.pdf.

Also, a 1999 report issued by the Intergovernmental Panel on Climate Change, entitled, *Aviation and the Global Atmosphere,* discusses contrail formation and its effects in detail. The influence of contrails on cirrus clouds is noted as a key area of scientific uncertainty that limits the ability to project aviation impacts on climate and ozone. Further work is required to reduce scientific and other uncertainties of aviation impacts. EPA fully supports continued research to address these issues.[36]

[36]Intergovernmental Panel on Climate Change (IPCC), "Aviation and the Global Atmosphere," J.E. Penner, D.H. Lister, D.J. Griggs, D.J. Dokken, and M. McFarland, editors. Cambridge University Press, 373 pp., 1999.

5.12 Deicing

What Commenter Said:

A commenter expressed a concern about chemical deicing of aircraft and the resulting pollution.

Our Response:

Aircraft deicing is not within the scope of this rulemaking since we only proposed new NO_x standards for aircraft engines.

5.13 Airport Water and Noise Pollution

What Commenter Said:

AReCO expressed a concern that "airport operations emit extraordinary levels of air, ground, water and noise pollution."

Our Response:

Water and noise pollution from airports are not within the scope of this rulemaking since we only proposed new NO_x standards for aircraft engines. For a discussion of air pollution at airports, see sections 3.2 and 5.8 of this document (*Aircraft Emissions Contribution* and *Regulations for Airports*).

5.14 Effect of September 11, 2001, and Economic Downturn on Emissions Growth

What Commenters Said:

In regard to the effect of September 11, 2001 and the economic downturn on the projected growth of commercial aircraft emissions, ATA indicated that major airlines decreased their flight schedules and grounded aircraft. The NPRM (Table III-1) references the FAA Terminal Area Forecast summaries (December 2000 and May 2003), which reflect the decreased level of aircraft activity after 2000. Also, nearly every major airline altered its fleet plan to reflect its changing economic situation.

In addition, ATA expressed that EPA has the ability to translate actual post-September 11 activity data and continuing forecasts into emissions data, as part of its ongoing assessment of national emissions trends. The Agency's February 2003 national emissions inventory (updated through 2001), indicates that 2001 aircraft NO_x to be 19 percent below their peak, and at their lowest point since 1996. "EPA has at its disposal the data and models that would allow it to make the more refined post-September 11 analysis that it seeks. ATA and its member carriers have not had the resources to devote to such an analysis, particularly in view of the many non-cyclical factors that have affected industry operations, such as the wars in Afghanistan and Iraq and SARS."

Our Response:

We would not disagree with the commenter's characterization of nationwide aircraft NO_x in 2001 compared to prior years. More recent EPA estimates of national aircraft NO_x show similar trends.[37] In addition, recent (June 2005) FAA Terminal Area Forecast summaries continue to show a reduced level of aircraft operations after 2000. However, as indicated in the NPRM and the preamble of the final rulemaking, the FAA expects the demand for air travel to recover, and then continue a long-term trend of annual growth in the United States (though from a lower base and a slower rate in the United States).[38] FAA reports (2005 Terminal Area Forecasts) that flights of commercial air carriers and commuters/air taxis will increase by 22 percent from 2000 to 2015, about 12 percent less than what was forecast before September 11th.[39,40]

5.15 Funding Clean Engine Research

What Commenter Said:

AReCO suggested that airlines should be required to contribute (e.g., through passenger facility charges) at least $10 million per year to EPA and NASA for research aimed at reducing aircraft engine emissions.

Our Response:

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[37]U.S. EPA, "Documentation for Aircraft, Commercial Marine Vessel, Locomotive, and Other Nonroad Components of the National Emissions Inventory, Volume I - Methodology," Prepared by Eastern Research Group, Inc., October 7, 2003. This document is available at www.epa.gov/ttn/chief/net/1999inventory.html. A copy of this document can also be found in Docket No. OAR-2002-0030.

[38]U.S. General Accounting Office, "Aviation and the Environment: Strategic Framework Needed to Address Challenges Posed by Aircraft Emissions," GAO-03-252, February 2003. This document is available at www.gao.gov/cgi-bin/getrpt?GAO-03-252, and it can also be found in the Docket No. OAR-2002-0030.

[39]U.S. FAA, "APO Terminal Area Forecast Summary Report," Aircraft Operations, June 30, 2005. The flight forecast data is based on FAA's Terminal Area Forecast System (TAFS). TAFs is the official forecast of aviation activity at FAA facilities. This includes FAA-towered airports, federally-contracted towered airports, nonfederal towered airports, and many non-towered airports. For detailed information on TAFS and the air carrier activity forecasts see the following FAA website: http://www.apo.data.faa.gov/main/taf.asp. The June 30, 2005 aviation forecasts contained in TAFS for Fiscal Years 2002-2020 included the impact of the terrorists' attacks of September 11, 2001 and the recent economic downturn. Currently, the aviation industry is undergoing significant structural and economic changes. These changes may necessitate revisions to forecasts for a number of large hub airports prior to the update of the entire TAF next year. A copy of the June 30, 2005 forecast summary report can also be found in Docket No. OAR-2002-0030.

[40]U.S. FAA, "APO Terminal Area Forecast Summary Report," Aircraft Operations, December 14, 2000. A copy of this document can be found in Docket No. OAR-2002-0030.

Such a funding program is not within the scope of this rulemaking since we only proposed new NO_x standards for aircraft engines.

5.16 Voting Representation in CAEP Process

What Commenter Said:

In another comment, AReCO expressed that EPA and FAA need to demand that ICAO have significant representation from environmental interests for CAEP meetings, [otherwise] the U.S. will appropriately reduce its funding to ICAO/CAEP.

Our Response:

A change in the representation structure within CAEP is not within the scope of this rulemaking since we only proposed new NO_x standards for aircraft engines.

5.17 Accuracy of Method to Determine Visibility

What Commenter Said:

The commenter expressed the opinion that in footnote 72 of the NPRM (Section III, *Environmental Need for Control*) that we define "visibility" by using a subjective method in part as follows: "Visual range can be defined as the maximum distance at which one can identify a black object against the horizon sky. Visibility is typically described in miles or kilometers." The commenter was concerned that a subjective method to determine visibility would result in a loss of accuracy.

Our Response:

The commenter is technically correct that use of a photometric method and instrumentation would probably produce more accurate visibility determinations. However, for ease of implementation, we plan on making visibility estimates by employing the visual method partially described in footnote 72 of the Proposed Rule.